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Home Automation System using GSM Technology

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Abstract: ***In our modern society, Home Automation systems are in very high demand. By automation in all daily processes, the ease of living is increased substantially. By using the unparalleled connectivity of the Global System for Mobile Communication (GSM), an inexpensive and easy method of controlling the electrical devices present in homes can be achieved. Using GSM, the control and monitoring of the appliances can be done in a very efficient manner. The major components of this automation system are the Arduino Pro Microcontroller board, based on the microcontroller ATmega 328. It is used along with a GSM module and relays for each appliance. By using the SMS feature of the GSM communication network, the controller compares the received string to a list of preset strings, and if found matching, the function corresponding to that string is performed by the controller, in controlling the operations of the various electrical devices. By this method, home appliances can be controlled from any part of the world, where GSM connectivity is available.***

Index Terms – GSM, Home Automation, Energy Conservation, Microcontroller Applications, Automation Systems

I. INTRODUCTION

Global System for Mobile Communications (GSM) is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe the cellular networks used by mobile phones. As of 2014, it has become the default standard for mobile communications around the world. Recent statistics show that it has a market share of over 90%, and operates in around 219 countries and territories.

The major component of the GSM features that is used in this automation system is the Short Messaging Service (SMS). It uses standardized protocols for exchanging short alphanumeric messages between mobile phones or also fixed line phones.

The Arduino Pro Mini, based on the microcontroller ATmega 328[1], is the microcontroller board, which performs the controlling operations of this microcontroller. It has 14 digital input/output pins, 6 analog inputs, an on board resonator. It acts as the interface between the GSM Module and the appliances. The GSM module used here is a SIM900A module, which is used along with a SIM card with an assigned number, which will be the phone number to which the SMS is sent for controlling the appliances.

IC ULN2003A, which is an array of seven NPN Darlington transistors, is used as the interface between the Microcontroller and the relays. These relays act as electrical switches, to turn ON and OFF the appliances. Certain strings are pre-programmed into the Arduino microcontroller, so as to identify them, and perform the requisite functions.

II. SYSTEM ARCHITECTURE

A. SIM 900A GSM Module:

The SIM900A GSM Module[5] acts exactly like a mobile device, and has a Receiver (Rx) and Transmitter (Tx), which are present as two pins on the module. A SIM card, which is to be used to control the home appliances, is inserted into this module.

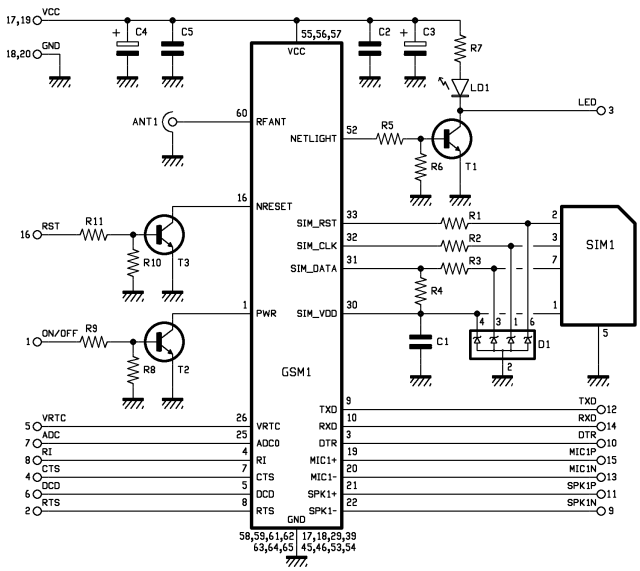

Fig.1 Architecture of GSM900A Module

The schematic diagram of the SIM900A GSM module is shown in Fig.1. SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. In addition, the GSM900 device integrates an analog interface, an A/D converter, an RTC, a SPI bus, an I²C, and a PWM module.
A TTL circuit is present as seen above, and it is in charge of communicating all the data relative to the SMS sent and received by this mobile phone module. The module is supplied with continuous energy (between 3.4 and 4.5 V).

B. Arduino Pro Mini

The Arduino Pro Mini[2]schematic diagram is given below (Fig.2). Here the pin numbers 30 and 31 are the Receiver (Rx) and Transmitter (Tx) pins respectively. These pins are connected to the Rx and Tx pins of the GSM module. This enables the transmission and reception of the information between the Module and the Microcontroller.

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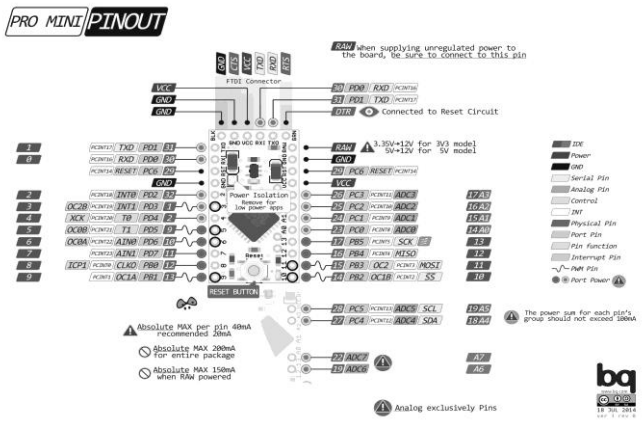

Fig.2 Arduino Pro Mini Schematic Diagram

The most important point here is that the Ground terminals of both the Arduino board and the GSM module should be connected to each other. Otherwise the connection establishment between these two interfaces will fail.

C. ULN2003A Integrated Circuit

The ULN2003A IC (Internal Schematic shown below in Fig.3) is used to connect the GSM Module and the Microcontroller to the relays, which are the electric switches being used. ULN2003 IC is a high-voltage high-current Darlington transistor arrays. Each consists of seven NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The relays used in this automation circuit are 5V relays.

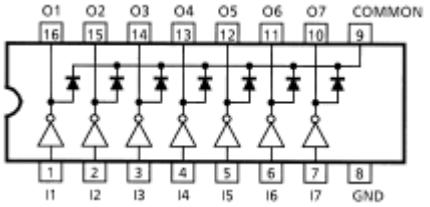

Fig.3 ULN2003A Internal Schematic

D. Relay

Joseph Henry invented the first relay in 1835. A relay is an electrical hardware device having an input and output gate. It acts as an electrical switch[3]. The output gate consists of one or more electrical contacts that switch when the input gate is power. Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, based upon the requirement.

III. Circuit Diagram of Automation Setup

The circuit diagram of the automation setup is seen in Fig.4.

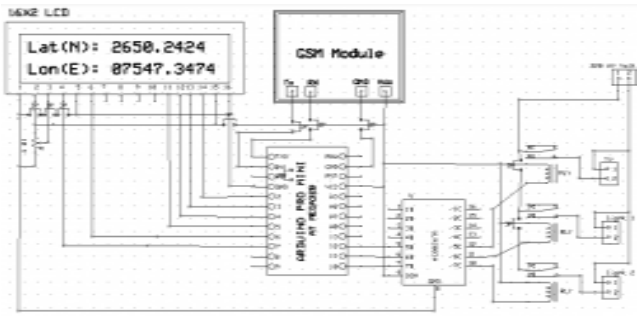

Fig.4 Circuit Diagram of Automation Setup

Here, we use a 16x2 LCD display to display the messages. The GSM Module and the Microcontroller are coupled, and are connected to the various relays through the IC ULN2003A, which are in turn connected to the various appliances such as televisions, ceiling fans, lights, motors etc.

IV. LCD Initialization

Liquid Crystal Display (LCD), is helpful for providing a suitable user interface as well as for debugging purposes. An LCD screen is coupled and initialized with this automation system, so as to view the messages sent, and to also view the functions, which are being currently performed by the Microcontroller.

The LCD Display is preferably of a 2x16 line display, which can display two lines of 16 characters each, for a total of 32 characters at a time. The LCD display must be properly interfaced with the Microcontroller to ensure its proper working. The most widely used LCD Display is the Hitachi 4478[4], which is a simple, cost-effective and efficient LCD Display screen.

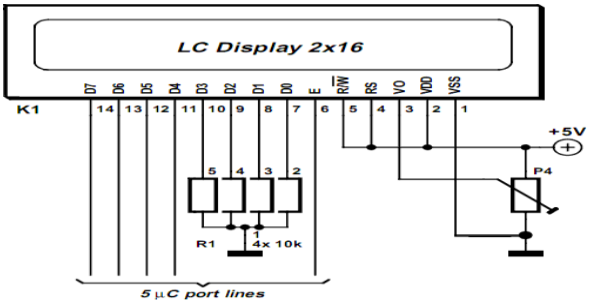

Fig.5 LCD Module Block Diagram

V. Working

The functional block diagram of the automation system is given in Fig.6:

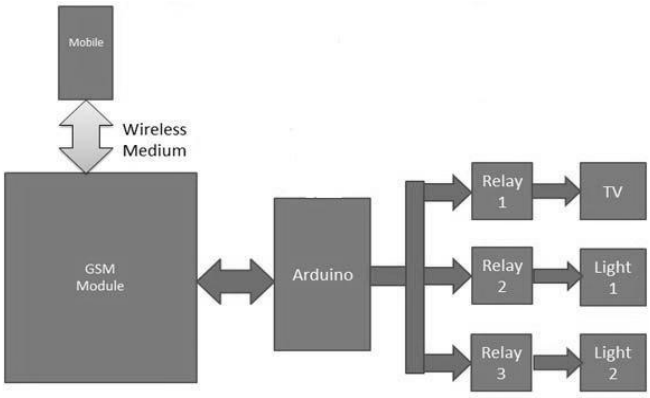

Fig.6 Block diagram of Automation System

As seen above, we send an SMS from a mobile device, through the GSM network, to the GSM Module present in the automation system.

The messages being sent for the control are pre-programmed into the Microcontroller. Thus, it compares the string with the message string, and performs the requisite action required.

For example, for controlling a television and a pair of lights, the string commands may be given as:

```
String TV_ON="TV ON";
String TV_OFF="TV OFF";
String LIGHT1_ON="Light 1 ON";
String LIGHT1_OFF="Light 1 OFF";
String LIGHT2_ON="Light 2 ON";
String LIGHT2_OFF="Light 2 OFF";
```

Now, if the above strings are sent through SMS, the GSM module receives the string, and stores the string in an array present in it, known as the STR array. The module then extracts the message and the mobile number from which it is sent. The message sent is stored within an asterisk and a hash symbol, that is, the message must be sent to the module in the format of *Light 1 ON#, such that the string comparison function may be performed. The separated message is then compared with the pre-programmed message in the Microcontroller, and if the strings are matched, then it performs the required action.

We can also program the GSM module in such a manner that it acknowledges the reception of the message sent by the user. If the user sent message is received by it, the GSM module generates an automatic reply to inform the user that the module has received the message.

The program coding for extracting the message can be given as follows:

```
if(str[i]=='*')
{
      i++;
      while(str[i]!='#')
      {
      name+=str[i];
      i++;
       }
 }
}
i++;
```

The above program isolates the message string from the SMS, where it comes combined with the numeric mobile number. The isolated message is then compared with the pre-programmed strings in the microcontroller.

For the comparison if two strings and sending the acknowledgment notification message, the Microcontroller program coding can be as follows:

```
if(name==TV_ON)
{
digitalWrite(TV, HIGH);
serial.printin("AT+CMGF=1");
delay(1);
serial.print("AT+CMGS=");
serial.printin(number);
delay(1);
serial.print("TV ON");
serial.write(26);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("TV ON");
delay(2000);
}
```

By programming the Microcontroller appropriately, the message is received, compared, and if found matching, the suitable required action is performed. The relays, which act as switches for the appliances, are connected to the digital pins 10, 11 and 12 of the Arduino Microcontroller circuit board. Based on the input message, the Microcontroller sends an activating HIGH or LOW signal to the required pin, to turn ON or turn OFF the required appliance.

Thus, the Home Automation is achieved by using GSM, SMS and Arduino Pro Mini Microcontroller.

VI. Requirements

- It is necessary that a constant power supply is required for this system to run.
- It can only be accessed from places where there is GSM connectivity. However, this is not necessarily a major drawback, since GSM connectivity is present worldwide.

VII. Conclusion

It can be seen that this is a very efficient method of Home Automation. The major advantage is that the appliances can be controlled from literally anywhere in the world. Since GSM connectivity is present worldwide, it is a very useful system.

It is also very simple, and the strings used to control the appliances can be suitable modified according to the needs of the user.

VIII. Scope for Implementation

These GSM based Home Automation systems are inexpensive, and their ease and flexibility of usage is unparalleled. Futuristic homes may be attached with a main GSM module, where a SIM card may be installed, and connections may be provided to all the household appliances.

Just by sending a simple SMS message, all the devices and home appliances can be controlled. Such is the power of the GSM network.

REFERENCES:

[1] Mazidi, Muhammad Ali, 'The Microcontroller and Embedded System', Second Edition, Prentice Hall, 2007.

[2] Arduino Pro Mini Datasheet, copyright Arduino, 2015

[3] MA Laughton, MG Say, 'Electrical Engineer's Reference Book', Fourteenth Edition, Butterworth International Editions, 2013

[4] Hitachi LCD Module 4478 Datasheet, copyright Hitachi, 2015

[5] SIM 900A GSM Module Datasheet, copyright Probots, 2015.