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Energy Management Technology Based on Cloud Network

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ABSTRACT : *we propose in this paper a technology that can perform remote control and monitoring of electrical appliances on the Internet. To do this, an intelligent power socket (IPS) module that is able to control and monitoring the power of electricity is realized in this research. The IPS modules are placed in conjunction with the electrical appliances that are to be controlled from a far-end place . In addition, an embedded system based home gateway that can be connected with the Internet is set up in which the electrical appliances are located. Moreover, the acquired power consumption information or the status of the appliances is stored in a database server in the Cloud. With the proposed structure, authorized users or system managers can log into the web server which is connected with the database, monitoring the power status and take actions on the appliances remotely. The control command from the far-end place, i.e., from the web server on the Internet, is first sent to the home gateway and then transmitted to the IPS modules through the Zigbee wireless communication protocol so that the remote control of appliances can be achieved. The proposed architecture has been shown to be very convenient and useful for remote control and monitoring of electrical appliances, and hence can facilitate the life of human beings*

Keywords: *Cloud Computing, Power management, Embedded systems.*

I. INTRODUCTION

Today, around 80% of the world's primary energy is produced from fossil fuels; renewable energy sources add up to around 4.3%. However, the world is coming to realize, that keeping on burning fossil fuels is not an option in the long run. This affects not only electrical energy production in power plants but also the fuel demand of usual combustion engines in vehicles. On the other hand, as our world is suffering energy crisis on oil and natural resources shortages, how to make efficient use of limited power energy has remained a major problem to be conquered so far. Aimed to facilitate the life of human being as well as to use the limited power energy more efficiently. What's worse is that most of the scientific industries all over the world rely heavily on these resources, especially the power energy. As more and more home appliances and consumer electronics are installed, residential energy consumption tends to grow rapidly. Considering our living environment, almost every place, e.g., office, school, and dwelling house, are all equipped with computers, air conditioners, lights and other high-power consumption devices. People usually forgot turning off the power devices after they are not in use. Therefore, how to make efficient use of the limited energy resources so that wasting of power energy can be avoided has become a major problem to be conquered. The embedded remote monitoring and controlling power socket was developed for automatic and power management of home appliances [3]. To monitoring the power consumption, some of the researches propose measuring the power consumption in digital manners [4][5] or reading the power consumption remotely [14] so that the human resources of the power company originally arranged for recording the power meter of individual customer can be saved. On the other hand, the user can also know the status of individual electrical appliance remotely.

II. PROPOSED SYSTEM

As can be seen in Fig. 1, the proposed architecture is mainly composed of three blocks, the client, the cloud web server and database server.

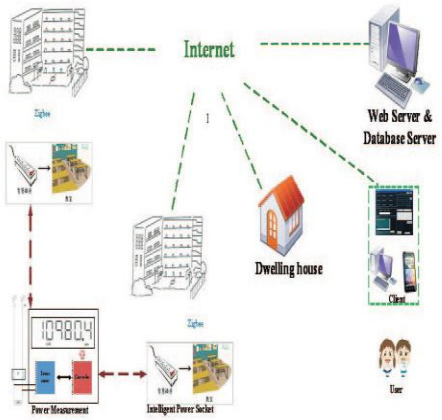

Fig.1.cloud-based remote power control and monitoring system

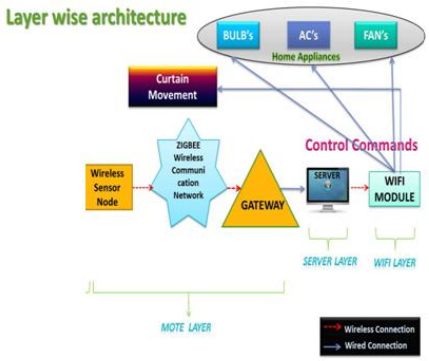

Fig.2. Layer wise architecture

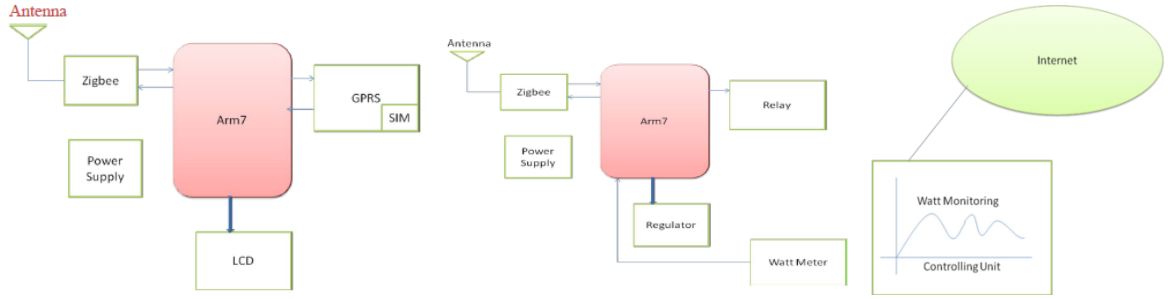

Fig.3.Blockdaigram (a-Home Gateway, b-Device Unit, c-Monitoring unit):

Basically Fig 2 shows the diagram of home gateway, is a server which is used to receive the user command from the far end place on the internet and also to transmit the status as well as power consumption information of appliances back to the database server Then Fig 2 shows the diagram of device unit which has a browser and can be used as client device.. So that we can communicate through HTTP protocol also we can monitor the status and take action on individual appliances. The database server here is used to record the status or power consumption of individual electrical appliances. Here, we use MySQL, powerful and free software, as our database server. To bridge the user, i.e., the browser, and the database server, a web server is required. We apply Apache, a widely used, free, and stable software, as our web server. The client can now communicate with the web server through HTTP protocol, an application layer protocol which is based on TCP/IP protocol in the Internet hierarchy, monitoring the status and take actions on individual appliance. The control commands from the server in the Cloud are first sent to the home gateway through TCP/IP protocol and then transmitted to the appliance with Zigbee wireless communication The gateway will then transmit the received commands to a Zigbee transceiver through the universal asynchronous transmitter and receiver (UART) interface. An automatic standby power cutoff outlet can contribute to the reduction of home energy cost[1]. Furthermore, web-based monitoring and control systems were developed to enable users to view home energy data and control home devices remotely through the Internet [4], [5]

III. POWER CONTROL AND MANAGEMENT:

As a result, the HEMS of the home server can monitor and control the lights and the home devices. It displays hourly, daily, weekly, and monthly energy usage of each home device and encourages users to make efforts to save home energy. The HEMS can also display the real-time active power consumption and the accumulated power consumption of each home device. A user can figure out which home appliance is unnecessarily turned on through the real-time active power consumption and how much power each home appliance consumes in this month through the accumulated power consumption. He can also analyze the energy usage of each room through the ZigBee hub. A user can access the HEMS through the Internet in the remote area and turn off unnecessarily turned-on home devices.[2]

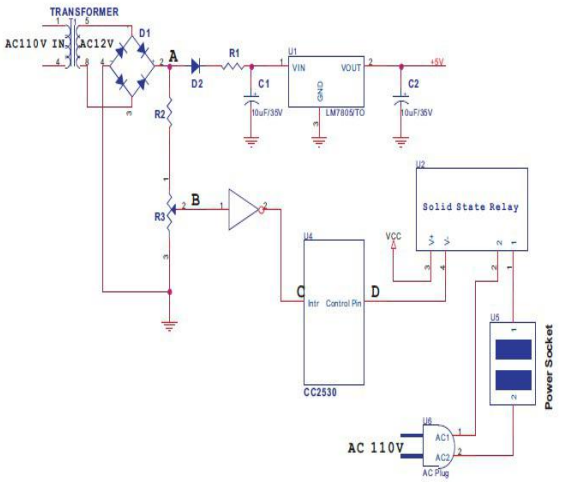

Fig.4. power control mechanism

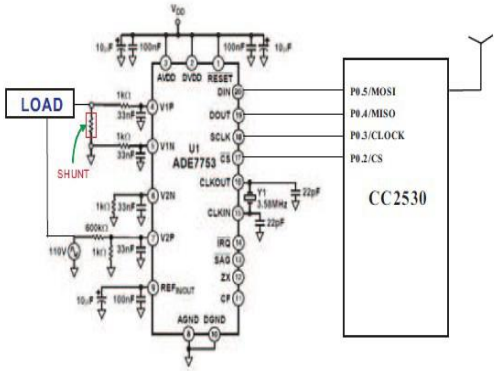

Fig. 5. Schematic diagram of the power measurement module and connection with Zigbee transmission module.

The basis of the power control mechanism is the zero crossing detection circuit, which is shown in Fig. 4. Point A in Fig. 4 is a fully rectified waveform, where point B is just an attenuated signal of A. After the inverter in Fig. 4, the zero crossing signals can be detected at point C, and the zero crossing signals can then be used for the control of power electricity. In the proposed architecture, the point D is used to control the duty cycle between on and off state of the solid state relay (SSR), which is indeed a pulse width modulation system.

In Fig. 5, a small resistor is used in series with the load to measure the current flow of the electrical appliance. The sensed current and voltage signal are then amplified and processed through the chip, a single phase multifunction metering IC. Besides, the instantaneous current, voltage signal, the instantaneous power consumption, active power, reactive power as well as the power factor information can all be calculated and kept in the registers. We can then read all the values out by connecting the serial SPI interface between the single phase multifunction chip and the zigbee controller as in Fig. 5. The controller can calculate the power energy used by summing up the acquired instantaneous power consumption. These power energy information will be transmitted to the home gateway via the wireless Zigbee signal, and then sentback to the database in the cloud.

IV. DATABASE LAYOUT

In the proposed architecture, we use MySQL, a very popular and free database software, as our database server. In the database, we have a main table that records the authorized users and their password. Every registered user has an individual table that records the status of every electrical appliances. The basic layout of the database server can be observed. After connected and logged into the database server, the authorized user will see the status of each electrical appliances.The user can then change to the command mode as which is actually a *FORM* component in HTML document for interactive page design. The user can then select the command or adjust the power of selected appliance. After selecting the button *Next,* the control command will. be sent out to the home gateway through the TCP/IP protocol on the Internet. The TCP/IP connection flow is shown in Fig.6. The function *socket write()* in Fig. 6 is to transmit the command to the home gateway, while the function *socket read()* is to *read* the status as well as the power consumption information of the appliance. The read procedure is necessary because we have to make sure that the commands or actions have been carried out on the appliances to be controlled.[1]

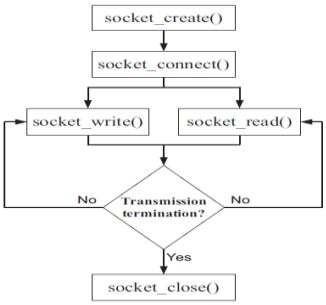

Fig.6. Database layout.

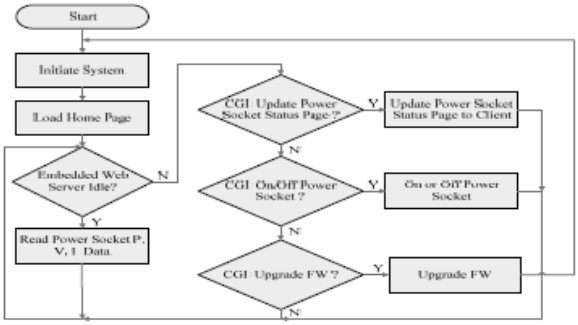

Fig.7. the software process illustration for remote monitoring and controlling

In fig.7.after booting, the overall system has to be initiated, and then the Home Page to client application program for remote monitoring and controlling is loaded. By using the spare time available for the embedded Web server, the power consumption, Vrms and Irms of power supply sockets can be read and temporarily saved in memories to wait for Web-page retrieval. After the network packets have been processed by the embedded Web server, if there is a remote user demand, the corresponding process will be connected to CGI applications such as the demands for the Web-page to display a new power socket status, the overall control of the specific on/off operation on power sockets and the firmware (FW) updates. This process convenient for the user to remotely monitor and control the power sockets. [8]

V. CONCLUSION

We propose in this paper a technology that can perform remote control and monitoring of electrical appliances on the Internet In addition, an embedded system-based home gateway that can be connected with the Internet is set up in which the electrical appliances are located. Moreover, the acquired power consumption information or the status of the appliances is all stored in a database server in the Cloud. The control command from the far-end place, i.e., from the web server on the Internet, is first sent to the home gateway and then transmitted to the IPS modules through the Zigbee wireless communication protocol so that the remote control of appliances can be achieved. We actively reduce standby power consumption by turning off a home device and the power outlet simultaneously through the ZigBee hub. This method eliminates the waiting time of a typical automatic power cut-off outlet. The proposed HEMS is expected to contribute to reduce home energy usage in the future.

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