AN ECS PROJECT REPORT ON

HOME AUTOMATION BASED ON GSM MODULE

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ABSTRACT

This paper describes the design and development of a home control and monitoring system that includes a low-cost and adaptable system for accessing and controlling household appliances like lights, fans, door locks, and so on. using a basic Android smartphone application to send SMS remotely. In this project, a home power control system that uses GSM networks has been proposed. This embedded system, which uses built-in input and output peripherals to monitor and control appliances and other devices locally, has a two-minute delay before starting the next command.

The system allows the homeowner to remotely monitor and control the home appliances via SMS messages sent from a mobile phone. The Android application is used to control appliances, making the system more adaptable, cost-effective, and ubiquitous in terms of appliance control. The GSM protocol's ability to control the target system from a far through the use of frequency bandwidths is the primary focus of the proposed research. The smart GSM-based home automation system was developed using the ideas of serial communication and AT-commands.
Using their mobile phones, homeowners will be able to remotely view the status of any home appliances they control, whether they are turned on or off. The smart automated house system gets the desired baud rate of 9600 bps from the PIC16F887 microcontroller with GSM integration.

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1. <u>INTRODUCTION</u>

The automatic and electronic control of household features, activity and devices is called Home Automation. There has been an exponential increase in the interest among the consumers in smart home appliances and concepts down the years. It is a network which connects everyday devices with each other over the internet. Devices such as lighting, temperature control, irrigation control, door locks, entertainment systems etc. all can be intelligently incorporated to the concept of home automation.

To make this happen, engineers have used some of the most advanced technologies with the likes of Bluetooth, Wireless LAN (Wi-Fi), ZigBee, Global System for Mobile Communication (GSM) etc. It not only made our lives easier but also gave a ray of hope for the scope of technologies and advancements in the near future. Where people needed to switch the lights and fans off physically over a century ago can be just controlled with a few clicks of our smartphones is really astonishing. This is how home automation helps us to take advantage of luxury and comfort that was not possible before.

Although GSM is the most widely used cellular communication device, it has some limitations as well which makes it a bit difficult to use. Multiple users trying to access the network, it results in latency and there is a bandwidth lag. It also offers very restricted data transfer. GSMs are 3 decades old but still are the most commonly used cellular network device and with higher and higher data transfer rates each year.

GSM network belongs to mobile radio technology. Suitable for communication between home appliances And users, due to its wide distribution, the entire system is almost always online. Other advantages of using GSM networks in home automation are advanced security infrastructure for maximum security reliability that others cannot monitor this information sent or received. So, this project implements an SMS based home automation system with no access to the local network.

2. <u>BACKGROUND</u>

2.1 CONTEXT

Our proposed smart GSM-based home design automation system architecture exists for a mobile phone and GSM modem. In the designed system, incoming SMS messages are sent from the user's phone to use your GSM modem as SMS over the mobile network. Then the GSM modem sends the command in text mode PIC microcontroller with RS232 interface. RS232 Voltage levels are around ±12V, but both microcontrollers the inputs and outputs operate from 0V to +5V because there is no RS232. Microcomputer compatible, using MAX232 GSM modem.

A PIC microcontroller that converts RS232 level signals to TTL level signals. outgoing messages from the system. Send the status of home appliances to mobile phones via GSM modem. An 8-bit PIC16F887 microcontroller typically consists of timers, analog-to-digital converters (ADCs), and Universal Synchronous asynchronous transceivers (USART). In this research work, the microcontroller is ordered and decoded to provide the device address, execute the command and send the appropriate signal to the driver circuit. In addition, the microcontroller has dual independent operational actions for turning on and switching devices out. Feedback status of all devices under control.

On or off is provided by the microcontroller. The RS-232 interface standard is an electrical and mechanical details of interfaces between data terminals equipment (DTE) and data communications equipment (DCE) uses serial binary data exchange. The current version of the standard calls DCE the data circuit graduation equipment. Physically as an interface between GSM modem implemented with PIC16F887 and RS232 installed by default on Max232.

Our system design does not contain battery power supply as sufficient current to flow through the circuit terminals. A relay was connected to the output load for stable operation; these relays can be powered, so electrical control loads with different voltage levels. Simulations of the proposed GSM-based home automation system have been implemented in several ways. PIC16F887 simulated with a GSM modem connected to a physical port on your PC. MAX232 is placed to ensure proper data transfer between the two. A virtual terminal monitors incoming and outgoing text PIC16F887 and when checking the transfer process, the transmitted waveform and incoming messages are monitored with an oscilloscope.

2.2 MODULES USED IN SETUP

- **GSM SIM 900 module (GSM modem)**
  GSM modules provide connectivity along with wi-fi information conversation switches. They can be used for monitoring verbal exchange initiatives, linking together a faraway website online tracking system together with your LAN, as well as many other programs (Fig 2.2.1). A GSM module is a specialized form of device which accepts a SIM card, and operates over a subscription to a mobile operator, like a mobile phone or pager. Mobile connections may be a brief and efficient way to get started out with SMS notifications in network monitoring answers because a unique subscription to a separate service company is not required. In most elements of the world, GSM modules are a free and powerful answer for sending and receiving alarm notifications because of the utilization of existing networks as an alternative of having to enlarge your infrastructure to consist of hardware that lets in direct connections with your remote web sites.

Fig 2.2.1 GSM Module

- **Arduino Uno Microcontroller**
  The hardware aspect of an Arduino board is a programmable circuit board that is additionally called a microcontroller. A microcontroller is a small pc with a processor, reminiscence, and different peripherals designed for embedded packages (Fig 2.2.2). The software program element is called Arduino IDE wherein developers write and add the code onto the microcontroller, it will be further explained later inside the article. Arduino is mainly used to build electronic initiatives for every person – electricians, tinkerers, hobbyists, makers, and beginners. you could feed an Arduino board a set of instructions for it to perform positive responsibilities.

Fig 2.2.2 Arduino Uno Module

- **Relay Board**

  The relay is the device that opens or closes the contacts to motive the operation of the other electric control. It detects the unwanted situation with an assigned region and gives the commands to the circuit breaker to disconnect the affected place thru ON or OFF.

  While the circuit of the relay senses the fault present day, it energizes the electromagnetic subject which produces the brief magnetic discipline. This magnetic field moves the relay armature for opening or last the connections. The small power relay has at best one contact, and the high-power relay has two contacts for opening the transfer.

- **User GSM mobile Handset**

  The GSM mobile handset consists of an advanced Android software that includes buttons to strengthen on/off the appliances. When the button is pressed, an SMS is generated automatically and is sent to the GSM module. The cellular telephone carries a SIM card that has a specific quantity through which communication is feasible.

3. <u>PROBLEM DEFINITION</u>

In the past few decades, technology has advanced to such an extent that it has improved life's efficiency and comfort. Because it saves so much time and effort, having the ease of being able to control devices from a single location has become an absolute necessity. As a result, it becomes necessary to do so in a methodical manner, which we have attempted to implement with our system. An extended strategy for automating a control system is our proposed system. People's lives have become more complicated over time as a result of technological advancements, making them busier than ever before. We can take control of some things that need constant attention by adopting our system. When people forget to turn on or off simple devices at home or at work, such as turning them on or off, the application of our system makes it possible for them to do so remotely via a phone call. I think this development will ultimately save a lot of time, especially when people don't have to return to their homes or offices to do simple things like turn off switches before starting their work.

4. <u>OBJECTIVES</u>

This project aims to create a device that can automatically control power surges in the home and let users remotely control and monitor a number of home appliances using a cell phone. With the limitations of the technologies used, this system is a powerful and adaptable tool that will provide this service at any time and from anywhere. Lights, home appliances, security systems, and climate control systems are potential targets; anything with a connection to electricity. Implementing a microcontroller-based control module that receives its instructions and commands from a cellular phone over the GSM network is the proposed strategy for designing this system. As the project's title suggests, ***"Home automation based on GSM module using Arduino"*** aims to construct a control system that enables complete control of the interface it is based on.

Some of the basic objectives of the project are as follows-
- To cut the power and time consumption
- To control appliances and other devices through SMS
- To obliterate the requirement of being physically present to complete the tasks which involves operations with the concerned appliance.

5. <u>METHODOLOGY</u>

5.1 PROCEDURE

- The user clicks an option on his mobile and a text message is generated.

- The text message is sent via the GSM network attached in the system.

- The GSM Sim900 Module attached in the system receives the message sent from the user's

- The GSM Sim900 module is attached to the Arduino Uno module which is included with ATMEGA microcontroller

- The microcontroller keeps a check on the module if it has received any text message from the user's end.

- The GSM module sends a message to the microcontroller. While the GSM Module and Arduino Module communicate via a special set of messages called as AT COMMAND SET.

- After the command is received, the microcontroller sends another set of commands to GSM as it can hold only one message at a time. It commands to delete the holding message so that the next command can be executed.

- The microcontroller receives the command to perform the task by performing a search and match technique in which it goes through a table of commands with the set of corresponding tasks (See table (2)).

- Finally, the microcontroller dispatches a command to the relay to the appliance which is to be turned on/off.
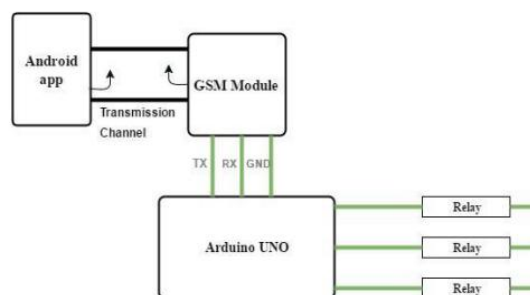
Fig. 5.1 - Block diagram of the entire system

5.2 COMMAND SET TABLES

SR.NO.	COMMANDS (INPUT)	STATUS (OUTPUT)
1.	REDON	RED LIGHT ON
2.	BLUEON	BLUE LIGHT ON
3.	GREENON	GREEN LIGHT ON
4.	REDOFF	RED LIGHT OFF
5.	BLUEOFF	BLUE LIGHT OFF
6.	GREENOFF	GREEN LIGHT OFF

Table (2) shows the commands corresponding to the actions.

SR.NO	COMMANDS	DESCRIPTION
1.	AT + CGMI	Issue manufacturer ID code
2.	AT + CGMM	Issue model ID code
3.	AT + CGMS	Selection of message service
4.	AT + CGMR	Read SMS
5.	AT + CMGD	Delete SMS in memory

Table (3) - AT Commands (AT = attention)

6. <u>RESULTS AND DISCUSSIONS</u>

We tested and evaluated the entire setup and proposed a SMS based home automation system. The SMS in the form of text message is sent to the GSM module (See Fig. 6.1 - (3)). It is received by GSM and is read by the microcontroller (Fig. 6.1 - (4)) with the help of AT command set (Table (3)). The microcontroller searches up the command on the table (Table (2)) and performs the task corresponding to it. So by this we can control any electrical device or appliance connected to the relay. We sent the commands from the mobile of one of our member's cell phone and the lights were turning on/off simultaneously (See Fig 6.1 - (1)) with the current status of the lights displayed on an LED display(Fig 6.1 - (4)). The overall experiment is performed with the help of codes written in embedded C which is attached at the end of the report (appendix).
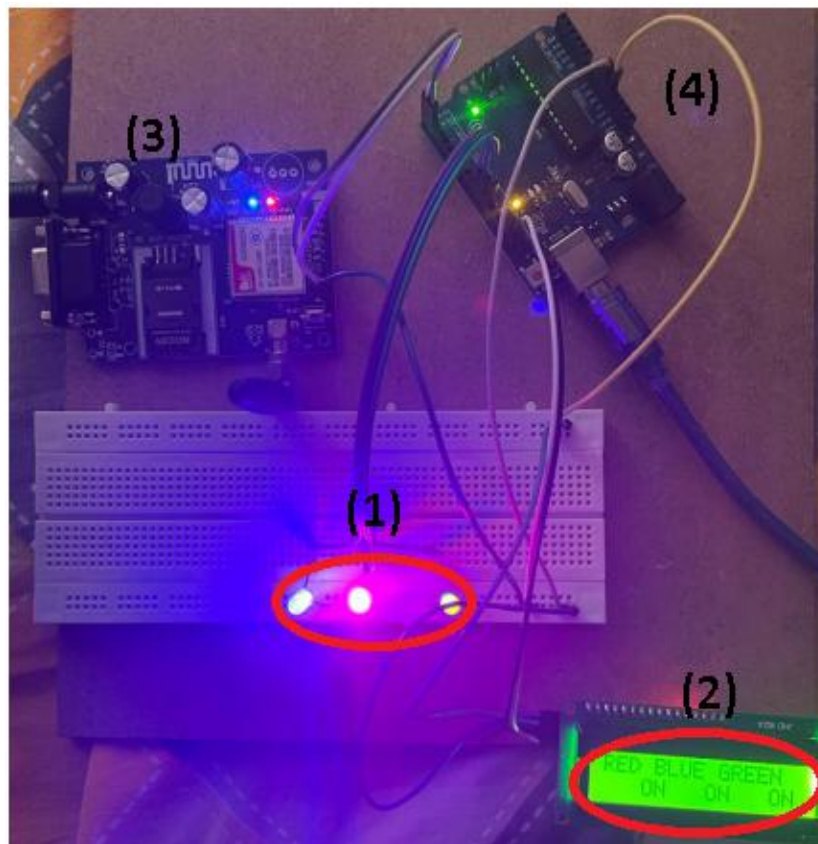
Fig. 6.1 - Experimental setup of the system

7. CONCLUSION AND FUTURE SCOPE

SMS based remote control home appliances will be a boon to the future generations because we can easily predict that mobile will be used mostly by each and everyone. So the person can control the home appliances using a mobile application. In easy automation devices where the internet facilities and even laptops are not provided, you'll be able to use cellular telephone-based control devices which are simple and price effective. It has a bright future as appliances can be controlled using audio/voice commands which will be beneficial for handicapped folks and blind persons.

8. REFERENCES

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9. **APPENDIX**

Given below are the codes used in the setup in embedded C.

```
1    #include <Wire.h>
2    #include <LiquidCrystal_I2C.h>
3    LiquidCrystal_I2C lcd(0x27, 16, 2);
4    String textMessage;
5    String redledState = "LOW";
6    String blueledState = "LOW";
7    String greenledState = "LOW";
8
9    // LEDS connected to pin 10,11,12
10   const int blueled = 10;
11   const int greenled = 11;
12   const int redled = 12;
13   int S1=1,S2=1,S3=1;
14
15   void setup() {
16     lcd.begin();
17     pinMode(redled, OUTPUT);
18     pinMode(blueled, OUTPUT);
19     pinMode(greenled, OUTPUT);
20     lcd.setCursor(0,0);
21     lcd.print("GSM Based Home");
22     lcd.setCursor(0,1);
23     lcd.print("   Automaton    ");
24     delay(2000);
25     // By default the leds is on
26     digitalWrite(redled, HIGH);
27     digitalWrite(blueled, HIGH);
28     digitalWrite(greenled, HIGH);
```

```
31   // Initializing serial communication
32   Serial.begin(19200);
33
34   // Give time to your GSM shield log on to network
35   delay(20000);
36
37   // AT command to set SIM900 to SMS mode
38   Serial.print("AT+CMGF=1\r");
39   delay(100);
40   // Set module to send SMS data to serial out upon receipt
41   Serial.print("AT+CNMI=2,2,0,0,0\r");
42   delay(100);
43   lcd.clear();
44   lcd.setCursor(0,0);
45   lcd.print("RED BLUE GREEN");
46
47   }
48
49   void loop(){
50     if(Serial.available()>0){
51       textMessage = Serial.readString();
52       textMessage.toUpperCase();
53       delay(10);
54     }
55     if (textMessage.indexOf("REDON")>=0){
56       S1=1;
57       // Turn on red led and save current state
58       digitalWrite(redled, HIGH);
59       redledState = "on";
60       textMessage = "";
```

```
S1=0;
// Turn off red led and save current state
digitalWrite(redled, LOW);
redledState = "off";
textMessage = "";
}
  if(textMessage.indexOf("BLUEON")>=0){
    S2=1;
  // Turn on blueled and save current state
  digitalWrite(blueled, HIGH);
  blueledState = "on";
  textMessage = "";
}
if(textMessage.indexOf("BLUEOFF")>=0){
  S2=0;
  // Turn off blueled and save current state
  digitalWrite(blueled, LOW);
  blueledState = "off";
  textMessage = "";
}
  if(textMessage.indexOf("GREENON")>=0){
    S3=1;
  // Turn on green led and save current state
  digitalWrite(greenled, HIGH);
  greenledState = "on";
  textMessage = "";
```

```
  greenledState = "off";
  textMessage = "";
}
lcd.setCursor(3,1);
if(S1==1){
  lcd.print("ON ");
}
else{
  lcd.print("OFF");
}
  lcd.setCursor(8,1);
if(S2==1){
  lcd.print("ON ");
}
else{
  lcd.print("OFF");
}
  lcd.setCursor(13,1);
if(S3==1){
  lcd.print("ON ");
}
else{
```

--------X------X-------