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Design and Construction of a Microcontroller Based SMS Activated Home Appliance Control System

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Abstract

Electrical appliances are an important and necessary part of everyday existence and are not new. The Global System for Mobile Communication (GSM) is a mobile telephone technology that enables people to make and receive phone calls from any location. The GSM also provides additional services like Wireless Application Protocol (WAP) and Short Message Service (SMS), which usually allow users to send relatively cheap text messages from one mobile to another. In this work, users control their home appliances remotely using a mobile-phone based interface. In order to access the control unit, the user sends an authentication code with the desired function to the home control system via GSM. Once it is authenticated, the mobile phone-based interface at home (the control unit) relays the commands to the microcontroller circuit that would perform the required function, and a function completion code is returned to the source of the original command (the user's mobile phone).

Keywords: Electrical Appliance, GSM, SMS, Control Unit, Microbasic

1. Introduction

The period of Thomas Hobbes' State of Nature, which described the early stages of the human society as a nasty life and assigned that control over man's environment by man himself should be of paramount importance, man's innate need to seek control over his environment has been on his list of priorities. Either way, it is a well-known fact that a system without some form of control can only result in chaos. Control is therefore an integral part of man's existence. For instance, imagine a car without steering wheels or a break system and electrical devices without control switches, that would obviously be less productive, less efficient, and less effective and that would cause more stress on the operator of equipment like this and sometimes result in calamity. However, with total control comes great power, less stress, and improved productivity, efficacy, and effectiveness.

Advances in technology have made it possible to fully automate systems such as automobile assembly plants, cooling systems, and so on that require little or no human intervention. These systems have predefined processes that they carry out in a timely manner until stopped by an operator. Recent developments have also caused computers, in one form or other to be actively involved in the control of a wide array of processes, such as in the case of networking and the internet, which allow processes to be controlled in real time. Thus, automation is seen as the automatic control of a process or system.

The Global System for Mobile Telecommunication (GSM) is a digital wireless telephone network that allows a user to make and receive calls from any location where its technology exists. Other existing services it allows are: Wireless Application Protocol (WAP), Video calls, and Short message service.

The technology of the GSM is easy to install, use, and maintain, and due to its portable feature, the user has the flexibility of carrying it around and making use of it from any location. Thus, using the GSM to control devices remotely via microcontrollers is a relevant area research ought to be carried out continuously.

1.1 Problem Definition

The aim of the work is to develop a device that helps users monitor and control home appliances using a mobile phone. The System will offer this service anywhere and at any particular time, subject to constraints of the technologies used. The developed system uses a microcontroller based control module that receives commands and instructions from a mobile phone through the GSM Telecommunication. The microcontroller then carries out the given commands and communicates the state of a given appliance back to the mobile phone. In order to enhance security, a means of user authentication and identification was implemented that combined caller identification with password authorization.

1.2 Home Automation System

Home automation, in its simplest form, is the ability to remotely control lighting and electrical appliances within and outside the home. For instance, security lights can be turned on via the same control that switches on the television, cooling system, microwave oven, and other electrical appliances. Home automation connects all aspects of a system together through one central panel and a microcontroller. It involves the remote control and monitoring of domestic appliances, home security, and energy management [2].

During the industrial and home revolutions of the late 1700s and 1800s, more sophisticated machines were developed and applied to situations requiring a faster response than was possible with manual and code adjustment. This need has led to the concept of automation and the development of digital computers (microcomputers or microcontrollers), which monitor external appliances and provide appropriate control (switch on and off, and even do more) to a system, adding refined methods to the applications of automation. Thus, automation has itself existed.

1.3 Features of Home Automation Systems

Anderson [2] identified certain features of home automation systems that are listed below:

- a) Home automation allows access to appliances in the home. Computer interfaces, remote control, and other methods of access substitute for mobility, strength, and agility in providing access.
- b) Home automation helps systems in the home communicate automatically and share information.

1.4 Benefits of Home Automation

Home automation has benefits [2] and some of the more important ones include:

- a) *Safety. It allows the security of checking the status of devices from any location and allows the user to be alerted in the event of an external body.*
- b) *Flexibility. It allows the user to carry the remote control system around and make use of it from any location.*
- c) *Energy Savings. This reduces electricity usage in devices such as rotors, electric bulbs can be put on only when needed.*
- d) *Convenience. It saves a lot of time and effort. Devices can be controlled from any location, and the system can be automatically set to carry out routine checks.*

Thus, home automation systems can provide a sort of stress free like life controlling the home appliances while one is still in bed or out of the home.

1.5 Applications of Home Automation

According to the Microsoft Encarta Encyclopedia [15] software package and the Texas Burglar and Fire Alarm Association [13], some of the fields in which automation has been regularly applied are:

- a) *Security Systems and Access control: this includes alarms, surveillance cameras, motion detectors, door control and access, and the monitoring of critical facilities like gas, water, and electricity.*
- b) *Lighting and Appliance control: this involves the control of home lighting and appliances.*
- c) *Thermostats allow the monitoring of room temperature and switching on heating or cooling systems as appropriate.*
- d) *Industrial robots control involves automated machines that can be programmed to perform different jobs under various operating conditions.*
- e) *Process control allows the monitoring and control of technical or engineering processes by means of a computer or microcontroller. Examples of these include traffic light systems, conveyer belts, etc.*

1.6 The Need for Home Automation in Nigeria

The concept of home automation in Nigeria just started around the mid-2000s. According to Homestyle [6], it is understood that an automation system is about improving one's home and standard of living by extracting more benefits from one's electrical home equipment, so it is imperative to know the various problems that can be solved or, at least, reduced to a minimum by such a system.

2. Methodology

2.1 Architecture of the System

2.1.1 Design of the Switching Circuitry (Relay Switch Board)

The relay switch board is the hardware that switches on and off electrical devices. It is connected to a standard parallel port/protocol and accepts commands from it. Two relay switches were used to control up to two devices, which implies that a relay switch can be used to control only one device. The components used in the construction of the switch board are Relays, ULN2803, an IC, Light Emitting Diodes (LEDs), resistors, and a 12-volt DC power supply.

2.1.1 Design of the Firmware

The microcontroller is normally a dumb device that needs to be instructed sequentially, which is achieved via the use of microbasic code. The programming language to be used for the implementation is microbasic. The few advantages of the microbasic programming language are:

- a) *It is user friendly.*
- b) *It is easy to modify.*
- c) *It is very fast and efficient.*

A significant problem with microbasic is that it is object-oriented, thus making it too abstract for programmers. Microbasic is preferred because of its ability to allow the microcontroller to interface with mobile phones with in-built modems. With this ability, such phones accept the standard AT commands to perform different operations requested by the microbasic program.

2.1.2 Command Format for the SMS

The ability to control the relays via SMS is based on predefined command syntax to carry out different actions like switching off and on, requesting the status of the relays, or sometimes controlling the temperature of the specific device.

Using a case study of two home appliances, an electric fan and a light bulb, a string of two characters of either 1 or 0 is to be expected. A 1 generally indicates the ON state of the device, and a 0 indicates the OFF state.

As done in most control systems, a loop action can be carried out, requiring the GSM modem to query for a message, and if no new message is sent or received, the loop is continued. A new message can be read and deleted after it has been decoded. Correct message format will trigger switch board action, and incorrect message format will only trigger the sending of an error SMS message.

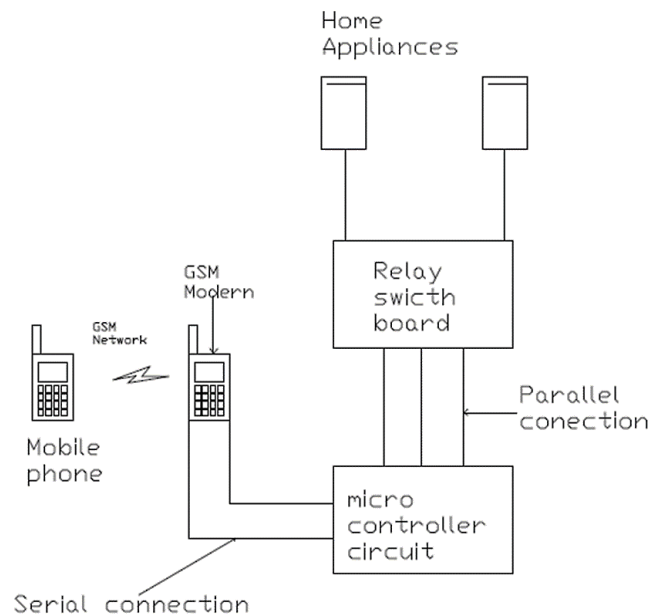


Figure 1: The design for the SMS activated microcontroller based home automation system.

3. Results and Discussion

The single M2M controller circuit performs the following functions:

- Receive commands and instructions from a messaging device on a communication network.
- Control target devices through an electrical based interface.
- Monitor the device status from an electronic based interface.

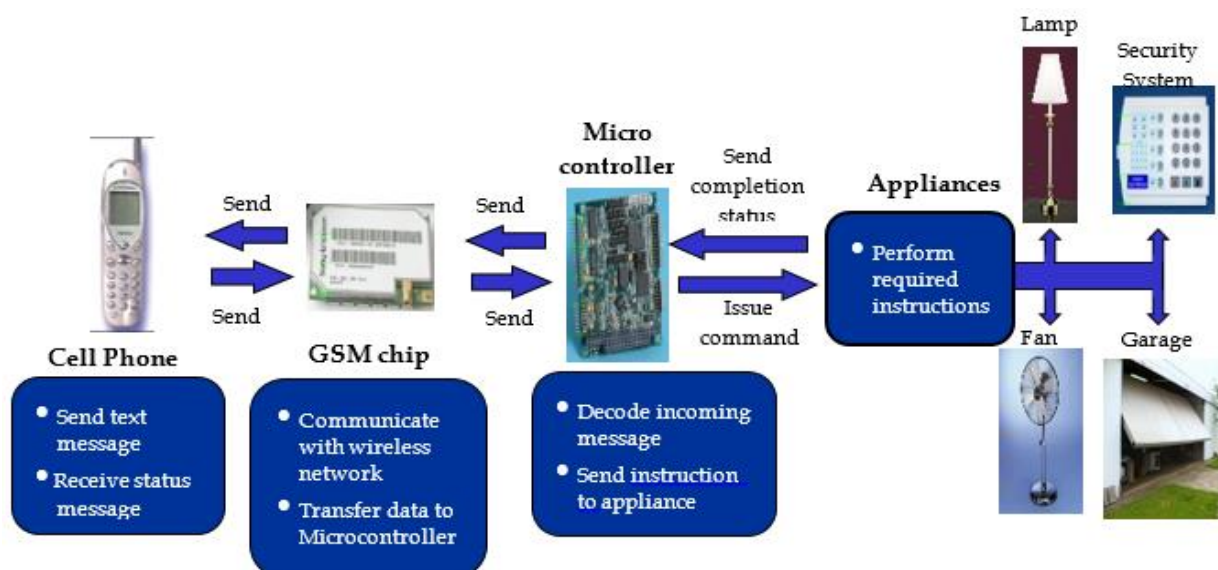


Figure 2: System Operation Flow Diagram

This system helps an average person control household appliances remotely from their mobile phones, provided that the appliances are controlled electrically. Examples of feasible appliances and applications under consideration include enable or disable security systems, fans, lights, kitchen appliances, and adjusting the temperature settings of a heating, ventilation or air conditioning system.

4. Conclusion

The use of computers has resulted in a powerful, reliable, and affordable lifestyle because of their vast and important role in human existence. But with the recent function replacement of computers with microcontrollers, there is now a more reliable, affordable, cost-effective, and portable livelihood in our society today. More so, with the introduction of networking and communications technology, the ability to carry out activities from distances never before imagined has made life much easier. The significance of microcontrollers cannot be overemphasized, as they can be programmed to perform both simple and very complex functions, depending on the intelligence of the programmer. The ability to control home appliances from outside the home through SMS messaging will become a part of every home over time. Its advantages are numerous, and far exceed the costs. The implementation of the system was successful. Although simple, this shows that the possibilities of automation are limitless as far as the human mind can reason and think.

5. Recommendation

Finally, for proper implementation, the automated system must be on all the time. This may not be possible due to epileptic power supplies and other factors. The possibility of extending this work to carry out more complex functions on connected devices should be considered.

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