



ABSTRACT

Home automation systems are required for energy savings, safety, protection and convenience use of appliances in any developing economy. This system invented to keep home appliances safe against current fluctuations on the load, reduce energy wastage and protections of life and properties of the owner or user. In this current work, we proposed

A

NDROID BASE IMPROVED AUTOMATION APP (ABIAA)

***S. O. ADETONA; *K. U UDEZE; **S. K. OGUAGBAKA**

*Department of Electrical & Electronics Engineering, University of Lagos, Lagos, Nigeria.
**ICT-Information and Communication Technology Unit, Federal Polytechnic Oko, Oko, Anambra State.

Introduction

In this part of the world, electricity is epileptic and there is need to save the quantity of electricity being consumed on the daily bases, protect the appliances and safeguard the life and property of the user. Energy can be saved if a user doesn't need energy at a particular time to power his equipment; he then put off the equipment that is not needed at that time to allow other user to use the electricity. By so doing energy is saved. Also, there is need to use advance technology to control the usage of electricity so that the appliances can be automatically put off when the utility is interrupted so that the appliance can be safeguarded and life and property can be protected against any forgetfulness that would have resulted to fire outbreak. So, many researchers have done projects on home/offices



suitable technique known as Android Base Improved Automation App (ABiAA) for design and application of GSM-based home-automations system using Android Application that consumed very low power. This system comprises of wireless home-network that contains GSM modem along with magnet followed by relay that act as “load protective device”. The system can response faster when power is restored and GSM module would alert home owner via SMS with recorded voice that Electricity is restored for the owner to POWER (ON) the loads. This Home/Office automation system use in alerting house/offices owner wherever he is; at any given time so that he can power ON the required loads that are necessary supposed to be ON as required. The default mode is such that once the Electricity is interrupted, the loads are switched OFF thereby providing energy savings to the owner and safeguarded the connected appliances as well as safety of life and properties that would have resulted from fire outbreak. In this arrangement, a magnet and relay positioned at point of entry produce signal via telecom network and relay message that gives information concerning update at home or pre-defined and detailed messages that are stored in micro-controller. Suspected set of activities are moved to local-user via SMS. This design reduces the energy wastage and inefficiencies. The different results obtained show that the project worked based on specification of the design. But every system has its pros and cons. Our proposed system is easy to implement and understand.

Key Words: GSM, SMS, ABiAA, WIFI, REFID, RAM, ROM, MTN, AIRTEL, PSC, LED,

automation using wifi, Bluetooth, Internet of Things etc.

[1] designed home automation will send an SMS to the owner of the house that electricity has been restored to the house and the user will have to send a code to check the status of the load and upon receiving



the notification on the status of the load he can then send a code back to put ON/OFF the appliances based on demand at that particular time. Smart/intelligent home also called Home-automation is a home in which the daily activities of electrical devices and appliances are automated [2]. Automated homes are fortified with specialized appliances to help occupants in controlling and programing their electronic appliances for instance, an owner of a house trying to go for holiday could design system for home security, controlled temperature system, on/off switch appliances, control light system, programed home-theater and entertainment gadgets and perform several tasks. Smart-homes are generally designed to build an environment that is conscious of things that are happening in it. Before now, automated gadgets are independent and sectioned in smaller independent structures and the concept of providing them with interoperability with usual “language” continues to grow. Therefore, first structure of home automation originated from idea of house networking which has several possibilities, but included novel factors to consider and some of these factors are interoperability, scale-ability, acceptability, security and limited services. House automations are considered as smarter when the controlling is carried out efficiently from localized or remote locations. The technology available for this isolated interaction is Internet, Mobile-phone, and Bluetooth [3].

With the rising increase in population and its attendant rise in energy usage, there is massive need for energy conservation in all means possible. Not having the capacity to contact and control home-devices from localized locations is among the key reasons while developing nation like Nigeria involve in massive energy wastage. This current work proposed developing and implementing GSM-based localized control structure for electrical devices and lighting that helps for total control of the interface with Android apps contained in GSM Modem. GSM is used in receiving SMS from owner’s mobile-phone which automatically helps



micro-controller in taking needed actions such as switch OFF or ON electrical gadgets. It basically decodes this SMS and responds based on the message. Products which are available commercially depend on Internet and therefore lack the actual concept of security and mobility. However, this current GSM-based localized control structure allows people to control their gadgets from anywhere with their phone apps and equally restricts illegal access to the gadgets. This current structure is crucial because they provide security to detect intrusion through SMS using GSM. [3].

The Office/Home automation involves application of Electrical/Electronic semiconductor gadgets and other materials to control electrical appliances at home/Offices. There are various devices today that allow the use of control and consequently manage the electricity utilization efficiently through localized control or voice command [4]. One of the control devices is GSM which GSM module is used for Home/Office load automation that smartly remote lighting points, Air-condition system, Refrigerators, switches and as many other loads connected to this designed system. This Home/Office automation is needed because residential occupants usually leave the appliances ON unconsciously at the closure of the day or when leaving their home for work due to epileptic power supply mostly in upcoming nations like Nigeria. This leads to wastage of energy and can also, cause fire outbreak. Because in most cases, people are not always present in the home and offices, there is need to automation of residences and offices to remotely switch OFF devices and turn ON, when necessary, demand electronically. With this, there will be reduction in the rate of electricity consumption, decrees in electricity bill, increase in safety and on life span of these appliances [3], in developing nation like Nigeria, wastage of electricity is common. To control this wastage, the use of centrally control device is advisable.

This concept of central automation has existed for several years now. The use of GSM module has so many applications. Such as in the homes



or offices central control lighting, security locks systems to give conducive environment and energy efficiency [5]. This GSM base module system is also considered beneficial especially in disability persons and elderly people too to reduce the stress they are likely to encounter and energy that can be lost when power is restored in their home or office. There are several wireless ICTs that uses some kind of isolated control and sensing gadgets as well as localized data transfer example “Wireless Fidelity (WiFi), Radio Frequency Identification (RFID), Internet of Things (IoT)”.

All these detectors and sensors are interrelated or interlinked to micro-controller using several forms of circuits [6]. These micro-controllers would monitor the entire sensors continuously and when it notices power supply, it would send SMS to mobile-phone of the user via GSM modem. This Micro-controller equally turns ON or OFF electrical gadgets in offices or home based on information or message from end user’s Android-apps.

GSM is cellular network and its network operates based on four different ranges of frequencies. Most networks used by GSM work in “900 MHz or 1800 MHz bands”. The transmission energy and power in mobile-phones is controlled at 2 watts maximum, GSM and 1-watt in 1800/1900 and long distance which GSM requirement allows in practical application is 35Km. In this work we employed SIM-300-based modem for receiving and sending short message to HA structures and user [7].

In the previous work done, [1] a home/automation system was design using Arduino that will send a notification when utility restores electricity in the buildings then the user has to send a code to first know the status of the load before taken a decision to send another code to turn OFF/ON the appliances but the problem with this is that people can forget codes which makes this design not user friendly. Again, the design is such that some appliances will still maintain their ON state before the interruption of power supply which means that appliances that are not needed to be



ON; is likely to be ON when its use is not required at a particular time and this is a waist of energy. Let us assume assumed that what was ON before the interruption of the electricity was an electric iron or kettle, when the power is restored, there is every tendency that network might fail and the user's life and property might face fire outbreak. Hence, there is need to design a system that will put OFF all load as soon as utility interrupts electricity and then the owner can use an Android Application to ON any load that is required to be ON and any particular time. Again, because people can easily forget code, the use of a designed application which is an Android base with ON/OFF button makes the usage very flexible. Hence, the reason for the designing of The Android Base Improved Automation App (ABiAA).

It is important to note that since electricity loads can lead to fire outbreak, it is very important to use the advance technology for the remotely control the load appliances in the house/offices. One of the ways of achieving this is to design an android base home automation that can put OFF the entire system when electricity of interrupted. With the, the loads are protected, energy is saved and the possibility for a fire outbreak is eliminated.

This designed paper is significantly designed to benefit both the Owner of the house or residences, protect the life of the equipment/loads connected to it, save the cost of utility, for the safety of life and properties and reduces energy wastage.

There are many ways of designing home automation system such as designs based on "Wireless Fidelity (WiFi), Radio Frequency Identification (RFID), Internet of Things (IoT), Bluetooth wireless, wireless Zig-Bee network" and wired X10 tech and the use of Arduino controller. However, this paper is based on sim800l GSM module that communicate with the 8051-microcontroller.

The overall work was achieved by combining the use of designed hardware, software and the introduction of GSM module for the home



automation system. The hardware comprises of the relay session, the power supply unit, the combination of microcontroller architecture and the biasing resistors was well as the transistors that act as switches. The GSM module is having a sim slot where you can choose the best network coverage in your vicinity to save your purpose with regards to the availability of network. For example, in Nigeria where we use MTN, Glo, AIRTEL etc. your choice of sim should be a factor of the particular network provider in your area.

Materials and Methods

The Android Base Improved Automation App (ABiAA) project using GSM Module designed with low cost, effective, simple and smart system has two major modules. The hardware interfaces and software module.

1. Hardware Interface Module

The hardware used in Android Base Improved Automation App (ABiAA) designed is SIM-module, 12-V, 10A moveable or Magnetic relay single pole double throw (SPDT), 8051 Micro-controller, transistors, resistors-diodes and power unit. Inter-connection of hardware achieves general project purpose.

A GSM SIM800l module Fig. 2 is special form of module that accepts SIM-card and function over subscription to mobile operation. The micro-controller interacts with mobile network through GSM-module.

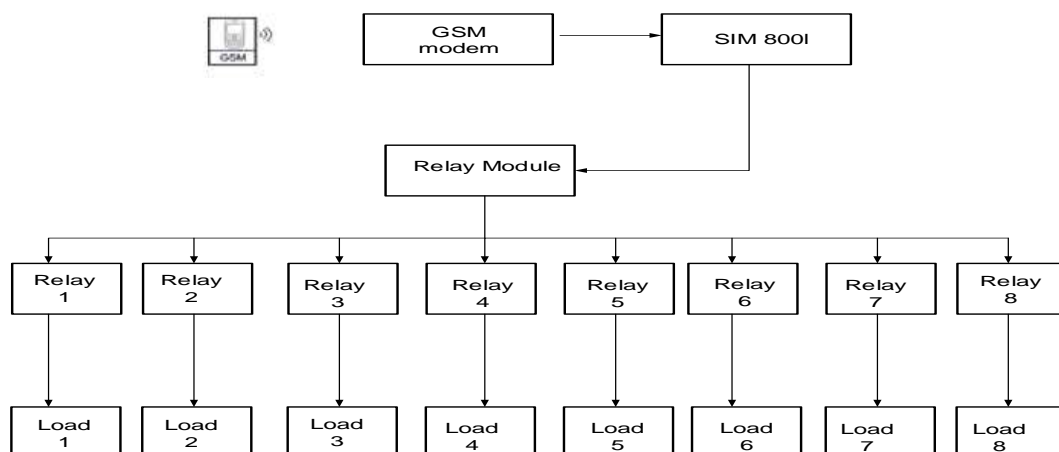


Figure 1 Block diagram of the Android Base Improved Automation App (ABiAA)



Figure 2 GSM SIM Modules

Relay, fundamentally, is electromagnetic link or switch which is employed in turning electrical loads either On or OFF by using voltage within these contacts. 12 V 8-channel relay used for this project is as shown in Fig. 3 a&b.



Figure 3a The SPDT circuit Board of the 8-channel relay

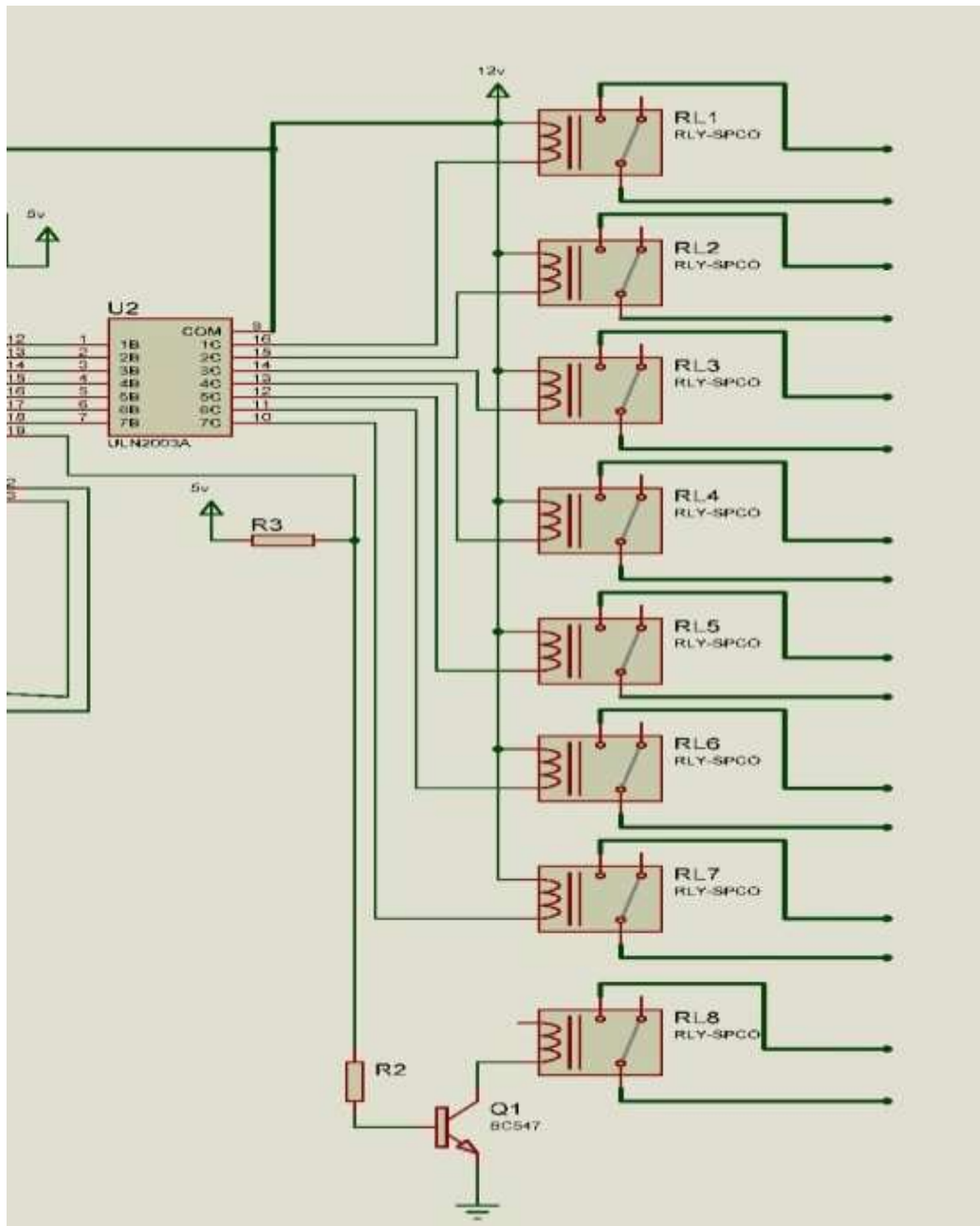


Figure 3b Schematic diagram of SPDT the 8-channel relay

The moveable relay ie. SPDT is used because the static relays used in some of the previous work done are not good on inductive loads. The moveable magnetic relays are very suitable for all kinds of loads. The relay is used to drive both relay circuit that switches different gadget linked to interface; ON and OFF and protect micro-controller from relay



kick-back using integrated clamp diodes. It contains seven high-current Darlington pairs that has standard emitters [1].

Microcontroller needs a program that involves integration of instructions and such program informs micro-controller on how to carry out certain tasks. Hence, the programs need memory where these programs are saved and accessed by Micro-controller to carry-out certain operations specific function. The memory used in storing these programs for micro-controller is called “code-memory or Program-memory”. It is called ROM-memory and is needed for storing data for micro-controller.

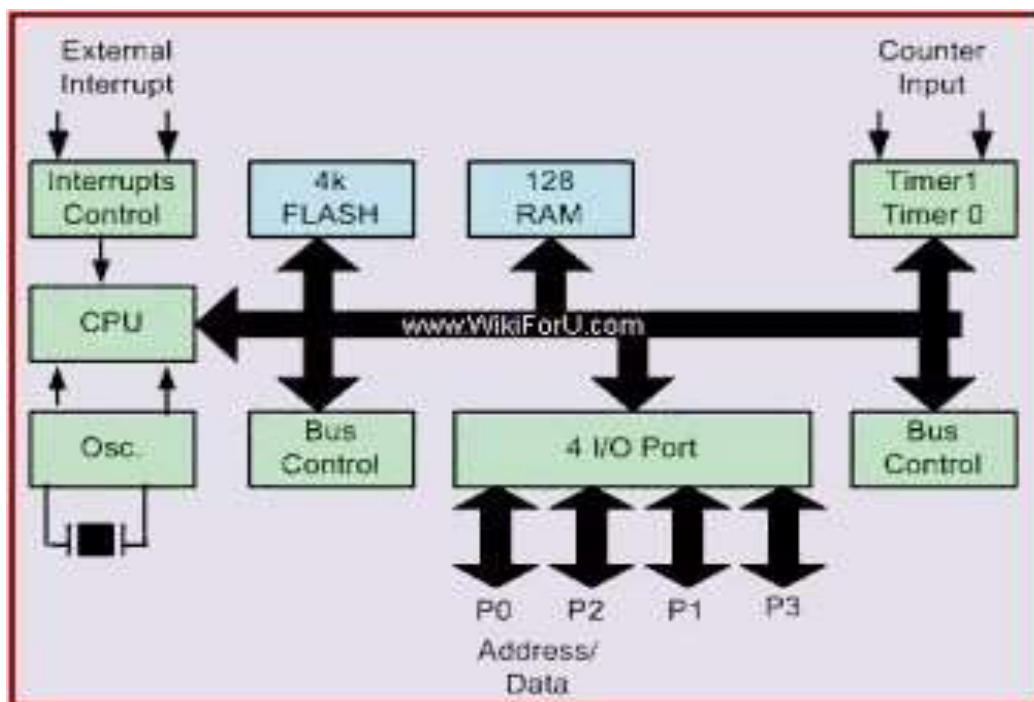


Figure 4 8051 Microcontroller Architecture

The data-memory used in storing data for operation temporarily is called RAM-memory. 8051 micro-controllers have “4K of code-memory or program-memory” which has 4KB ROM and 128 bytes of data-memory for RAM <https://www.watelectronics.com/8051-microcontroller-architecture/>.

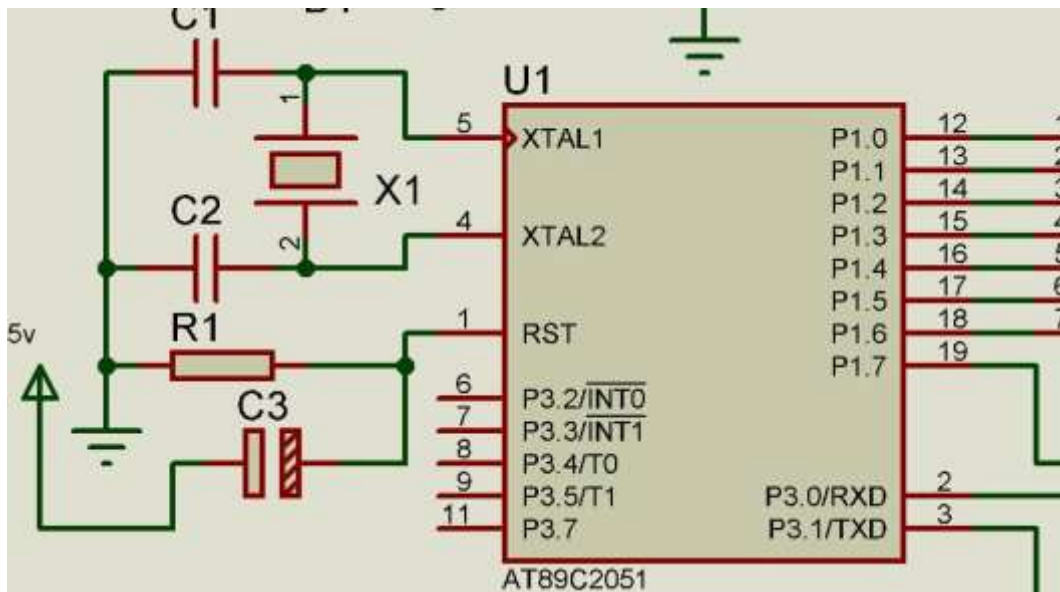


Figure 5 Schematic Diagram of the microcontroller

Mode of operation

The GSM-module is linked to micro-controller board with serial interconnected port. The modules have RS232-port and sim 800l which could connect using Transistor-to-Transistor logic. A max-232-IC is employed in making two directional changes between RS232 and this logic and TX-pin of micro-controller is linked to RX-pin of GSM module using max-232 and RX-pin of micro-controller is linked to TX-pin of GSM module using max-232 itself. The code programmed in this micro-controller could interact with GSM modular using AT-command. And AT-command is moved or received from modular using serial interconnected functions provided by micro-controller library. The operation like Serial begins which aids in initializing serial port with specified baud rate, Serial-code to send details to serial-port, Serial-availability and Serial-decode operations to decode data from serial-port. GSM module employs in this process is SIM-800l based modular which could interact with other gadgets using RS-232 serial interaction port. It operates on 5 V power. Mobile-phone modules respond “OK” when they receive intending order “AT” and that’s best way to control interaction



between module and micro-controller. To work on Rela-1 in ON condition, click on “TURN ON” gadget grid in HACS-mobile app that send “#a1bocodo” though encrypted via SMS to GSM and micro-controller to recollect similar value from HEX via serial-read register that makes “digital-pin 2 high” and made Relay in “OFF condition simply TURNS ON” gadget grid in HACS-mobile app [3].

Power Supply Circuit

Fig. 6 is PSC and it converts AC signal to DC through the rectifier; the capacitors connected between the rectifier and the Regulator is used as a filtering capacitor. The 7805 regulator is used as a 5 V regulator to supply current to the designed Android-Based HA using GSM module.

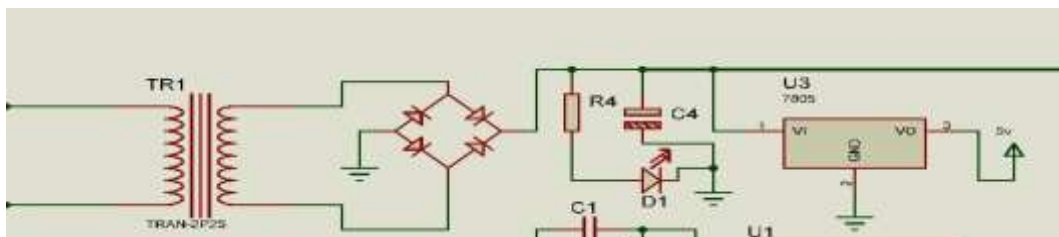


Figure 6 Schematic Diagrams for Power Supply Circuit (PSC)

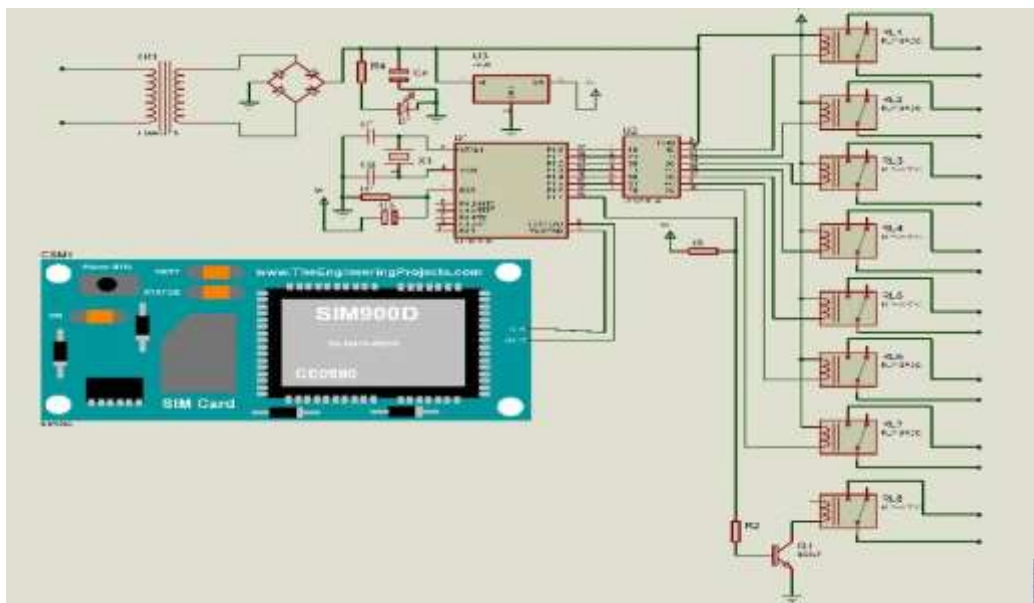


Figure 7 Schematic diagram of the Android Base Improved Automation App (ABiAA)



The sensor and the buzzer were assigned to two analog-pins on the microcontroller board while the other actuators and the GSM Shield are assigned to the digital pins of the microcontroller Board. The circuit was designed using Proteus circuit designer. Fig. 7 shows the circuit diagram of the prototype.

Software Modules

Microcontroller programming has two key sections; set-up function and loop. The initial is function that performs when app runs while second one is performs as look. There are more functions that were added in segment that aided this program work efficiently. The program functions for every service mode which provides for suitable control loop. The C++ program that runs microcontroller was coded to control or convey orders to microcontroller-pin to perform certain duty.

The Fig 8 shows the flow chart of code for operation micro-controller developed from algorithm [1].

1. Start
2. Configuration of input/output pins
3. Configuration of input/output pins for the microcontroller
4. Input the Receipt Mobile Number
5. Configuration of LCD and Relay Drivers
6. Check the energy source to the device
7. Is the device energized? No, Go to 6
8. Yes, send 'Electricity is restored' power is restored to the user's mobile line
9. Define the outlet for each load
10. Is the user interested in knowing the state of loads? No, Go to 13
11. Yes, send the appropriate command, go to 9 and return
12. Display the state of load on LCD and User's mobile line
13. End

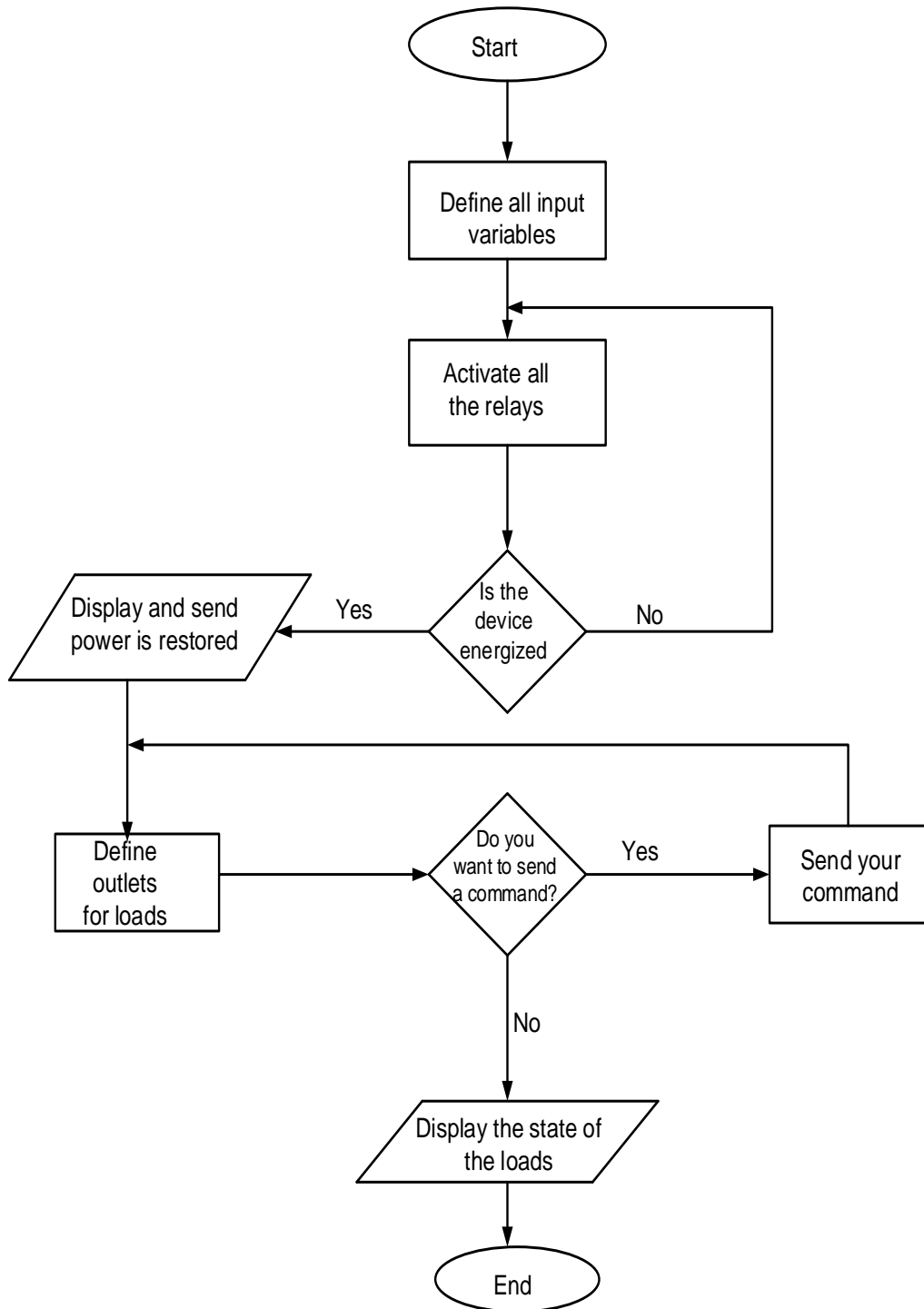


Figure 8 Flow Chart of microcontroller programming

The written C++ program code for the software designed the runs the system can be seen in the appendix A.



3. The Designed Android Base Improved Automation App (ABiAA) Using GSM Module



Figure 9 External picture of the Designed Android Base Improved Automation App (ABiAA) Using GSM Module

In the Fig. 9, the loads are the 4-bulb with the 4-soucket. At the point, the loads are in the OFF state.

The Fig. 10 shows the state of the designed system when the it was powered ON. The red LED shows that the device is in the ON state although the system is not loaded.



Figure 10 The Internal Picture of the Designed System



Figure 11 The Picture of the Designed Android Base Improved Automation App (ABiAA) Using GSM Module in its Functioning State

Experimental Set Up

Experimental arrangement to assess performance of this presented gadget when 4 electric loads are linked to them and power were turned-On as revealed in Fig. 12



Figure 12 Devices with the Connected Loads

This is energies through the flip-flop button; after delay of about three seconds, the SIM800l will blink and keep blinking until there is network on the device after which the sim LED will keep blinking at about a



defined frequency to indicate that there is network on the design system. And then the LED at the power source remains steady.

RESULT

After the experimental performance, it was satisfied that the designed project worked as proposed and the result shows that appliances can actually be controlled from anywhere provided that the owner is within the network coverage. When the power was switched OFF using the push-pool button as a testing tip, on switching on the button with was seen that the whole system connected to the designed system that they all went OFF on the user uses the designed Android button to switch it ON.

The result from the design project as can be seen from the experimental set shows the performance evaluation of this proposed gadget when operated and corresponding outcome obtained. From the experimental set up, it is evidently clear that when the power is restored at home or office, the Android Base Improved Automation App (ABiAA) design system will send an SMS 'the power is restored check your load status' remotely through the GSM-network to owner for prompt action, as show Fig 13.



Figure 13 Screen-shot of SMS on Owners Phone

When the end user receives the SMS notification, the user has to open the Android Application on the phone to switch ON the required load the needed to be on at that particular time since the default mode is such



that the designed system has to switch OFF all connected to as soon as the power is interrupted.

The Android interface is as shown in the Fig. 14 below.



Figure 14 Screenshot of Android Application Interface in default mode



Figure 15 Screenshot of ABiAA Application Interface in ON state

In Fig. 15, the green colour indicates the Energy Bulb is in the ON state likewise the Home Theater. While others remain in their default OFF state.

However, in Fig. 16, the owner can put OFF the like using the same android Application and the red colour on the interface shows that the appliance is in the OFF state.



Figure 16 Screenshot of ABiAA Application Interface in ON and OFF state

The Fig. 16 shows that Energy Bulb, Home Theater and Refrigerator are in the ON state while Television, Fan and Air Condition are in the OFF state. Meanwhile, the rest of the appliances are in the default Off state.

Discussion

From the result obtained, when the Android Base Improved Automation App (ABiAA) Project Using GSM Module was tested, shows that this gadget work based on designed specification. This revealed that all electric gadget linked to this system could be locally controlled by this proposed gadget. That means that all connected appliances can be switch ON and OFF through the Android Apps on the end users' phone; provided these gadgets are linked to power supply via this proposed system provided this system is within area of network coverage. The phone used must be a smart phone.

CONCLUSION

This project has been able to provide solutions to the envisaged gaps in the previous designs technologies on the home automation systems. These gaps are energy wastage, load or appliances control & protections and safety of lives and properties of the owner that would have resulted



from fire outbreak when electricity is restored and some loads like Electric Kettle, Irons or heater are left connected while utility is restored. This project is a system that can cutoff the loads connected to it when electricity is interrupted and has the ability to inform the owner or user when electricity is restored in home/office on the mobile line and send an SMS to the user to check the state of the loads/gadgets; to reduce energy waste, protect the loads connected to it and prevent possible fire outbreak. The default state of the system is such that the loads connected to the system will all be switch OFF when the power is interrupted in the residences.

The limitation of this work is the inability for the designed ABiAA application to retain the status of the load when the application is close on the user's phone. There is every tendency to decide to switch OFF/ON some load while the utility is still available; if the user mistakenly turns OFF the ABiAA Application, then decides to turn it ON again the application will go into default. Hence there is need to improve on the ABiAA application to be able to retain the status of the load when the application is open and close at any given time. The moment ABiAA apps are closed, all buttons are reset to default mode even when there is power supply in the circuit.

This project Android Base Improved Automation App (ABiAA) is recommended for home and offices as another solution to reduce energy wastage, to make sure that the residences are protected against any fire outbreak which often time can be disastrous. It equally reduces amount of utility bills (cost of electricity). The efficiency and practical application of the designed project for home automation will not just enhance industrialization in upcoming nation like Nigeria. [1] and this would prevent loss of properties and lives that usually result from fire-outbreak in home or offices because of negligent utility users.



ACKNOWLEDGEMENT

The authors are pleased to acknowledge the support provided by the Department of Electrical and Electronic Engineering, University of Lagos, Akoka, Yaba Campus, Lagos, Nigeria.

VII. REFERENCE

- [1] Adetona S.O, Ogundeji A.O, Ipinimo O. and Salawu R.I (2020). 'REDUCING Wasrade in Electricity Usage Though the use of Advancement in GSM Technology' Journal of Engineering and Technology, vol. 11
- [2] Rahman M, Zaidul Karim A.H.M., Nyeem S, Khan F and Matin G (2015), "Microcontroller Based Home Security and Load Controlling using GSM Technology", I.J. Computer Network and Information Security, 2015, Vol.4, pp. 29-36
- [3] Effah E., Aryeh F.L and Kehinde W.K. (2016). GSM-Base Home Application Control System for Domestic Power Users in Ghana. Ghana Journal of Technology 1(1): pp. 25-31.
- [4] Inderpreet, K. (2010). Microcontroller Base Home Automation System with Security. International Journal of advance computer science and application ,1(6): pp. 60-65.
- [5] Amudha, A. (2017). Home Automation using IoT. International Journal of Electronics Engineering research 9(6): pp. 939-944
- [6] Ying-Wen B., Shi-Chang C., and Fu Jen (2007). "Design and Implementation of Home Intercom and Security Control Systems for Buildings" Catholic Univ. Information Fusion, 10th International Conference on Publication, ISBN: 978-0-662-45804-3, (2007) 1-6.
- [7] Al-Ali A. R., Rousan M. A., Mohandes M., (2004). "GSM-based Wireless Home Appliances Monitoring & Control System", IEEE International Conference, ISBN: 0-7803- 8482-2, 237-238.