

Embedded System for Home Automation Using SMS

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Abstract— This paper describes the design and development of a system for household appliance control using cell phone through global system for mobile communication (GSM) technology. The cellular communications is a potential solution for such remote controlling activities. SMS (short message service) technology can be used to control household appliances from distance. 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 and receiving the appliances status as well. The proposed system makes use of wireless control hence can be effectively used in systems where unwired connections are desired. The system uses the user's mobile handset for control and therefore the system is more adaptable and cost-effective and also providing ubiquitous access for appliance control.

Keywords— *Mobile handset; microcontroller; short message service (SMS); GSM modem; AT command set.*

I. INTRODUCTION

The electrical appliance and instrument have made a profound impact on the 21st century and the need of controlling them remotely is an original idea. The appliances can be anything in the home such as an air conditioner, security system, set top box, light and so on. The ease 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.

The objective of this project is to develop a device that allows for a user to remotely control and monitor multiple home appliances using a cellular phone. This system will be a powerful and flexible tool that will offer this service at any time and from anywhere with the constraints of the technologies being applied.

These days, apart from supporting voice calls a mobile phone can be used to send text messages. We have used this very concept to design a system that acts as a platform to receive messages [1] which in fact are commands sent to control different appliances and devices connected to the central control system with Atmega 8 as the main controller. We have designed a control system which is based on the GSM technology that effectively allows control from a remote area over the appliances which are

interfaced with the main microcontroller system. The application of our suggested system is immense in the ever changing technological world where automation is making its way fast. It allows a greater degree of freedom to an individual whether it is controlling the household appliances or office [2] equipments. The need to be physically present in order to control appliances of a certain location is eliminated with the use of our system.

The proposed approach for designing this system is to implement a microcontroller-based control module that receives its instructions and commands from a cellular phone over the GSM network interfaced with the main controller module. The microcontroller then will carry out the issued commands.

Home automation is slowly entering our society; R.das et.al developed a security based home automation system [3]. A local interfacing technique for interfacing was discussed by S.Dutta et.al [4] So our main motto of the project is to make use of the GSM technology and also Atmega8 based embedded system [1]-[13] to make a Home smarter and wireless. The existing devices like fan, CFL, bulbs etc. which we intend to control will be connected in series with some relays which can be controlled by the microcontroller. In this project we have used a 16X2 LCD display to know the status of the devices.

II. 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. A text message is sent by the user through the GSM network.
2. GSM receiver receives messages sent from user cell Phone.
3. GSM modem is connected to ATMEGA8 Microcontroller via serial port using internal UART [5] Module of ATMEGA8.
4. 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.

5. GSM receiver sends the message to the microcontroller. GSM modem and ATMEGA8 communicates through a special command set known as "AT COMMAND SET"
6. 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.
7. 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.
8. Microcontroller drives the desired relay to control the target appliance.

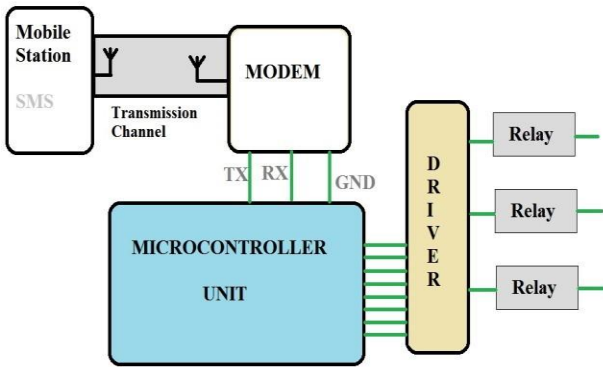


Fig. 1. Block Diagram of the system

III. SYSTEM DESCRIPTION

The system comprises of hardware and software. The hardware architecture consists of a stand-alone embedded system that is based on 8-bit microcontroller (Atmega8), a GSM handset with GSM Modem and a driver circuit as shown in the schematic block diagram in Fig. 1. The GSM modem provides the communication medium between the homeowner and the system by means of SMS messages [6] over the GSM network. The SMS message consists of commands to be executed. 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 and learn and can be accessed easily when needed.
2. The only barrier in the system can be the non-availability of the transmission medium i.e. the lack of GSM network coverage.
3. A microcontroller can be controlled and monitored from any GSM phone that supports SMS. Considering the fact that most GSM phones support SMS, the system is therefore universal i.e. the remote to this system can be any basic GSM phone.
4. The system saves time and effort. No dedicated well established connections like Bluetooth and internet is necessary, a simple text message is all that is need to control the proposed system.
5. SMS services are generally cheap and is a viable option for other remote connection options like internet or radio waves. Furthermore more the GSM network covers the

entire face of the Earth hence this remote connection is valid for any viable range.

6. User and/or system administrators are more likely to have their phones with them at all times than they are likely to physically be in front of their computers. Thus proposition of a system which is an integral part of their phone itself is an innovative solution for remote home appliance control and monitoring.
7. After the desired operation of the system is performed the system provides the user with a acknowledgement.
8. SMS is used as the main communication medium.
9. Abnormal conditions like power failure or the malfunction of the device is also also monitored and informed by the installed system to the user who is remotely located.
10. 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 detail description of individual modules in the system is as follows.

A. User GSM mobile Handset

Cellular phone containing SIM (Subscriber's Identifying Module) card has a specific number through which communication is possible. A mechanism of GSM technology is chosen as the mode of communication which is wireless. Here, the user transmits instructions to the system to control the appliance in the form of SMS.

B. GSM modem

We have used general packet radio service (GPRS) modem SIM300 from SIMCON Ltd. Designed for global market, SIM300 is a Tri-band GSM/GPRS engine that works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS1900 MHz [7]. SIM300 provides GPRS multi-slot class 10 capabilities and support the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. With a tiny configuration of 40mm x 33mm x 2.85 mm, SIM300 can fit almost all the space requirement in application, such as smart phone, PDA phone and other mobile device. 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 SIM300 is designed with power saving technique, the current consumption too as low as 2.5mA in sleep mode. The SIM300 is integrated with the TCP/IP protocol, extended TCP/IP AT commands are developed for customers to use the TCP/IP protocol easily which is very useful for those data transfer applications.

C. 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 ATmega8 [8] is used whose pin configuration shown in Fig. 2. It has advanced RISC architecture, 130 powerful

instructions & most single-clock cycle execution. It works with 32×8 general purpose working registers. It has On-chip 2-cycle multiplier, 8Kbytes of in-system self-programmable flash program memory, 512Bytes EEPROM, 1Kbyte internal SRAM.

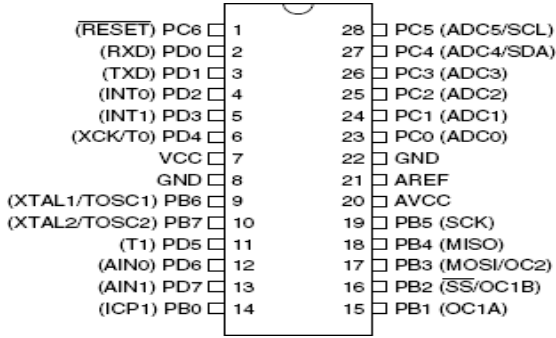


Fig. 2. PIN Configuration Of Atmega8.

D. Communication protocols

RS-232 (recommended standard 232) is an asynchronous standard for serial binary data communication. In RS232 standard the logic 0 or space is given by any voltage ranging from +3V to +25V and logic 1 or mark is given by any voltage from -3V to -25V as shown in Fig. 3.

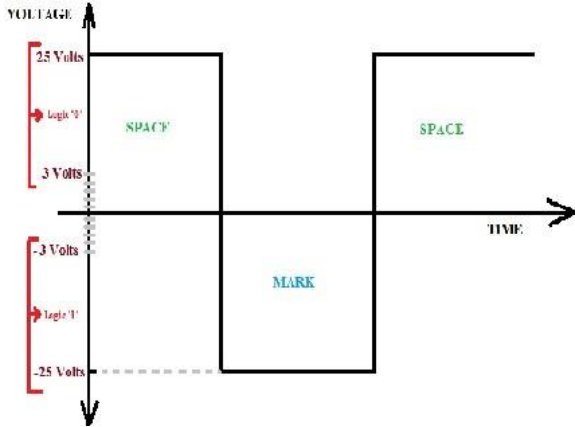


Fig. 3. RS232 voltage levels.

E. Relay board

Relay board consists of three SPDT relay and a relay driver ULN2803. ULN 2803, shown in Fig. 4, is a unipolar motor driver IC with maximum output voltage 50 V and output current 500 mA. It contains eight darlington pair transistors [9], each having a peak rating of 600 mA and can withstand 50 Vin off-state. Outputs may be paralleled for higher current capability.

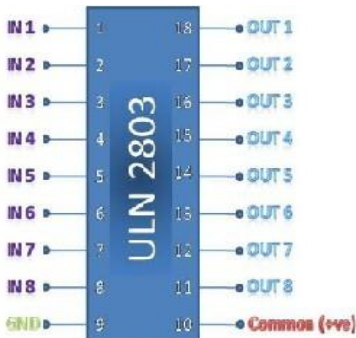


Fig. 4. ULN 2803 relay driver.

F. Connection between ATMEGA8 & 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. 5. Auto bauding supports baud rate from 1200 bps to 115200 bps [10].

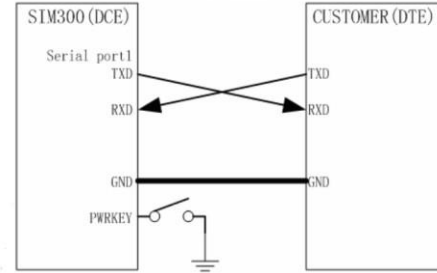


Fig. 5. Internal connection.

G. 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 07.07 and GSM 07.05 specification as well as several manufacturer specific AT commands [11] 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
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.

Table I.

H. Experimental setup

The whole experimental setup shown in Fig. 6 includes the GSM modem as shown in Fig. 6 (a) is connected to the development board in Fig. 6 (b) consisting of microcontroller Atmega8, 16 x 2 LCD display and LCD driver acting as serial to parallel converter. The development board is connected to the

relay[10] board as shown in Fig. 6 (c) which is connected to the electric bulb as Fig. 6 (d).

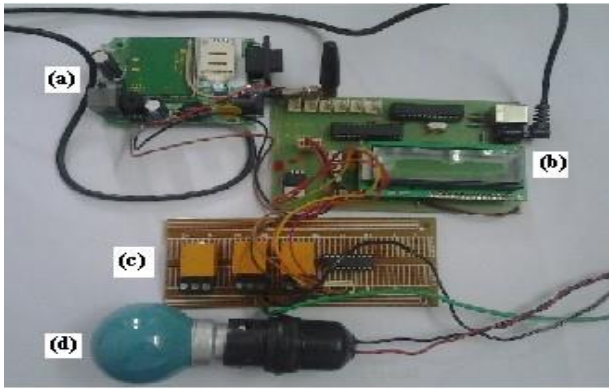


Fig. 6. Experimental setup

(a) GSM modem, (b) Development board, (c) Relay board and (d) Electric bulb.

The circuit diagram for the entire system has is given in Fig 7.

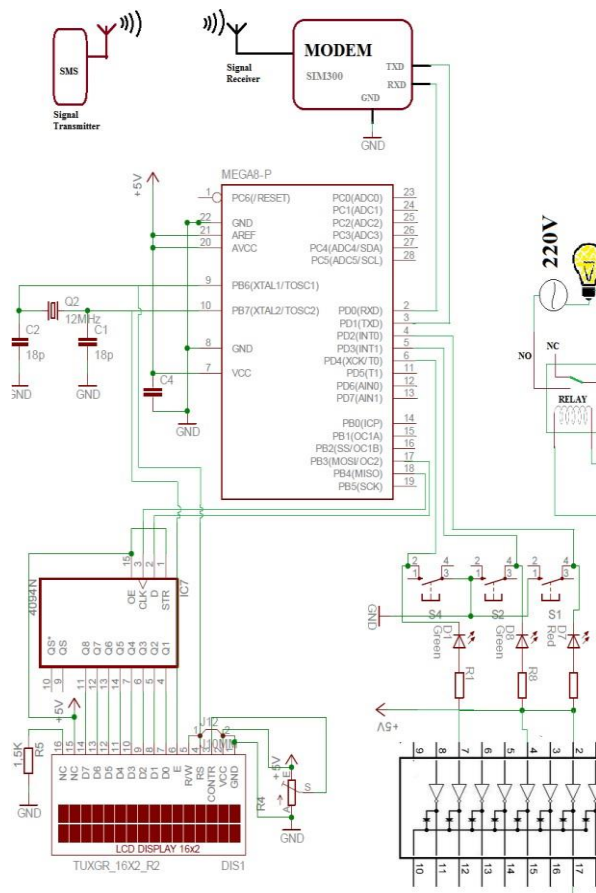


Fig. 7. The complete Circuit diagram of the system

IV. EXPERIMENTAL RESULTS

We fabricated and evaluated a prototype system for the proposed SMS based home automation system shown in Fig. 6. The microcontroller was fed with electric current to make it on. An SMS is sent by the user to the gsm module. The SMS is received and is read by the microcontroller with the help of some

predefined AT command set that was provided by the user to the microcontroller earlier. 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.

V. CONCLUSION

SMS based remote control for home appliances are beneficial for the human generation because mobile is mostly used for communication purposes 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. In future we are going to develop the audio or voice [12]-[13] based remote home and office control system which is beneficial for physically handicapped persons or blind persons.

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REFERENCES

- [1] Amit Chauhan, Reecha Ranjan Singh, Sangeeta Agrawal, Saurabh Kapoor, and S. Sharma, "SMS based Remote Control System", International Journal of Computer Science and Management Studies, Vol. 11, pp 19-24, Issue 02, Aug 2011.
- [2] E. Wong, "A phone-based remote controller for home and office automation," *IEEE Trans Consumer Electron.*, vol. 40, no. 1, pp. 28- 33, Feb 1995.
- [3] R.Das, S.Dutta, K.Samanta, A.Sarkar and D.Das, "Security Based Domotics", International Conference On Computational Intelligence: Modeling, Techniques and Applications (CIMTA-2013), ELSEVIER (ISSN: 2212-0173).
- [4] S.Dutta, R.Das and A.Sarkar, "Microcontroller Based Data Acquisition System", International Journal of Engineering and Technology, July edition 2013. (Paper Code-IJERTV2IS70678 with ISSN: 2278-0181)
- [5] Muhammad Ali Mazidi and Janice Gillispie Mazidi, "The 8051 Microcontroller & Embedded System," Pearson Education India.
- [6] Adamu Murtala Zungeru, Ufaruna Victoria Edu, and Ambafi James Garba, "Design and Implementation of a Short Message Service Based Remote Controller", Computer Engineering and Intelligent Systems ISSN 2222-1719 (Paper) ISSN 2222-2863 (Online) Vol 3, No.4, 2012.
- [7] Data sheet of Sim300.
- [8] A workshop on Atmega8 organized by Burdwan University in Sept., 2012.
- [9] Robert, L. Boylestad and Nashelsky, L. (2002), "Electronic devices and

- circuit theory," 8th edition, Prentice Hall (Pearson Education Inc.), 870-875.
- [10] Richard. H. Barnett, Sarah Cox, and Larry O'Connell, "Embedded C Programming and the Atmel AVR," 2nd Edition, Cengage Learning, 50-51.
- [11] www.datasheetarchive.com.
- [12] Yuksekkaya, B.; Kayalar, A.A.; Tosun, M.B.; Ozcan, M.K.; Alkar, A.Z., "A GSM, internet and speech controlled wireless interactive home automation system," *IEEE Transactions on Consumer Electronics*, vol.52, no.3, pp. 837- 843, Aug. 2006
- [13] N. Sriskanthan and Tan Karande, "Bluetooth Based Home Automation Systems," *Jnl. of Microprocessors and Microsystems*, Vol. 26, pp. 281-289, 2002