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Short Message Service Controlled Domestic Appliances*

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ABSTRACT

Short Message Service (SMS) is a feature of most mobile devices. Mobile phones most times transmit signals in the form of SMS. The sent signal is received and decoded by another mobile phone attached to the main system which converts the received signals into binary for the controller. The micro-controller takes in the binary output from the receiving mobile phone, and processes it based on a code written in the form of Assembly language, to drive certain appliances such as lighting points and sockets. With current energy crises, and issues regarding the efficient use of energy, it is the aim of this paper to propose a control system that will enable the end-user of energy to remotely control and operate electric appliances using SMS. The overall system enables the users to remotely control such appliances using their phone provided the SMS provider is online and that there is GSM network coverage over the area of control. This system can however be implemented using other methods such as Dual Tone Multi-frequency (DTMF) to achieve several other levels and types of control. Investigation has shown that energy consumption and efficiency can be achieved by the application of this proposal. About 30% of power is saved in a particular household during this investigation.

Keywords : Short Message Service; Energy saving; GSM; Efficient use of Energy; Remote mobile control

1 INTRODUCTION

The concept of automation is as old as human existence. The application of automation and control is in all aspects of human endeavor. Biological systems, the solar system, communication, aeronautic, industrial and so on, are some of the applications of automation. Investigation has shown that, there is wastage in the day-to-day use of energy [1], [2], [3], but with the application of some control measures as in this research, energy waste is reduced and this leads to the reliable and efficient use of energy which has a lot of advantages to both the supplier and the consumer of energy [4], [5]. Several technologies have been researched and developed even implemented to enable users control their domestic consumption from within the home or outdoor. This research is yet another way of controlling energy use, allowing the end-user to switch off when not in use, in order to save energy and reduce the energy bills. Therefore, this paper proposes a method to achieve such domestic control using mobile phones. The system makes use of a mobile phone, which is capable of receiving text (SMS) messages from another mobile phone or device capable of sending (SMS) messages. Today almost every individual owns a mobile phone; this makes the proposed system very affordable and cost effective. The mobile phone shall contain an active SIM card, registered with a network provider. The phone converts the SMS to binary and sends to the microcontroller via serial connection. This implies that one bit is sent after another (bit-serial) on a single transmission line. The microcontroller sends control signals from the mobile phone to the respective loads, based on some executable instruction codes.

Usually, GSM (Global System of Mobile Telecommunication) modems are recommended for use with a computer due to the limitations such as inability for some mobile phones to receive concatenated SMS (Messages with more than 140 bytes of data). However, for the scope of this work, mobile phones work just fine, and besides the above shortcomings of mobile phones, GSM modems and mobile phones are more or less the same for sending and receiving SMS messages. The mobile phone used in this work is a Sagem MyX5-2.

Short message service is a globally accepted wireless service that enables the transmission of text or even binary messages to and from mobile phones [6]. One SMS message contains 140 bytes of data which is equivalent to 160 characters if 7-bit encoding is used [7] as in English alphabets. One major advantage of SMS is that it is supported by all mobile phones; also most pay plans provided by GSM carriers provide affordable SMS prices. Some other features of SMS include the ability of a mobile phone to receive or submit a short message at any time independent of whether a voice call is in progress. SMS provides flexibility in that almost any type and combination of characters can be sent as text message in a store-and-forward process. Graphics can also be sent as part of an SMS [8].

2 BACKGROUND

Home automation is the residential extension of building automation. It is the automation of the home, housework or household activity [9]. Automation can be defined as the automatic control of equipment, a process or a system. Home automation systems provide comfortable and productive environment via automatic control systems like fire safety, security and energy or lighting management.

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The term automation has existed for many years. It began with a student connecting two electric wires to the hands of an alarm clock in order to close a circuit of a battery and light bulb. Other companies later developed automated systems of their own to control alarms, sensors and cameras thereby creating the first automated buildings [10]. There are many recent tendencies to incorporate various kinds of embedded devices and consumer appliances into software systems. The possibility of having access to many devices within a building from anywhere at any time solves a lot of problems of the user often saving significant amount of time and energy. It also notably increases security in a building. This access could be achieved from many different digital devices and it is known that the network hierarchy has been rapidly moving lower in the chain towards smaller and more personal devices [11]. With the exponential growth of the internet and telecommunication technology, home automation is experiencing an accelerated growth based on different kinds of residential network. Compared to many other transmission types, the GSM wireless transmission has a good advantage in setting up a home automation system without installation of many additional devices, hence providing relatively low cost of the system. Consequently, several GSM-related monitoring and control systems have been researched and implemented in the past such as GSM based automation of irrigation water controller system, GSM based monitoring and control of digital energy meter, GSM based highway vehicle traffic monitoring system and others, incorporating several wonderful features.

3 Design Methodology

The overall system is implemented following the block diagram below.

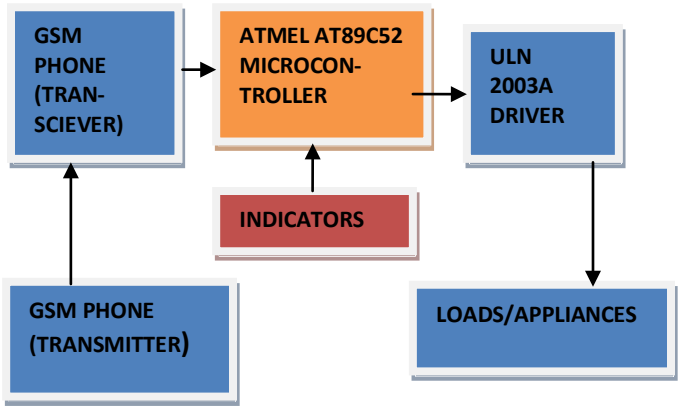

Fig. 1 Block Diagram of SMS based mobile control system

The block diagram showing the system architecture is shown in Fig. 1. The diagram also shows the cycle of events. As can be seen from the above, the events that take place in the functioning of this system are as follows:

1. The remote user sends text messages (SMS) including the necessary commands to the receiving mobile phone, which is integrated within the system.
2. The receiving mobile phone receives the message sent from the transmitting mobile phone via GSM wireless network.
3. The receiving mobile phone decodes the received message and sends the commands to the microcontroller
4. The microcontroller acts on the received commands following an assembly program on its memory, to effect the required control action.

3.1 Transmission Standards

The various coding techniques define how the signal states change during the transmission of a serial bit flow. Out of these standards, the one of which is frequently used for computer and control applications is the RS232 or V.24 serial interface. It is applied in point-to-point connections between two devices, and in this case, between the mobile phone and the microcontroller.

3.2 AT Commands

AT commands are instructions used to control modems. AT stands for 'Attention'. Every command line starts with 'AT' or 'at' hence the name AT commands. Many of these commands used to control wired dial-up modems are also supported by GSM modems and mobile phones. Aside the general command sets, GSM modems and mobile phones support another AT command set which is specific to the GSM technology, and includes SMS-related commands like AT+CMGS (send SMS message), AT+CMGD (to delete a message), AT+CMGL (list SMS messages) and AT+CMGR (Read SMS message) [12], [13]. In this work, these commands are embedded in the assembly language program which is written to the microcontroller chip.

3.3 AT89C52 Microcontroller and Sagem MyX5-2

The development of extremely high service integrated circuits has greatly reduced the sizes and costs of microcomputers which designer routinely consider in using their power and versatility in a wide range of applications [14]. In this work, the AT89C52 microcontroller manufactured by ATMEL is used. It is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory (PEROM). The choice of sagem mobile phone as receiver was made due to its support for the RS232 standard serial connection and its capability to send and receive AT commands. The hardware system is made up of the **input interface, the output interface and the feedback and control system.**

The input interface comprises a GSM mobile phone which receives the SMS message from an external (remote) mobile phone (transmitter) which sends the SMS message, with the network coverage acting as a bridge or connecting medium. It also includes the serial connection between the receiving mobile phone and the microcontroller.

The output section consists of the ULN2003A driver and the necessary relay devices rated 12v each. The test loads operated in this system are lamps.

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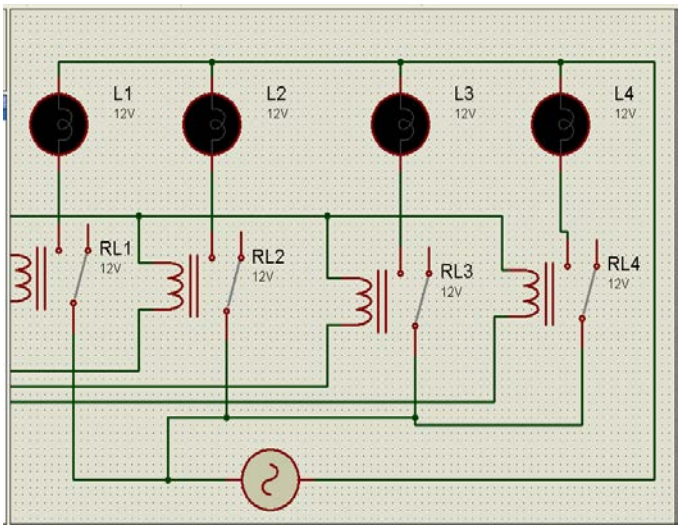

Fig.2. Section showing Output interface

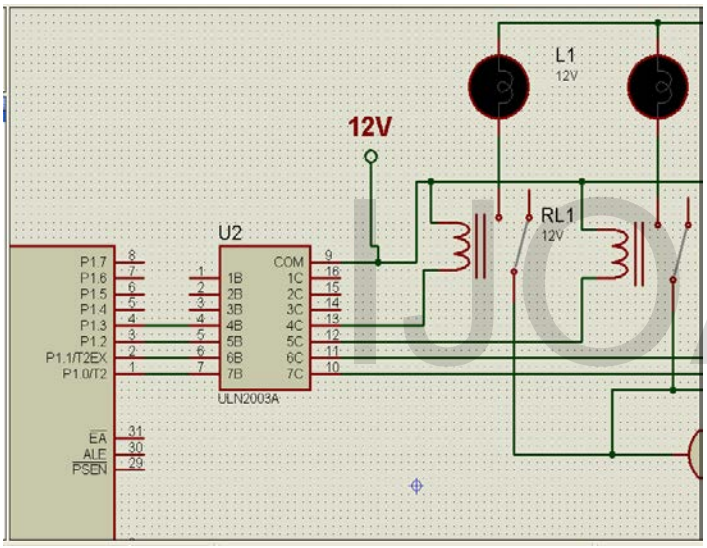

Fig.3. Section showing ULN2003A coupled to the Output devices

3.4 The Power Supply

A 240/12v step-down transformer is used to step down the voltage, the free-wheel diode; IN4001 is used in rectification of the voltage which is fed into a filter capacitor. The system requires an unregulated 12v and regulated 5v. A 7805 regulator is used to provide the required regulated +5v.

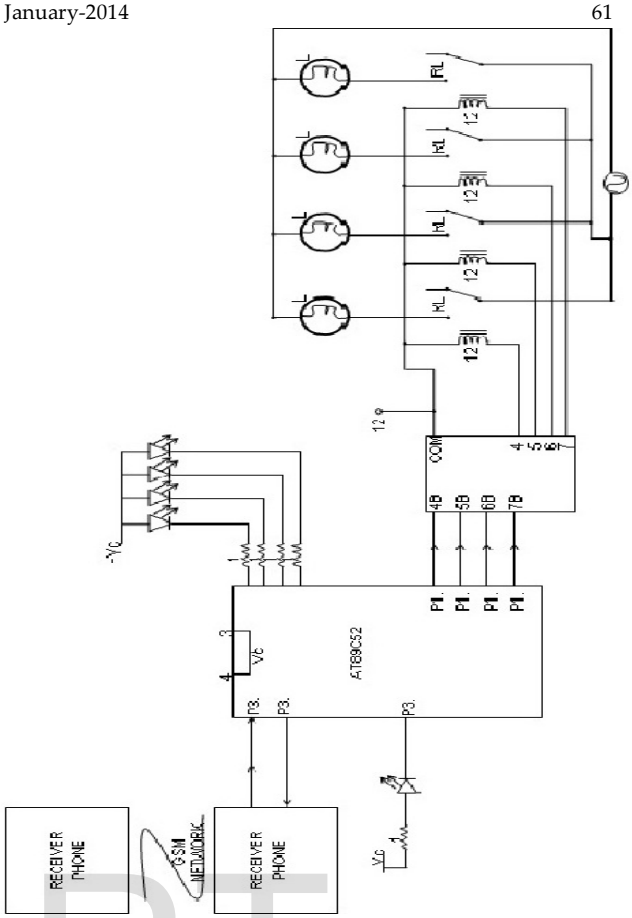

Fig.4. Circuit Diagram

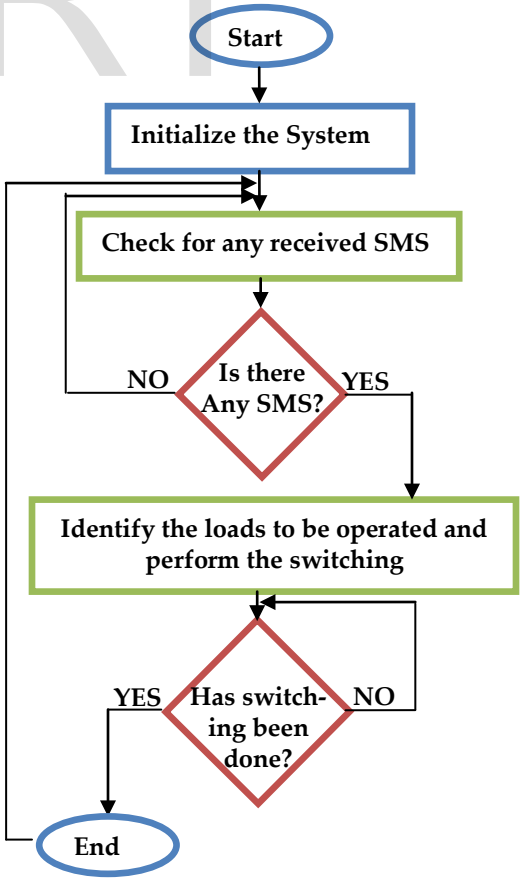

Fig.5. Flowchart of the switching

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4 Results and Discussion

After the system was tested, all its inherent parts performed consistently. Based on the test program that was written, the following results were observed.

As seen from the table above, the first four were programmed to be used in switching **ON (1)** the loads, while the last four to switch **OFF (0)** the loads.

Let us consider the security lights in a domestic installation as an example. If the owner of the house goes to work and forgets to switch off these lights, we can estimate the amount of energy loss. If the lamp rating is 100watts, 8 lamps yields 8 x 100 = 800Watts. Average work period per day is 8am to 5pm (9 hours). Hence we have,

Wattage = 800Watts
Usage (per day) if left ON = 9 hours
800 x 9 = 7200Watt hour per day

In Kilowatts, 7200/1000 = 7.2KWatt hour of energy is lost per day.

We can also estimate the amount of money the user would have lost as a result of this energy wastage. Using the average cost of electricity in Nigeria today of about N17.00 per KWh, we get the following,

Cost = N17.00 per KWh
7.2 x 17.00 = N122 per day.

Hence, the user loses over a hundred naira daily from just security lamps, much less talk of when any other domestic light is left powered on. The application of this work could be used to reduce and prevent such wastage whereby the user could switch off the lamps remotely from work or travel as the case may be, hence improving energy savings and efficiency.

5 Conclusion

This paper has demonstrated the possibility of using cellular technologies such as SMS to remotely control electrical appliances in the home or office. This uses commercial mobile communication networks as the path of data transmission. This program was tested using SMS to remotely control four appliances by switching of and on at will by the end-user.

The feature of feedback on system performance is still under investigation. This system can be applied using several methods different from the one used here. With increasing demand for energy in our society today, there is need for control of the available energy and reduction in wastage. Mobile phones are very handy and can serve as a tool to achieve this energy conservation goal. The application of this control system can save an average of 30% power.

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