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DESIGN AND IMPLEMENTATION OF AN EMBEDDED SYSTEM FOR LOCKING MECHANISAM & ELECTRONIC DEVICES AND COMMUNICATING IT WITH SMS

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Abstract-This paper describes the design and development of a system for Locking mechanism 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 locking mechanism from a distance. Remotely, the system allows the home owner to monitor and control the home locking 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 were 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

In the 21st century the electrical appliance and instrument have made a profound impact in our living environment and the need of controlling them is an original idea. We find these appliances such as air conditioner, security system, set top box, light and so on every where right from our homes, offices, industries, etc. The possibility of achieving the capability of controlling these appliances remotely at a reasonable 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 home locking system as well as other electrical appliances by using a cellular phone. With the constraints of the technologies being applied, the system will provide service at any time and from anywhere because of its powerful flexible tool.

These days, apart from supporting voice calls a mobile phone can also be used to send text messages. By using this concept a system based on GSM is designed which acts as a platform to receive the Messages[1] which in fact are commands sent to control locking mechanism as well as other electronic devices connected to the central control system with LPC 2148 as a main controller. In the world of changing technology our suggested system has an immense growth because in the present days to come all the devices are controlled and monitored remotely. 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.

An ARM7 processor based control module is designed in order to approach the proposed system, which receives its instructions and commands from a cellular phone over the GSM network interfaced with the main controller module, then the issued commands are carried out by the ARM7 processor.

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 LPC2148 based embedded system [1]-[13] to make a Home smarter and wireless. The locking device and the electronic devices like fan, ac, bulbs etc. which we intend to control will be connected in series with some relays which can be controlled by the LPC 2148 processor. In this project we have used a 16X2 LCD display to know the status of the devices.

II. WORKING PRINCIPLE

By assuming that the control unit is powered and operating properly, the controlling of the locking mechanism is done by the fallowing steps

1. A text message is sent by the user to the GSM network.
2.GSM receiver receives messages sent from user cell Phone.
3.GSM modem is connected to LPC 2148 Microcontroller via serial port using internal UART [5] Module of LPC 2148.

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 LPC 2148 processor. GSM modem and LPC 2148 communicates through a special command set known as "AT COMMAND SET"
6. The LPC 2148 processor 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. The LPC 2148 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. The processor drives the desired relay to control the target appliance.

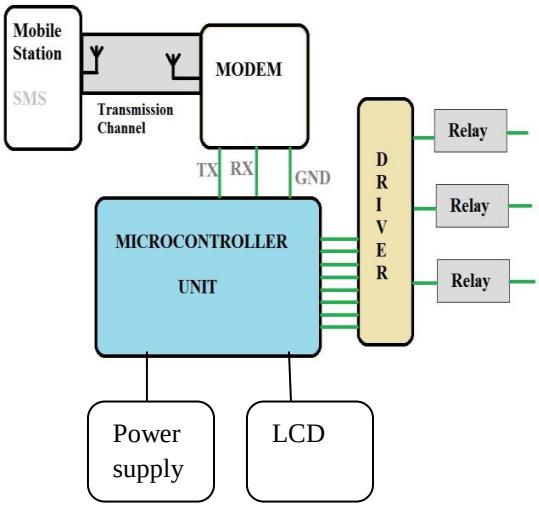

Fig. 1. Block Diagram of the system

III. SYSTEM DESCRIPTION

The system comprises of hardware and software. The hardware architecture consists of a stand-alone embedded system that is based on LPC 2148 ARM processor, a GSM handset with GSM Modem and a driver circuit as shown in the schematic block diagram in Fig. 1. The communication between the homeowner and the system is provided by the GSM modem by means of SMS [6]. The SMS 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 the non-availability of the transmission medium i.e. the lack of GSM network coverage.
3. A LPC 2148 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 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 an acknowledgement.
8. SMS is used as the main communication medium.
9. Abnormal conditions like power failure or the malfunction of the devices are 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.
The detail description of individual modules in the system is as follows.

A.GSM MOBILE HAND SET

Cellular phone consists of a SIM(subscribers identifying module) card which has a specific number through which communication is possible. As a mode of wireless communication GSM technology is used. Here, the user transmits instructions to the system to control the application (i.e, locking mechanism) in the form of SMS.

B.GSM MODEM

We have used general packet radio service (GPRS) modem SIM300 from SIMCON ltd.SIM300 is a Tri-band GSM/GPRS engine which is designed for global market and 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.SIM300 can fit almost all the space requirement in application, such as smart phone, PDA phone and other mobile device because of its tiny configuration of 40mm x 33mm 2.85mm. 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. AT command is used to configure the GSM. 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

In any embedded system in order to control and automation process Microcontroller plays a pivotal role. It acts as a single chip microcomputer and processing unit, memory, input output devices, timers, data convertors, serial port etc. are coupled to it. In this project LPC 2148 [8] is used. 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.

D.COMMUNICATION PROTOCAL

RS-232 (recommended standard 232) is used as a communication protocol, which is an asynchronous standard for serial binary data communication. It formally defines the signals connecting between a DTE (data terminal equipment) such as a computer terminal, and a DCE (data circuit-terminating equipment, originally defined as communication equipment) such as modem. In RS232 for voltage ranging from +3V to +25V logic 0 or space is given and for voltage from -3V to – 25V logic 1 or mark is given.

E. RELAY BOARD

Three SPDT relays and a relay driver ULN2803 are present in the relay board. ULN 2803 is a unipolar motor driver IC with maximum output voltage 50 V and output current 500 mA. It has 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.

F. CONNECTION BETWEEN AT89S52 AND 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. 2. Auto bauding supports baud rate from 1200 bps to 115200 bps [10].

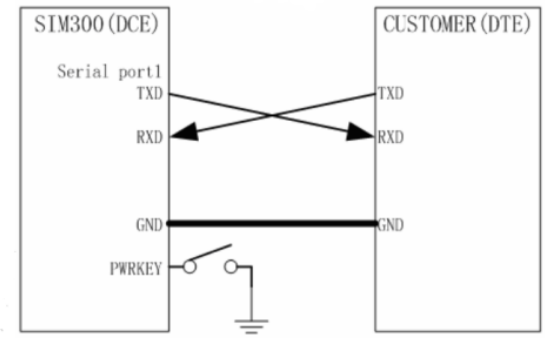

Fig 2 Internal connection.

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 07.07and 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, command's 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 the fallowing table.

S.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

Table 1. Commands used

H.EXPERIMENTAL SET UP

The whole experimental setup shown in Fig. 3. Here the GSM modem is connected to the development board. The development board consists of a LPC 2148 ARM7 processor, 16 x 2 LCD display and LCD driver acting as serial to parallel

converter, rs-232 The development board is connected to the relay[10] board. The commands use d in this are as shown in the table 1.

S.no	Commands	Function
1.	DOORLOCK	Locks the door
2.	DOUNLOCK	Unlocks the door
3.	DOORINFO	Gives the status of locking
4.	DEVICEON	It makes device ON
5.	DEVICEOF	It makes device OFF
6.	D5SEC10N	Device will be on for 5sec
7.	TVMAINON	It makes main ON
8.	TVMAINOF	It makes main OFF

Table 2.Commands used for communication with electronics devices.

1V. EXPERIMENTAL RESULT

We designed a prototype system for the proposed SMS based system for locking mechanism shown in Fig. 3. In order to turn ON the system the LPC 2148 is fed with electric current. An SMS is sent by the user to the gsm module. The SMS is received and is read by the LPC 2148 with the help of some predefined AT command set that was provided by the user to the LPC 2148 earlier. The ARM7 LPC 2148 processor analyses the commands and instruct the relay to switch ON or OFF any electrical device (DEV) attached to it as shown in the Fig.

Fig.3 Experimental result

V. CONCLUSION

In this project an sms based remote control is developed which is useful for the locking mechanism as well as electrical devices in the home because mobiles are being used mostly for the communication purpose now a days. The implementation of the remote control is very easy and by just sending an sms we can make the locking system turn On and OFF very easily. In simple the automation system doesn't require any internet or pc, one can use mobile to communicate with the electronics devices and this is cost effective. 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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