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Design and Construction of a Global System for Mobile Communication (GSM) Based Control System for Electrical Appliances

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Abstract: ***In recent time there is an increasing usage of electronic and electrical devices for many household operations. Similar increase in usage is seen in offices and industries. With recent increase in electrical tariff it becomes necessary to optimize the usage of such electrical devices only when necessary. Often however, many user of such appliance have no way of directly quantifying their daily or average usage of electricity, apart many people forget to switch off their appliances from the electricity, mainly when they are not around and as such incurring unnecessary electricity bills. This paper is aim at designing and constructing a GSM/GPRS base device for monitoring daily or average usage of electricity and ability to be remotely control through SMS codes for the activation or deactivation of electrical devices from the main electricity supply. The device will consist of an AC current transducer connected to an embedded microcontroller for the calculation of power consumption rate. The microcontroller will also be attached to several relay as the case may be, for the direct switching ON or OFF of the attached appliance. The controller was also connected to a GSM/GPRS module for transmission of daily power consumption rate and the reception of the control signals to and from a remote cell phone is received accordingly through a message.***

Keywords: Design, Construction, Global system for mobile communication, Control system, Electrical appliances

I. INTRODUCTION

Charges allotted to most homes in Nigeria over the consumption of electricity are very alarming based on their electrical appliance. In most cases, the consumption charges cannot be quantified with the quantity of electricity used as in the case of analogue meter. However, with the recent development in technology, the digital meter came into existence by overriding the analogue meter whereby electricity consumption for electrical appliance is solely determined by the users. Maintenance of the power is an important task as the human operator goes to consumer's house and produces the bill as per the meter reading. The billing process takes much time if the consumer is not in the house while taking reading on energy consumption [1]. Obviously, it is still important for the electrical appliances in the home to be controlled most especially when we are not around or probably we forgot to switch off our appliances when we are running late for work or other activities. It is in view of this that the paper design and constructs a GSM device that can control electrical appliances in the home irrespective of the location it is been controlled from.

II. LITERATURE REVIEW

The rising increase in population and its attendant increase in the consumption of energy, [2] presented the development and implementation of a Global System for Mobile Communication (GSM) based remote control system for electrical appliances and lighting that enables complete control of the interface on which it is based. The GSM shield was used for receiving short message service (SMS) from the homeowner's mobile that automatically enables an Arduino microcontroller to take the necessary actions like switching OFF and ON electrical appliances. The design system reads the SMS and acts according to the message.

In designing a low cost and ubiquitous automated system, [3] developed a compacted short message service (SMS) based on automated hardware controlling system. The designed system developed will send instructions to different circuits, which are specially designed for specific events through hardware controlling system which receives SMS at the GSM modem attached with the server and relates it to the hardware controlling system through parallel port.

In the development and implementation of a global system for mobile communication, [4] presented a control system for electrical appliance that enables the complete control of the interface on which it is based. The GSM module control system was used for receiving short message service (SMS) from user's mobile phone that automatically enables the controller to take further action like switching ON and OFF the electrical appliances. The designed system was integrated

with microcontroller and GSM network interface using C language with the aid of MPLAB software which was utilized to accomplish the integration.

In suggesting two methods for home security, [5] uses web camera and SMS which uses GSM-GPS module. The designed implementation showed that whenever there was a motion in front of the camera, it gives security alert in terms of sound and a mail is delivered to the owner through SMS which uses sim548c and Atmega644p microcontroller, sensors, relays and buzzers.

In the implementation on global system module network by using short message service (SMS), [6] design a system that contains a GSM modem and interfacing unit circuit with microcontrollers. The designed system could control up to eight different electrical devices which are needed in daily life in different area. The system control is actualized by sending a specific SMS messages from traditional or smart phone which is restricted to a pre-defined phone number and are set in the software of the receiver.

In the application of mobile phone, [7] presented a design and development of an automated home control system (AHCS) for electrical home appliances. The research demonstrated how to develop a system that aids the control of remote devices using mobile phones to enable devices without infrared though connected to power sources to be controlled and considering the possibility of users to monitor the status and usage of the devices. The design system makes use of programmable interface controller (PIC) to control the switching of the output.

III. DESIGN METHODOLOGY

The design paper consists of the hardware and software interface system. The hardware interface system are incorporated together on a veroboard through soldering and which consists of many units which includes a GSM module, a PIC unit, a current sensor, liquid crystal display, relay switch, transformer and real time clock. The software interface system deals with the programs that are written to control the microcontroller at the processing centre of the system.

The design system uses GSM signal system which allows its users to effectively control and monitor their house/office appliances simply by sending codes. The code received by the GSM module is then processed by a microcontroller to perform the required operations. The type of the operation performed is based on the nature of the code sent. An encoded GSM signal is generated and sent from the GSM base station to the device. In the design methodology, GSM network was used because of its wider coverage. The relay driver is used to drive the relay circuits which switches the different appliances connected to the output of the project.

The Figure 1 and Figure 2 is the schematic diagram and the simulation circuit of the design. It is a simple illustration of how the design was implemented and the various parts involved in it. From the representation below, the first Mobile station is used as a transmitting section from which the subscriber sends the code which is the command or instruction received by the GSM module. A SIM card is inserted in the GSM module to be able to establish communication between the first mobile station and the GSM module over a preferred network. The microcontroller would be installed into the design that incorporated the written program that forms the design been connected to the power supply and an oscillator where execution of the program takes place.

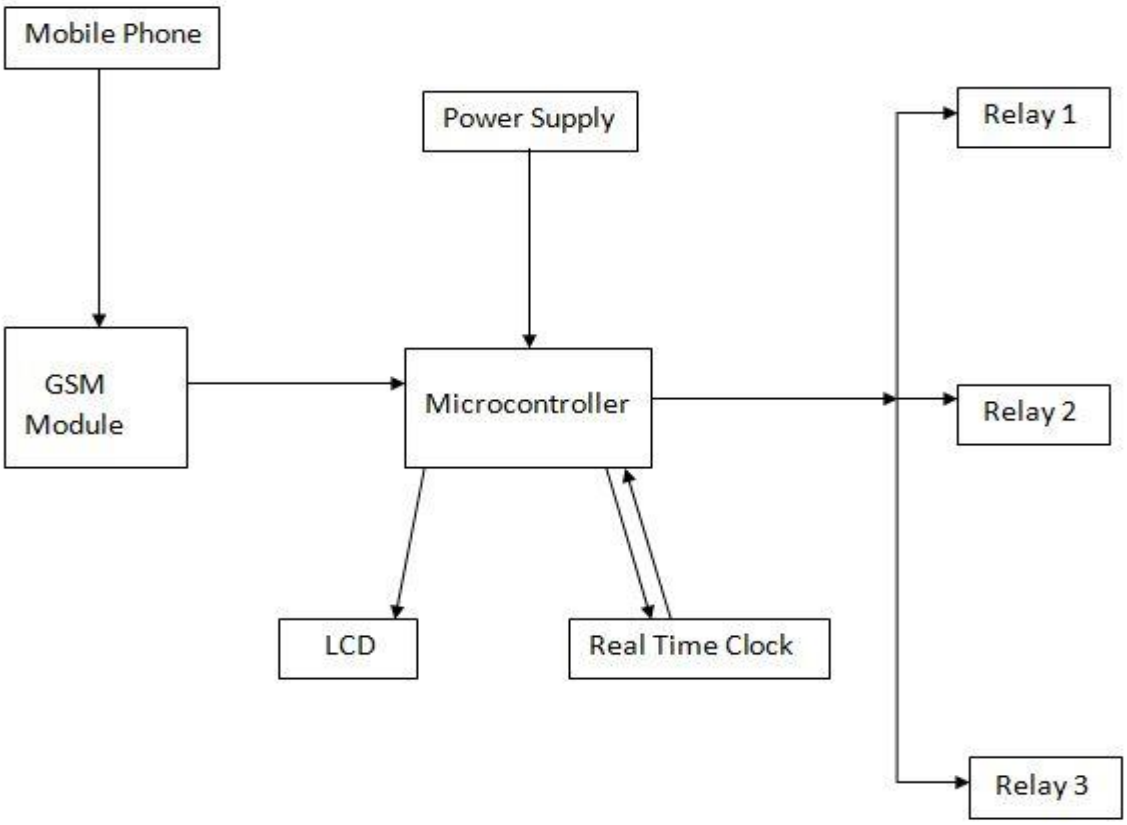

Figure 1: Block diagram of the design

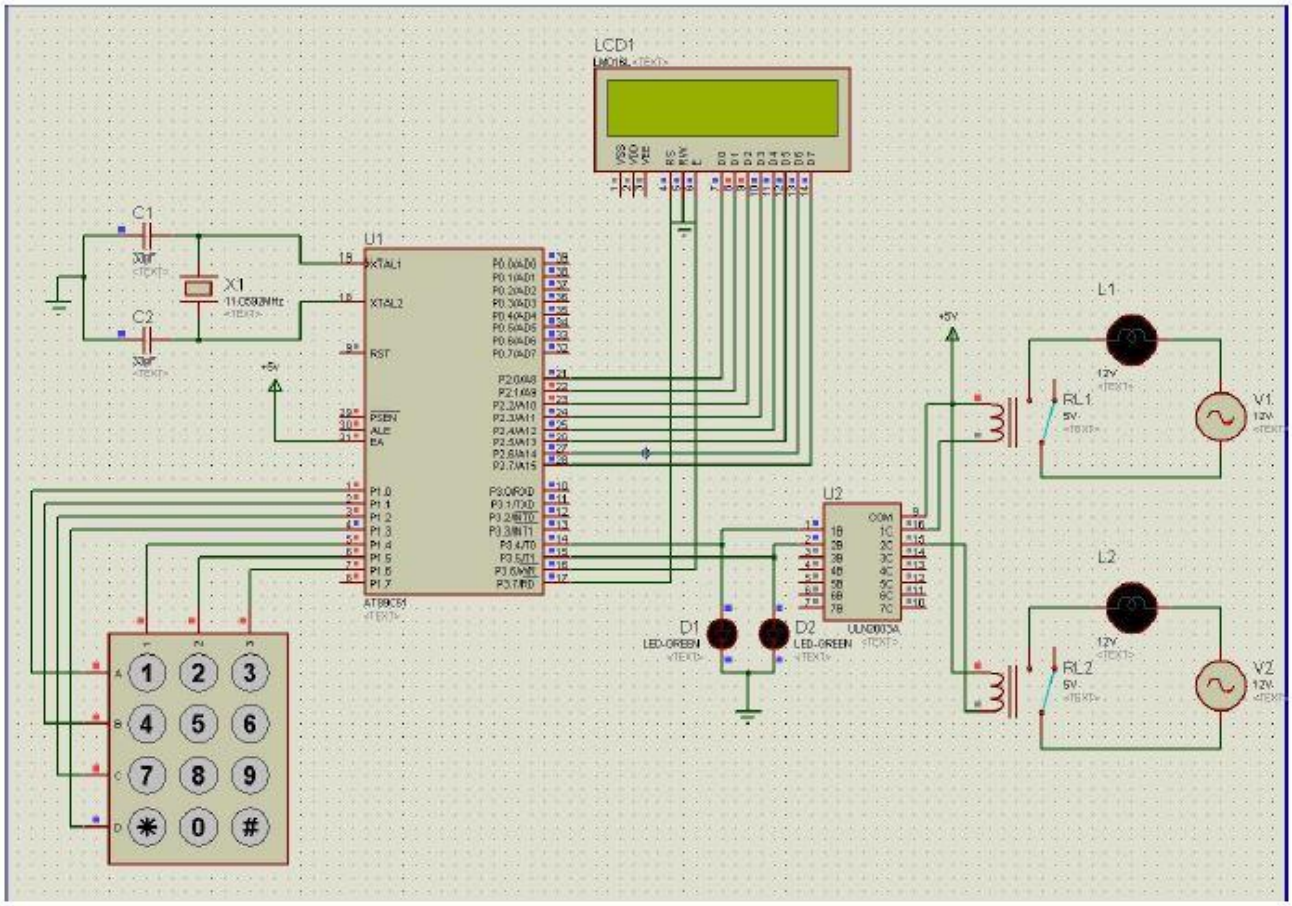

Figure 2: Simulation Circuits

IV. DESIGN RESULTS

Figure 3: (1) The front view of the design system (2) The back view of the design system (3) The design system in an idle mode (4) The design system when only one of the outputs is ON (5) The system when the two outputs are ON

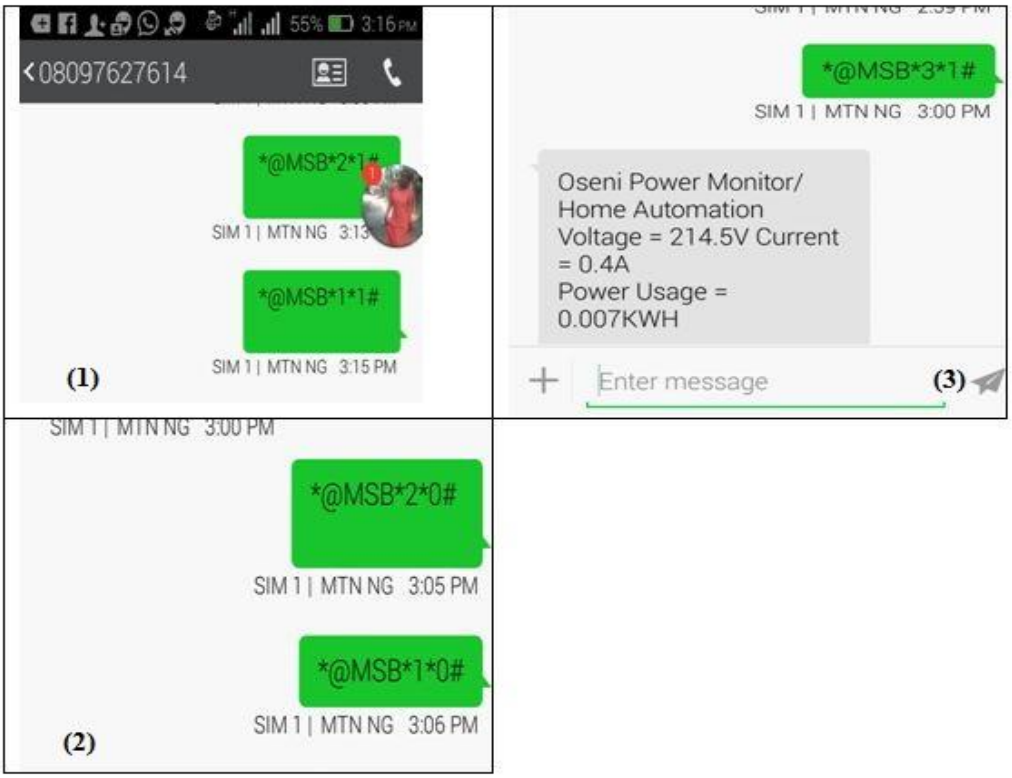

Figure 4: (1) Commands for putting ON the equipment (2) Commands for putting OFF the equipment (3) Commands for generating power usage

Figure 3 comprises of the various hardware structure of the design system which includes (1) front view of the entire component of the design system (2) the back view of the design system which are been soldered (3) the design system in an idle mode which is ready for activation (4) the design system when only one of the outputs is ON as been indicated from single bulb switch and (5) the design system when the two outputs (bulb samples) are ON.

Figure 4 comprises the command instruction of the design system as it responds to the activation of putting ON and OFF the equipment based on the generating power usage in the house. The design system was designed to receive SMS from the user of the mobile phone which is sent to the GSM modem connected to the PIC microcontroller. The GSM modem sends the code to the PIC which then process it and gives the necessary command. The design system after executing the command then replies by displaying the status of the devices based on "turned ON" or "turned OFF" status. The status message is to show the user that the command as based on the electrical home appliance is either on the ON or OFF idle mode.

V. CONCLUSIONS

The constructed design system when been activated through a PIC circuit with the aid of power supply of 12V DC, there is a flow of current through the transducer which monitors the design usage. When the design is activated, a self test is performed which indicates that it is actually ready for the PIC and GSM modem which in turns measure and display the amount of voltage and current passed through it and as well calculate the power usage while expecting the necessary command to be sent. In addition, the command is sent from the user mobile phone according to the programmed codes, the GSM module acting as a GSM phone receives the code and forwards it to the microcontroller which compares it with the programmed codes and processes it. After processing the command, the microcontroller then activates or deactivates the relays according to the command sent thereby putting ON or OFF the connected electrical home appliance. However, when a mobile phone user sends a code to request for power consumption, the GSM module receives the message and send to the microcontroller which gathers the necessary information from the transducer and the transformer and uses that to calculate the power consumption based on the coded program. The actualized constructed design can automatically switch ON and OFF the device remotely using SMS and also monitor daily/average power consumption. The design system is very practical when the user is away from home to control the home electrical appliance as long as the mobile phone is within the network coverage.

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