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SMS CONTROLLED SMART HOME SYSTEM IN IOT

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Abstract- This paper describes the design and development of a system that incorporates a low-cost and flexible home control and monitoring system for accessing and controlling household appliances (like lights, fans, door locks, etc.,) remotely by sending SMS using a custom made Android Smart Phone Application. The cellular communication (GSM) is a potential solution for such remote controlling activities. Remotely, the system allows the home owner to monitor and control the home appliances via mobile phone set by sending commands in the form of SMS messages. The system uses the Android Application for control of appliances and therefore the system is more adaptable and cost-effective and also providing ubiquitous access for appliance control.

Keywords— Mobile handset; Android Application; Arduino Uno microcontroller; short message service (SMS); GSM SIM900 module; AT command set.

1. Introduction

The controlling of electrical appliance and instrument remotely have made a profound impact on the 21st century. The appliances that can be incorporated can be anything in the home such as an air conditioner, door locks, set top box, light and so on. The case of remote control capability and the possibility of achieving it at a reasonably low cost have motivated the need to research into it not only for industrial application but also for domestic use [1].

The objective of this paper is to develop a system that allows a user to remotely control and monitor multiple home appliances using a cellular phone. This proposed system will be a powerful and flexible tool that will offer this service at any time leading to overall cost reduction and energy saving.

These days, apart from supporting voice calls, a mobile phone can be also used to develop applications for sending predefined text messages with a single click of a button. We have used this concept to design a system that acts as a platform to receive messages ,which in fact are commands sent to control different appliances and devices using Arduino Uno as the main controller. The control system which is based on the GSM technology effectively allows control from a remote area over the appliances which are interfaced with the main microcontroller system.

The application of our suggested system will definitely gain popularity in the ever changing technological world where automation is making its way fast. It provides a greater degree of freedom to an individual for controlling the household appliances or even the office

equipments. The need to be physically present in order to control appliances at a certain location is eliminated with the use of our system [9].

The proposed approach for designing this system is to implement an Arduino microcontroller-based control module that receives its instructions and commands from a cellular phone over the GSM network to carry out and execute the issued commands and control the appliances.

Home automation is slowly entering our society. So our main aim of the project is to make use of the GSM technology and Arduino based embedded system to make a Home smarter and wireless. The existing devices like fan, CFL, bulbs, door locks etc. which we intend to control will be connected with some relays which can be controlled by the microcontroller [2][3].

2. Working Principle

Assuming that the control unit is powered and operating properly, the process of controlling a home device will proceed through the following steps:

1. The user pushes a button on his android application and a predefined text message is generated [5].
2. A text message is sent through the GSM network.
3. GSM Sim900 module receiver receives messages sent from user's cell Phone.
4. GSM Sim900 module is connected to Arduino Uno which has ATMEGA 32 Microcontroller.
5. Microcontroller keeps polling to check if the modem has received any text message and sends command to modem to transmit the text message if received [2].
6. GSM receiver sends the message to the microcontroller. GSM modem and Arduino communicates through a special command set known as AT COMMAND SET.
7. Microcontroller crops the command text part of the SMS and sends another command to the modem to delete the current SMS so that the next SMS can be processed.
8. Microcontroller decodes action required corresponding to the SMS command by a search and match technique where a look up table is created with set of command and corresponding actions.
9. Microcontroller sends command to the desired relay to control the target appliance [4].

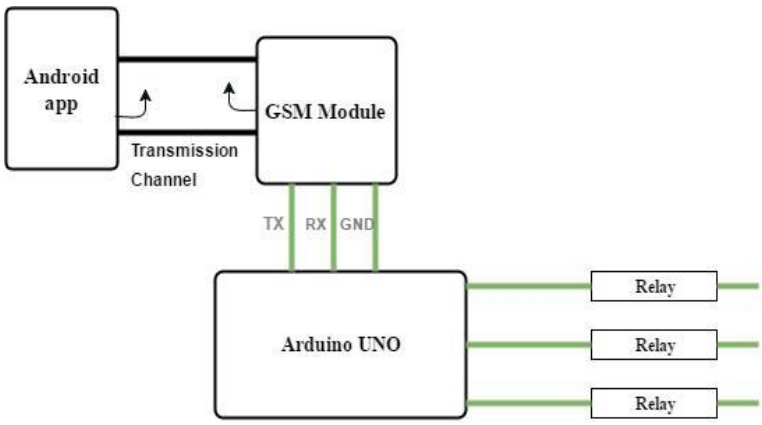

Fig. 1 Block Diagram of the system

3. System Description

The system comprises of hardware components and their respective softwares. The hardware architecture consists of a stand-alone embedded system that is based on Arduino Uno microcontroller (Atmega32), a GSM handset, GSM SIM900 Module and a driver circuit as shown in the schematic block diagram in Fig. 1. The GSM modem provides the communication medium between the user's phone and the system by means of SMS messages over the GSM network. The SMS message consists of commands to be executed by the microcontroller. The format of the message is predefined.

The Key feature and characteristics of the system can be summarized as**:**

1. SMS technology is easy to use, learn and is quite accessible [6][10].
2. The lack of GSM network coverage will render the system incapable of performing any task.
3. A microcontroller can be controlled and monitored from the android application developed for GSM phone that supports SMS. Therefore, the system is universal i.e. the remote to this system can be any basic GSM phone that supports the application developed [1][10].
4. The system saves energy and effort. The appliances can be switched on and off according to the wish of the user, simply by sending message from anywhere in the world.
5. SMS services are generally cheap and hence, are a viable option to consider. Further, GSM network is spread worldwide, which makes this system a remotely accessible system [10].
6. After the desired operation of the system is performed the system provides the user with an acknowledgement.
7. SMS is used as the main communication medium.
8. The system is versatile and can be used in any process industry with a little modification. More over the construction of this system is easy and cheap.

The detailed description of individual modules in the system is as follows.

A. User GSM mobile Handset

The GSM Mobile handset consists of a developed Android application that consists of buttons to power on/off the appliances [8]. When the button is pressed, an SMS is generated automatically and is sent to the GSM module. The cellular phone contains SIM card that has a specific number through which communication is possible. This limits the usage of our system to only authorized users.

B. GSM SIM 900 module (GSM modem)

We have used general packet radio service (GPRS) modem SIM900 from SIMCON ltd. Designed for global market; SIM900 is a GSM/GPRS-compatible Quad-band cell phone chip, which works on a frequency of 850/900/1800/1900MHz and which can be used not only to access the Internet, but also for oral communication (provided that it is connected to a microphone and a small loud speaker) and for SMSs. Internally, the module is managed by an AMR926EJ-S processor, which controls phone communication, data communication (through

an integrated TCP/IP stack), and (through an UART and a TTL serial interface) the communication with the circuit interfaced with the cell phone itself.

The processor is also in charge of a SIM card (3 or 1.8 V) which needs to be attached to the outer wall of the module. The physical interface to the mobile application is made through a 60 pins board-to-board connector, which provides all hardware interfaces between the module and customers' boards except the radio frequency (RF) antenna interface. It has two audio channels include two microphones inputs and two speaker outputs. This can be easily configured by AT command. The SIM900 is designed with power saving technique, the current consumption too as low as 2.5mA in sleep mode.

C. Arduino Uno Microcontroller

Microcontroller is the key element in all embedded systems, control and automation processes. It behaves like a single chip microcomputer and is coupled with a processing unit, memory, input output devices, timers, data convertors, serial port etc. In this project Arduino Uno microcontroller is used which contains ATmega32 whose pin configuration shown in Fig. 2. It is a high-performance, low-power Atmel 8-bit AVR RISC-based microcontroller which has 32KB of programmable flash memory, 2KB SRAM, 1KB EEPROM, an 8-channel 10-bit A/D converter, and a JTAG interface for on-chip debugging. The device supports throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts.

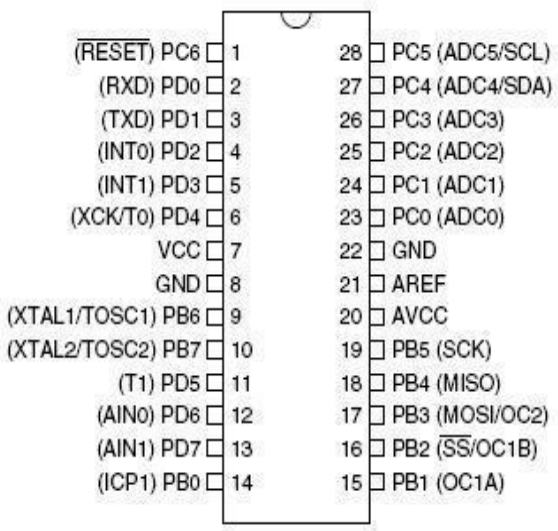

Fig. 2 Pin Cinfiguration of Atmega32

D. Relay board

Relay board consists of four SPDT relay and a relay driver ULN2003. ULN 2003, shown in Fig. 3, is a unipolar motor driver IC with maximum output voltage 50 V and output current 500 mA. It contains seven Darlington pair transistors, each having a peak rating of 600 mA and can withstand 50 Vin off-states. Outputs may be paralleled for higher current capability.

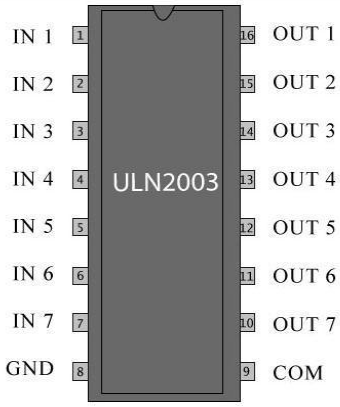

Fig. 3 ULN 2003 Pin Diagram

E. Connection between Arduino Uno & SIM900 MODEM

The GSM module is designed as a DCE (data communication equipment), following the traditional DCE-DTE (data terminal equipment) connection, the module and the client DTE are connected through the following signal as shown in Fig. 4. Auto bauding supports baud rate from 300 bps to 115200 bps.

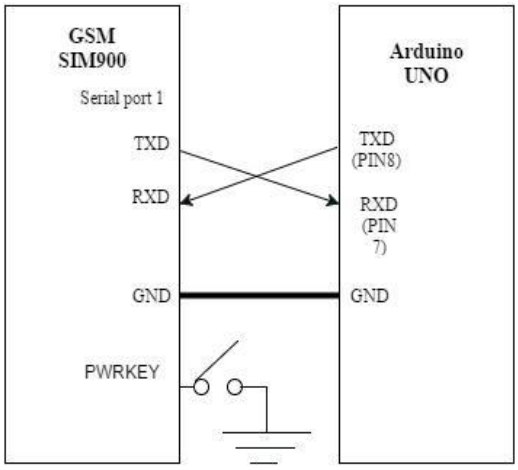

Fig. 4 Internal connection

F. AT command set

Remote control operation of the GSM mobile telephone runs via a serial interface (data cable of infrared connection), where AT+C commands according to ETSI GSM 07.07and GSM 07.05 specification as well as several manufacturer specific AT commands are available. The modem guideline V.25 applies to the sequence of the interface commands. According to this guideline, commands should begin with the character string “AT” and end with “<CR>” (= 0x0D). The application of a command is notified by the display of “OK” or “ERROR”.

Some of the commands used in this project are listed in Table I

Table 1. Commands Used

Sl. No.	Commands	Description
1	AT+CGMI	Issue manufacturer ID Code
2	AT+CGMM	Issue model ID code
3	AT+CSMS	Selection of message service
4	AT+CMGR	read SMS
5	AT+CMGD	Delete an SMS in SMS Memory

AT = attention.

G. Experimental setup

The whole experimental setup shown in Fig. 5 includes the GSM SIM 900 modem as shown in Fig. 5 (d) is connected to the Arduino board in Fig. 5 (b) consisting of microcontroller Atmega32. The Arduino board is connected to the relay board as shown in Fig. 6 (a) which is connected to the electric bulb as Fig. 5(e). The battery shown in Fig. 5(c) powers all the parts except the light bulb which uses an AC power supply.

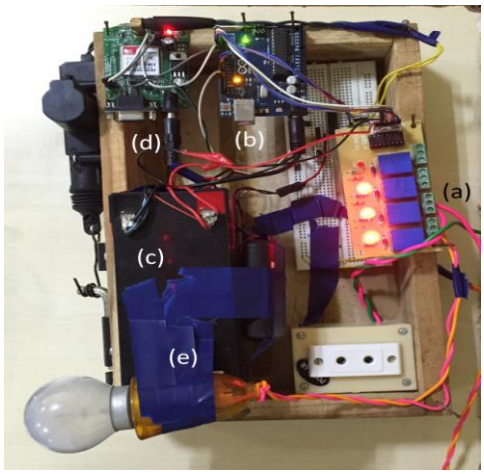

Fig. 5 Experimental setup (a) Relay Board, (b) Arduino Uno board, (c) Battery, (d) GSM SIM900 module and (e) Light Bulb.

4. Experimental Results

We fabricated and evaluated a prototype system for the proposed SMS based home automation system shown in Fig. 5. The microcontroller was switched on with electric current from the battery. An SMS is sent by the user from the mobile application to the GSM SIM900 module. The SMS is received and is read by the Arduino microcontroller with the help of some predefined AT command set. The microcontroller analyses the command and instruct the relay to switch ON or OFF as given in Table II any electrical device (DEV) attached to it. The overall experiment is performed with the help of software coding mentioned in APPENDIX-I.

TABLE II		
COMMAND – RELAY STATUS		
Sl. No.	User's Command	Status of Relay
1	DEV 1 ON	Relay 1 is ON
2	DEV 2 ON	Relay 2 is ON
3	DEV 3 ON	Relay 3 is ON
4	DEV 1 OFF	Relay 1 is OFF
5	DEV 2 OFF	Relay 2 is OFF
6	DEV 3 OFF	Relay 3 is OFF

DEV = Device.

5. Conclusion and Future Enhancements

SMS based remote control for home appliances are beneficial for the upcoming generation because mobile is one of the mostly used communication device nowadays. The SMS based remote control for home appliances is easy to implement to make the electrical device ON/OFF. In simple automation system where the internet facilities and even PC are not provided, one can use mobile phone based control system which is simple and cost-effective. In many cases for instance landline phone with extension card could also be used for the system. For future enhancements, we are going to develop the audio or voice based remote home and office control system which is beneficial for physically handicapped persons or blind persons [7].

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