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# Development of A GSM Wireless Control of Electrical Home Appliance

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## ABSTRACT

This paper seeks to develop and design a smart home system by sending short message service (SMS) via global system for mobile communication (GSM) to save energy consumption for home owners. The concept of smart home is an emerging issue to the modern technology dependent society. GSM module was used for receiving SMS from user's mobile phone that automatically enable the controller to take any further action such as to switch ON and OFF the home appliances such as light, air-conditioner, and fan. The system was integrated with microcontroller and GSM network interface using assembly language. The system is activated when user sends the SMS to controller at home. Upon receiving the SMS command, the microcontroller unit then automatically controls the electrical home appliances by switching ON or OFF the device according to the order set by the user. In other word, it read message from the mobile phone and response to control the devices according to the received message. The developed system could provide an effective mechanism for energy consumption in home.

**Keywords:** GSM, Microcontroller, SMS, GSM module, Electrical appliances

## I. INTRODUCTION

Mobile phones are widely used nowadays, for different applications such as wireless control and monitoring, because of its availability and easy to use.

Remote control technologies are widely used to control household electrical appliances without walking up to them. Controlling household appliances through computer can also be a possible solution. However, it cannot fulfill the current demand which is to control them from remote places. The advantages of cellular communications like GSM technology is a potential solution for such remote controlling activities. GSM and SMS technology can be used to control household appliances from remote places. The approach for designing remote control based on GSM Mobile Technology, and using SMS message that is generated by mobile user was proposed by (Amit et al 2011).

It is implemented based on microcontroller that receives SMS and commands from a cellular phone over the GSM network. The microcontroller then carry outs the issued commands and then communicate the status of a given appliance or device back to the cellular phone. and (Das et al 2009), proposed a method which enables users to control their home appliances and systems from anywhere using a cell phone. To access the control unit, the user should send an authentication code along with the required/desired function/action to his/her home control system via Global System for Mobile communication (GSM).

GSM based remote management control is a subject of growing interest which has found application in different areas. (Tan et al 2007) developed an automatic power meter reading system using GSM network. It utilizes the GSM network to send power usage reading to authorize office to generate the billing cost and send back the cost to the respective consumer through SMS. (Lock 2004) developed a remote and security control system via SMS to control the switch for lamp, door and alarm system using Visual Basic 6.0 software. Furthermore, (Abdullah 2008) developed a system for Acquiring Water Level and Temperature Status via SMS by utilizing PIC 16F877Aand MPLAB IDE software for programming. He also suggested a system triggered by SMS to a home to notify the owner of any

incident happening around the house such as robbery or fire. (Priyasree et al 2012) developed an automatic street light intensity control and road safety module using embedded system. (Rajput et al 2013) also developed an Intelligent Street Lighting System Using GSM. (Mohamaddoust et al) developed A Novel Design of an Automatic Lighting Control System for a Wireless Sensor Network with Increased Sensor Lifetime and Reduced Sensor Numbers.

## II. SYSTEM DESIGN

The System was designed with Figure 1 as the block diagram, the first Mobile station is used as a transmitting section from which the subscriber sends text messages that contain commands and instructions to the second mobile station (GSM module) which is based on a specific area where our control system is located. The received SMS message is stored in the SIM memory of the phone and then extracted by the microcontroller and processed accordingly to carry out specific operations. The relay driver (BUFFER ULN2003) is used to drive the relay circuits which switches the different appliances connected to the interface. The LED is used to indicate the status of the operation performed by the microcontroller and also its inclusion makes the overall system user-friendly.

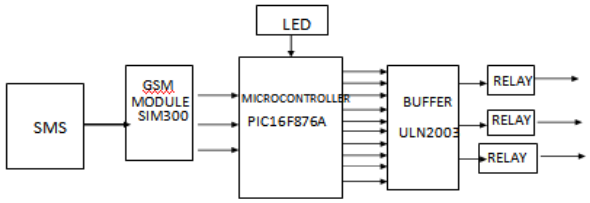


**Figure 1.** System Block Diagrm

The system has two parts, namely; hardware and software. The hardware architecture consists of a stand-alone embedded system that is based on 8-bit microcontroller (PIC16F876A), switching module, and GSM module.

### 2.1 User GSM Mobile Handset

Cellular phone containing SIM (Subscriber's Identifying Module) card has a specific number through which communication takes place. The mode of communication is wireless and mechanism works on the GSM (Global System for Mobile communication) technology. Here, the user transmits instructions to the system to control the appliance in the form of SMS.

### 2.2 Receiver (GSM Module)

This GSM Module is used to receive the SMS sent by the user and then to transmit an acknowledgement or status to the user's mobile. The receiver handset has to be equipped with an AT Modem and a valid SIM card. In our design we have used GSM Module sim300. The handset has a built in AT modem with UART interface and supports most of the AT command instructions. This handset is attached with the microcontroller used to control the appliance through serial cable. The command set consists of a series of short text strings which combine together to produce complete commands for operations such as dialing, hanging up, and changing the parameters of the connection. Most modems follow the specifications of the Hayes command set.

AT commands are instructions used to control a modem. AT is the abbreviation of Attention. Every command line starts with "_".

**Figure 2.** GSM Module (SIM300)

### 2.3 Microcontroller Board

This contains the micro-controller (PIC16F876A) and a timeout generator circuit. This is the main module of the system. On receipt of the SMS message, text words are checked with predetermined format which includes desired device ON/OFF commands. To read a message the microcontroller sends the appropriate AT command to the Receiver GSM Modem through serial cable. The Modem then responds with the message and the microcontroller stores the message in the RAM. When the message ends there is no way to know by the microcontroller. The time-out generator circuit performs the vital function of providing the microcontroller board with the ability to detect the end of a message from the receiver GSM mobile. The microcontroller then processes the command and sends the appropriate controlling signal to the switching module.

### 2.4 Switching Module

This module drives (switches ON/OFF) the appliance according to the command sent in the SMS. The switching module is controlled by the microcontroller. The switching module may be in the form of a relay which allows a low power circuit to switch a relatively high current on or off for example a bulb connected to the 220V mains supply.

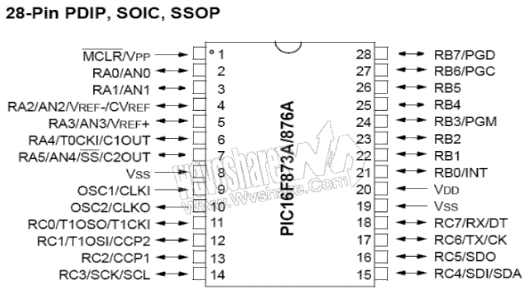


**Figure 3.** Microcontroller (PIC16F876A)

## III. SOFTWARE DEVELOPMENT

The software was developed using a simple high level language tool in C. The software extracts the sent message from the SIM location at a regular interval and processes it to control the different appliances connected within the interface. RS232 was used to communicate with the GSM module. Most GSM modules have RS232 connections that can be used to connect a phone to a PC or in this case a microcontroller. The connection can be used for controlling just about all functions of the phone, as well as uploading new firmware. This port allows SMS messages to be sent and received. All the peripherals used in the program were first initialized. In the coding, ASCII code was used in declaring the coding for received and read SMS message.

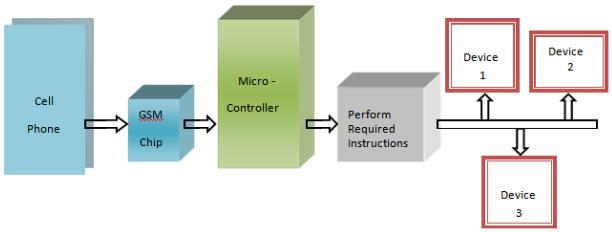


**Figure 4.** System operation flow

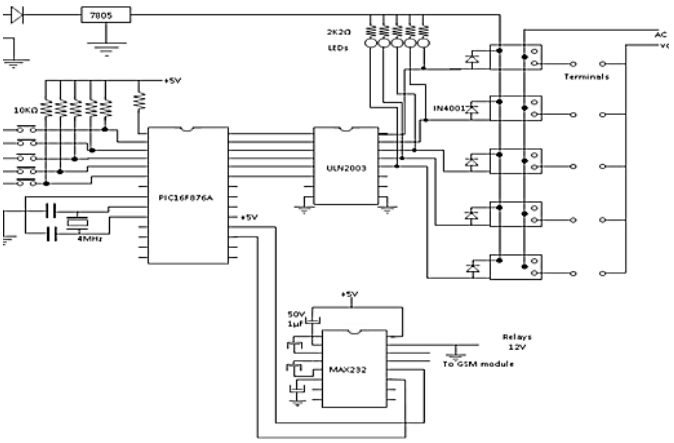


**Figure 5 .**Complete Circuit Diagram

## IV. RESULT AND DISCUSSION

This section describes the output of the implemented system. Several testing were performed to ensure proper execution and production of the intended result. The system was designed to receive SMS from user mobile phone to the GSM module connected to the PIC16F876A circuit. This can be performed by texting the mobile phone number which has been set in the GSM module. The incoming message was deleted by the microcontroller upon completion of the requested process and the message is erased in the connected mobile phone which acts as GSM module. The system then replies by sending a message to user mobile phone reporting the status of the devices (turned ON or turned OFF). When a command to check the status is sent ( T ).

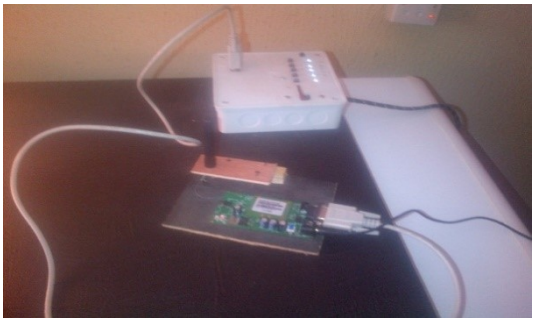

**Figure 6.** GSM module connected to microcontroller unit

**Figure 7.** Lamp A and Lamp B on with _LA1LB1 command

**Table 1.** Truth table for the input command and appliance response

| S/N | TERMINAL | COMMAND | | |
|---|---|---|---|---|
| | | ON | OFF | TOGGLE |
| 1. | LAMP A | _LA1 | _LA0 | _LA2 |
| 2. | LAMP B | _LB1 | _LB0 | _LB2 |
| 3. | LAMP C | _LC1 | _LC0 | _LC2 |
| 4. | SWITCH A | _SA1 | _SA0 | _SA2 |
| 5. | SWITCH B | _SB1 | _SB0 | _SB2 |

## V. CONCLUSION

The project which is development of a GSM based control system for electrical appliances was designed considering some factors such as economic application, design economy, availability of components and research materials, efficiency, compatibility portability and durability. The performance of the project after test met design specifications. However, the general operation of the project and performance is dependent on the user who is prone to human error such as entering wrong timing.

Also the operation is dependent on how well the soldering is done, and the positioning of the components on the Vero-board. If poor soldering lead is used, the circuit might form dry joint early and in that case the project might fail. Furthermore, if logic elements are soldered near components that radiate heat, overheating might occur and affect the performance of the entire system. Other factors that might affect performance include transportation, packaging, ventilation, quality of components, handling and usage.

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