

IMPROVED HOME AUTOMATION SYSTEM BASED ON GSM

Ms. S. Naveena
UG Scholar

Dr.R.Deepalakshmi
Professor

Department of Computer Science and Engineering,
Velammal College of Engineering and Technology,
Madurai, Tamilnadu, India

Abstract-- In the world of automation we want our daily life to be controlled remotely. The aim of the project is controlling of home appliances remotely when the user is away from the place. This is SMS based system and user uses wireless technology (GSM). The system uses GSM technology thus providing universally access to the system for automated appliance control. PIC16F877A Micro Controller is the vital component of this project. The main objective of this project is to investigate controlling of home appliances remotely and cost effectively. The motivation was to facilitate the users to automate their homes having remotely universal access. The home appliances control system with an effective cost was thought to be built that should be mobile providing remote access controlling scheme to the appliances. This work includes the study of GSM modem using sensors device. GSM network users have roaming facilities so that user can often continue to use the mobile phones when they travel to other countries etc.

Keywords-- PIC16F877A Microcontroller, GSM Modem, Crystal Oscillator, Regulated Power Supply, OPTO Coupler, Reset, LED Indicators, Mobile Phone.

I. INTRODUCTION

“A home which is smart enough to assist the inhabitants to live independently and comfortably with the help of technology is termed as smart home. In a smart [1] home, all the mechanical and digital devices are interconnected to form a network, which can communicate with each other and with the user to create an interactive space”. Monitor and control the house or office appliances and equipment’s effectively through the mobile phone set by sending Commands in the form of SMS messages and receiving the devices status. The main concept behind this project is receiving the sent SMS and further processing it as required to perform several operations. The nature of the SMS sent decides the type of operation. The project [2] is based on a very simple principle. First, the SMS sent is stored and collected from the receiving mobile station and then the required control signal is generated and sent to the intermediate hardware that we have designed according to The command received from the sent message. A microcontroller based using SMS system has been proposed for our project:

GSM (Global System for Mobile Communications): It is a cellular communication standard.

SMS (Short Message Service): it is a service available on digital mobile phones that permits the sending of short text messages (text messaging service).

Smart homes have the following five fundamental characteristics:

Automation: the ability to accommodate automatic devices or perform automatic functions;

Multi-functionality: the ability to perform various duties or generate different outcomes;

Adaptability: the ability to learn, predict and meet the needs of users;

Interactivity: the ability to allow the interaction among users;

Efficiency: the ability to perform functions in a convenient manner that saves time and costs.

There are different generations of home automation systems .They are

- **First generation:** wireless technology with proxy server, e.g. ZigBee automation;
- **Second generation:** artificial intelligence controls electrical devices, e.g. Amazon Echo;
- **Third generation:** robot buddy who interacts with humans, e.g. Robot Rovio, Roomba.

The Microcontroller is programmed used embedded ‘C’ language. The system [3] proposed in provides three means to control the home: the GSM network, the Internet and through speech. The real time monitoring has been an important feature that can be used in the home automation systems.

In the existing system the design remains the electrical switches and provides more safety control on the switches with low voltage activating method. The switches status is synchronized in all the control system whereby every user interface indicates the real time existing switches status. Today’s homes require sophistication control in its different gadgets which are basically electronic appliances. This has revolutionized of the home automation with respect to an increased level of

affordability and simplicity through the integration of home appliances with mobile phone.

In this proposed system the advent of new high-speed technology and the growing computer Capacity provided realistic opportunity for new robot controls and realization of new methods of control theory. This project describes a new economical solution of load control systems. The presented control system can be used for different sophisticated applications. The home [4] server is built upon a SMS/GPRS mobile cell module and a microcontroller. This allows the user to monitor and control any appliances at home using any embedded c enabled cell phone.

GSM systems [5] primarily use SMS messages to communicate the commands issued by the user to the main control system at home. This system offers the ability to control the appliances from all over the world.

For example, a person on a drive within his car all of a sudden memorizes that he left the Cooler, ON actually it should be OFF. The usual circumstance is to drive back and switch OFF. But with the Android mobile phone in the hand equipped with GHAS (GSM Home Automation System) Application, one looks on how the same could be used to result control at any point, anywhere and time without worrying geographical locations. Home [6] automation is achieved with a combination of GSM, Bluetooth technologies. The user interfacing is done through an Android application. These commands are sent through SMS to another phone at home. This in turn transfers the commands through Bluetooth to a PIC controller.

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. GSM modem is connected to PIC16F877A Microcontroller via serial port using internal UART Module of ATMEGA8.
3. 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.
4. GSM receiver sends the message to the microcontroller. GSM modem and ATMEGA8 communicates through a special command set known as "AT COMMAND SET"
5. 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.
6. 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. Microcontroller drives the desired relay to control the target appliance.

The following Fig.1 represents the basic block diagram of the existing system;

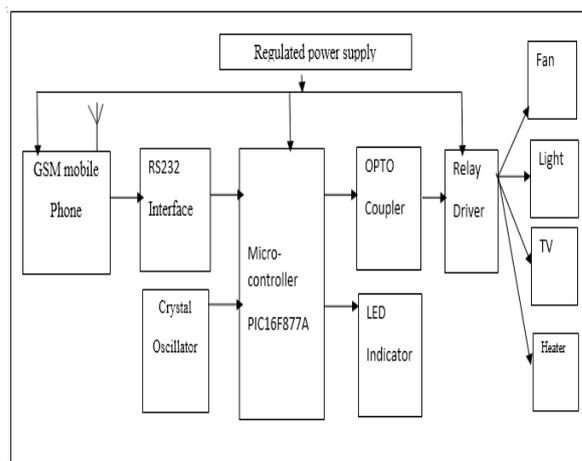


Fig 1: Block Diagram for a HA System

III. SYSTEM DESCRIPTION

The system comprises of hardware and software. The hardware architecture consists of a stand-alone embedded system that is based on

- GSM Modem
- Mobile Phone
- Regulated Power supply
- RS232 Interface
- Crystal Oscillator
- Microcontroller
- OPTO Coupler
- Relay Drivers
- LED Indicator

3.1 GSM Modem

Modem (from modulator-demodulator) is a device that modulates an analog carrier signal to encode digital is shown in fig : 2 .Information, and also demodulates such a carrier signal to decode the transmitted information. The system [7] is described as an M2M system. It uses GSM for communication. GSM offers options for M2M which include **Dual Tone Multi Frequency (DTMF)**, **SMS** and **General Packet Radio Service (GPRS)**. The goal is to produce a signal that can be transmitted easily and decoded to reproduce the original digital data. Systems using wireless communication can be made [8] by linking up standalone appliances that are present at home or in office and integrating to form a cooperating network. Modems can be used over any means of transmitting analog signals, from fault detector circuits. A hardware based remote controller for power point control has been described [9]. The

function of this remote controller is to control the power supplied to devices at a remote location.



Fig 2: GSM Modem

3.2 Mobile Phone

Cellular phone containing SIM (Subscriber’s Identifying Module) card has shown in fig : 3 is 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.



Fig 3: Mobile Phone

3.3 Regulated Power supply

The power supply circuit is designed to get regulated output DC voltage is shown in fig: 4. This unit is used to supply the over to the all circuits. 7812 IC is used to give the constant 12v supply.

Transformer: This block consist step-down transformer for our required rating

Rectifier : This block consist diode based rectifier Circuit

Filter circuit: This block consist capacitor based filter Circuit.

Regulator : This block consists +ve (and) – ve three terminal regulators.

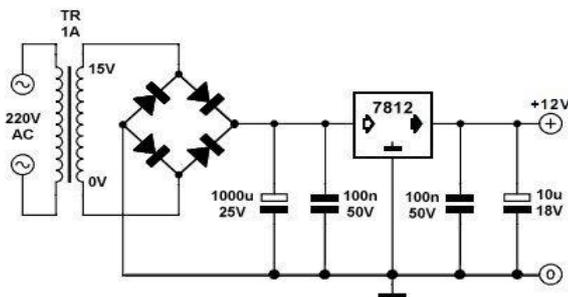


Fig 4: Power Supply

3.4 RS232 Interface

RS232 Interface shown in fig: 5 is used to interface between GSM modem and a microcontroller. Here using DB9 (D-Subminiature) connector. It a sub-connector used for serial connections and it consists of 9 pins. In any connection the RXD (Receive Data) and TXD (Transmit Data) pins must be used to transmit and receive data. The COM must be connected to give a common voltage reference. All of the remaining pins are used for handshaking.

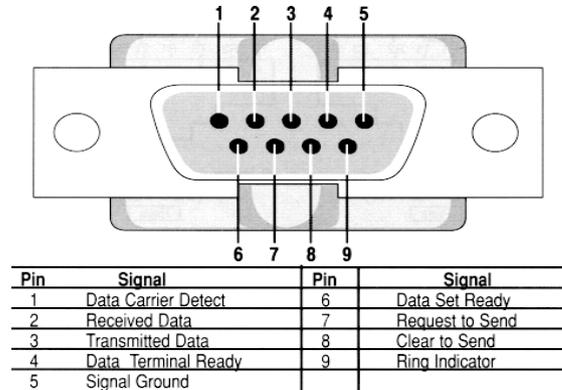


Fig 5:RS232 Interface

3.5 Crystal Oscillator

The **oscillator** converts the direct current from the power supply to an alternating current and they are used in many of the electronic devices. The signals used in the oscillators are a sine wave and the square wave. The some [10] of the examples are the signals are broadcasted by the radio and television transmitter, clocks which are used in the computers and in the video games.

There are *two types of electronic oscillator's* they are linear and nonlinear oscillators. The **linear oscillators** give the sinusoidal input. The linear oscillators consists a mass m and its force in the linear in equilibrium. By applying the hook’s law the spring creates the force that it’s in linear for small displacements

A **crystal oscillator** is shown in fig: 6 an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a precise frequency. An electronic circuit that is used to generate an electrical signal of precise frequency by utilizing the vibrating crystal’s mechanical resonance made of piezoelectric material. There are different types of piezoelectric resonators, but typically, quartz crystal is used in these types of oscillators.

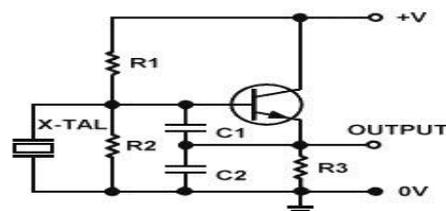


Fig 6 : Crystal Oscillator

3.6 Microcontroller

The PIC16F877A Microcontroller series a family of specialized microcontroller’s chips is shown in fig: 7 made by microchip technology in 1993 at Chandler, Arizona. The PIC 16F877A is derived from the PIC1650 originally developed by General Instrument’s Microelectronic Division. The PIC microcontroller (Peripheral Interface Controller) is electronic circuits that can be programmed to carry out a vast range of tasks. The main features[11] of PIC microcontroller are RAM(Random Access Memory),flash memory, timer/counters, EEPROM(Electrically Erasable Programmable Read Only Memory),I/O ports, CCP(Capture/Compare/PWM module),ADC(Analog to Digital Converter),PSP(Parallel Slave Port), ICSP(In Circuit Serial Programming),BUS and LVP(Low voltage Programming). The system makes use of a

PIC16F877A microcontroller for home appliances control. It makes use of GSM for control of the appliances. The performance of the PIC microcontroller is very fast because of using RISC architecture. A system [12] uses the GSM network along with an AVR (Advanced Virtual RISC) microcontroller. The user enters the commands .These are sent via SMS When compare to other microcontrollers, power consumption is very less and programming is very easy. Interfacing of analog device is easy without any extra circuitry. The ZigBee wireless communication technology can be applied [13] for home automation. The system uses PIC microcontroller and voice recognition for this purpose.

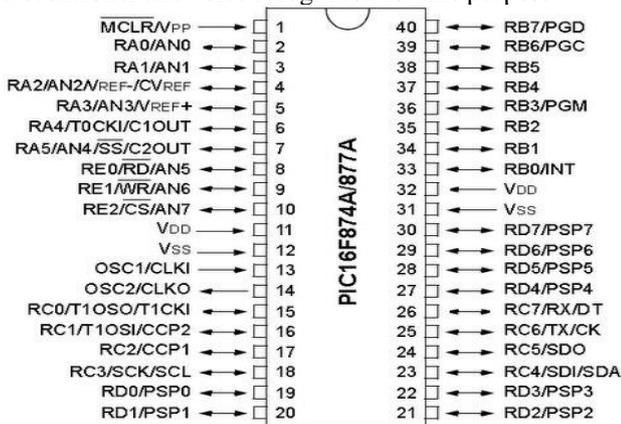


Fig 7 :Microcontroller PIC 16F877A

3.7 OPTO Coupler

The LED is a light emitting device and photo-transistor is a light sensitive device. The conduction current of phototransistor can be controlled via the conduction current of the LED, even though the two devices are physically separated. The most important use of the opto coupler device is that a circuit connected to its input can be electrically fully isolated from the output circuit and that a potential difference of hundreds (or) thousands of volts can safely exist between these two circuits without adversely influencing the opto coupler action. This isolating characteristic is the main attraction of this type of opto coupler device, which is generally known as an isolating opto coupler. The following fig: 8 represent an OPTO Coupler circuit.

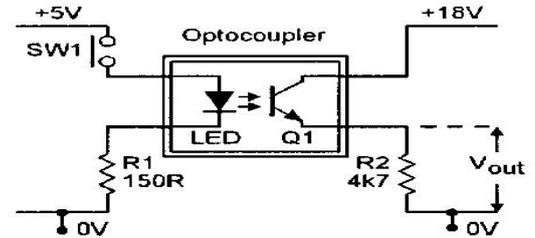


Fig 8: OPTO Coupler

3.8 Relay Drivers

Relays are switching devices is shown in fig: 9. Switching devices are the heart of industrial electronic systems. When a relay is energized or activated, contacts are made or broken. They are used to control AC or DC power. They are used to control the sequence of events in the operation of a system such as an electronic heater, counter, welding circuits X-ray equipment, measuring systems, alarm systems and telephony.

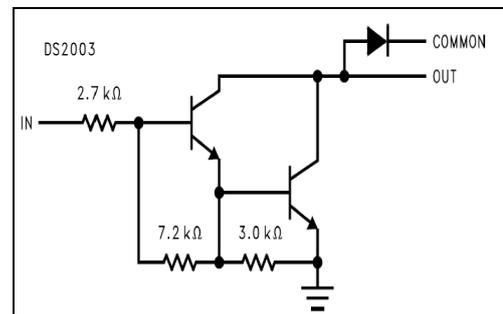


Fig 9: Relay Driver

3.9 LED Indicator

A light-emitting diode is a two-lead semiconductor light source is shown in fig: 10. It is a p-n junction diode that emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons.

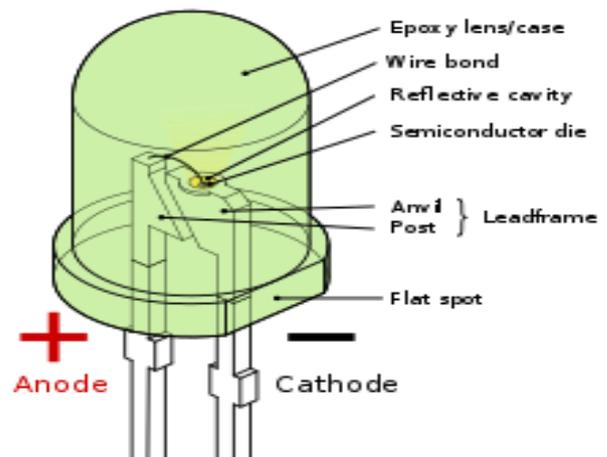


Fig 10: LED Indicator

IV. AT COMMAND SET

Remote control operation of the GSM [14] mobile telephone runs via a serial interface (data cable of infrared connection), where AT+C commands according to GSM specification as well as several manufacturer specific AT commands are available... 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 2. AT Command Set

Sl.No	COMMAND	DESCRIPTION
1	AT+CGMI	AT command returns information about device manufacturer.
2	AT+CSQ	AT command returns the signal strength of the device
3	AT+CREG	AT command gives information about the registration status and access technology of the serving cell.
4	AT+CPIN	AT command sets the password of the mobile device
5	AT+CMGS	AT command is used to send SMS message.

V. PROPOSED SYSTEM FLOW CHART

The following Fig.1 represents the basic flow chart of the existing system;

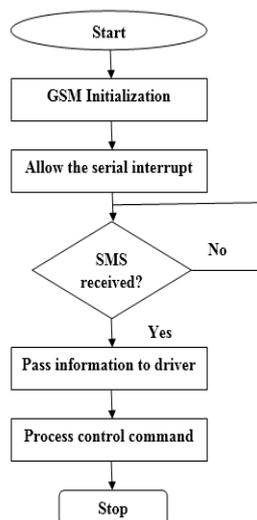


Fig 11: Flow Chart of HA

VI. EXPERIMENTAL RESULTS

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 instructs the relay to switch ON or OFF as given in Table II any electrical device (DEV: device) attached to it. The overall experiment is performed with the

help of software coding mentioned in embedded “C”. This project work explained about the potential work flow of ‘Full Home Control’, which is the aim of the Home Automation Systems. The analysis and implementation of the home automation technology using **Global System for Mobile Communication (GSM)** modem to control home appliances such as light, conditional system, and security system via **Short Message Service (SMS)** text messages is presented in this paper. The proposed project is focused on functionality of the GSM protocol, which allows the user to control the target system away from residential using the frequency bandwidths. The concept of serial communication and AT-commands (**Attention-Command**) has been applied towards development of the smart GSM-based home automation system. Home owners will be able to receive feedback status of any home appliances under control whether switched on or off remotely from their mobile phones. PIC 16F877A microcontroller with the integration of GSM provides the smart automated house system with the desired baud rate of 9600 bps. The proposed prototype of GSM based home automation system was implemented and tested with maximum of four loads. Some systems are described as an enabling system that can be used to provide a common framework for home Automation. It provides a system for a smart home that includes facilities such as a system controller, house-wide wiring and a common interface. This will enable using the existing system for home automation

Table 2. Experimental Result

Command	Relay status
DEV 1 ON	Relay 1 ON
DEV 1 OFF	Relay 1 OFF
DEV 2 ON	Relay 2 ON
DEV 2 OFF	Relay 2 OFF

VII CONCLUSION

The design and implementation of the Smart Home Automation Controller using GSM for mobile phone has been discussed. The purpose of this is to use mobile phone’s inbuilt SMS facility and GSM Modem for automation of Home Appliances. The different hardware and software section of our system is described. The android application software has been designed using Eclipse and MP lab software is used to write and burn the C program into microcontroller. The application program is tested on various Android mobile phones which are quite satisfactory and responses received from the community in general are encouraging.

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