FIRE DETECTION AND NOTIFICATION SYSTEM

Submitted in partial fulfillment of the Degree of

Bachelor of Technology

May 2014

By

SAHIL KUMAR - 101012

SANDEEP KUMAR - 101026

TANMAY SHRIVASTAVA – 101024

Under the Supervision of

Dr. PRADEEP KUMAR CHAUHAN

Associate Professor, Department of ECE, JUIT

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

(Established by H.P. State Legislature vide Act No. 14 of 2002)

P.O. Waknaghat, Teh. Kandaghat , Distt. Solan – 173234 (H.P.) INDIA

Website:www.juit.ac.in

Certificate

This is to certify that project report entitled "***Fire Detection and Notification System***", submitted by ***Sahil Kumar (101012), Tanmay Shrivastava (101024), Sandeep Kumar (101026)*** in partial fulfillment for the award of degree of Bachelor of Technology in Electronics and Communication Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

_____

Dr. Pradeep Kumar Chauhan

Associate Professor, Department of ECE

Jaypee University of Information Technology,

Waknaghat, Solan, Himachal Pradesh

Date : _____

ACKNOWLEDGEMENT

It is our pleasure to be indebted to various people, who directly or indirectly contributed in the development of this work and who influenced our thinking, behavior, and acts during the course of study.

We express our sincere gratitude to our Project Guide Dr. Pradeep Kumar Chauhan for providing us an opportunity to work under him.

We are thankful to Mrs. Meenakshi Sood for her support, cooperation, and motivation provided to us during the project for constant inspiration, presence and blessings.

We also extend our sincere appreciation to Mr. Mohan Sharma, Mr. Pramod Kumar, Mr. Manoj Pandey, Mr. Dhirendra Kumar Singh who provided their valuable suggestions and precious time in accomplishing our project.

Lastly, we would like to thank the almighty and our parents for their moral support and our friends with whom we shared our day-to-day experience and received lots of suggestions that improved our quality of work.

Date: _____

Sahil Kumar (101012) _____

Sandeep Kumar (101026)_____

Tanmay Shrivastava (101024)_____

Table of Content

List of Figures

List of Tables

ABSTRACT

At the end of third year when there is announcement about the final year projects and groups we decided to make something that is related to our real life, something that is interesting and different. We sit together and discussed upon a number of projects like Temperature Sensing, GSM based Home Security, Voice controlled Robotic Car, Vehicle Speed Measurement System etc. But finally, we decided to do something related to fire Detection and Control.

Since our childhood we have seen fire alarm systems at various locations, such as schools, restaurants, organization offices, colleges and other public places, but never knew rhat how these systems work and what engineering approach is involved to meet this criterion. We started with a heat sensor LM-35 that gives a certain output voltage corresponding with increase in temperature. As fire occurs temperature increases therefore we have used this sensor in this project. But sometimes it may take time to reach heat to a certain level to produce enough voltage to turn on Buzzer. So in order to avoid this confusion we have used another sensor i.e. smoke sensor MQ-2. It gives a certain voltage corresponding to ionized smoke particles indicating the presence of smoke in the atmosphere. To avoid any false triggering we set a reference at the comparator depending upon the location where the system is installed, when a positive (Logic High) signal is received from both the sensors by the microcontroller that continuously monitors both the sensors, three signals are sent simultaneously from the microcontroller. One is to the buzzer that turns on the buzzer and the alarm starts sounding confirming fire and the second one sent to the GSM Modem to inform the concerned authorities regarding location of fire.

KEYWORDS: M-FAS , FDSS , FNSS , UC, SM-MT , SM-MO

CHAPTER I

Introduction and Objective

1.1 Introduction

A short circuit, an overheated electrical appliance, a lit cigarette, a burning splinter or just about any of these can trigger a fire and the presence of foam sofa sets, nylon settings and other flammable materials works as a catalyst and the poisonous gases and smoke is generated. So it hardly needs a few minutes to spread the fire and render persons helpless, even before they realize what is happening.

The fire alarm system that is installed in our university is not so advanced and the systems that are currently available in the market have high initial cost as well as it requires more maintenance. So on the basis of currently existing fire alarm system a new M-FAS (Multilevel Fire Alarm System) is developed. The M-FAS developed by us consists of two sub-systems: Fire Detection Sub-System and Fire Notification Sub-System

The FDSS consists of a heat sensor and a smoke sensor that are used for detection of fire.

The FNSS consists of Buzzer, LCD Display and GSM Modem. The FNSS (Fire Notification Subsystem) is associated with FDSS (Fire Detection Subsystem), to easily detect the fire and send notifications.

The microcontroller used here, works as the heart of the entire design. It controls the whole operation that is involved in the emergency situation due to fire. The M-FAS developed can be the best and cheap thing to reduce the loss of property and save lives.

1.2 Aim

The main idea of this project is to design and implement a multilevel fire alarm system (M-FAS) that can be produced at a low cost with effective and competitive usage. This system is designed to be more users friendly, easy to operate at any level and at any location and whose parameters can be adjusted according to requirements of a client or customer.

1.3 Problem Identification

The existing fire alarm systems available now-a-days in the market are costly and complex in terms of its design and structure. Due to higher complexity of the fire alarm system, it needs regular maintenance in order to properly working of it. So it raises the using cost of the system. Therefore, the proposed M-FAS are designed with a low cost that can be used by all users for a safety purpose.

1.4 Project Objective

Our objective is to design a Fire Alarm System that would fulfill the following objectives:

- Indicate the room in which fire erupted.
- Sound the alarm if fire occurs.
- False Alarm occurrence should be kept minimum.
- The system should be flexible enough to be easily modified in case if new rooms are added to the building
- The system should also provide the flexibility to adjust the temperature and smoke sensitivity levels as per the operating environment.

1.5 Inspiration behind this

In any modern structure or building of the world, safety has the highest priority and every now and then we witness the incidents of fire due to one reason or other, therefore fire detection system is one of the biggest necessity and should be included in basic design of the structure.

Also our GSM based messenger system ensures the quick spread of word about the fire to concerned authority, as timely information of fire not only helps save lives but also makes it easier to put out fire.

CHAPTER II

Technical Details

2.1 Reasons for choosing digital solution

Conventional fire alarm systems having hard wire layout and normally opened warning devices like heat detector and smoke detector in general specifications, have a good view in low price, but have a bad view in:

1. Low efficiency to warn and to communicate to human

2. Difficulty of maintenance

3. Hard expansion and transformation of working

4. No record and no database to develop in the future

Our proposed fire alarm system is designed and built to solve these problems. The connections between warning devices are dealt with microcontroller.

2.2 General working of the proposed system

This project proposes the design and construction of fire alarm system which is controlled by ATATMEGA8 microcontroller. LCD is used to indicate situations of the system composed of 2 modes of working state, normal working mode and fire mode. Output states are displayed on LCD by using software 'Keil uVision4', interfacing with microcontroller. Input signal coming from the normally opened warning devices: heat detector and smoke detector is sent into a detectable instrument to separate the mode of working state. After that, output signal is dispatched to ATMEGA8 microcontroller for analysis. This microcontroller can transfer data and display the situation of detector on LCD. In case of fire mode, the data will be sent to LCD and to Buzzer simultaneously.

The GSM modem will then send messages to the numbers specified about the accident. The stepper motor will be ON and water will start flowing to put down fire.

2.3 Block Diagram

The inputs for the ATATMEGA8 microcontroller are heat sensor LM-35 and smoke sensor MQ-2. ATATMEGA8 is interfaced serially to a GSM Modem r. A GSM modem is used to send the SMS or voice recorded message to a remote place. An EEPROM is used to store the mobile number. The hardware interfaces to microcontroller are LCD Display GSM Modem, Buzzer, Fan and Stepper Motor. The design uses RS 232 protocol for serial communication between GSM modem and microcontroller. A serial driver IC is used for converting TTL voltage levels into RS 232 voltage levels. A driver IC is also used for stepper motor.

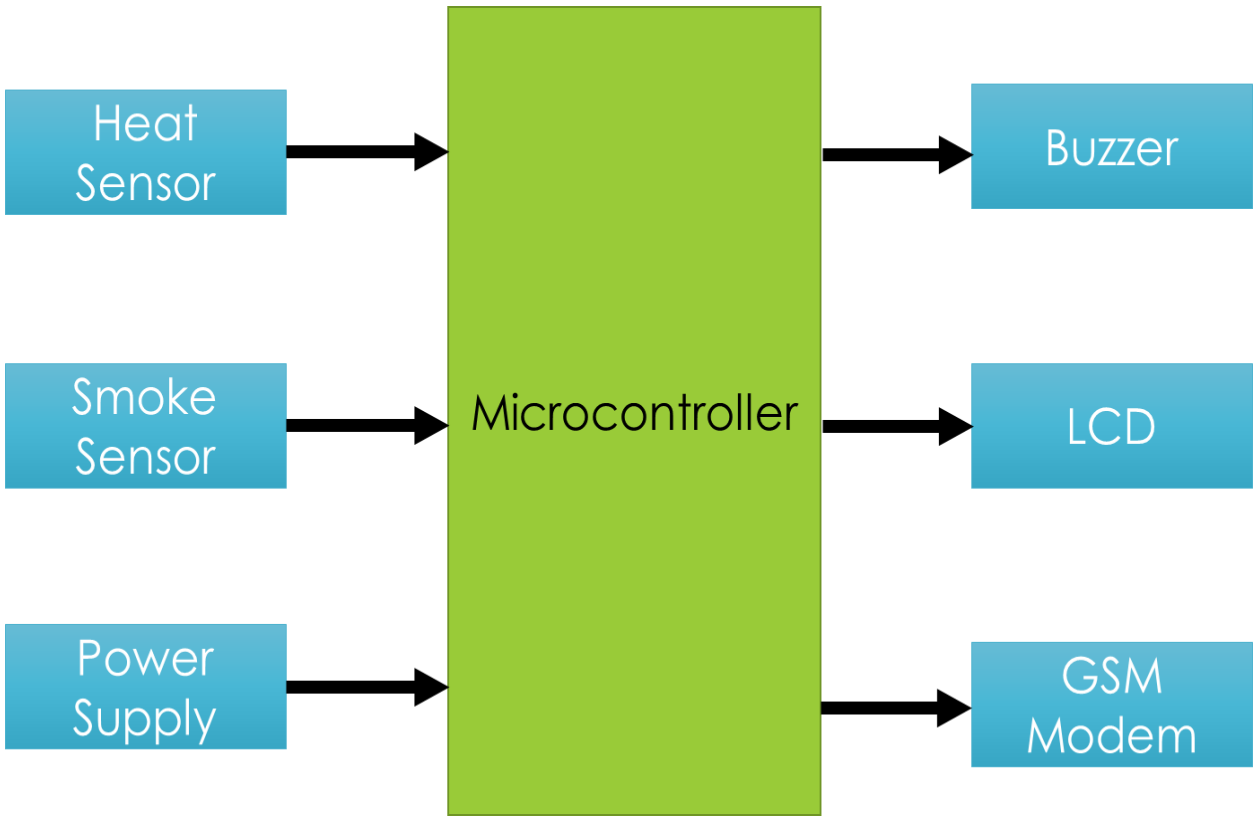


Fig. 1 : Block Diagram

2.4 Brief Description of Components

The propsed Fire detection and notification system will include :

- Heat sensor LM-35
- Smoke sensor MQ-2
- Microcontroller ATMEGA 8
- 16x2 LCD.
- Buzzer
- Power Supply
- Relay
- GSM Modem
- Max 232
- Wiring and miscellaneous

2.5 Detailed Description of Components

Now we are going to discuss the details of the components that we have been used in our project one by one.

2.5.1 Heat Sensor

Now a days various kinds of heat detecting devices are available in the market. Some of them are :

• Thermistor

• Thermocouple

• RTD LM35

• Diode based Temperature sensor

All of the above mentioned device have their own advantages and disadvantages but we are going to discuss the device that is most suitable for pur design. The advantages and disvantages of each of the following are as follows:

2.5.1.1 Thermistor :

A thermistor is a device whose resistance increases with temperature. It has very high sensitivity for a wide range of temperatures but it has a non-linear scale.So a lot of mathematicsis required to get linear results.

2.5.1.2 Thermocouple :

It works upon the principle of "Seeback Effect". The main advantage of a thermocouple is its temperature range i.e. it can be used for a very wide range of temperatures but the disadvantage is its low sensitivity.

2.5.1.3 Diode as Temperature Sensor :

As we know that the current flowing through the diode is a function of temperature. So a diode is an extremely low cost device that can be used as a temperature sensor but it has the disadvantage of a non-linear scale and it poor rating on the scale of realibility.

2.5.1.4 RTD:

Resistor Temperature Device are the devices that gives linear change in voltage with temperature. Its working range of operation is also suitable for our design and most important its cost is also less compared to other devices.

2.5.1.5 LM-35:

For our application RTD is the best choice mainly due to its linear variations in voltage with change in temperature and its temperature range that is well suited for our design.

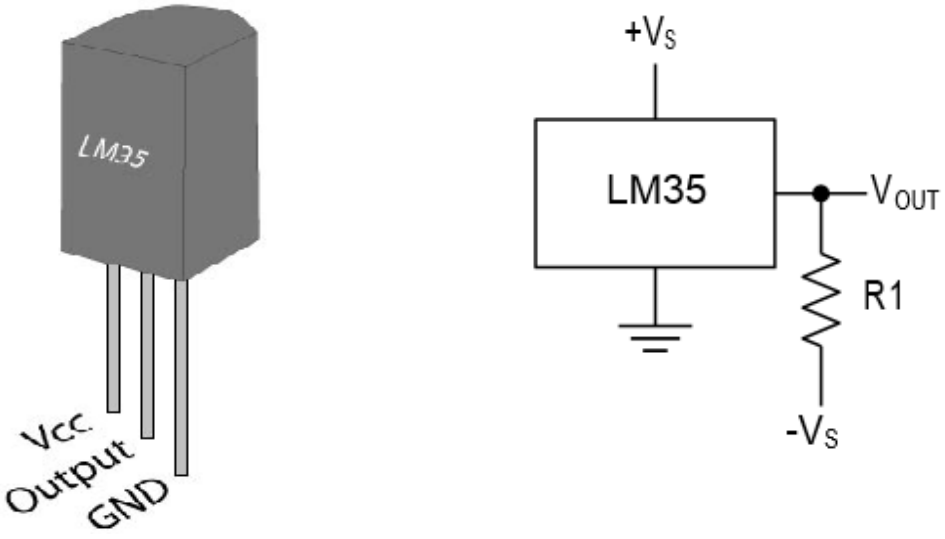


Fig. 2 : LM-35

LM 35 has three pins a, b and c. Pin a is connected to Vcc, pin c is connected with ground whilethe output is from pin b .The output of this sensor is going to a comparator. According to requirements of a particular location we need to send a high signal to the microcontroller when the temperature is above a certainlevel, say 50degree centigrade. Since the output of heat sensor gives a change of 10mv corresponding to achange of 1 degreecentigrade in temperature. So at 50 degree centigrade it will give 0.5 volts as output due to the linear behaviour of sensor with temperature .So in order to meet our requirement we have set 0.50 volts as reference at the other terminal of comparator, so that when the output of sensor will give 0.5 volts or more thecomparator will pass high signal to microcontroller.

2.5.2 Smoke Sensor

As the smoke sensor conforms smoke in the environment, it is a most important component of the project. A lot of smoke sensors are available into market, which are compared on account of their availability in the market, the difference in the principle of their operation, their respective price and last but not the least their sensitivity. Few of the smoke sensors easily available in the market are as follows:

- TGS-308

- MQ-2
- P-2500

Based upon the availability price we choose MQ-2. The detailed description of MQ-2 is given below.

2.5.2.1 MQ-2

Smoke sensor MQ-2 has high sensitivity , long and stable life and most important its fast response. It is also used as a gas leakage detecting equipments in households and industry. It is suitable for detection of LPG,alcohol,smoke,Hydrogen, i-butane, propane, methane. It works on the principle of ionization and therefore detects any change in the ionized particles in the atmosphere due to smoke and gas. It has an internal resistance of 33 ohms. As the smoke or gas is detected its output voltage increses rapidly.

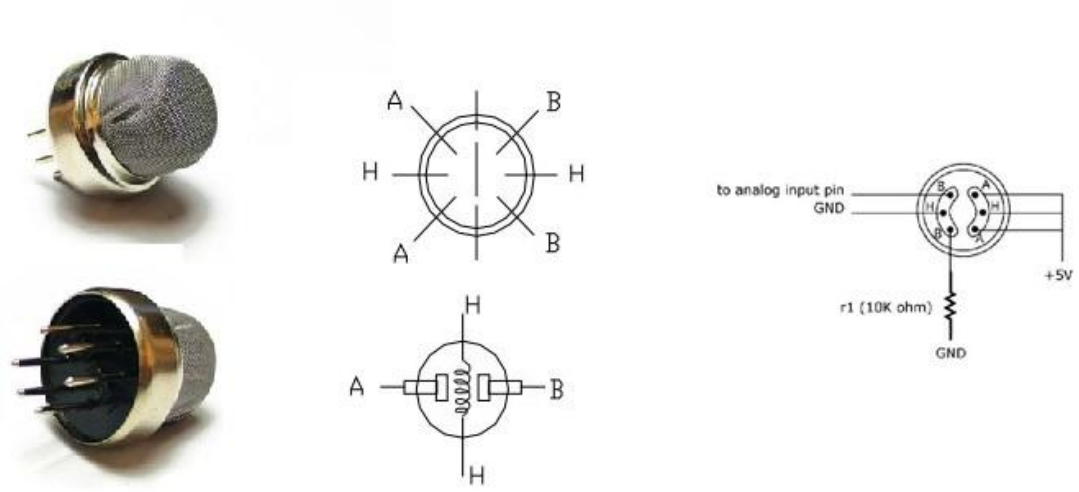


Fig. 3 : MQ-2

2.5.2.1.1 Features

- It provides LPG gas PPM in the air
- TTL Level Compatible (Directly connection to Microcontroller)

- Analog output also available to connect this with ADC
- Value can be set through given potentiometer

2.5.2.1.2 Applications

- Automotive Domain
- Security & Surveillance
- Smart Home System
- Industrial Control System

PIN No	PIN Information
GND	Supply Ground
DOUT	Digital Output(TTL Level)
AOUT	Analog Output(0 to 5V)
VCC	Supply +5V

Table 1: Pin Description of MQ2

2.5.3 ATATMEGA8 Microcontroller

A lot of microcontrollers are available in the market which are best for different jobs. Some of them are:

1. AVR

2. AT 89S52

3. AT 89S51

4. AT 89C51

5. PIC and many more.

Here we are going to use ATMEGA8 because it best suits our requirements. The details of ATMEGA8 are as follows:

2.5.3.1 Features

- High-performance, Low-power Atmel®AVR® 8-bit Microcontroller
- Advanced RISC Architecture
  - 130 Powerful Instructions – Most Single-clock Cycle Execution
  - 32 × 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 16MIPS Throughput at 16MHz
  - On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory segments
  - 8Kbytes of In-System Self-programmable Flash program memory
  - 512Bytes EEPROM
  - 1Kbyte Internal SRAM
  - Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
  - Data retention: 20 years at 85°C/100 years at 25°C(1)
  - Optional Boot Code Section with Independent Lock Bits In-System Programming by On-chip Boot Program
  - Programming Lock for Software Security
- Peripheral Features
  - Two 8-bit Timer/Counters with Separate Prescaler, one Compare Mode

- One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
- Real Time Counter with Separate Oscillator
- Three PWM Channels
- 8-channel ADC in TQFP and QFN/MLF package Eight Channels 10-bit Accuracy
- 6-channel ADC in PDIP package Six Channels 10-bit Accuracy
- Byte-oriented Two-wire Serial Interface
- Programmable Serial USART
- Master/Slave SPI Serial Interface
- Programmable Watchdog Timer with Separate On-chip Oscillator
- On-chip Analog Comparator

• Special Microcontroller Features

- Power-on Reset and Programmable Brown-out Detection
- Internal Calibrated RC Oscillator
- External and Internal Interrupt Sources
- Five Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, and Standby

• I/O and Packages

- 23 Programmable I/O Lines
- 28-lead PDIP, 32-lead TQFP, and 32-pad QFN/MLF

• Operating Voltages

- 2.7V - 5.5V (ATmega8L)

– 4.5V - 5.5V (ATmega8)

- Speed Grades
  - 0 - 8MHz (ATmega8L)
  - 0 - 16MHz (ATmega8)
- Power Consumption at 4Mhz, 3V, 25□ C
  - Active: 3.6mA
  - Idle Mode: 1.0mA
  - Power-down Mode: 0.5µA

• 4K Bytes of In-System Reprogrammable Flash Memory

• Fully Static Operation: 0 Hz to 24 MHz

• 128 x 8-bit Internal RAM

• 32 Programmable I/O Lines

• Two 16-bit Timer/Counters

• Six Interrupt Sources

• Programmable Serial Channel

2.5.3.2 Description

The Atmel®AVR® ATmega8 is a low-power CMOS 8-bit microcontroller based on the AVR RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega8 achieves throughputs approaching 1MIPS per MHz, allowing the system designer to optimize power con- sumption versus processing speed.

2.5.3.3 Pin Diagram and Pin Description

- VCC : Supply voltage.
- GND : Ground.

- Port B (PB7..PB0) XTAL1/XTAL2/TOSC1/ TOSC2: Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tri-stated when a reset condition becomes active, even if the clock is not running.

  Depending on the clock selection fuse settings, PB6 can be used as input to the inverting Oscil- lator amplifier and input to the internal clock operating circuit.

  Depending on the clock selection fuse settings, PB7 can be used as output from the inverting Oscillator amplifier.

  If the Internal Calibrated RC Oscillator is used as chip clock source, PB7..6 is used as TOSC2..1 input for the Asynchronous Timer/Counter2 if the AS2 bit in ASSR is set.

Table 2: Port B Special Functions

Port	Alternate Functions
PB7	XTAL2 (Chip Clock Oscillator pin 2) TOSC2 (Timer Oscillator pin 2)
PB6	XTAL1 (Chip Clock Oscillator pin1 or External clock input) TOSC1 (Timer Oscillator pin 1)
PB5	SCK (SPI Bus Master clock Input)
PB4	MISO (SPI Bus Master Input/Slave Output)
PB3	MOSI (SPI Bus Master Output/Slave Input) OC2 (Timer/Counter2 Output Compare Match Output)
PB2	SS (SPI Bus Master Slave select) OC1B (Timer/Counter1 Output Compare Match B Output)
PB1	OC1A (Timer/Counter1 Output Compare Match A Output)
PB0	ICP1 (Timer/Counter1 Input Capture Pin)

- Port C (PC5..PC0):): Port C is an 7-bit bi-directional I/O port with internal pull up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, e

Table 3: Port C Special Functions

Port Pin	Alternate Function
PC6	RESET (Reset pin)
PC5	ADC5 (ADC Input Channel 5) SCL (Two-wire Serial Bus Clock Line)
PC4	ADC4 (ADC Input Channel 4) SDA (Two-wire Serial Bus Data Input/Output Line)
PC3	ADC3 (ADC Input Channel 3)
PC2	ADC2 (ADC Input Channel 2)
PC1	ADC1 (ADC Input Channel 1)
PC0	ADC0 (ADC Input Channel 0)

Even if clock is not running.

- PC6/RESET : If the RSTDISBL Fuse is programmed, PC6 is used as an I/O pin. Note that the electrical char- acteristics of PC6 differ from those of the other pins of Port C.

  If the RSTDISBL Fuse is unprogrammed, PC6 is used as a Reset input. A low level on this pin for longer than the minimum pulse length will generate a Reset, even if the clock is not running.
- Port D (PD7..PD0): Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tri-stated when a reset condition becomes active, even if the clock is not running.

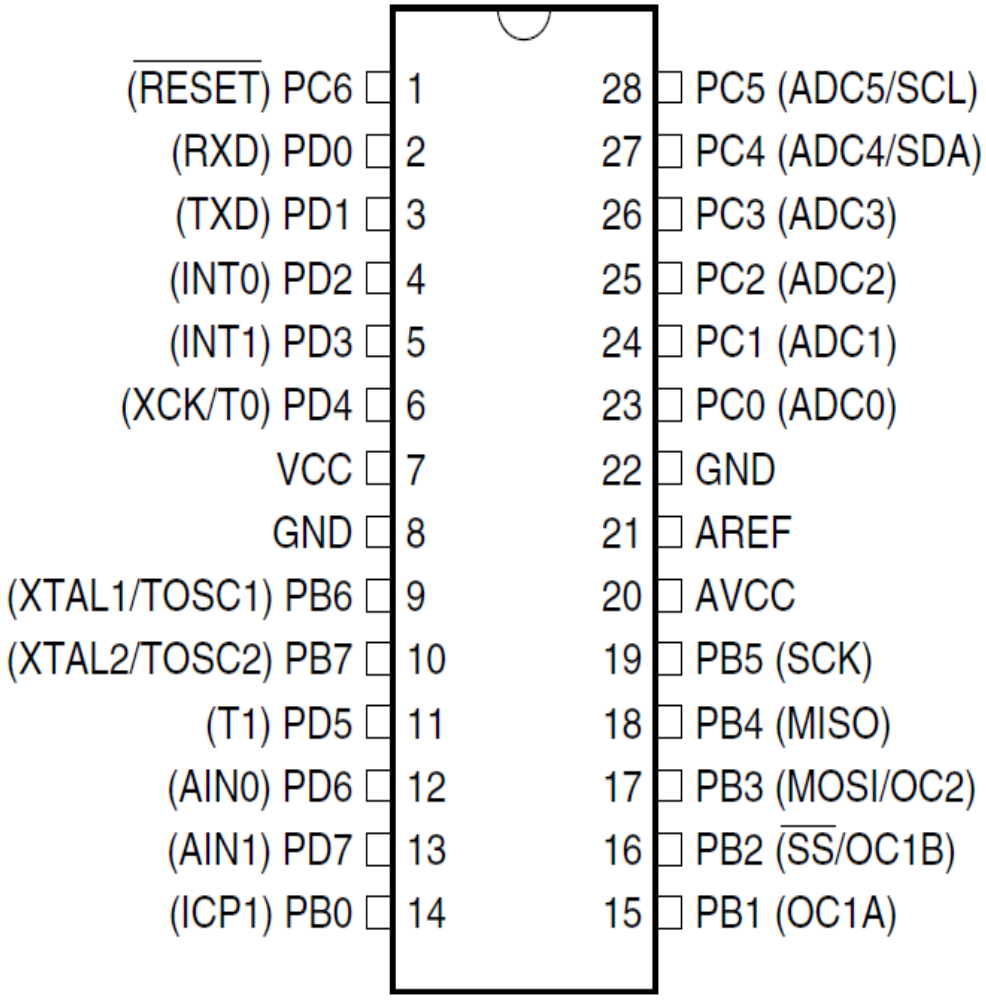
Table 4: Port D Special Functions

Port Pin	Alternate Function
PD7	AIN1 (Analog Comparator Negative Input)
PD6	AIN0 (Analog Comparator Positive Input)
PD5	T1 (Timer/Counter 1 External Counter Input)
PD4	XCK (USART External Clock Input/Output) T0 (Timer/Counter 0 External Counter Input)

PD3	INT1 (External Interrupt 1 Input)
PD2	INT0 (External Interrupt 0 Input)
PD1	TXD (USART Output Pin)
PD0	RXD (USART Input Pin)

- RESET: Reset input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running
- AVCC :AVCC is the supply voltage pin for the A/D Converter, Port C (3..0), and ADC (7..6). It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be con- nected to VCC through a low-pass filter. Note that Port C (5..4) use digital supply voltage, VCC.
- AREF:AREF is the analog reference pin for the A/D Converter.

Fig 4: Pin Diagram of microcontroller



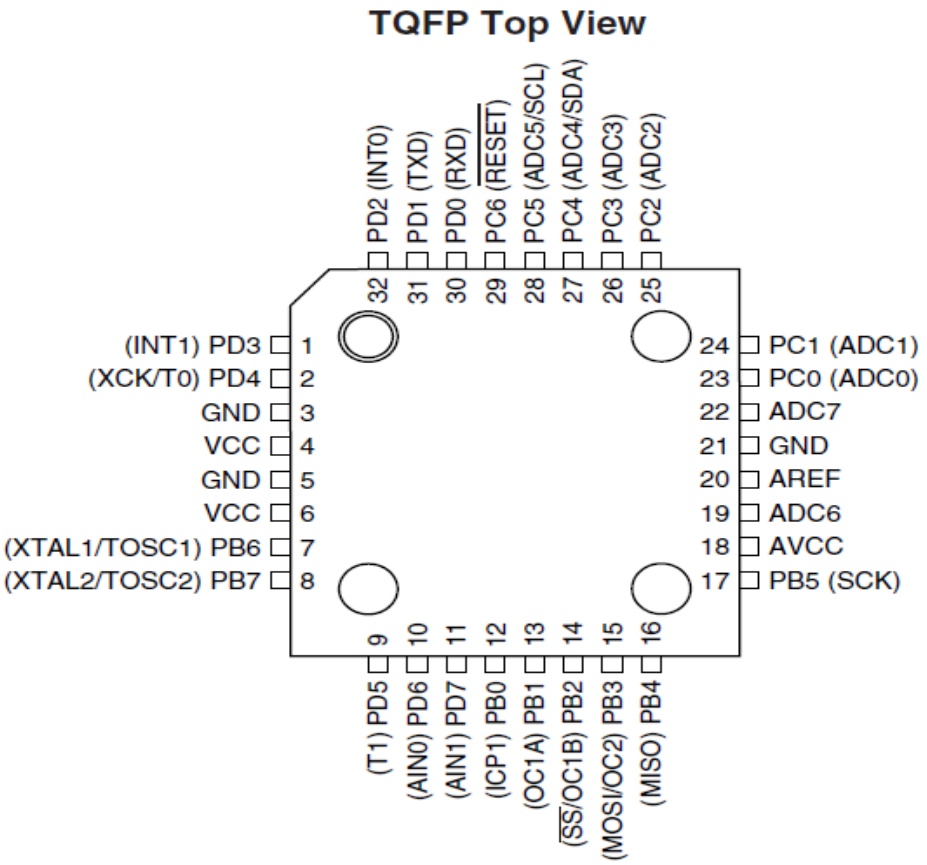


Fig 5: TQFP Top view Diagram

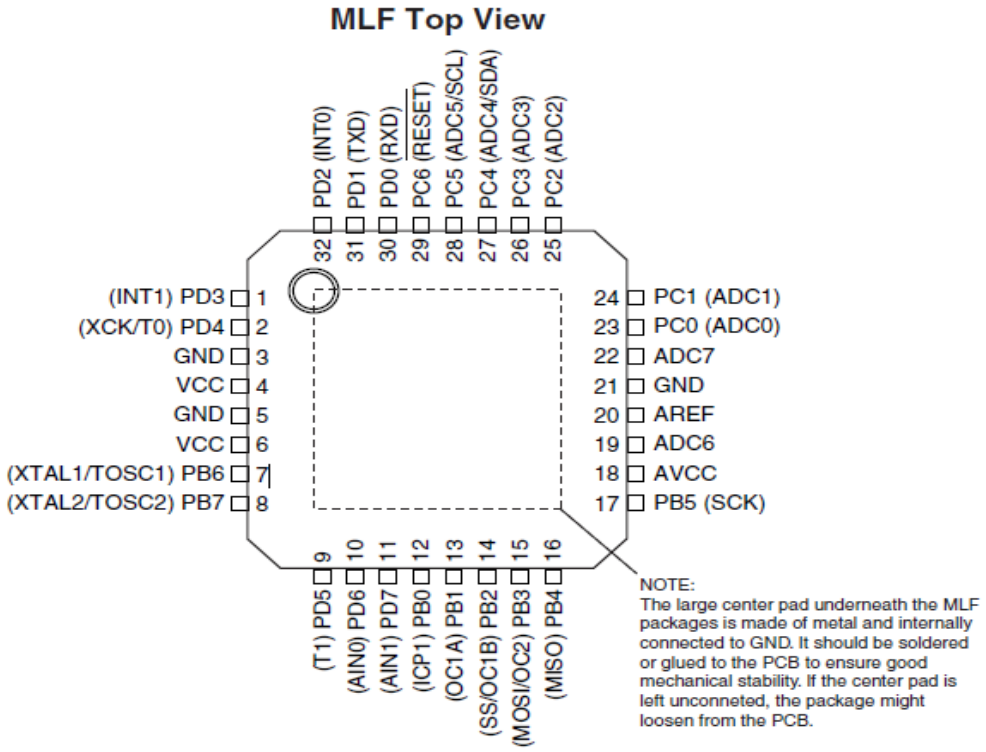


Fig 6: MLF Top View Diagram

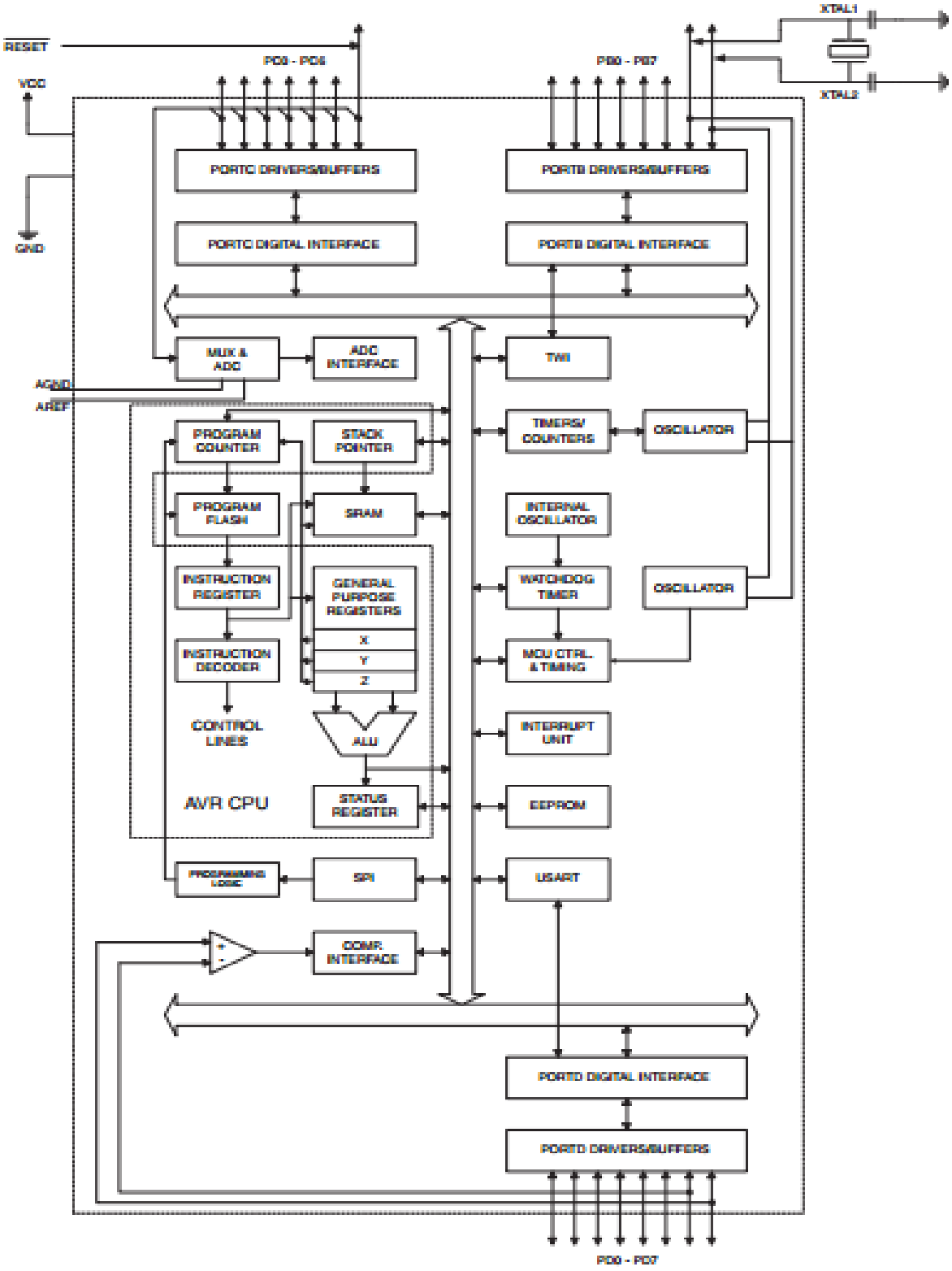


Fig 7: Internal Architecture Of Microcontroller

2.5.4 LCD Display

Now-a-days a lot of LCDs are available in the market but for normal display purpose in the projects the 2x16 pin LCD is used which is easily available.

Now we will discuss the specifications of a 2x16 alphanumeric LCD. It has 8 data pins, 3 control pins, and rest 5 pins are for GND and VCC connections. We can also adjust its contrast and light intensity, so it is useful for the day as well as and night time use for better display.

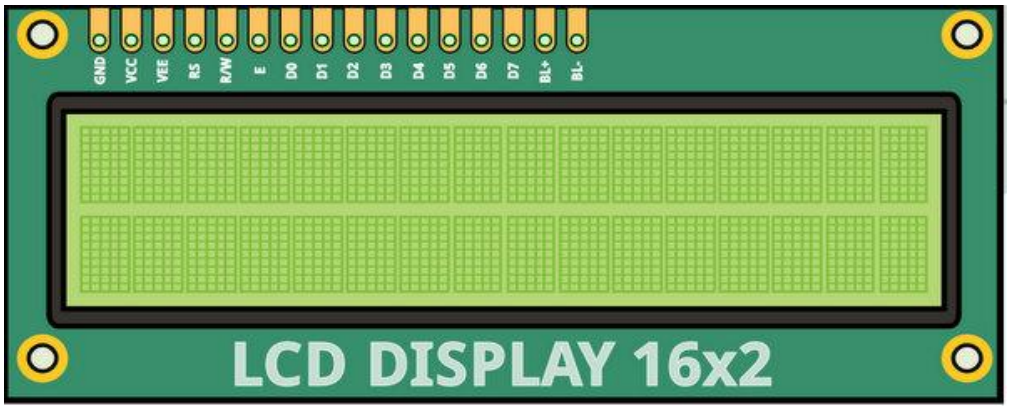


Fig. 8 : LCD Display

Here we have used only 4 out of 8 Data pins of LCD which are directly going to microcontroller i.e. pin number 11 to 14. Out of 5 VCC and Ground pins, two pins are connected with V_{CC}, two are with ground and one with the potentiometer to adjust the resolution and intensity of light of LCD display.

Three control pins of LCD which are used for enabling LCD,to select command or data register and to perform read or write operations are also connected to microcontroller.

Table 5: LCD Pin Description

Pin No.	Name	Description
1	**VSS**	Power supply (GND)
2	**VCC**	Power supply (+5V)
3	**VEE**	Contrast adjust
4	**RS**	0=Instruction input 1 = Data input
5	**R/W**	0=Write to LCD module 1 = Read from LCD module
6	**EN**	Enable signal
7	**D0**	Data bus line 0 (LSB)
8	**D1**	Data bus line 1
9	**D2**	Data bus line 2
10	**D3**	Data bus line 3
11	**D4**	Data bus line 4
12	**D5**	Data bus line 5
13	**D6**	Data bus line 6
14	**D7**	Data bus line 7 (MSB)
15	**LED+**	Back Light VCC
16	**LED-**	Back Light GND

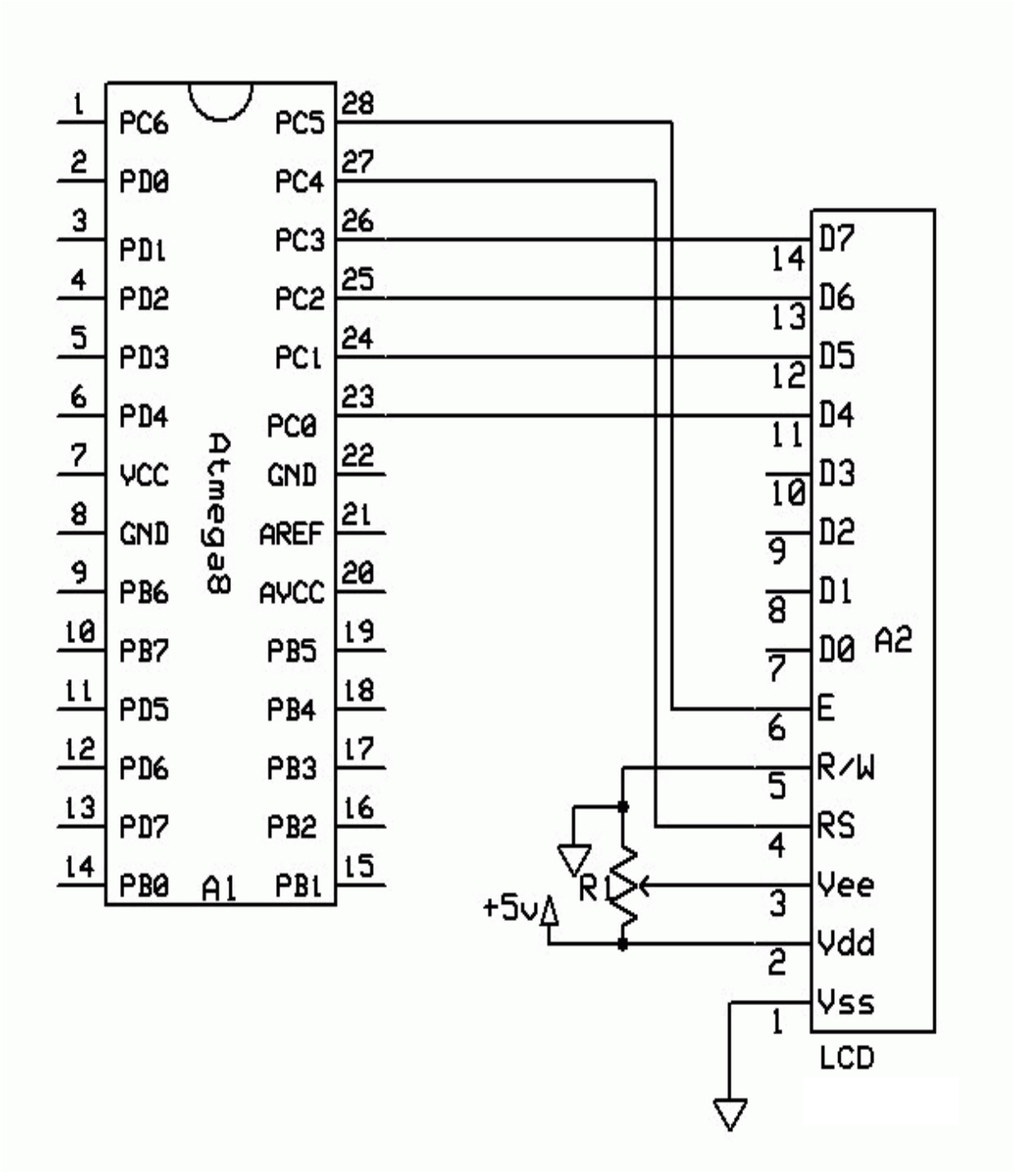


Fig 9: Circuit Diagram of Lcd Interfacing with Atmega8

2.5.5 Buzzer

A lot of buzzers,electric bells and alarms are available in the market for alarm purposes having different prices and uses. The buzzer that we have used is a 5-12 V buzzer and it has sufficient sound to inform.A buzzer with louder sound would have been better but it will require high operating voltage, a constraint to our design because we have only 12 V maximum supply voltage. One pin of the Buzzer is connected to power supply and the another one is connected to Relay which is further connected to microcontroller.

Fig. 10 : Buzzer

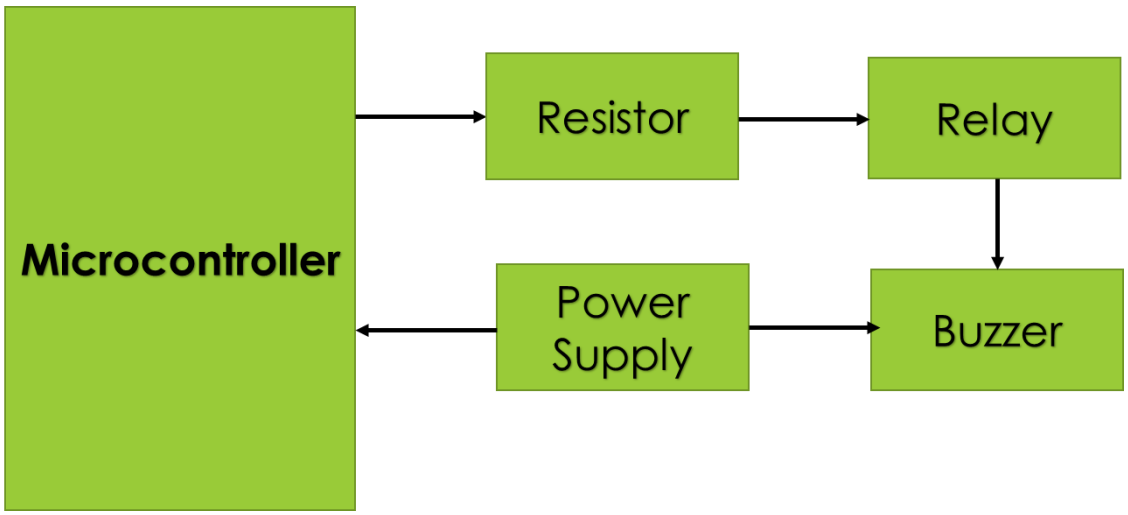


Fig.11 : Buzzer and fan Circuit

2.5.6 Power Supply

The following diagram explains the steps involved in designing a power supply.

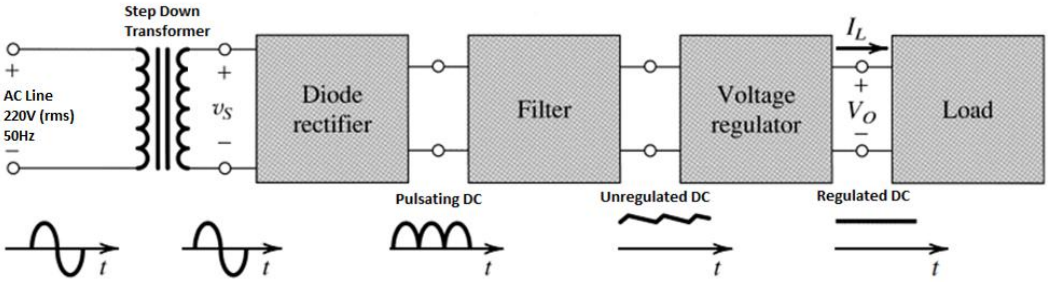


Fig. 12 : Regulated DC Power Supply Generation

2.5.6.1 Advantages of Regulated DC Power Supplies

Regulated DC power supplies:

- Provide acurate DC voltage
- Are cheaper in nature
- Provide constant voltahe irrespective of load variation

2.5.6.2 Details of Power Supply Componenets

Here is the details of the steps involved in designing of the power supply design. The various steps are :

2.5.6.2.1 Step Down Transformer

A step down transfer is used to reduce the dangerously high mains voltage to a safer level. For this, the number of turns in secondary coil is less than the number of turns in

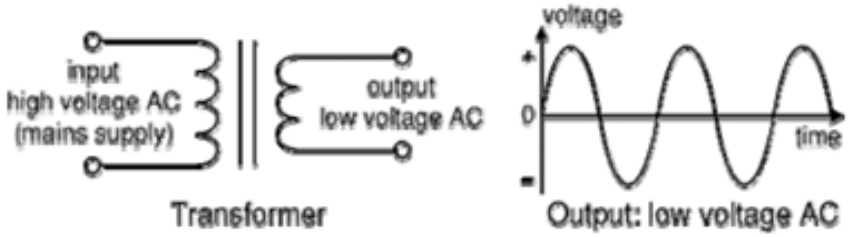


Fig.13 : Output of Step Down Transformer

2.5.6.2.2 Full wave Bridge Rectifier

It converts the ac voltage to dc voltage. It uses four diodes connected in a bridged manner. During the positive half of the cycle diode D1 and D3 conducts and during the negative half of the cycle diodes D2 and D4 conducts. Direction of current in load is same for the entire half cycle but the direction of current in transformer secondary is opposite in both positive and negative cycles. So losses will be less and the efficiency will be more.

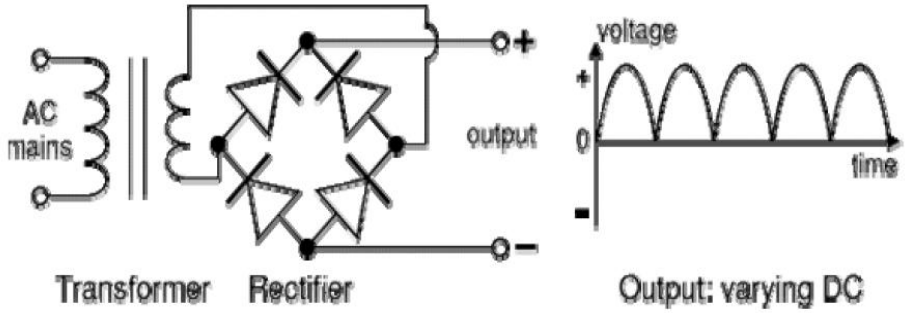


Fig. 14 : Output of Transformer + Bridged Full Wave Rectifier

2.5.6.2.3 Filteriing

The output of the rectifying circuit consists of dc compnenet as well asac Component (called ripples) of the voltage. This is due the pulsating nature of the output of any circuit.

The dc supply voltage with ripples is not useful for driving many type of electronic devices. The circuit for battery chargers may have ripples with not so serious effect. But for some sophisticated electronic gadgets such as radio, tape recorder, TV or computer , pulsating dc supplies are not suitable.

So we require that the output of the supply should not have any ripples i.e. the ac component should be zero. This can be achieved by employing circuits that smoothen the rectified output to a ripple free dc waveform, called filters in cascade with rectifying circuit. The basic components of filters are the inductors and capacitors.

Some of the important filters are the following :

- Capacitor filter
- Inductor filter
- L section filter
- Π section filter

Capacitor is used to remove ripples from voltage and the inductor is used to remove ripples from current.

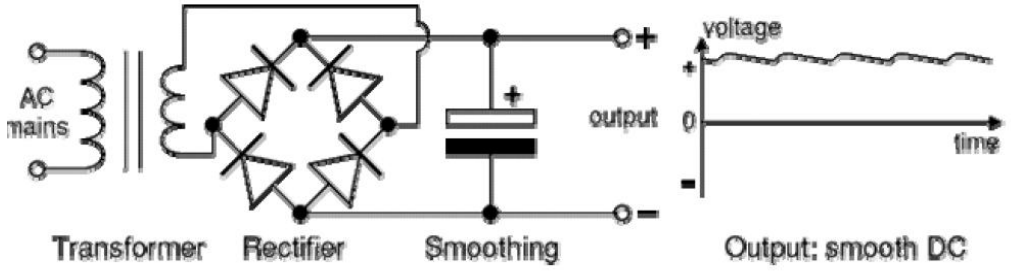


Fig.15 : Output of Transformer + BFW Rectifier + Filter

2.5.6.2.4 Voltage Regulator

The primary function of a voltage regulator is to maintain a constant dc output voltage . Howeveer, it also rejects ac ripple voltage that is not removed by the filter.

A regulator may be constructed from a zener diode or discrete transsitor or integreated circuits. All voltage regulators must have a stable reference voltage.

if the voltage regulator is not perfect, voltage across the load changes with variations in load current. As the load current increases load voltage diminishes. It is called load regualtion.

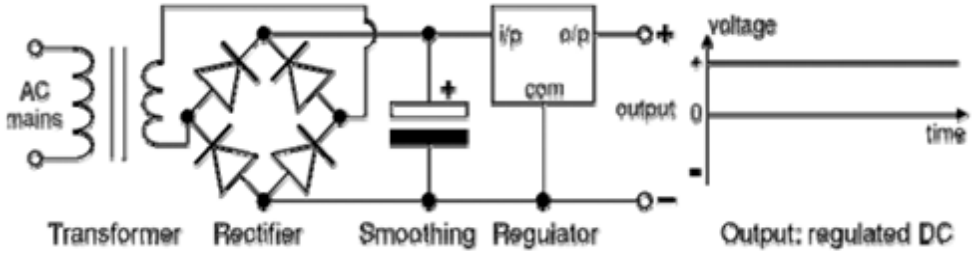


Fig.16 : Output of Transformer + BFW Rectifier + Filter + Regulator

We have two types of voltage regulators: Series voltage regulator and Shunt voltage regulator

(1) Series Voltage Regulator

The input to the control element is a unregulated dc voltage. The operation of control element is to control the output voltage. Sampling circuit samples the output voltage and if any deviation is there, ir goes as a feedback voltage to the comparator which is compared with reference voltage. The comparator provides control signal to the series element, which will decrease or increase according to the output voltage. This process continues till constant voltage is maintained at output.

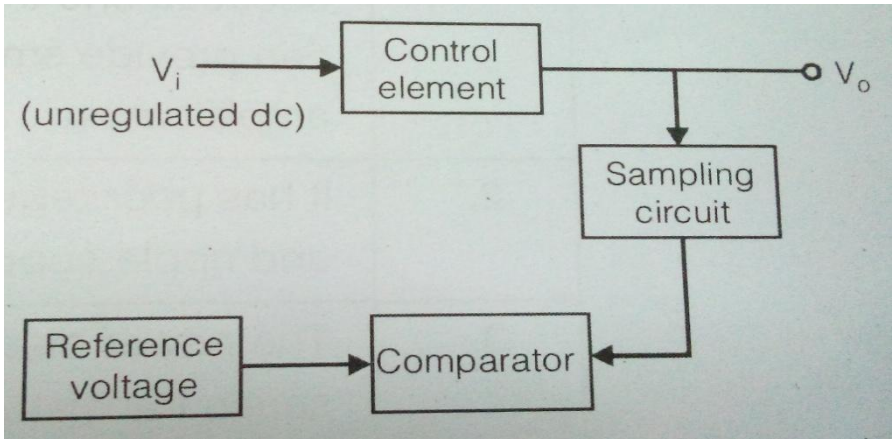


Fig.17 : Series Volatge Regulator

(2) Shunt Voltage Regulator

The input unregulated voltage provides current to the load. Some of the current is shunted away by the control element to maintain the regulated output voltage across the load. If the output voltage tends to change due to change in load,the sampling circuit provides a feedback signal to a comparator circuit. The comparator circuit provides a control signal to vary the magnitude of current shunted away from the load. For example when the output voltage tends to decrease, the sampling circuit provides a feedback signal to the comparator circuit which then provides a control signal to draw less shunt current, providing more load curren, keeping voltage constant.

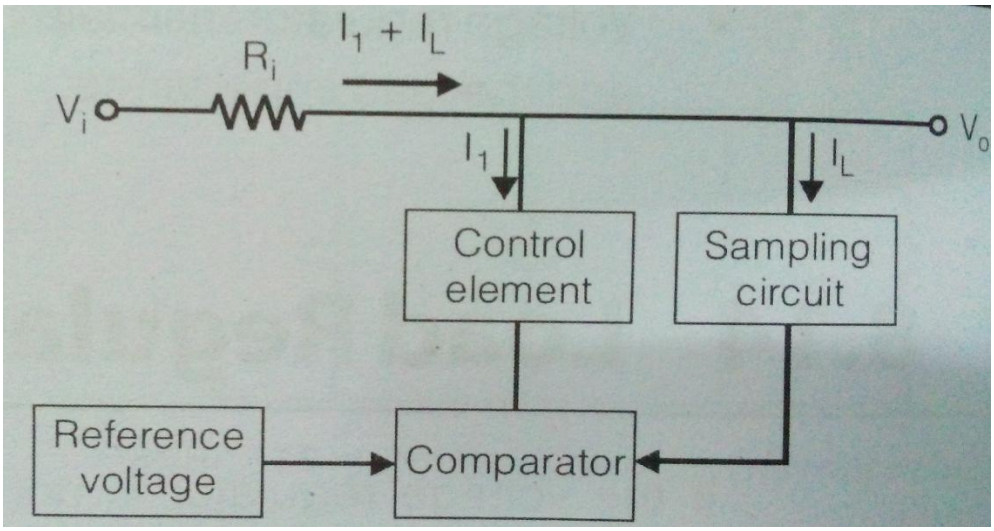


Fig. 18 : Shunt Voltage Regulator

2.5.7 Relay

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb.

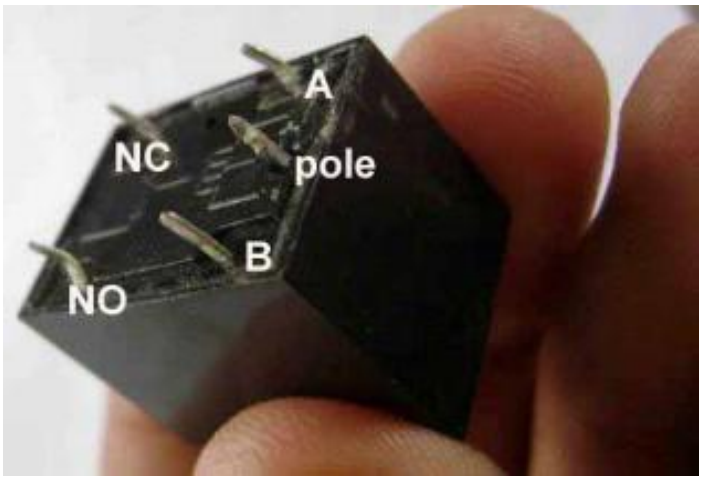


Fig 19: Top View Of Relay

A relay switch can be divided into two parts: input and output. The input section has a coil which generates magnetic field when a small voltage from an electronic circuit is applied to it. This voltage is called the operating voltage. Commonly used relays are available in different configuration of operating voltages like 6V, 9V, 12V, 24V etc. The output section consists of contactors which connect or disconnect mechanically. In a basic relay there are three contactors: normally open (NO), normally closed (NC) and common (COM). At no input state, the COM is connected to NC. When the operating voltage is applied the relay coil gets energized and the COM changes contact to NO. Different relay configurations are available like SPST, SPDT, DPDT etc, which have different number of changeover contacts. By using proper combination of contactors, the electrical circuit can be switched on and off. Get inner details about structure of a relay switch.

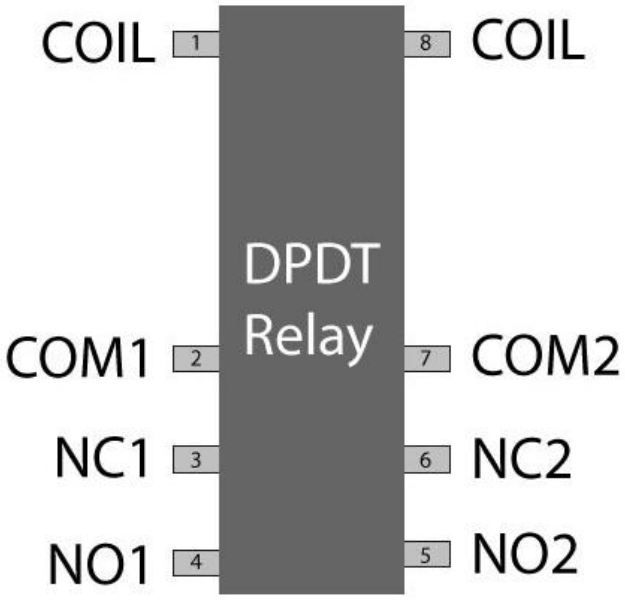


Fig 20: Pin Diagram of Relay

2.5.8 GSM Modem

The SIM900 is a complete Quad-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. Featuring an industry-standard interface, the 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. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900 can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design.

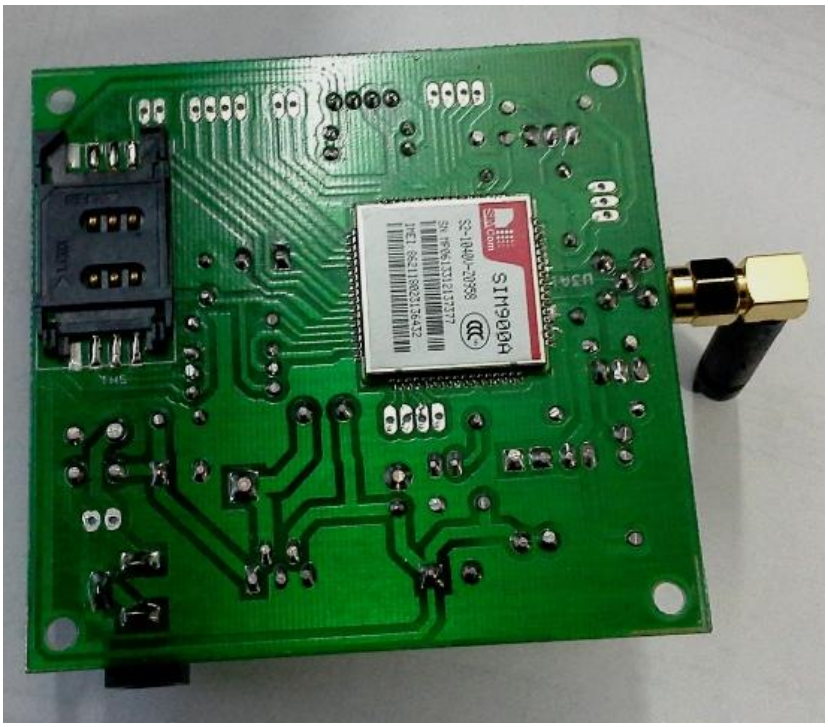


Fig 21: Bottom View Of GSM Modem

2.5.8.1 Features

- GPRS multi-slot class 10/8
- GPRS mobile station class B
- Quad-Band 850/ 900/ 1800/ 1900 MHz
- Compliant to GSM phase 2/2+
  - Class 4 (2 W @850/ 900 MHz)

– Class 1 (1 W @ 1800/1900MHz)

- Control via AT commands (GSM
- SIM application toolkit
- Supply voltage range 3.4 ... 4.5 V
- Low power consumption
- Operation temperature: -30 °C to +80 °C
- Point-to-point MO and MT
- SMS cell broadcast
- Text and PDU mode

2.5.8.2 Applications

- Security & Surveillance system
- Smart home system
- Data logging & transfer system
- Water pump control system
- Robot control system

Table 6: Pin description of SIM 900

PIN No	PIN Information
DBX_RXD	Debug Receiver
DBX_TXD	Debug Transmitter
SPK_N	Speaker Negative
SPK_P	Speaker Positive
MIC_N	Microphone Negative
MIC_P	Microphone Positive
RESET	Reset

PIN No	PIN Information
VDD_EXT	VDD External
5V	5 Volt Supply (OUT)
GND	Ground
RX	TTL Receiver
TX	TTL Transmitter
RTS	Request to send
CTS	Clear to send
DCD	-
DTR	-
RI	Ring
PWR_KEY	Power Key
Status	Status

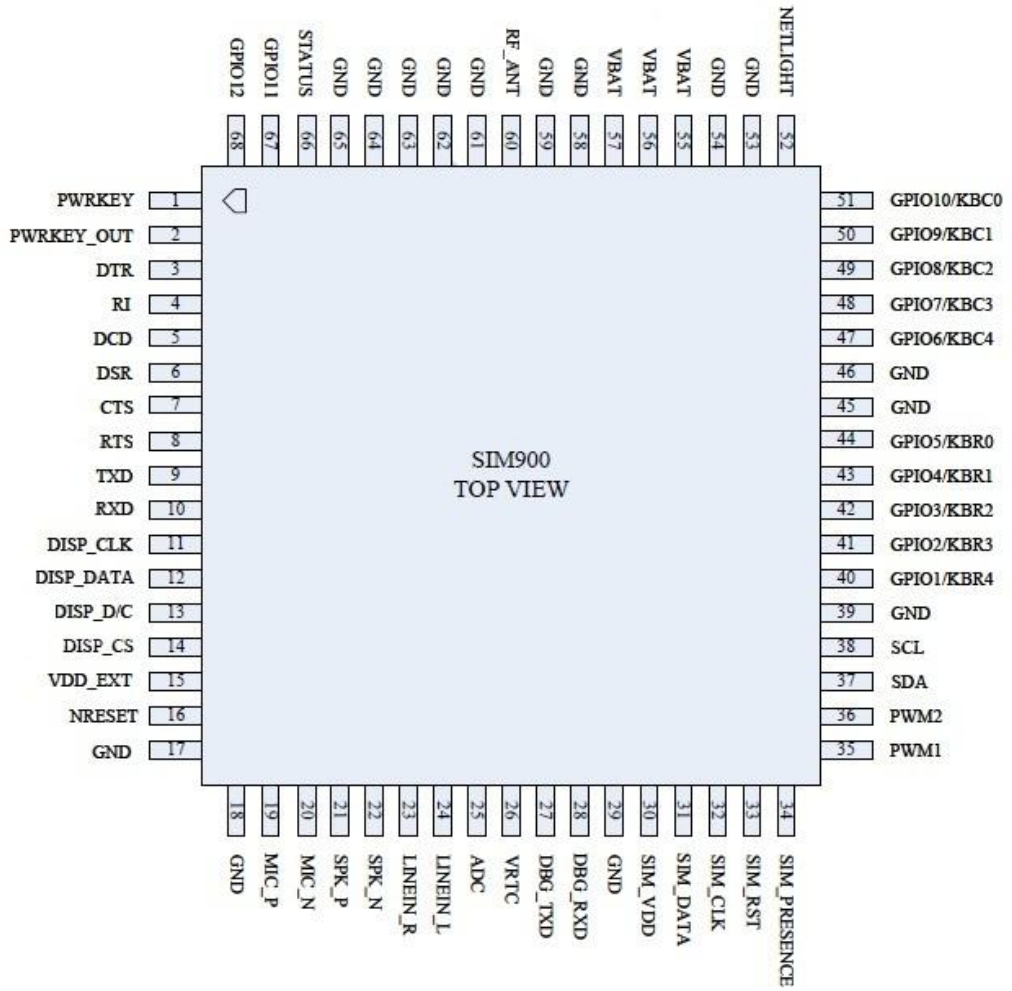


Fig 22: Top View of SIM 900

\

2.5.9 MAX 232

The MAX232 IC is used to convert the TTL/CMOS logic levels to RS232 logic levels during serial communication of microcontrollers with PC. The controller operates at TTL logic level (0-5V) whereas the serial communication in PC works on RS232 standards (-25 V to + 25V). This makes it difficult to establish a direct link between them to communicate with each other.

The intermediate link is provided through MAX232. It is a dual driver/receiver that includes a capacitive voltage generator to supply RS232 voltage levels from a single 5V supply. Each receiver converts RS232 inputs to 5V TTL/CMOS levels. These receivers (R1 & R2) can accept ±30V inputs. The drivers (T1 & T2), also called transmitters, convert the TTL/CMOS input level into RS232 level.

The transmitters take input from controller's serial transmission pin and send the output to RS232's receiver. The receivers, on the other hand, take input from transmission pin of RS232 serial port and give serial output to microcontroller's receiver pin. MAX232 needs four external capacitors whose value ranges from 1µF to 22µF.

2.5.9.1 Pin Diagram

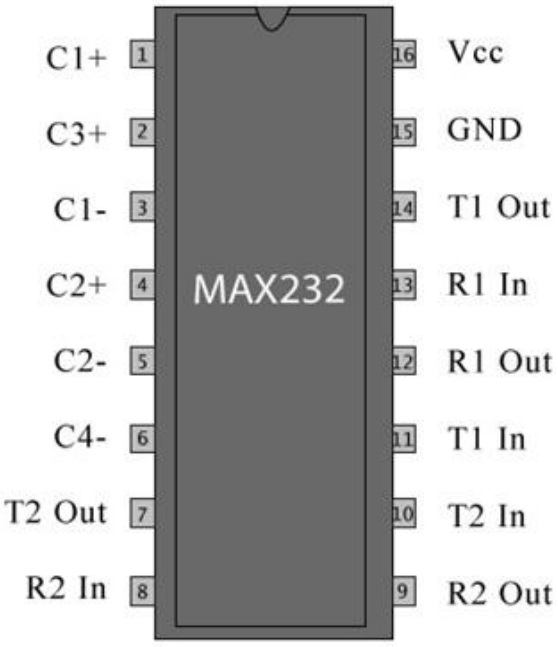


Fig 23: Pin Diagram of MAX232

2.5.9.2 Features

- Input voltage levels are compatible with standard CMOS levels Output voltage levels are compatible with EIA/TIA-232-E levels Single Supply voltage: 5V
- Low input current: 0.1μA at TA= 25 °C Output current: 24mA
- Latching current not less than 450mA at TA= 25°C
- The transmitter outputs and receiver inputs are protected to ±15kV Air ESD

2.5.9.3 Applications

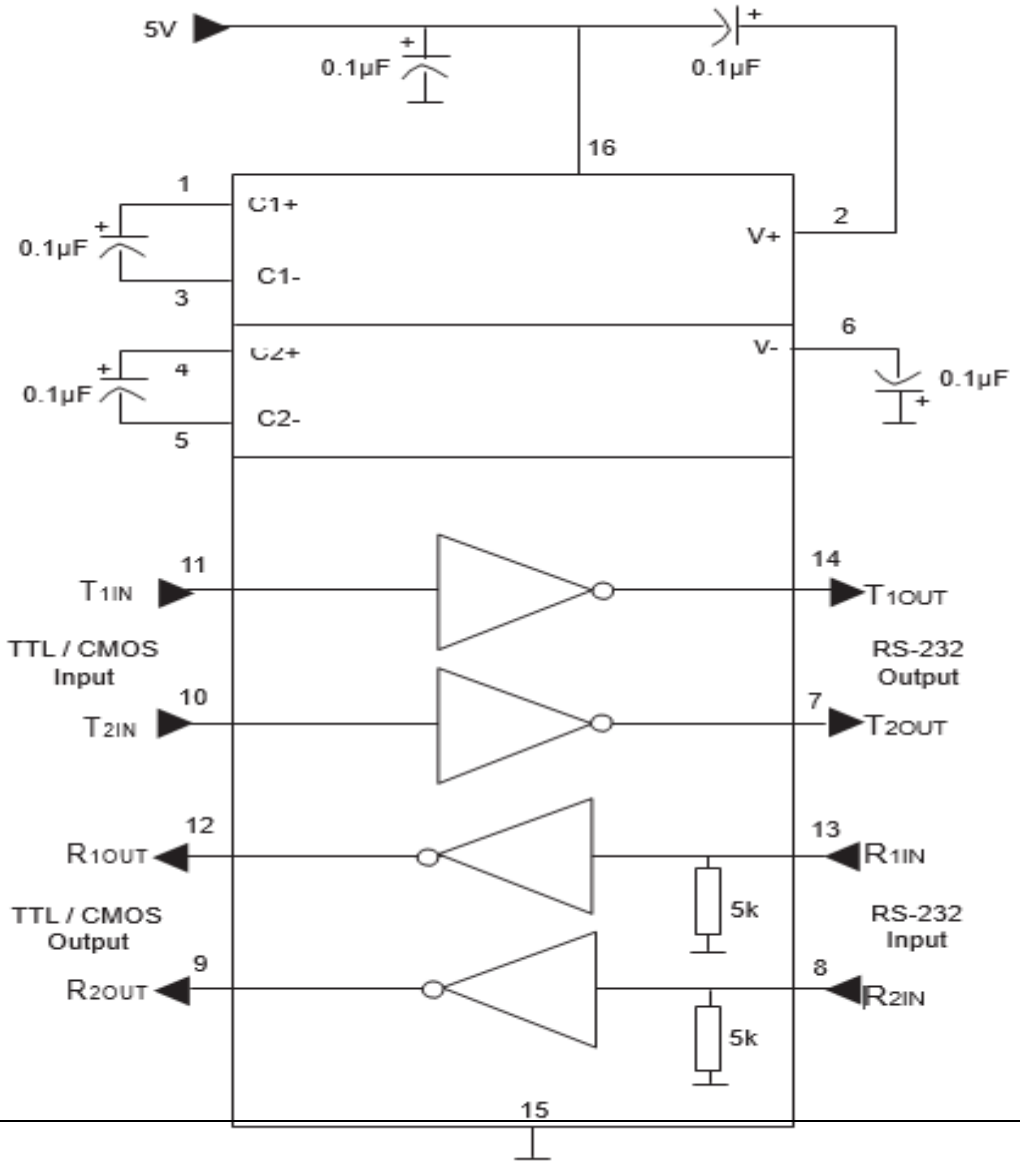
- Battery-Powered RS232 Systems
- Terminals
- Modems
- Computers

Table 7: Pin Description of MAX 232

No.	Name	Function
1	C1+	External capacitance of positive voltage multiplier unit
2	V+	Output of positive voltage of multiplier unit
3	C1-	External capacitance of positive voltage multiplier unit
4	C2+	External capacitance of negative voltage multiplier unit
5	C2-	External capacitance of negative voltage multiplier unit
6	V-	Output of negative voltage of multiplier unit
7	$T2_{OUT}$	Output of transmitter data (levels RS–232)
8	$R2_{IN}$	Input of receiver data (levels RS–232)
9	$R2_{OUT}$	Output of receiver data (levels TTL/CMOS)

10	$T2_{IN}$	Input of transmitter data (levels TTL/CMOS)
11	$T1_{IN}$	Input of transmitter data (levels TTL/CMOS)
12	$R1_{OUT}$	Output of receiver data (levels TTL/CMOS)
13	$R1_{IN}$	Input of receiver data (levels RS–232)
14	$T1_{OUT}$	Output of transmitter data (levelsRS–232)
15	GND	Ground
16	V_{CC}	Supply voltage

2.5.9.4 Application Circuit



We can directly connect the microcontroller Receiver(Rx) and Transmitter(Tx) pins directly to GSM Modem, but if we want safety of GSM Modem we can use two MAX 232 devices between microcontroller and GSM Modem .

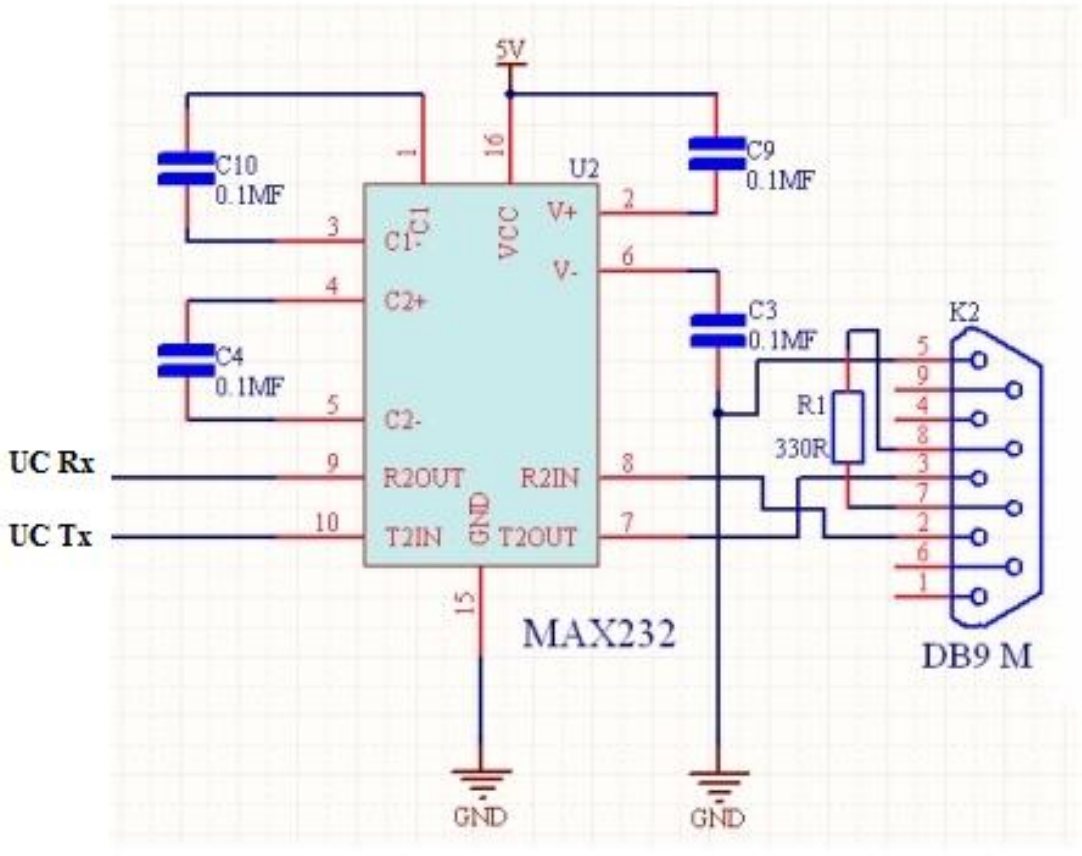


Fig 25: Circuit Diagram of MAX232

2.5.10 SMS Flow in GSM

GSM (Global System for Mobile Communications, originally Groupe Spécial Mobile), is a standard developed by the European Telecommunications Standards Institute (ETSI) to describe protocols for second generation (2G) digital cellular networks used by mobile phones. SMS Flow in GSM can be divided into two parts: (i) Message Flow SM-MT (Mobile Terminated Short Message Service Transfer)and (ii) Message Flow SM-MO (Mobile Originated Short Message Service Transfer)

2.5.10.1 Message Flow SM-MT

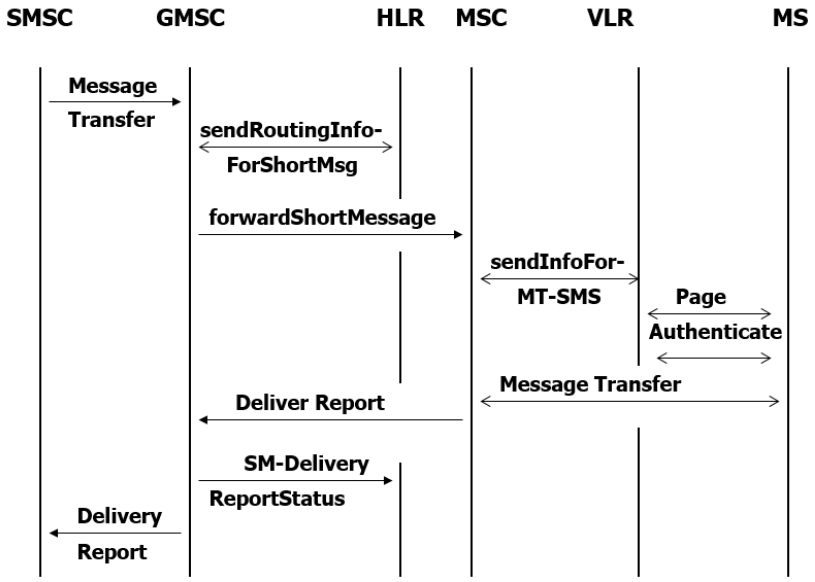
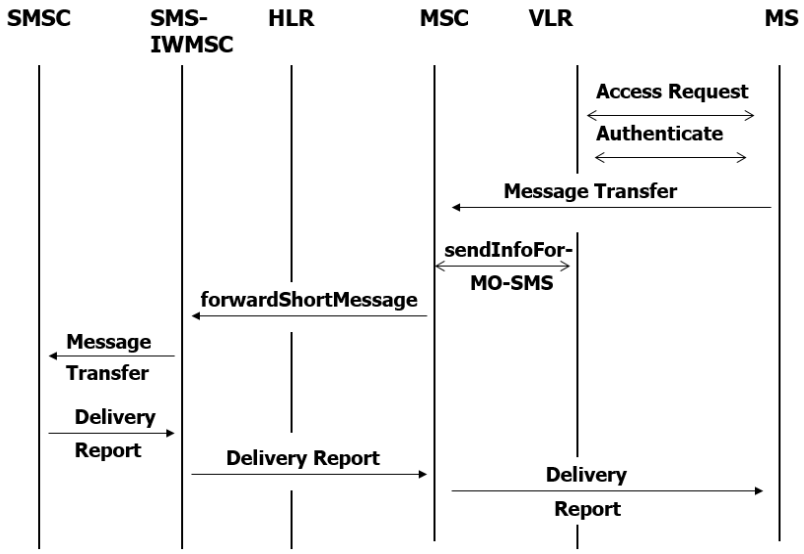


Fig 26: Message Flow SM-MT Diagram

2.5.10.2 Message Flow SM-MO



2.5.11 Softwares

For the designing and simulation of our project we have used the following softwares:

1. Keil uVision4
2. Proteus v6
3. CVAVR

2.5.11.1 Keil uVission4

2.5.11.1.1 Overview of Keil C Cross Complier

It is possible to create the source files in a text editor such as Notepad, run the Compiler on each C source file, specifying a list of controls, run the Assembler on each Assembler source file, specifying another list of controls, run either the Library Manager or Linker (again specifying a list of controls) and finally running the Object-HEX Converter to convert the Linker output file to an Intel Hex File. Once that has been completed the Hex File can be downloaded to the target hardware and debugged. Alternatively KEIL can be used to create source files; automatically compile, link and covert using options set with an easy to use user interface and finally simulate or perform debugging on the hardware with access to C variables and memory. Unless you have to use the tolls on the command line, the choice is clear. KEIL Greatly simplifies the process of creating and testing an embedded application.

2.5.11.1.2 Simulator/Debugger

The simulator/ debugger in KEIL can perform a very detailed simulation of a microcontroller along with external signals. It ispossible to view the precise execution time of a single assemblyinstruction, or a single line of C code, all the way up to the entireapplication, simply by entering the crystal frequency. A window canbe opened for each peripheral on the device, showing the state of theperipheral. This enables quick trouble shooting of mis-configuredperipherals. Breakpoints may be set on either

assembly instructions orlines of C code, and execution may be stepped through one instructionor C line at a time. The contents of all the memory areas may be viewedalong with ability to find specific variables. In addition the registersmay be viewed allowing a detailed view of what the microcontroller isdoing at any point in time.

The Keil Software 8051 development tools listed below are the programs you use to compile your C code, assembleyourassembler source files, link your program together, create HEX files and debugyour target program. µVision2 for Windows Integrated Development Environment:combines Project Management, Source CodeEditing, and Program Debugging in one powerful environment.

- C51 ANSI Optimizing C Cross Compiler : creates relocatable object modules from your C source code
- A51 Macro Assembler : creates relocatable object modules from your 8051 assembler source code
- BL51 Linker/Locator : combines relocatable object modules created by the compiler and assembler into the final absolute object module
- LIB51 Library Manager : combines object modules into a library, which may be used by the linker
- OH51 Object-HEX Converter : creates Intel HEX files from absolute object modules

2.5.11.2 Proteus v6

Proteus is a software for microcontroller simulation,schematic captureand printed circuit board design. It is developed by Labcenter electronics.

The proteus design suite includes ISIS, which is a networking tool to simulate programming ICs like PIC, Atmel etc., The model was successfully simulated. This simulated model was then used for assembling the hardware.

2.5.11.3 CVAVR

CVAVR stands for CodeVisionAVR. It is used for programming of AVR microcontrollers. It is similat to Keil C Compiler. First we write the code in embedded C language and then we generate HEX file from it. It is developed by HP Info Tech.

The CVAVR IDE combines project management, make facilities, source code editing, program debugging, and complete simulation in one powerful environment. The CVAVR development platform is easy-to-use and helping you quickly create embedded programs that work. The CVAVR editor and debugger are integrated in a single application that provides a seamless embedded project development environment.

CHAPTER III

Methodology

3.1Procedure

The entire project consist of the following components:

1. Microcontroller ATMEGA8

2. Temperature Sensor LM-35.

3. Smoke Sensor MQ-2.

4. 16x2 LCD.

5. 12 Volts Buzzer.

6. Potentiometers 10K.

7. GSM Modem

8. MAX 232

9. LED's.

10. Push Button.

11. Capacitors.

12. ISP Programmer.

13. 9 Volts Adapter.

14. Bread Board

15. KEIL UVision-4

16. Proteus v6

17. CVAVR

18. Wiring and miscellaneous.

To accomplish the desired task step wise execution of project is very necessary. First thing for this is the selection and purchase of all required components and software's was done. Thereafter we first implemented the circuit in Proteus using microcontroller AT89C51 and pulse voltages as sensor outputs to the microcontroller. After successfully seeing the results on LCD interfaced with UC in Proteus we implemented the circuit on a breadboard using the UC ATMEGA8. Then we designed a 5V power supply for the microcontroller using the voltage regulator 7805 and the capacitive filter. This supply voltage is given to the V_{CC} pin of UC. These steps are common for all projects related to microcontrollers. Now the heat sensor LM-35 that gives and output voltage corresponding to each temperature value was interfaced with the inbuilt microcontroller's comparator to convert analog signal into a digital signal. If the fire occurs the temperature increases and so the output voltage of the heat sensor and the comparator generates a high output and gives a positive indication of fire.

Now we interfaced the smoke sensor MQ-2 with the UC through its inbuilt comparator. Similar to the heat sensor, when the output of smoke sensor increases beyond the reference, the comparator output gives a high signal and hence indicates the presence of fire.

The output of heat and smoke sensor is given to the UC at pin number PC0 and PC5 respectively.The microcontroller continuously examines these pins and performs OR operation and high output of the OR operation confirms fire, there by sending the operation condition to the buzzer. Hence the buzzer will start and the SMS will be sent to the concerned authorities. The LCD will continuously display the temperature. For this system to work, the system should be installed at a location having GSM Network.

We divided our project into four Phases:

(i) Study Phase
(ii) Design Phase
(iii) Implementation Phase
(iv) Evaluation Phase

3.2 Flow Chart

Before starting any problem we should draw a rough diagram of the problem and its solution. Flow chart is also a tool used for designing and documenting complex processes or programs. A flowchart is a type of diagram that represents an algorithm or process, showing the steps as boxes of various kinds, and their order by connecting them with arrows. Flowcharts are used in analyzing, designing, documenting or managing a process or program in various fields.

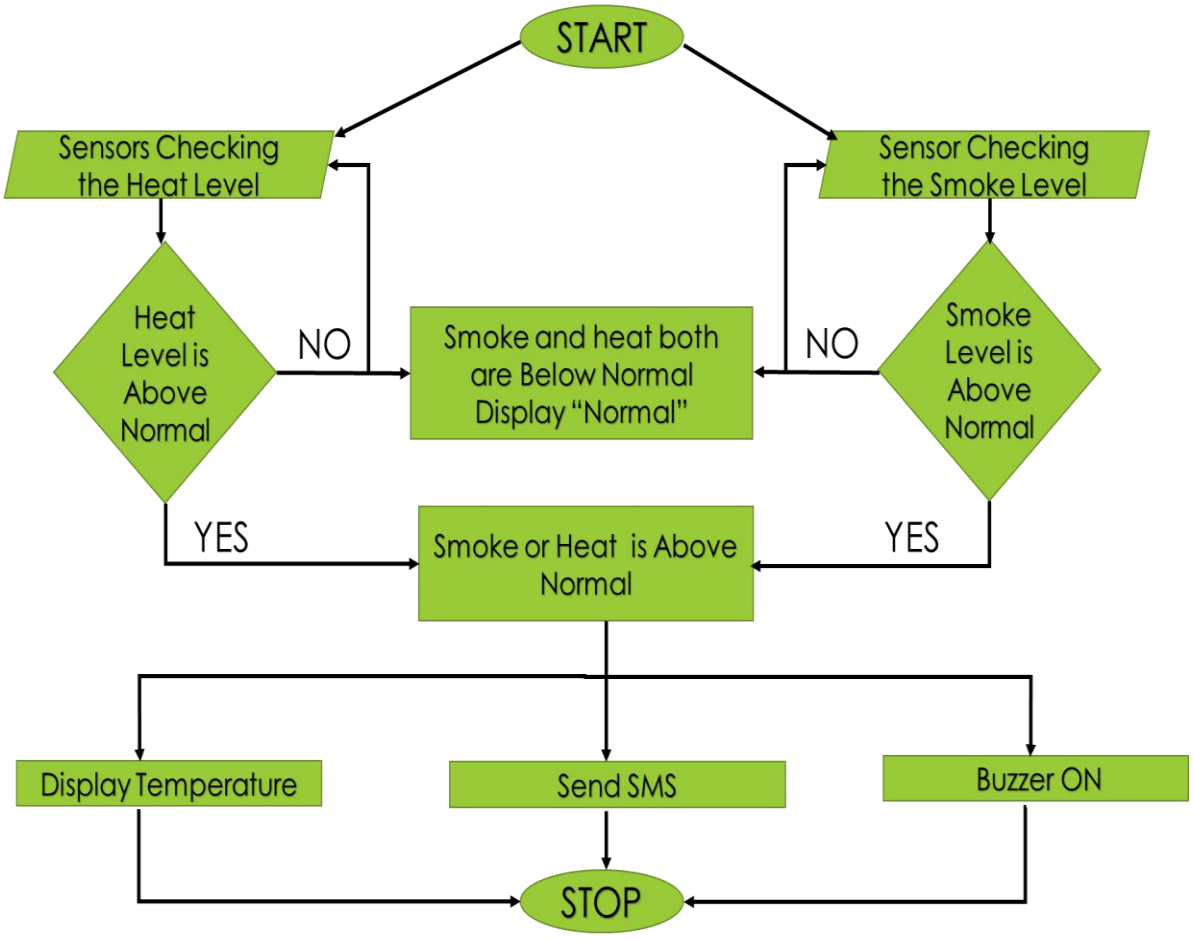


Fig 28: Flow chart

3.3 Schematic Diagram

A schematic, or schematic diagram, is a representation of the elements of a system using abstract, graphic symbols rather than realistic pictures. A schematic usually omits all details that are not relevant to the information the schematic is intended to convey, and may add unrealistic elements that aid comprehension. For example, a subway map intended for riders may represent a subway station with a dot; the dot doesn't resemble the actual station at all but gives the viewer information without unnecessary visual clutter. In the schematic diagram, the symbolic elements are arranged to be more easily interpreted by the viewer.

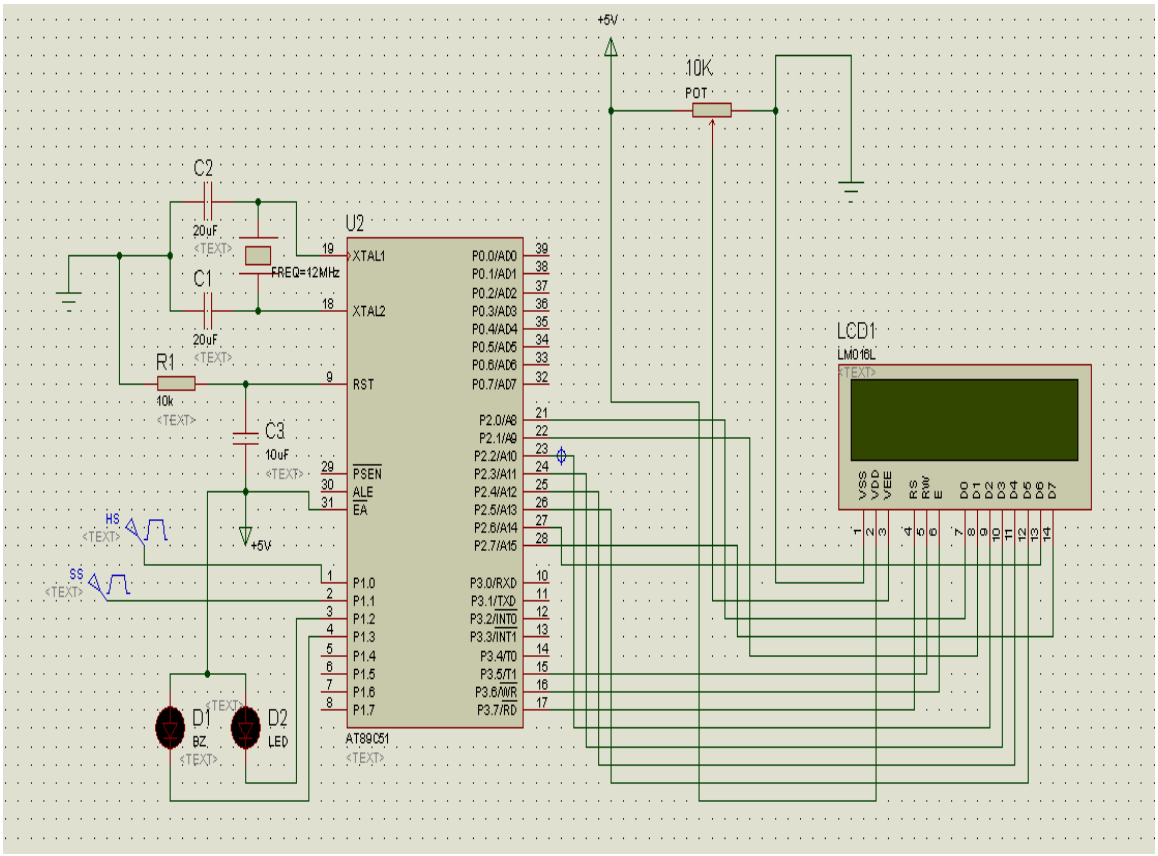


Fig 29 : Schematic Diagram

CHAPTER IV

Results and Challenges

4.1 Timeline of Project

In 7th Semester, we have implemented the circuit on the Bread board and some part on PCB using AT89C51. We also write the program for interfacing of LCD and Buzzzer to microcontroller. We run the HEX file of the project in proteus v6 and it is working correctly. We faced problem in burning our HEX file on microcontroller due to unavailability of progremmer.

In 8th Semester we changed our UC to ATMEGA 8 because it has inbuilt A/D IC. Now we written code for GSM Modem, LCD and Sensors in CVAVR and implemented the entire circuir on PCB and interfaced the GSM Modem, sensors and LCD to it.

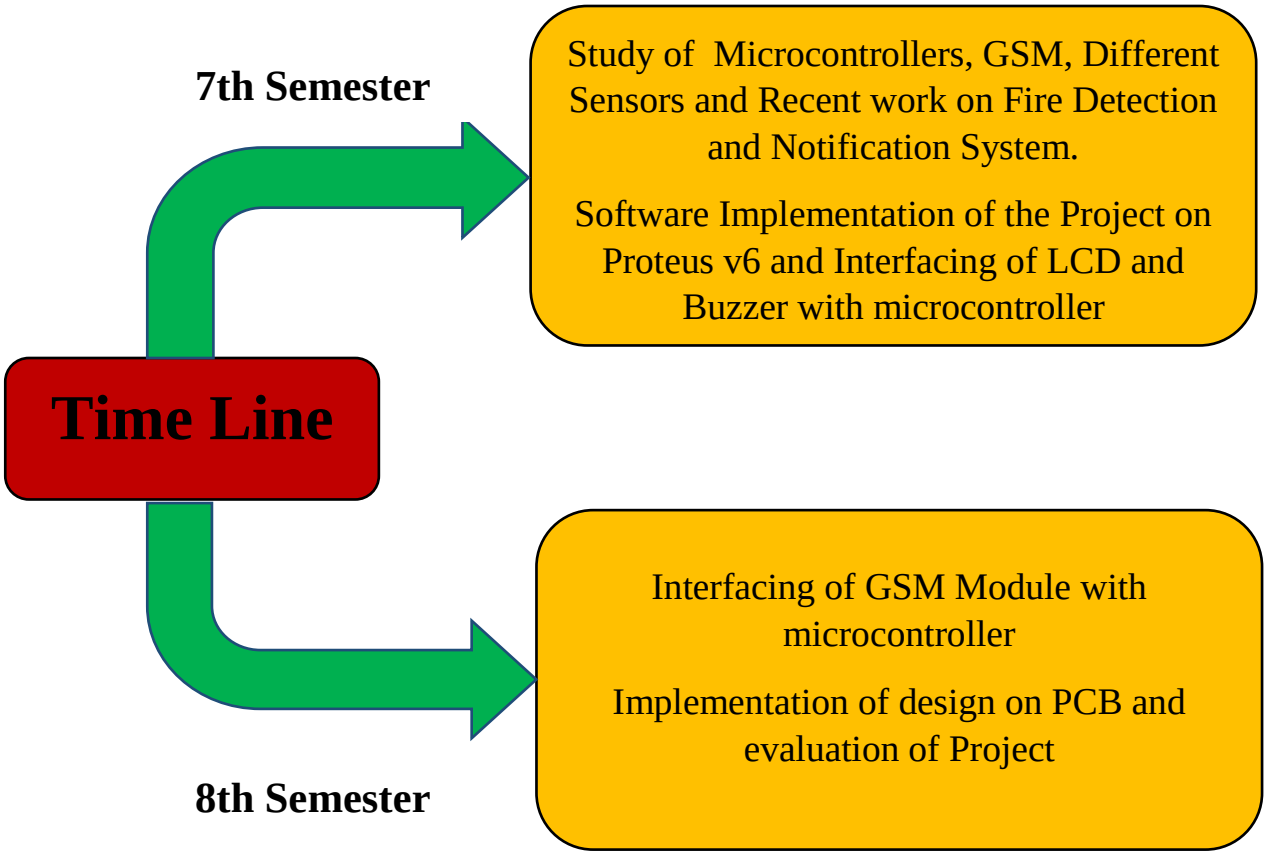


Fig. 30 : Time Line of Project

4.2 Hardware Implementation

\

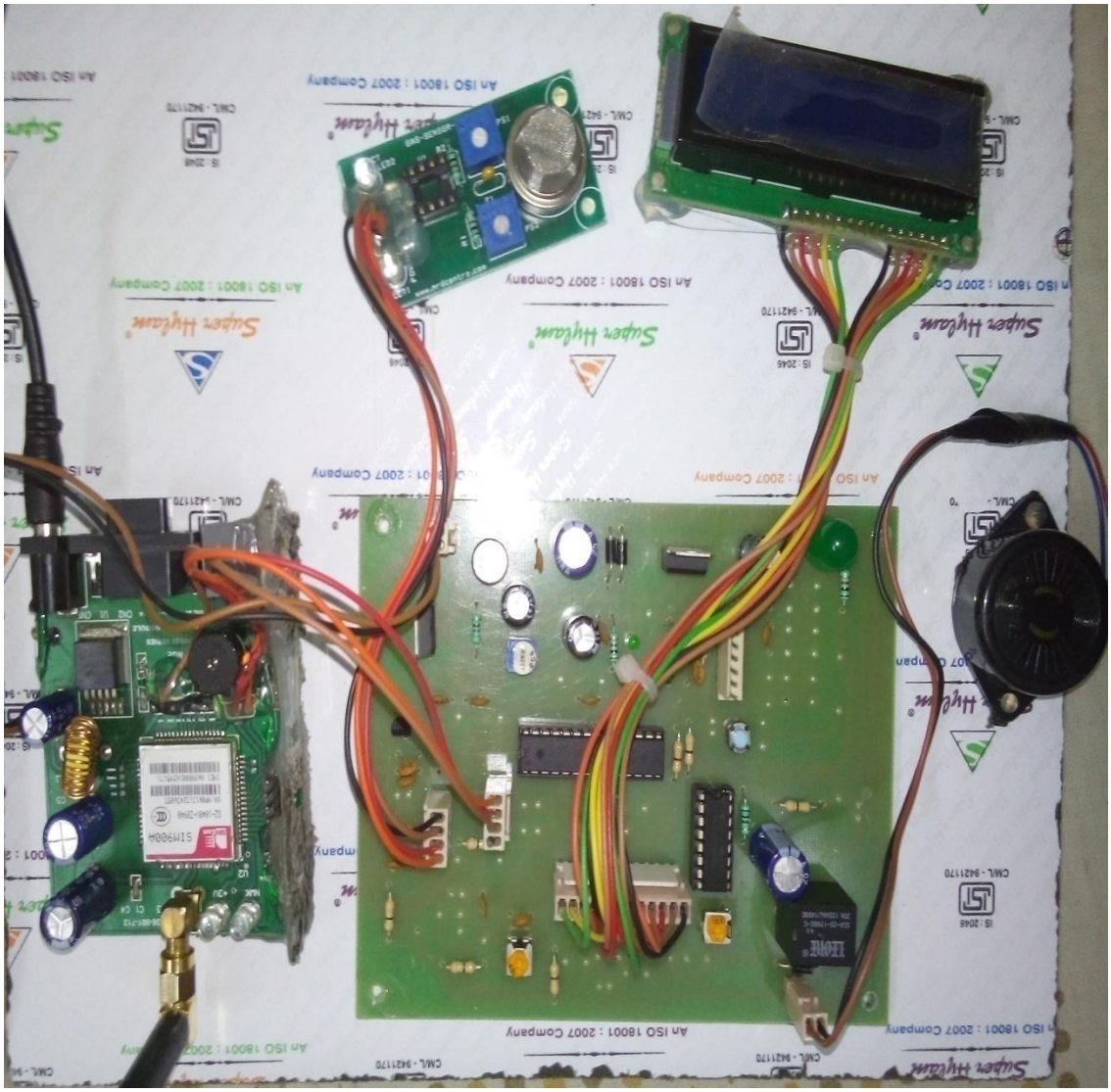


Fig. 31 : Hardware Implementation

4.3 Results

Based upon the work we have done till now, some snapshots at different time instants of the working program in Proteus is shown below.

(i) Both Heat and Smoke Sensor are ON

(ii) Only heat or Only Smoke Sensor is ON

(iii) Both Heaat and Smoke Sensor ae OFF

4.3.1 Both Heat Sensor and Smoke Sensor are ON

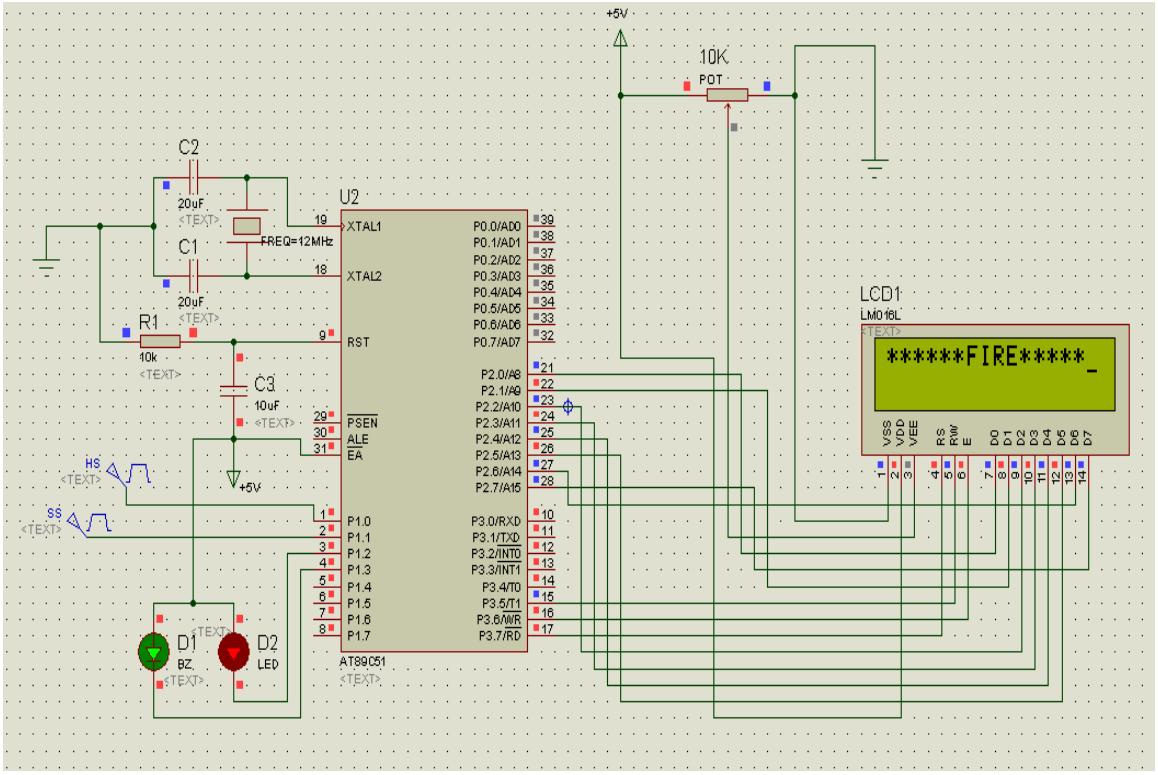


Fig.32 : Output When Both Heat Sensor and Smoke Sensor are ON

4.3.2 Only Heat or Only Smoke Sensor is ON

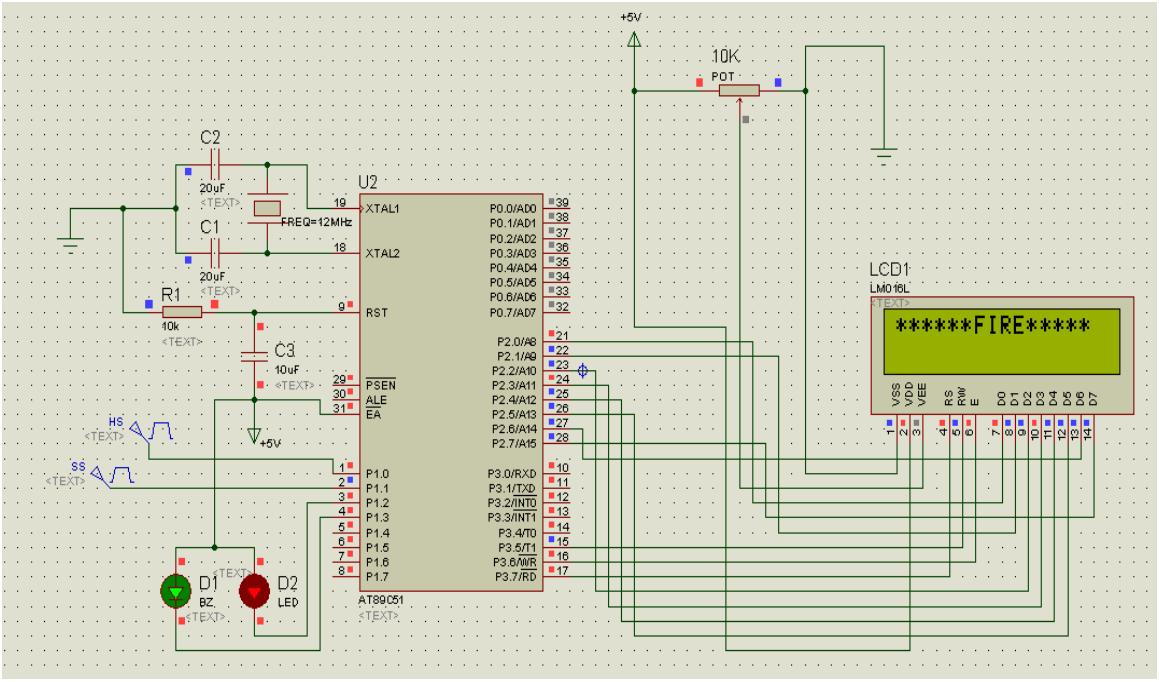


Fig. 33 : Output When Only Heat or Only Smoke Sensor is ON

4.3.3 Both Heat Sensor and Smoke Sensor are OFF

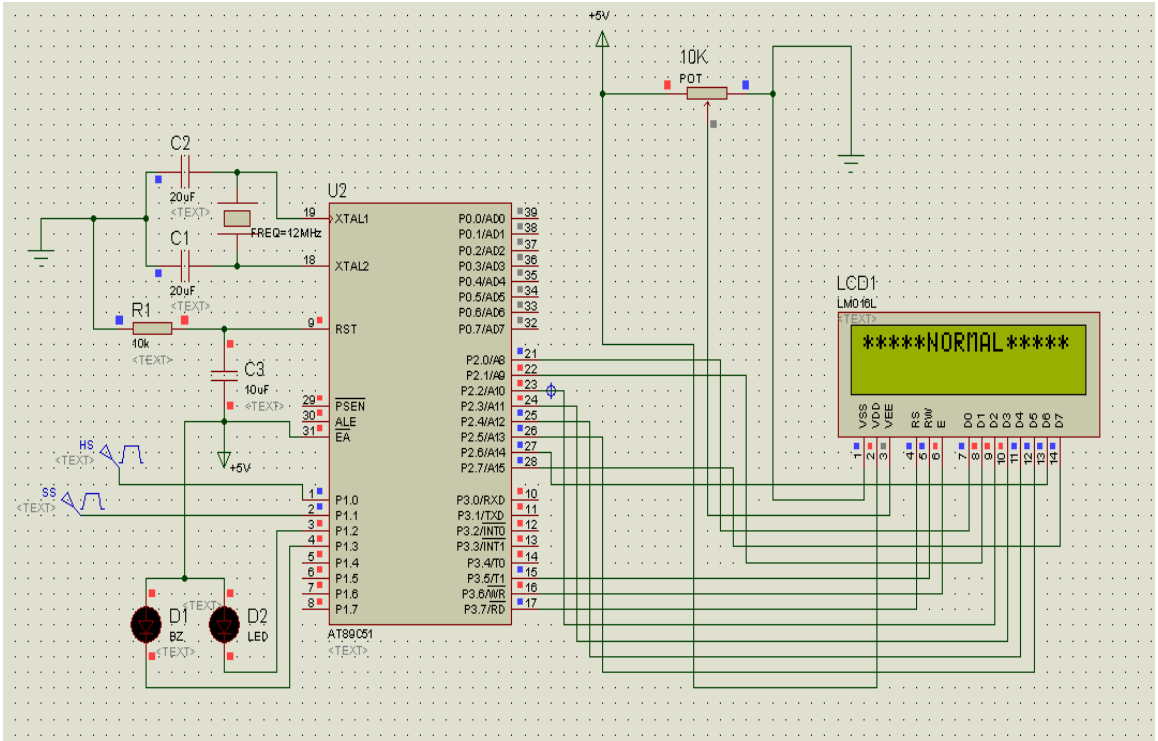


Fig. 34 : Output When Both Heat Sensor and Smoke Sensor are OFF

4.4 Future Enhancements

Further manipulation of hardware and software can enable us to detect and locate the fire in more than one locations simultaneously.

We can extend this project for the benefit of incidents of fire in a moving train, with the use of GPS technology we can get the exact position of the train by having the knowledge of latitude and longitude.

We can add the module of voice alarm system to indicate theft entry or gas leakage(MQ-2 also senses LPG and other gases).

Record keeping can be done in the system by software modification which enables us to keep the record of all the fire mishaps with exact location and time for future investigations and improvements.

4.5 Challenges

Since we are using Heat Sensor and Smoke Sensor as detecting devices and the analog output of sensors is given to comparator to convert it into digital signal. During this the reference voltage of comparator should be chosen carefully, otherwise we will get false signals. For example we should set the comparator reference voltage approximately 3V for smoke sensor. If we take reference voltage less than 3V, the alarm will start ringing even when someone is smoking. Similarly the reference voltage for heat sensor should be chosen according the environment and location.

Selecting the right microcontroller for the design is also a difficult task. Along with consideration of technical features, cost and other issues are also there. While choosing a microcontroller the following things to be taken care:

(a) Make a list of required hardware interfaces
(b) Examine memory needs
(c) Start searching for microcontrollers
(d) Examine cost and power constraints

(e) Check part availability

(f) Select a development kit

(g) Search for compilers and tools

(h) Start working on microcontroller

The microcontroller and the power supply should be kept in a fire proof container (box), so that in case of fire the system doesn't damaged during fire.

During the interfacing of the LCD and Buzzer the connections should be tight and while writing code for interfacing define pins properly, otherwise we are going to get nothing or false results.

Care should be taken while soldering, otherwise holes of PCB will touch each other and there is a chance of short circuit and the device can be damaged.

4.6 Conclusion

This project is done mainly considering safety and security of the households,people and industry equipment's. The heart of this project is a microcontroller, which does all the activities like monitoring, displaying and controlling the given parameters. In this project we have monitored and controlled the three critical parameters like temperature, smoke and fire. This project can also monitor and control more than three parameters by adding more number of interfacing circuits and control units. This project can be used for domestic purpose as well as industrial usage. The main advantage of this project is simple and easy method of controlling and it requires very low voltage for its operation and also faster in controlling the input parameters. By using GSM modem we can alert the emergency services and the owner of the property. So with this project we can safe guard the equipment's and prevent serious injury and heavy loses.

CHAPTER V

References

- P. Thiravasin, J. Sinthusonthichat, "*Fire Alarm System Controlled by Using Computer*", International Conference on Accelerator and Large Experimental Physics Control Systems, 1999, Trieste, Italy
- Kuncham ViswaTeja, Suresh Angadi, "*Fire Detection and Notification System in Trains*", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, Issue 4, April 2013
- Ravindran, "*Microcontroller based on fire alarm system using sensory and monitoring system*", Malaysia Technical University, Melaka, May 2007
- Mr. Hasban Mehmood, Mr. Muhammad Arsalan, Mr. Sikandar Ali, "*8051 based smoke detector*"
- Ms. G.HemaManvi, Ms. E. Sravanthi, Ms. K. Puja Chandran, "*Text Editroon a LCD using ATATMEGA8 Microcontroller and PC*"
- www.wikipedia.org
- http://microcontroller51.blogspot.in/2011/08/gsm-modem-interfacing-with.html"*GSM modem interfacing with microcontroller 8051 for SMS control of industrial equipments*"
- http://www.circuitstoday.com/interfacing-16x2-lcd-with-8051"*Interfacing 16×2 LCD with 8051*"
- http://home.howstuffworks.com/home-improvement/household-safety/fire/smoke3.htm"*Working of smoke detectors*"
- http://thesmokedetector.umwblogs.org/how-it-works/"*Working of smoke detectors*"