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Development and Performance Evaluation of a Short Message Service (SMS) Based Home Appliances Control System

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ABSTRACT
Mobile phones are widely used nowadays for various applications, including wireless control and monitoring, due to their accessibility and ease of use. The developed system is based on the "global system mobile (GSM)" network and employs SMS technology. This study has implemented a low-cost, secure, far-and-wide accessibility, auto-configuration, and remotely operated system for home automation. The method described in this paper successfully achieved the aim of utilizing household appliances tenuously using an SMS-based system while also meeting the demands and expectations of the user. The users can manage and monitor nearly any electrical gadget in the home using the simplicity of a primary cell phone. A mobile handset connected to the developed system by a power connection or wireless communication can send a message to operate electrical home appliances.The design's most important components are a GSM module and an Arduino Uno. The developed system is powered by an ATMEGA 328P microcontroller, which coordinates and interprets control commands sent as short messages from mobile stations. A functioning prototype was developed to show that the design can regulate up to five connected appliances with maximum current usage of 13A. The status of connected devices can be displayed on the LCD screen.

Keywords: GSM module, Arduino, microcontroller, control device, home appliances

I. INTRODUCTION

Electronic machines and equipment are becoming more common in today's homes and workplaces. Most of them are always switched on or off manually, either using a hand-held remote control device or turning them on or off by hand (Oyedepo&Oluwatobi, 2016). However, this may not always be possible because the operator may not always be available. In other circumstances, the operator may have forgotten to switch off or on the appliances, prompting a trip down to the appliances to make the necessary adjustments. As a result, there is a growing demand for a device or mechanism that allows consumers to monitor and operate these electronic appliances from a distance (Oyedepo&Oluwatobi, 2016).

Remote control of the various home and office appliances is becoming increasingly popular, and numerous systems have been created to provide such capabilities in recent years. For connection between a controller and a controlled device, most remote controllers use IR or Bluetooth technologies (Amusa et al., 2017). Many devices have all-function controls on the remote control, whereas the controlled device has a few key controls. The need to increase the control range beyond IR and Bluetooth-based controllers grows as gadgets and appliances become more sophisticated (Amusa et al., 2017).

Consumers seize any new facilities or household appliances that promise to improve their lifestyle. The more these facilities and appliances improve, the more critical it becomes to have simple and convenient ways to control and operate (Khin et al., 2019). Nearly everyone has access to a cell phone, making the world indeed a global village. A remotely accessible environment is one in which each appliance can be viewed and managed remotely using software, such as an Android application (Daraghmi&Daadoo, 2016). With the advancement of electronics technology over the last two decades, a new concept known as Smart Home has emerged. Consumers have attempted to operate and safeguard their home equipment remotely via SMS at a reasonable cost. Most individuals nowadays are connected to their mobile phones and want easy access to technology through their phones, regardless of where they are or when they are using them (Sarkar et al., 2017).

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GSM-based remote control management is a hot topic used in various areas.

The advancement of mobile communication technology has brought us to a point in our lives where we can see progress. Working with this concept inspired us to develop a new and innovative way to operate household appliances using GSM and GPRS technology (Al Asad et al., 2015). The entire system is based on embedded engineering, and this module's foundation is a microcontroller. For the SMS upstream and downstream, a microcontroller module with a GSM module was created (Al Asad et al., 2015). The relays are connected to the home appliances, and the appliances are controlled through the relays. Yuksekkaya (2006) developed a GSM-based home automation system that utilizes voice commands to control the appliances. A research report describes voice instructions for home automation (RifatShahriyar, 2008). The present work focuses on developing an SMS-based system for Home Appliances Control.

In this research work, we chose a microcontroller and GSM module for the assignment due to their simplicity and affordable cost. The primary goals of the developed system are to design and implement a low-cost, open-source home automation system capable of managing and automating most household appliances in an easy-to-manage and secure manner. The developed system uses an SMS service provided by a GSM network to enable users to control and monitor their home automation system remotely.

II. SYSTEM DESIGN

2.1 Design Methodology

There are basically two sub divisions in this system. Both the hardware and software components are important. The hardware consists of an ATmega328P microcontroller-based system with a GSM module connected via RS-232. The relays are connected to the appliances. The microcontroller's relays are its output gateways. As commands come and leave, the relays ensure that the entire system completes the specified task. In the entire project, the GSM module is really important. The system has been made totally self-contained, and the GSM module is responsible for all of the system's operations. Figure 1 shows a system block diagram that explains the overall system methodology.

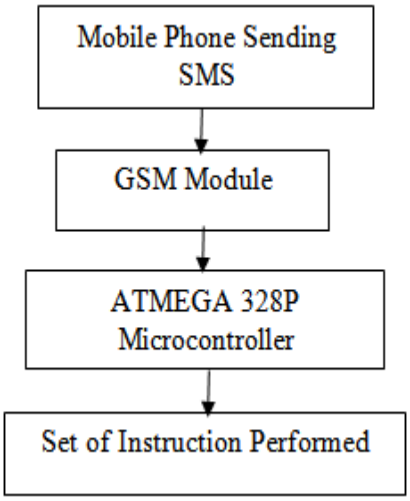

Fig 1: Complete System Block Diagram

2.2 System Specifications

The following are the main sub-systems of our developed system:

• GSM Receiver Module: This is a hardware component that enables the system to send and receive SMS messages. The RS232 serial port is used to communicate with the system. However, a cell phone can replace GSM hardware; it restricts the gear's capabilities, such as SMS sending and receiving.

• Microcontroller Module: The microcontroller (ATmega328P) and a timeout generator circuit are included in the module. This is the system's most important component. When an SMS message is received, the text contents are checked against a preset format that includes the desired device ON/OFF commands. The ATmega328P microcontroller delivers the proper AT command to the Receiver GSM module, which acts as a GSM modem, to read a message.

• Switching Module: This module controls (turns ON/OFF) the appliance in response to the SMS command. The microcontroller is in charge of switching the module. The relay-like switching module allows a low-power circuit to turn on/off a relatively high current, such as a bulb connected to a 220V mains supply. The relay in the project is responsible for switching.

• GSM (Global System for Mobile Communications) Technology

The Short Message Service (SMS) function of GSM technology was used in the created system to achieve control from a remote place. All communication may be done in a matter of seconds with SMS. It is widely used in the control of household appliances. It allows users to

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send a short command to control household appliances from a remote and local place. Users can, however, operate the appliances using SMS to provide the appropriate commands for greater flexibility. A SIM900D GSM module performed the SMS sending and receiving functionalities. A SIM (Subscriber Identity Module) is included, allowing it to send and receive SMS. It can be used with various network providers' SIM cards. The module may be set using normal AT commands and can perform functions similar to those found on standard mobile phones. An "enhanced AT command set" is also supported by the module here. During normal operation, it consumes 250mA of current.

2.3 Module Design

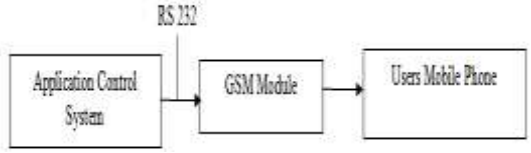

Fig. 2: Developed System Framework

One of the interfaces between the GSM module and the microcontroller is serial I/O. A control circuit was developed to regulate the electrical appliances using the microcontroller. The GSM module has been attached to the microcontroller, necessitating the development of a communication protocol. To secure the communication issue, an RS-232 parallel communication technique was developed. The GSM module includes a SIM (Subscriber identity module), responsible for maintaining a complete connection between the user and the system. The RS-232 circuit's primary function is to convert voltage levels. This study's GSM module voltage level is 3.6V, and the microcontroller voltage is 5V. In this model, the SIM900 GSM module demo board is used. This demonstration board was created to communicate with a computer. As a result, the communication environment's voltage level is roughly 7.5V. The RS-232 communication module units' working topology is depicted in the diagram below. The RS-232 voltage level transfer is the key to this project's success. Controlling the appliance will be difficult if this voltage level change is not performed.

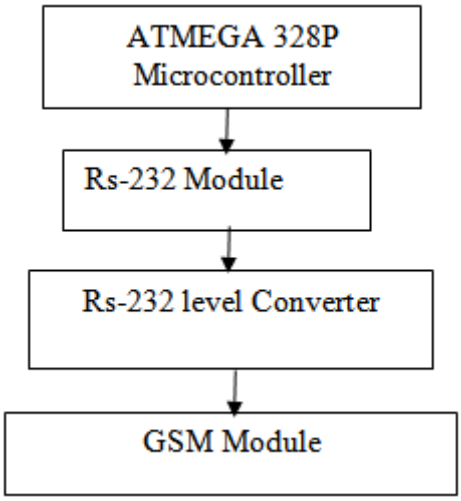

Fig. 3: depicts a more detailed graphical representation of RS-232 voltage conversion better to understand the RS-232 communication protocol and device applications.

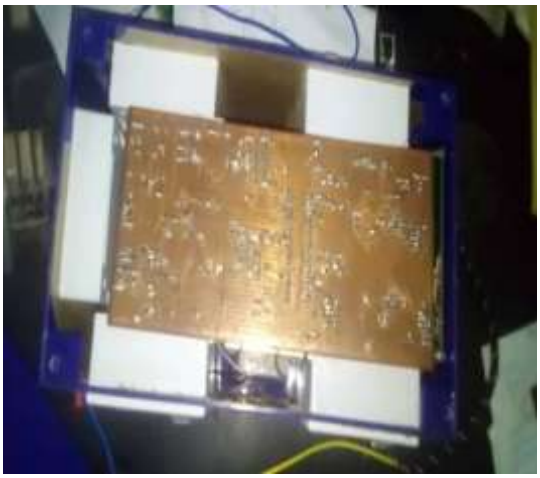

Fig. 4: Photograph of the developed system

The entire procedure is automated. People who want to communicate with any home appliance send an SMS to the GSM module's preferred mobile number. The RS-232 port converts the digital message to an analog voltage level signal, and the relays are terminated, allowing home appliances to be turned on and off using this voltage level. This might be the simplest approach. This variant differs from the others since it does not require an internet connection, allowing it to be utilized in remote regions.

2.4 Hardware Implementation

Figure 5 depicts the implementation of the developed system. It depicts the microcontroller's connection to the GSM module, which serves as an

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SMS gateway, LCD, and relays. A 220 V main supply in the home powers the developed system. In the event of a power failure, the developed system was kept working by using a 12 V battery as a backup. The hardware's operation is dependent on the microcontroller chip's program code. The Arduino IDE was used to create the software. The program's implementation will be discussed in detail shortly. The LCD shows the system's various statuses.

Fig.5: System implementation

2.5 Implementation of Firmware

The program that runs on the microcontroller chip is firmware code. The application was built in C++ and debugged with the Arduino IDE, a free, open-source software. After initializing the modules, the microcontroller keeps an eye on the GSM modules for requests from users. The module uses the RS232 serial communication protocol. The AT command set is required by the GSM module to perform particular functions. Some of the primaries AT commands used in this project are listed below.

AT+CMGR = read one message from the SIM card storage

AT+CMGD = delete the SMS from the SIM card storage

AT+CSMS = selects SMS service

When a message is received, the message's content is copied, and the user's legitimacy and control sequence are verified. The message is refused if it comes from an unauthorized user or is not correctly formatted, and the processing unit does nothing. The user's request is decoded from a well-formatted message received from an authorized user. To do this, a switch case command was employed. For each situation, appropriate instructions were written based on the command received. A universal chip programmer was used to transfer the Hex file generated by the program to the microcontroller chip.

Figure 6 depicts the complete circuit diagram of a developed system, which includes an ATmega328 Microcontroller Unit (MCU) with a Liquid Crystal Display (LCD) for displaying the status of various electronic devices connected to this gadget, which is directly connected to the microcontroller (Atmega328), GSM module, and relays to realize the SMS-based home appliance control system (HACS). The receiver and transmission pins of the microcontroller are directly connected to the SIM module.

The software was written in the Arduino IDE, compiled, and loaded into the MCU to collect the parameters, display them on the LCD, and save them to the SIM card. The GSM interface is required to ensure that the mobile phone and the microcontroller are correctly connected. This is because the microcontroller delivers 5 volts, while the GSM interface requires 3.3 volts for transmission and receiving pins.

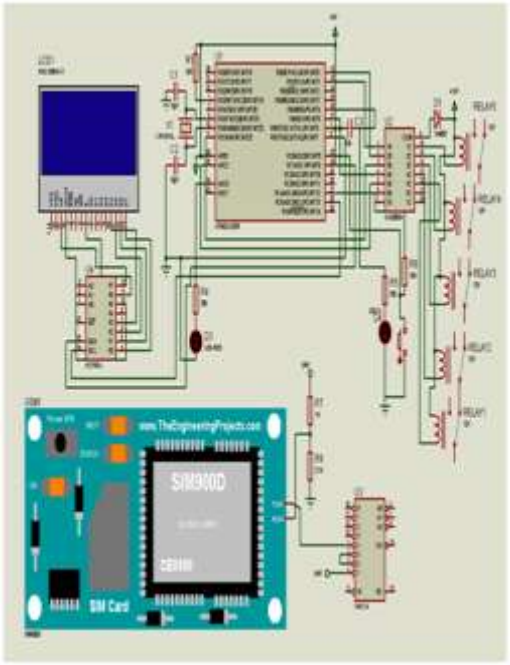

Fig. 6: Complete Circuit Diagram of Developed System

III. PERFORMANCE EVALUATION

Two distinct devices (a lightbulb and a standing fan switch) were attached to the developed system to evaluate its effectiveness. Users can activate the device by turning ON and OFF a switch on their phone or sending an SMS to the Home Appliances Control System (HACS) if they forget to turn on the switch.

Fig. 7: Snapshot showing Load 1switched OF

Fig. 8: Picture showing Load 1 switched ON and OFF

The appliances are being turned ON and OFF according to the pictures displayed in Figure 8. The status check technique has been changed, but it has also been implemented. Sending and receiving SMS was all that was required to complete the operation. As shown in the prototype example photo, after sending the status check command from the GSM module, we receive the reply command as programmed in the microcontroller. Users can control loads using their mobile devices after monitoring the status. The SMS was sent, and the commands were collected from the embedded system's RS-232 port and the module's overall organization.

IV. CONCLUSION

This study describes a GSM-based home appliances control system. A perfect smart-home system would be inexpensive, dependable, and simple to use and control. Because of GSM control, the developed system is inexpensive and has low operating costs. The system does not require the use of an internet connection or a computer. It is a secure, far-reaching accessible auto-setup and remotely operated system for home appliances control. The method described in this paper successfully achieved the goal of controlling household appliances remotely using an SMS-based system while meeting the demands and expectations of the users. A user can manage and monitor nearly any electrical gadget in their home using the simplicity of a basic cell phone. A mobile handset connected to the system via a power line or wireless connectivity can send a message to control all electrical household devices.Future work could focus on improving the system's security.

REFERENCES

[1]. Al Asad Md. Abdullah, Al Muzahid Md. &FarukMd.S. (2015). Design and Development of SMS Based Wireless Home Appliance Control and Security System. Journal of Modern Science and Technology Vol. 3. No. 1. March 2015 Issue. Pp.80-87 80

[2]. Amusa K. A., Olanipekun M. U., and Nuga O. O. (2017). Application of GSM for Home Devices Control, International Journal of Computer Applications (0975 – 8887) Volume 167 (12):1-8

[3]. Anirban Sarkar, Sadia Sultana & M.D. Habibur Rahman (2017). A Smart Control System of Home Appliances Using SMS, Global Journal of Researches in Engineering: Electrical and Electronics Engineering Volume 17 Issue 1 Version 1.0 Year 2017

[4]. Daadoo, M., &Daraghmi, Y. (2016). Design and Implementation of Low Cost Computer Numerical Control-Printed Circuit Boards Drilling Machine. Journal International Journal of Engineering and Innovative Technology, 5(10), 63-67.

[5]. KhinEiEiKhine, Nay SoeShwe and Aung MyoNaing (2019). "GSM Based Home Appliance Control System" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456- 6470, Volume-3 | Issue-5, August 2019, pp.1675-1680, https://doi.org/10.31142/ijtsrd26743

[6]. OyediranMayowaOyedepo, Akande Noah Oluwatobi (2016). Design and Implementation of a GSM based Electronic Appliances Monitoring and Controlling System, International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 2:475-479

[7]. Shahriyar, R., Hoque, E., Sohan, S. M., and Naim, I. (2008), 'Remote Controlling of Home Appliances using Mobile Telephony', International Journal of Smart Home, vol. 2, no. 3, 37-54.

[8]. Yuksekkaya, B., Kayalar, A. A., Tosun, M. B., Ozcan, M. K., and Alkar, A. Z. (2006), 'A GSM, internet and speech controlled wireless interactive home automation system', Consumer Electronics, IEEE Transactions on, vol. 52, no. 3, pp.837- 843.