WIRELESS HOOTER CONTROL FOR FIRE SAFETY

USES

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A project report submitted in partial fulfilment of the requirements for the Degree of
Bachelor of Technology
(Electronics Engineering)

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Under the guidance of

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Dehradun
March, 2015

(If work done externally then bring a certificate from the external supervisor else this will be signed by the local supervisor).

CERTIFICATE

This is to certify that the work contained in this report titled "WIRELESS HOOTER CONTROL IN FIRE SAFETY USES" has been carried out by ……under my/our supervision and has not been submitted elsewhere for a degree.

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ABSTRACT

The project is based on monitoring the environment and collection and transmission of data about the detection of noxious gases namely Liquid Petroleum Gas, Propane, Iso-butane, LNG combustible gases or in the event of breakage of fire at different nodes to a control room where this information is stored and displayed on a LCD. The number of nodes that can be connected to the control room does not have any limit but for practical purposes we are using only two nodes.

These nodes communicate to the control room through RF module where the AC hooter gets activated in case of any mis happening. Two sensors are used at each node which are LPG sensor and fire sensor. Both of these are event based sensors. The Fire sensor is a easy to use device to protect against fire. The module uses the principle of IR sensor and a comparator to detect fire and its range is of 1 metre.

Whereas the LPG sensor is used in for detection of carbonic and flammable gases . The sensor is not affected with the presence of alcohol, cooking fumes etc.

The project can also prove beneficial in fire safety areas by incorporating the technique of mock drills. In a mock drill the switches at the control room are pressed accordingly and the hooter is activated at the desired location .A mock drill thus enables or helps fire safety engineers to take measures to mitigate fire situations.

The project will also figure out the differences between wireless and wired communication techniques.

ACKNOWLEDGEMENT

We are highly grateful to Prof. Sushabhan Choudhary, HOD, Department of Electronics, Instrumentation and Control Engineering, University of Petroleum and Energy Studies Dehradun for providing us with the opportunity to implement our knowledge in practical forms through this project .

This project has been a complete new experience to know and test our practical skills .This major project had also given us the confidence to face our industrial projects with a more confident and practical approach.

This project has been completed under the guidance of **Dr. Rajesh Singh**, Assistant Professor, Department of Electronics, Instrumentation and Control Engineering , UPES ,Dehradun who had been a source of inspiration and motivation throughout the course of this project. It would not have been possible without our mentor. We would also like to thank our other faculties who had been generous to us throughout .Lastly we would like to thank our family and friends who had been a source of motivation and energy.

CHAPTER 1
INTRODUCTION

1.1 PROBLEM STATEMENT

Taking preventive steps against the breakage of fire and poisonous gases has become very important in every industry and high rise buildings.With growing concerns for taking safety measures against unnatural and undesired situations, smoke and fire detection systems is of utmost importance. This project is an ideal solution for working in remote locations, room aesthetics or even multi-storeyed buildings. The sensors at the nodes having transmitter will continuously monitor the environment and if any problem is found out then the Microcontroller will send the information to the receiver end via the RF modem where the hooter will be activated and the information will be displayed on the LCD.

1.2 INTRODUCTION TO WIRELESS COMMUNICATIONS

Wireless communication is the exchange of data between multiple points that are not connected by any kind of electrical or wired contacts.

The most common wireless technologies use radio waves as the carrier signal. The radio waves have applications in short range communications such as in television and it can also be used in the long distances communication such as in deep space radio communications. Other areas of applications of wireless communication are portable receivers, hand held devices ,cellular telephones ,personal digital assistants, GPS units, automatic garage door openings ,headphones and telephones.

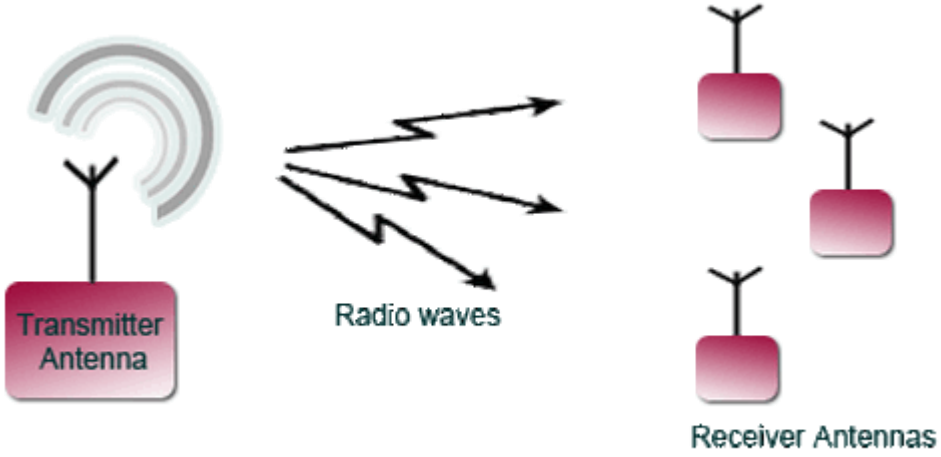

FIGURE 1: COMMUNICATIONS THROUGH RADIO WAVES

Wireless communications can also be achieved with other methods such as electromagnetic technologies using light, magnetic or sound energy.

Wireless communication is very important for mobile communications. The different parameters which decide the technology to be used are the local area network, coverage area and performance.

1.3 Advantages of wireless systems over wired systems

Let us first look at the advantages of a wireless system as compared to that of a wireless system.

- Very little or no wiring is required. No need for conducting works on Radio waves.
- Each node works as an independent unit .Thus in case if any node is not working ,it will not hamper the work of other parts of the system. In case of wired systems each node has to work in accordance so that the complete setup produces some output.
- Can be installed in running office as well as complex industries.
- Flexible to operate.

- Easy to test because of the feature of mock drill as it is not feasible to test the wired circuits by producing smoke again and again.

1.4 Aim of the project

- To develop a system to indicate fire breakage in industries or any other fire prone areas so as to alert the surrounding people.
- The project also incorporates the mock drill which is an important aspect in the fire safety uses with the help of switches.
- The project also uses the concept of data storage and keeps a record of the various fire events that took place at the different locations.

1.5 BRIEF METHODOLOGY

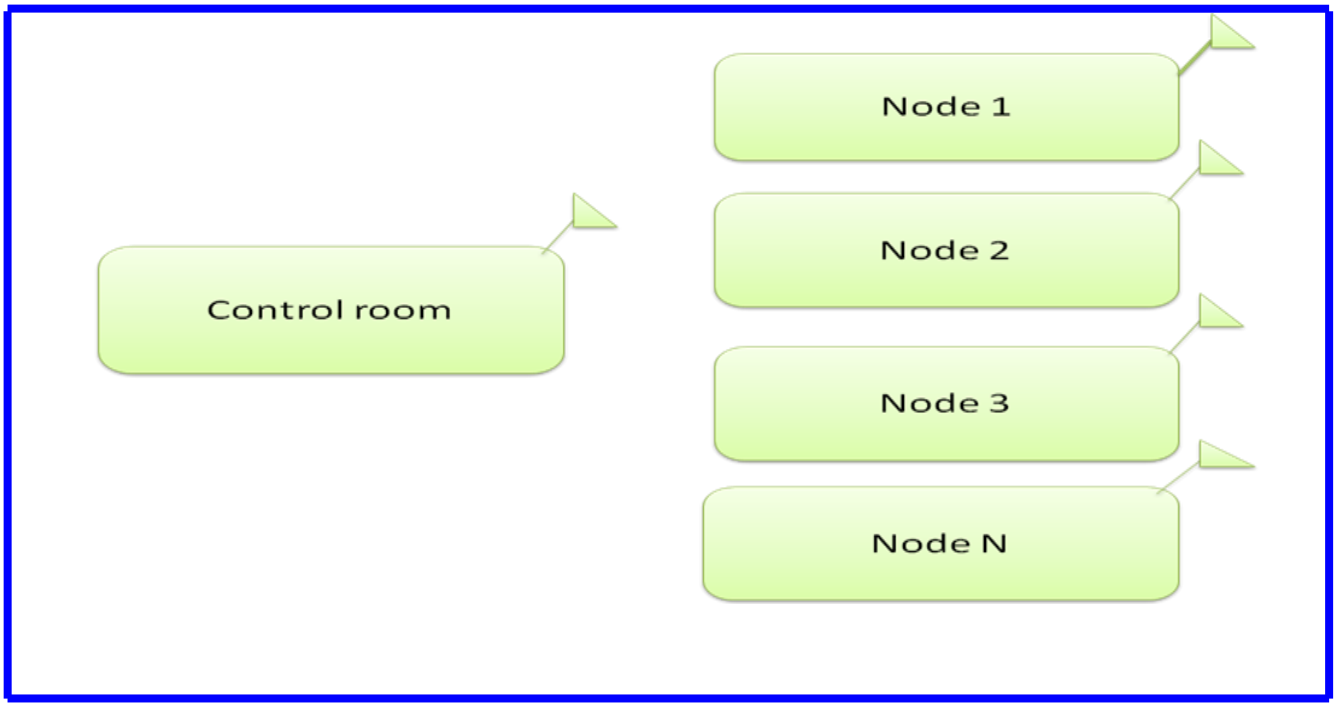

FIGURE 2: BLOCK DIAGRAM OF THE COMPLETE SYSTEM

This project deals with several different tasks .Firstly the individual kits are prepared which comprises of a power supply 9V giving power to the individual nodes placed in

different rooms to monitor the fire and hazardous gases content in the particular room .These boards are further connected with the sensors ,a displaying device LCD 16*2 and a relay DPDT which in turn is further connected to an AC hooter.

This project send the data wirelessly through RF module .There are several advantages of using RF communication over the usage of IF communications .The advantages include that the RF communication has a longer range of operation, also the RF communication is not disrupted because of any obstacles whereas the IF communication is a line of sight communication .RF communication works only on a specific band of frequencies and is not affected by frequencies of other range.

Secondly the microcontroller board in the control room is assembled which comprises of components like a MODEM(RF module),a displaying device LCD 16*2, a battery 12V for the power supply and switches for the mock drill .The microcontroller in the control room is also connected to a PC via a USB serial communicator for the data storage of the fire events taking place at the nodes. The control room can be connected to N nodes whereas practically we are demonstrating the project with two nodes.

CHAPTER 2

LITERATURE SURVEY

2.1 Atmega16 Datasheet –Atmel corporation

The datasheet of the Microcontroller is of utmost importance for this project as it tell us about the pin configurations ,features and specifications of the microcontroller along with the various commands and interfacing diagrams.

2.2 RF Based Wireless Fire Security System for Hospitals -Muhammad Arsalan Khan

SSU Res .J. of Engg. & Tech. Vol. 2. Issue 1. 2012

This paper basically deals about telling the advantages of having wireless systems over wired systems to monitor the conditions of the environment .Fire is one of the most disastrous calamities and therefore it should be dealt with in an organized manner. Conventional fire security systems are wired and usually contain smoke detectors and control panel. The control panel is sometimes hard to operate. In hospitals and other health care institutions high security against fire is needed in order to protect the expensive equipments and chemicals. This paper presents a system that will detect and show the exact place of fire. It is basically 2 channel device that can detect fire in specific rooms or floors.

2.3 The book—Fundamentals of Wireless Communication includes the research on basic concepts of wireless communication along with the techniques to explore the applications of it in modern communication era. The whole concepts have been structured into three levels. 1.) Channel investigations and modelling, 2.)Various communication concepts and their utility and 3.) Techniques to be applied at system level formation. Amidst many advantages wireless communication has a disadvantage because of which the capacity of the system is decreasing and the error output is increasing . The book elaborates the way in which how the fading can be used as an advantage to improve the system performance by means of various diversity

techniques.The concept of Time diversity, Frequency diversity and Antenna diversity i.e. MIMO is an approach due to which the system capacity increases manifold.

2.4 A survey on sensor networks

I.F. Akyildiz, Weilian Su, Sankarasubramaniam, E. Cayirci

IEEE Communications, Aug 2002

The authors of this paper studies the current research on the various architecture of protocols stack and also gives communication structure for sensor networks.

A sensor network is defined as a network which has a larger number of nodes kept in a close proximity to the phenomenon to be studied. Each of the sensor monitors the environment and sends the data to the receiver end. The author also differentiates an ad-hoc network from a sensor network which are as follows:

- Number of nodes can be higher in magnitude.
- The nodes are densely packed.
- Sensor nodes are more liable to failures.
- Topological changes are frequent.
- Limited power capabilities.
- Possible absence of unique global identification per node.

The author has presented his own architecture for communication and has also given the design parameters that should be taken care of while designing a sensor network.

The design factors listed by the authors:

 Fault Tolerance: Individual nodes are liable to more failure possibility with a much higher probability of error compared to any other system.

 Scalability: The number of nodes should be quite high such that the system is more reliable.

 Production Costs: The cost expended on a single node must be low.

 Hardware Constraints:A sensor node consists of several parts such as power supply sensor CPU and memory .All these units must consume a lower amount of power.

 Sensor Network Topology: The topology should be followed even at undesirable times.

 Environment: Nodes should be able to operate in each kind of mobile locations.

 Transmission Media: RF, Infrared and Optical

 Power Consumption: Power conservation should as low as possible.

2.5 Energy-efficient communication protocol for wireless microsensor networks [30]

W.R. Heinzelman, A. Chandrakasan, H. Balakrishnan

IEEE Hawaii International Conference on System Sciences, 2000

The authors of this paper have presented a hierarchical routing protocol which basically demonstrates procedures for reduction of energy usage and also t o distribute energy consumed by each node equal. This was done by the formation of clusters having localized coordination and the data was compressed locally.

The model used in this paper makes the following assumptions:

 A large number of nodes are present with only a single fixed base station .This base station does not have any kinds of energy limitations.

Each node and the base station are separated by some distance which makes the network expensive.

 The objective of this project is data acquisition from nodes and to transmit it to the base station .

.

The nodes arrange themselves into local clusters having any random node as a cluster head. Once this is done the data is transmitted to the cluster head where all the data of the cluster is combined and sent to the base station with high energy. This organization of the nodes is known as a 2-level hierarchy.

The clusters can be rearranged again and again with different cluster heads and different composite nodes.

Once the clusters are formed, the cluster head creates a TDMA schedule and sends it to its cluster members. To reduce interference, each cluster communicates using different CDMA codes.

For their analysis, the authors compare their scheme with a direct communication protocol and the minimum-energy routing protocol. In minimum energy routing protocol data sent to the base station takes a path through many intermediate nodes that and this is done by minimum energy transmission. The communication energy can also be reduced by using the principle of no rotation of cluster heads.

Drawbacks of this system:

- The author fails to describe the chances of failure of nodes due to the harsh environment.
- There is no provision for the cluster heads to be uniformly distributed with respect to their geographic location. Since in each round a node becomes a cluster head with a certain probability, it is possible that parts of the network will be left without a cluster head.

2.6 Energy concerns in wireless networks

A. Ephremides

IEEEWireless Communications, Aug 2002

Problem

The author of this paper stresses on the efficient use of power resources in ad-hoc networks. Ad-hoc networks are defined as infrastructure less networks because it requires the technique of multi hop for connecting the different nodes .The two main features of designing an ad- hoc network are the efficient way of energy consumption and integration of different layers.

Energy is an expensive as well as exhaustible resource which should be used efficiently and wisely. The same concept is denoted by the author in this article. The author says that for any wireless node there are three major modes of operation: transmitting, receiving and listening. While the node is in listening mode the energy consumed is minimal. However, for huge span of time spent in listening mode the energy consumption is high.

A useful distinction presented in the paper analyses whether energy should be treated as a expended cost function or as a hardware Therefore , the objective of the designer is to minimize the amount of energy, thinking of energy as an expensive resource. However, when energy is a hard constraint, the designer must keep in mind that it is a limited resource that will be exhausted. In this case, the designer's task is more complicated since he has to satisfy the objectives of his system thus maximizing the longevity of the network vs communication performance.

CHAPTER 3

THEORETICAL DEVELOPMENT

3.1 DESCRIPTION OF THE PROJECT

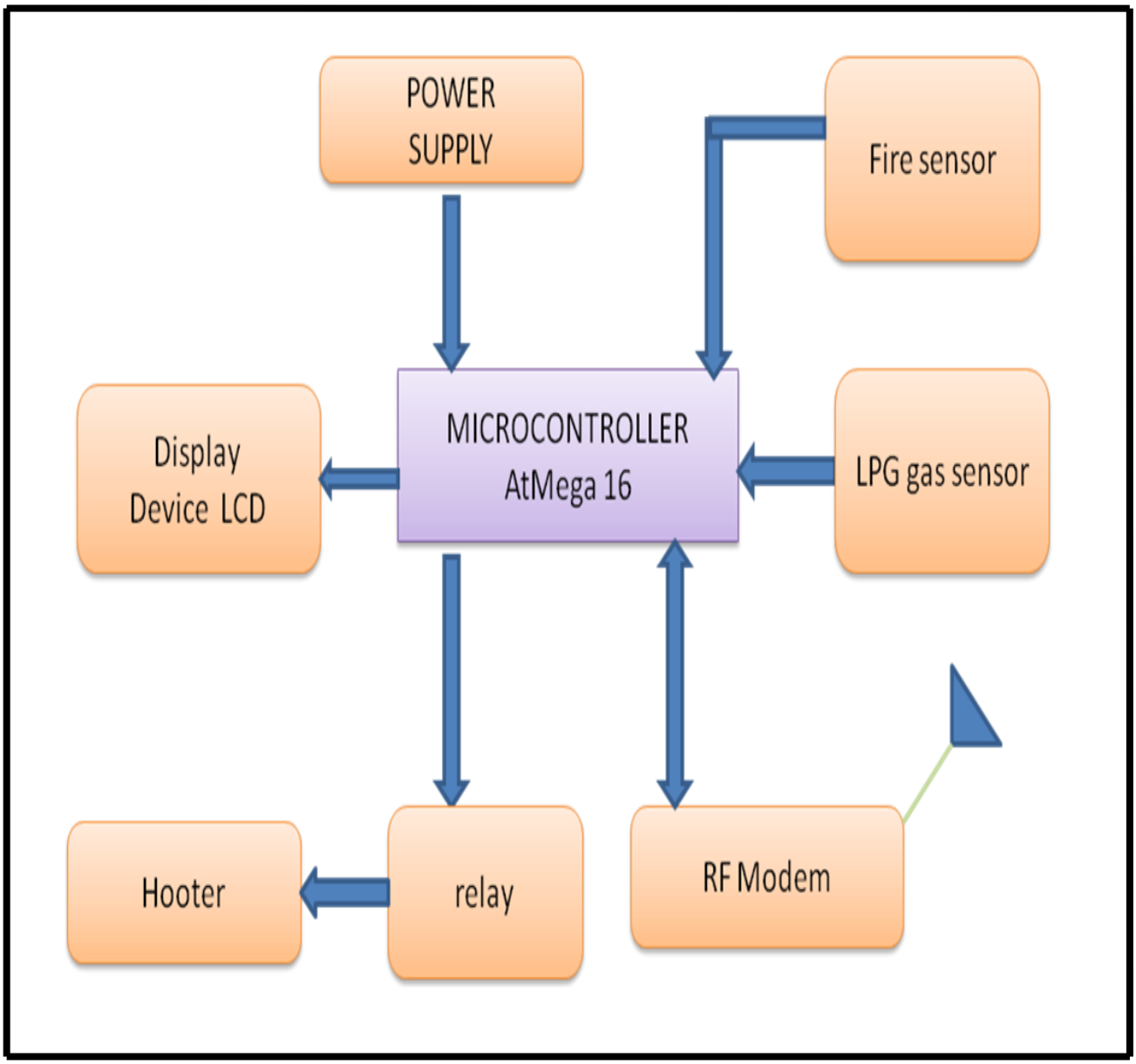

FIGURE 3: BLOCK DIAGRAM OF INDIVIDUAL NODES

The above given figure is the block diagram of individual node ,which consist of two sensors. Gas sensor is sensitive to hazardous gases like Liquid Petroleum Gases, Iso-butane, propane and LNG combustible gases, but the sensor does not get activated with the levels of alcohol, and cigarette fumes. It is only sensitive to flammable gases. The second sensor is a fire detector, which is used for the protection against fire. The module uses the IR sensors and comparator upto a range of 1 metre. It gives high output on detecting fire. The individual node also involve the RF modem which work at 2.4 GHz in half duplex mode with self switching capability receiver/transmitter mode. RF modem application is for two way wireless communication. The communication is self-controlled. This modem can be connected to the system so communication can work easily.

There are two sections in this project : A control room and various fire prone locations.

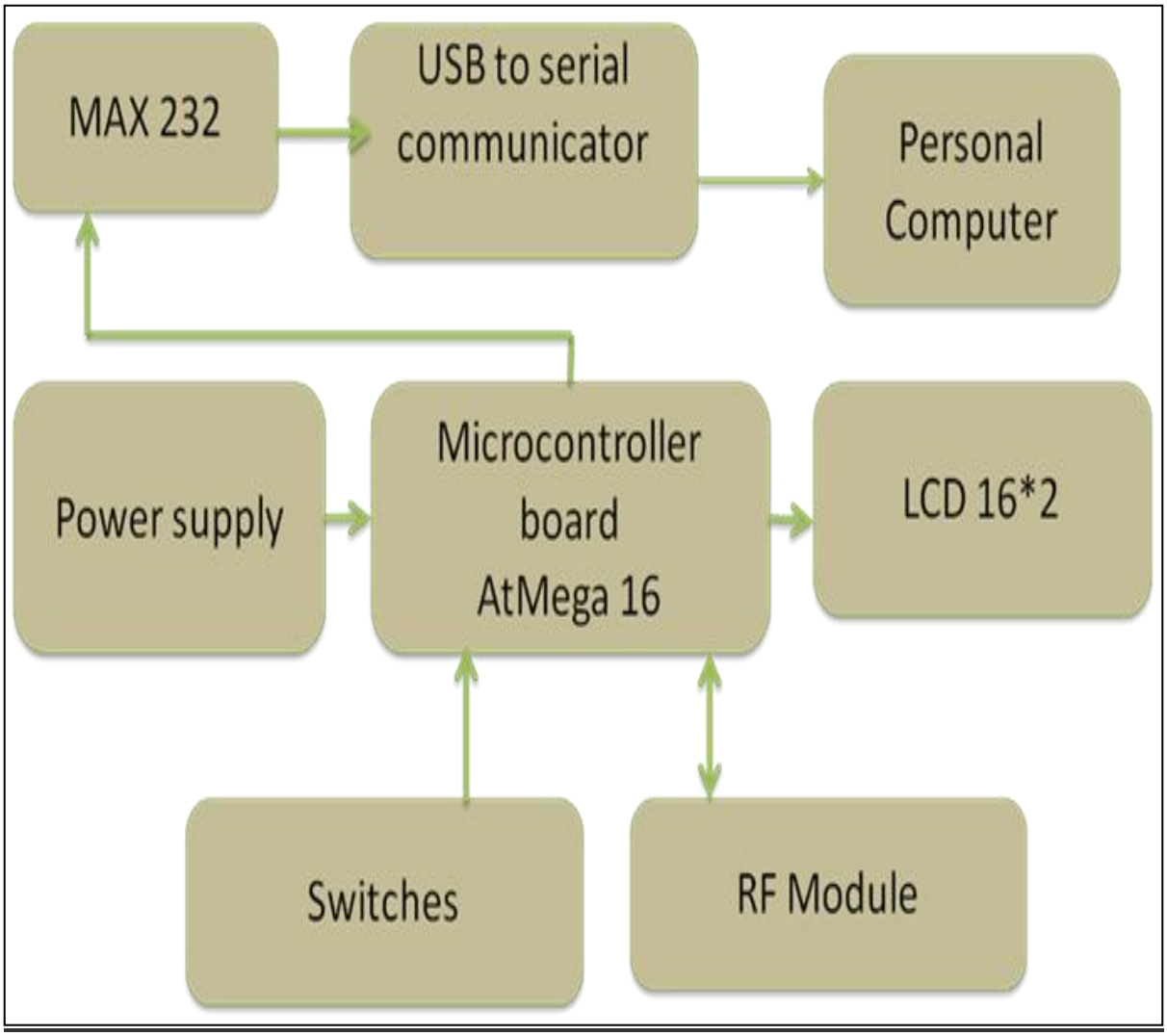

FIGURE 4 :BLOCK DIAGRAM OF CONTROL ROOM

The control room as the block diagram suggests has a microcontroller based circuit connected with a displaying device , a MODEM and switches altogether connected with a battery .This control room monitors the fire situations in different locations with the help of modems(RF module).As soon as a fire or hazardous gas is sensed at individual locations the sensors send the signal to the Microcontroller which in turn activates the hooter at the particular location .This further sends this signal to the control room through the MODEM wirelessly where the complete information about the event is displayed on

the LCD .The setup in the control room is also performing a task of keeping a record of the fire events at the individual locations.

The project can also prove beneficial in fire safety areas by incorporating the technique of mock drills. In a mock drill the switches at the control room are pressed accordingly and the hooter is activated at the desired location .A mock drill thus enables or helps fire safety engineers to take measures to mitigate fire situations.

3.2 HARDWARE SPECIFICATIONS

Microcontroller AtMega 16
Crystal oscillator
Liquid crystal display(LCD)
RF Modules
LPG sensor
Fire Detector Sensor
Relay
Resistor, Capacitor, Diode, LED, Battery, Transistors

3.3 MICROCONTROLLER

Microcontroller behaves as a single chip microcomputer that has inbuilt parts like CPU, RAM, ROM, I/O ports , interrupts and timers. A general purpose computer can perform several different tasks but a microcontroller is designed for only a particular work to control a particular system.

A Microprocessor includes a general purpose computer with a central processing unit(CPU),which consists of an arithmetic and logical unit (ALU) ,a program counter (PC),a stack pointer(SP),some working registers ,it also involves a clock timing circuit, and interrupt circuit. The main disadvantage of microprocessor over microcontroller is that it has no memory of its own, so we have to go for other way which is microcontroller

since it has existing ROM which can be programmed and also I/O port which can be programmed accordingly.

3.3.1AtMega 16:

Pin Diagram of ATMega 16

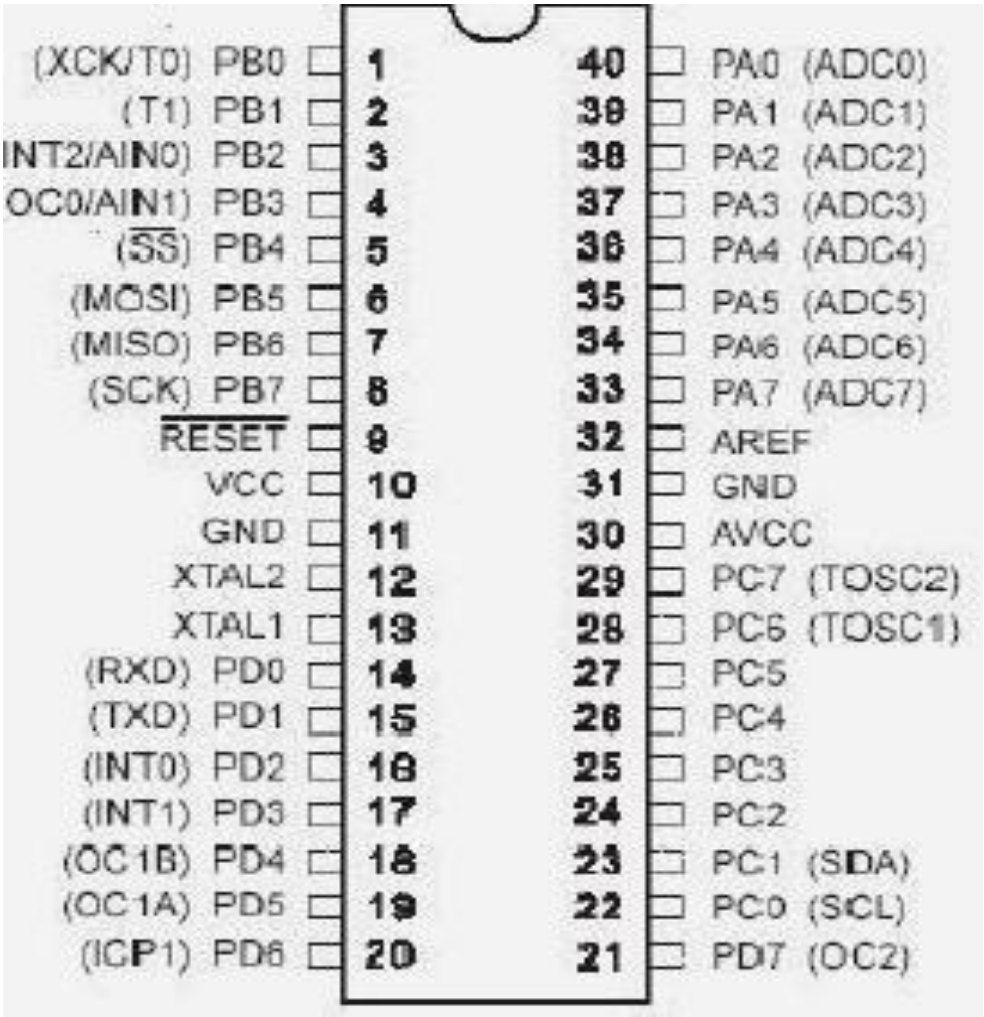

FIGURE 5: PIN DIAGRAM OF ATMEGA-16

PIN DESCRIPTION OF ATMEGA 16

Pin No.	Pin name	Description	Alternate Function
1	(XCK/T0) PB0	I/O PORTB, Pin 0	T0: Timer0 External Counter Input. XCK : USART External Clock I/O
2	(T1) PB1	I/O PORTB, Pin 1	T1:Timer1 External Counter Input
3	(INT2/AIN0) PB2	I/O PORTB, Pin 2	AIN0: Analog Comparator Positive I/P INT2: External Interrupt 2 Input
4	(OC0/AIN1) PB3	I/O PORTB, Pin 3	AIN1: Analog Comparator Negative I/P OC0 : Timer0 Output Compare Match Output
5	(SS) PB4	I/O PORTB, Pin 4	In System Programmer (ISP) Serial Peripheral Interface (SPI)
6	(MOSI) PB5	I/O PORTB, Pin 5	
7	(MISO) PB6	I/O PORTB, Pin 6	
8	(SCK) PB7	I/O PORTB, Pin 7	
9	RESET	Reset Pin, Active Low Reset	-
10	Vcc	Vcc = +5V	-
11	GND	GROUND	
12	XTAL2	Output to Inverting Oscillator Amplifier	
13	XTAL1	Input to Inverting Oscillator Amplifier	
14	(RXD) PD0	I/O PORTD, Pin 0	USART Serial Communication Interface
15	(TXD) PD1	I/O PORTD, Pin 1	
16	(INT0) PD2	I/O PORTD, Pin 2	External Interrupt INT0
17	(INT1) PD3	I/O PORTD, Pin 3	External Interrupt INT1
18	(OC1B) PD4	I/O PORTD, Pin 4	PWM Channel Outputs
19	(OC1A) PD5	I/O PORTD, Pin 5	

20	(ICP) PD6	I/O PORTD, Pin 6	Timer/Counter1 Input Capture Pin
21	PD7 (OC2)	I/O PORTD, Pin 7	Timer/Counter2 Output Compare Match Output
22	PC0 (SCL)	I/O PORTC, Pin 0	TWI Interface
23	PC1 (SDA)	I/O PORTC, Pin 1	
24	PC2 (TCK)	I/O PORTC, Pin 2	JTAG Interface
25	PC3 (TMS)	I/O PORTC, Pin 3	
26	PC4 (TDO)	I/O PORTC, Pin 4	
27	PC5 (TDI)	I/O PORTC, Pin 5	
28	PC6 (TOSC1)	I/O PORTC, Pin 6	Timer Oscillator Pin 1
29	PC7 (TOSC2)	I/O PORTC, Pin 7	Timer Oscillator Pin 2
30	AVcc	Voltage Supply = Vcc for ADC	
31	GND	GROUND	
32	AREF	Analog Reference Pin for ADC	
33	PA7 (ADC7)	I/O PORTA, Pin 7	ADC Channel 7
34	PA6 (ADC6)	I/O PORTA, Pin 6	ADC Channel 6
35	PA5 (ADC5)	I/O PORTA, Pin 5	ADC Channel 5
36	PA4 (ADC4)	I/O PORTA, Pin 4	ADC Channel 4
37	PA3 (ADC3)	I/O PORTA, Pin 3	ADC Channel 3
38	PA2 (ADC2)	I/O PORTA, Pin 2	ADC Channel 2
39	PA1 (ADC1)	I/O PORTA, Pin 1	ADC Channel 1
40	PA0 (ADC0)	I/O PORTA, Pin 0	ADC Channel 0

TABLE 1: PIN DESCRIPTION OF ATMEGA 16

3.3.2 **Features of AtMega 16**

- It has High performance and consumes low power.
- It is a 8-bit Microcontroller
- It shows Advanced RISC Architecture
  - supports 131different instructions
  - 32 x 8 General Purpose Registers (GPRs)
  - Shows very high speed of about 6 MIPS
  - Shows complete Static Operation

- Program and Data Memories (Nonvolatile)
  - It has a Flash memory of 16k Bytes
  - Optional Boot Code Section with Independent Lock Bits
  - Has a EEPROM capacity of 512K Bytes
  - Software Security is enhanced by Programming Lock

- Salient and additional Features
  -It has an on chip Analog Comparator
  - It supports Programmable Watchdog Timer with a Seperate On-chip Oscillator
  - Master/Slave SPI Serial Interface on PORT C.
  - Two 8-bit Timer/Counters
  - One 16-bit Timer/Counter with Seperate Pre-scalar, Compare and Capture mode
- I/O and Packages
  - It has a 32 Programmable I/O Lines feature
  - 40-pin PDIP(dual inline package), 44-lead TQFP, and 44-pad MLF
- Voltage requirement
  - It operates at an input voltage of 4.5-5.5V
- Operating Frequency
  - 0-16 MHz for ATmega16
- Power Consumption at 4 MHz, 3V, 35 °C
  - In Active mode it consumes a current of about 1.1mA

- In Idle Model it has a current ratings of 0.35mA
- In a Power-down Mode it consumes a current of less than 1µA
- Real Time Counter with Separate Oscillator
- 4 Pulse Width Modulator Channels
- 8-channel
-10-bit Analog to Digital Converter
- Byte-oriented Two-wire Serial Interface
- Programmable Serial USART

Special Mircocontroller Features

- Power-on Reset and Programmable Brown-out Detection
- Internally Calibrated RC Oscillator
- External and Internal Interrupt Sources
- Six Sleep Modes are present in this microcontroller which are Idle mode, ADC Noise Reduction mode, Power-saving mode, Power-down mode, Standby mode, and Extended Standby .

3.3.3 PIN Description of ATmega-16

- **I/O PORTS-** It consist 32 I/O Pins which are dual in nature, Dual in nature means that every pins is used for dual purpose, every pin has two functions it depends on the port which port we are using**.**

- **Analog to Digital Converter-**These pins are fabricated in PORTA. There are 8 no. of pins are present in PORTA .These pins are used to convert analog to digital data. The analog sensors are used these pins to send the information to the controller because microcontroller understands only digital language which means 0&1.

- **INT0/INT1-**These pins are used for the acknowledgement of signal to peripheral from microprocessor that when it is free to give the service.

- **VCC-I**t is the pin for the power supply of microcontroller.Atmega-16 works at 5V .Exceeding this voltage ,the controller will be damage.

- **RESET-**Reset pin is used to reset the microcontroller .It is an active low pin so it will be activated at low signal.

- **AVCC-**Analog VCC microcontroller has ADC pins for those pins we need a power supply of analog nature**.**

- **AREF-**It is analog reference voltage pin.It is again used for ADC purpose

- **XTAL1/XTAL2-**These are external oscillators microcontroller has 1MHz internal frequency .we can connect an external oscillator to generate higher frequency and clock pulses.

- **RXD/TXD-** RXD is used for the Receiving of Data (data I/p for USART). TXD is used for the Transmit Data (Data O/P for the USART).

3.4 CRYSTAL OSCILLATOR

A crystal oscillator is an electronic circuit that produces oscillations and works on the mechanical resonance produced by a vibrating crystal of piezoelectric material to create an electrical signal with a very accurate frequency. The generated frequency is used to provide clock to the microcontroller or to any other digital circuit, and to stabilize frequencies for radio transmitters and receivers.

Quartz crystals can be designed for frequencies ranging from a few kilohertz to hundreds of megahertz. The applications of the crystal oscillator includes circuitries such as wristwatches, clocks, radios, computers, cell phones ,test and measurement equipment such as counters, signal generations instruments, and oscilloscopes.

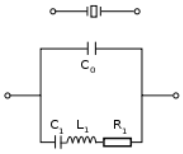

FIGURE 6:SCHEMATIC DIAGRAM OF CRYSTAL OSCILLATOR

3.5 LCD (LIQUID CRYSTAL DISPLAY)

It is the display device used to display the concentration of the LPG gases in the atmosphere .Also in case of fire breakage it shows the detection of fire We have used only one LCD to make the project economical ,but at the same time the LCD can be connected to any of the nodes because the program is burned in both the microcontrollers.

3.5.1PIN DESCRIPTION OF LCD

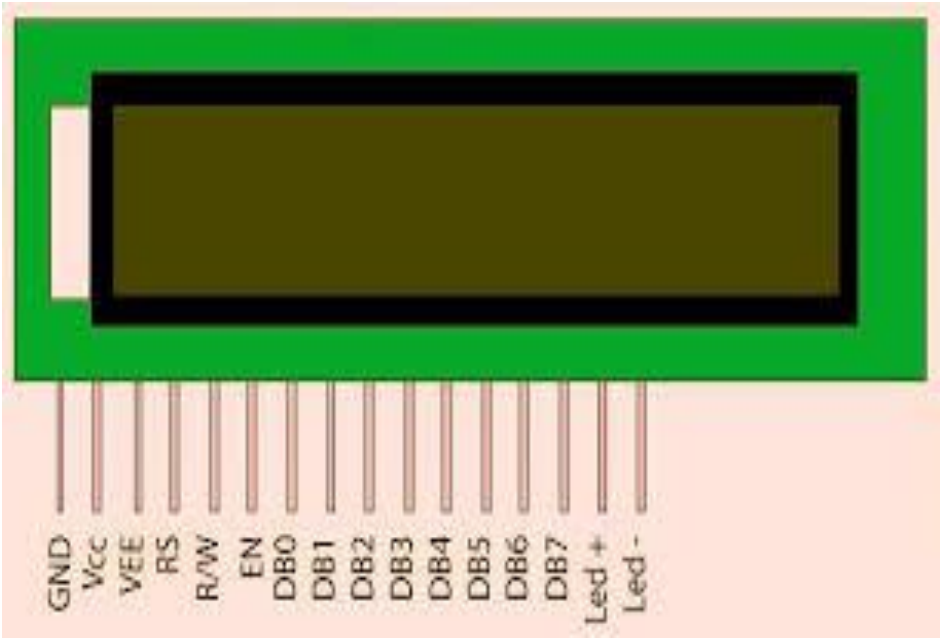

FIGURE 7: PIN DIAGRAM OF A LCD

Pin No.	Name	Description
1	VSS	GND
2	VCC	+5V
3	VEE	Contrast adjust
4	RS	0 = Command register 1 = Data register
5	R/W	0 = Write to LCD module 1 = Read from LCD module
6	EN	Enable
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)

TABLE 2 :PIN DESCRIPTION OD LCD

3.6 RF Module

RF modem works at an input frequency of 2.4 GHz in half duplex mode with easy switching of receive/transmit mode. The module Receives and Transmits serial data which can be adjusted to different baud rates of 9600/4800/2400/19200 bps working at 5V or 3V level. It can be directly interfaced to microcontrollers. RF modem supports applications that need wireless data transmission from both the sides. It features include very high speed and longer transmission distance. The communication protocol is self controlled .

3.6.1 Features of RF module

- The most important feature of a RF module is that has no need for manual switching between TX and RX mode.
- It follows FSK technology , also it works in half duplex mode, unaffected by interference.

- 2.4 GHz frequency band.
- Self controlled protocol translation, easy to use.
- High sensitivity to data, secured and higher transmission range.
- Standard UART interface, works on TTL (3-5V) logic level.
- Stable, small size, easier mounting.
- It requires no outside tuning for data, Phase Locked Logic based self tuned.
- Error checking of data is in built.

3.6.2 Application of RF Module

- Sensor Networks such as transmission of any unnatural undesired happening .
- Wireless metering.
- Identity discrimination by more secured systems
- Home appliance such as automatic turning on of an A.C.
- Smart house products / Security Systems
- Remote control used in cars or television.
- Weather stations

3.6.3Specifications of RF Module

- Working voltage range between 4.5 to 9V (Typical 5V)
- Adjustable UART baud rate (8 bit data, no parity, 1 stop bit) 9600/4800/2400/19200 bps
- Operating Frequency 2.4 GHz
- Output RF Power 1 dBm.
- Typical Operating Range: 30-50 meters

FIGURE 8 :RF MODULE

3.6.4Pin description of RF Module

RXD (Receive Input).Connected to TXD pin 11 of microcontrollers.

TXD (Transmit Output) connected to RXD pin 10 of microcontrollers

+5V : 5V supply input.

GND : Ground level of power supply.

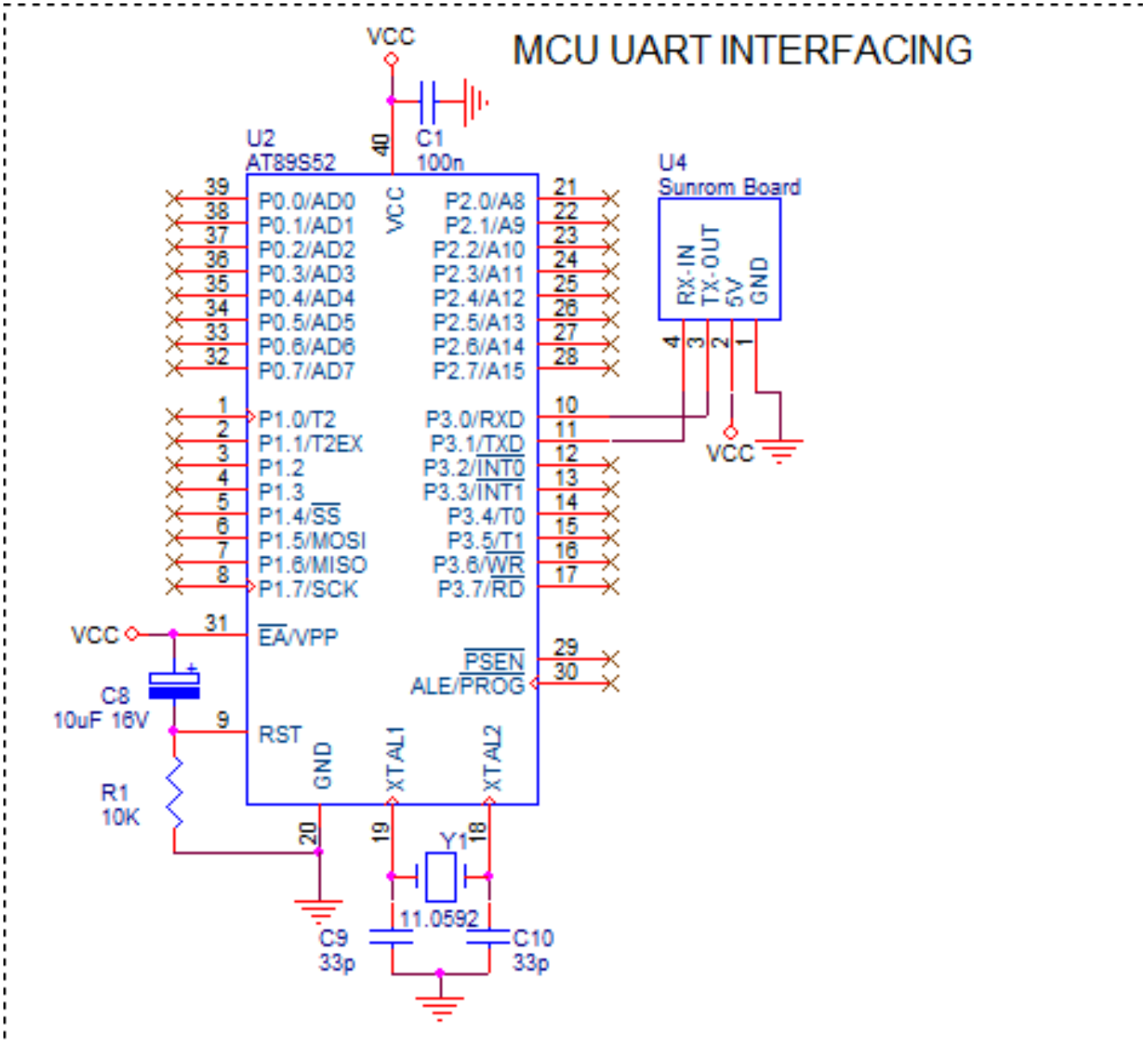

FIGURE 9: USB INTERFACING OF RF MODULE WITH MICROCONTROLLER BOARD

3.7 LPG SENSOR

Used in gas leakage detecting equipments for detecting of Liquid Petroleum Gases, Iso-butane, propane, LNG combustible gases. The sensor is not affected by the presence of levels of alcohol, cooking fumes and cigarette smoke.

- Analog output connected to ADC port of microcontroller .
- It shows high sensitivity to LPG, iso-butane, propane
- Little or no sensitivity to alcohol or smoke
- It shows a fast response to the unfavorable conditions.
- Longer detection range.
- Stable performance and long life.

3.8 FIRE SENSOR

The Fire sensor is used for protection against fire. It is an event based sensor and sends a 1 as output in case of fire breakage .The range of this fire sensor is 1 meter and it uses the principle of IR sensor and comparator to detect the presence of fire. The weight of this module is about 5 grams and can be easily mounted on the node. It gives a high output on detecting fire. A LED is also provided on the sensor board for visual indication.

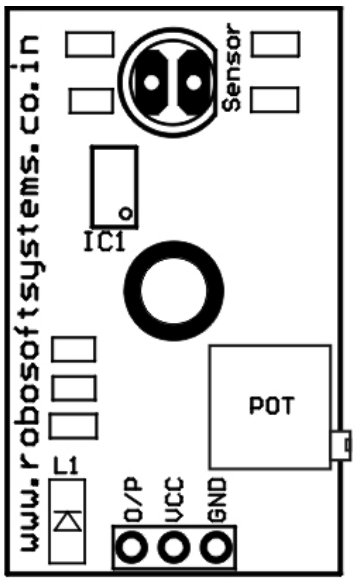

FIGURE 10:FIRE SENSOR

3.9 RESISTOR

Resistor is an electrical component that obstructs the flow of current and also provides the specific voltage. In case of DC the, current is inversely proportional to the resistance, and directly proportional to the voltage of the system, this is **Ohm's Law**. In Case of (AC) circuits, this rule is applicable only when the resistance does not include any inductance or capacitance. The common type of electronic devices and systems is the "carbon composite material".

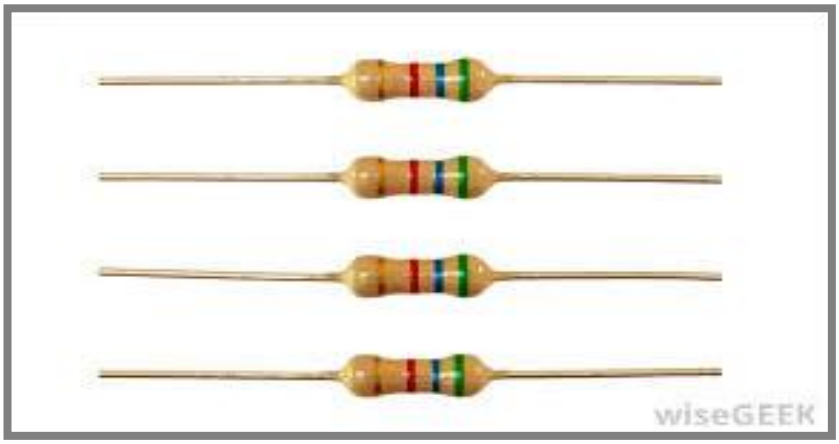

FIGURE 11: RESISTORS

A different type of resistor is fabricated by winding Nichrome or similar wire on an insulating form. This type of a resistor is known as a wire wound resistor, and it is able to withstand greater amounts of currents than a carbon-composition resistor .As the wire is wound into a coil, the component works as an inductors as well as exhibiting the properties of resistance.

3.10 CAPACITOR

Capacitor is a electronic component which stores energy in the form of an electrostatic field. In its simplest form, a capacitor is made up of two metallic plates separated by an insulating material which is known as a dielectric. The Capacitance of a component is directly proportional to the surface area of the two plates, and is inversely proportional to the distance maintained between the plates. The dielectric constant of the material

separating the plates is also an important parameter for calculating the capacitance of the component .

The unit of capacitance is the farad. It is a large unit however the common units are microfarad, μF (1 μF =10^{-6}F) and Picofarad, pF (1 pF = 10^{-12} F).

FIGURE 12:DIFFERENT TYPES OF CAPACITORS

Capacitors can be fabricated onto integrated circuit chips. They are applied in dynamic random access memory (DRAM) with transistor circuitry. The capacitors are used for retaining the contents of the memory.

3.10.1USES OF CAPACITORS:

Most of capacitors are used in fabrication of the power supply of electronic devices which includes computers and other microcontroller based equipments. The application of capacitors in such systems is to reduce the ripple factor and to convert the pulsating D.C. source into almost purified D.C. input.

3.11 DIODE

A diode is an electronic component which consist two electrodes terminal known as an *anode* and *cathode*. Diodes are mostly made up of semiconductor materials because its properties are appropriate according to the needs of the characteristics.

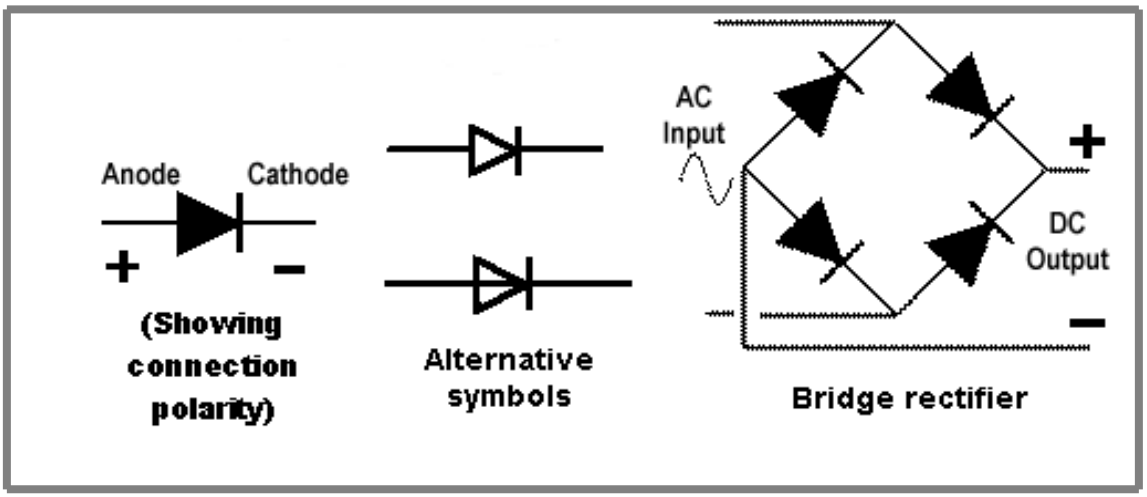

FIGURE 13: USE OF DIODE FOR RECTIFICATION

If a diode is made up of metallic electrodes then it is to be done in a chamber full of inert gas at low pressure .

3.11.1 APPLICATIONS OF DIODES :

Diodes works as rectifiers to convert A.C. to D.C., signal limiters, voltage regulators, switches, signal modulators and demodulators , signal mixers, and oscillator circuits .

A diode conducts current in only one direction which is known as the forward bias condition and this occurs only when the cathode is negatively charged with respect to the anode

The diode does not conduct current if the cathode is at a positive voltage with respect to the anode or if it is negative relative to the anode by a voltage lesser than the forward breakover voltage. The value of forward breakover voltage is approximately 0.6 V for silicon devices and 0.3 V for germanium devices, and 1 V for selenium devices.

If a sudden high positive is given to the cathode relative to the anode , the diode will conduct current and this phenomenon is known as the *avalanche voltage*, changes .
The avalanche voltage can vary between a few volts to several hundred volts.

3.12 LIGHT EMITTING DIODES (LED)

A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current is made to pass through it. The light in LED is not that much bright and is emitted only at a specific wavelength in most LEDs i.e. it is monochromatic in nature. The output from an LED can range from red (700 nanometers) to blue-violet (about 400 nanometers). There are different kinds of LEDs out of one which emits infrared waves (830 nm or longer); this type of components are known as an *infrared-emitting diode* (IRED).

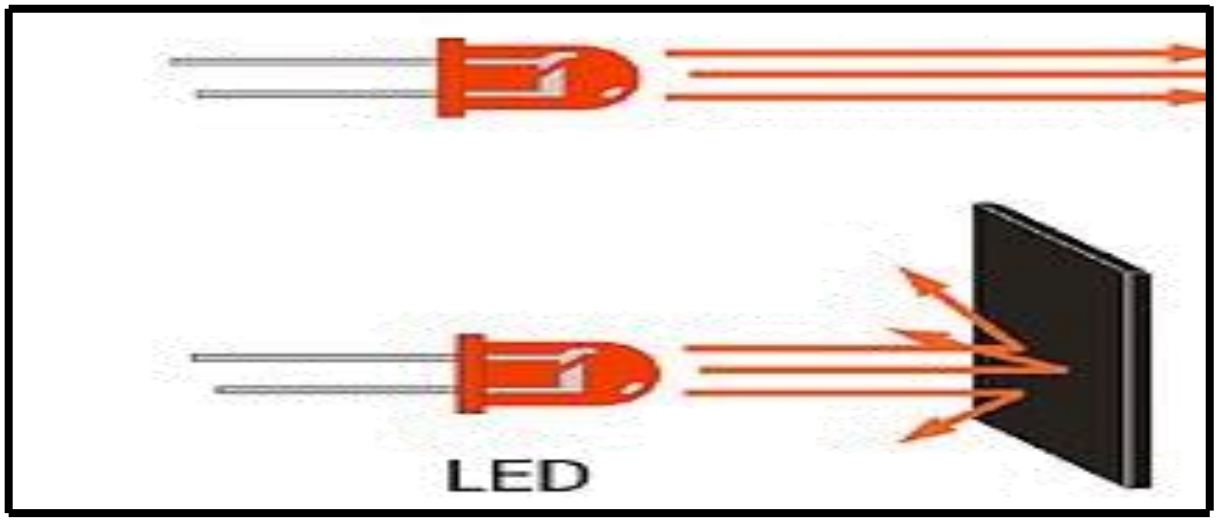

FIGURE 14: LED

An LED is composed of two kinds of materials which is of n-type and p-type semiconductors. When these two materials are placed in direct contact , a PN junction is formed which when given a supply voltage conducts current and emits light. The LED is transparently packed such as to allow light to pass through it.

3.13 BATTERY

Alkaline type of battery has been used.
The chemicals used in this battery is Zinc Manganese oxide.
It has a shelf life of 5 years at 21 C.
Metal outer frame.
Operating temperature range lies between -18 C to 55 C
It weighs around 46 grams.
Its output Voltage is 9v

FIGURE 15: BATTERY 9V

3.14 RELAY:

A relay is a switch operated by electrical contact. Relays employ an electromagnet to operate a switch mechanically, but many other operating technologies or methods can also be used for fabrication of a relay, such as solid state relay. Relays have applications where it is necessary to control a circuit derived by an input of low power or where a week signal is obtained which has to be further connected to a peripheral output device. The primitive relays were applied in long distance circuits as amplifiers to repeat the

signal coming out from one circuit and to transmit it to some other circuit for amplification of the week signal. The above given application of a relay can be used in telephone exchanges for long distance calls to take place.

FIGURE 16: SIMPLE ELECTROMECHANICAL RELAY.

Simple electromechanical relay can handle large amounts of power required to run an electric motor which is called a contactor. Solid state relay control power circuits by using a switch made up of a semiconductor material rather than using moving parts. Relays with predefined characteristics are chosen according to the needs of the circuit and also to protect the circuit from any kind of overload of excessive heat buildup. These kind of relays are known as protective relays and they literally protect the circuit from electrical faults.

3.14.1 Types of Relays:

- **Latching relay**

Latching relay maintains its contact position even if no power is applied to the coil. The advantage of latching coil is that it consumes power only when relay is in working mode and relay contacts stay in this position even in a case of power outage.

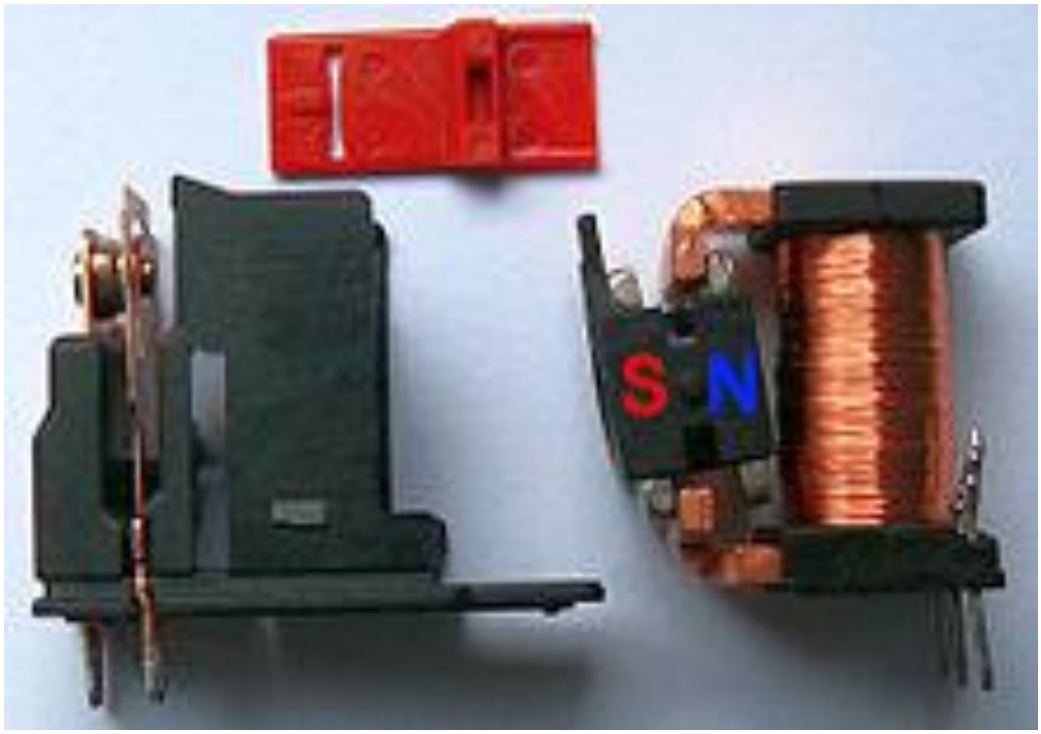

FIGURE 17 : LATCHING RELAY

The mechanism of latching relay is that it consists of two opposing coils connected by a permanent magnet which holds the contacts in position even after the coil is de-energized. If an input is given to any of the coils the relay is switched on whereas when the input is given to the second coil the relay is switched off. This type is widely used where control is from simple switches or single-ended outputs of a control system, the application of latching relays are found in avionics , an earth leakage circuit breaker and numerous industrial applications.

- **Reed relay :**

A reed relay is a reed switch enclosed in a solenoid. To protect the reed switch from any kind of atmospheric hindrance it is placed inside a glass tube having an evacuated or inert gas environment .The contacts are made of magnetic material that makes them move under the effect of a magnetic field of the present solenoid or an external magnet.

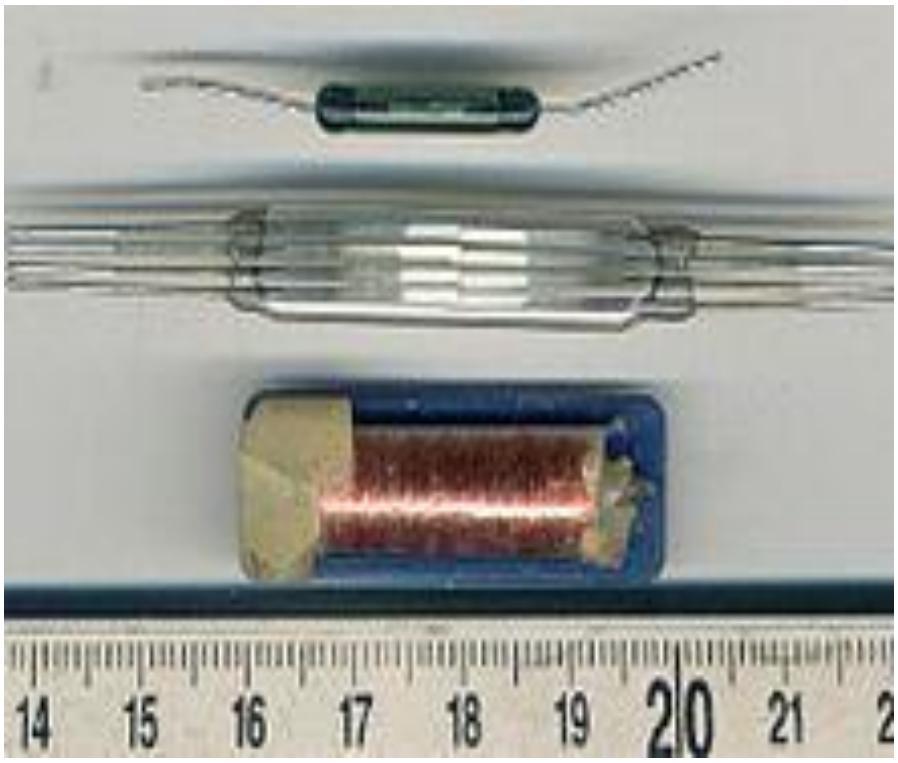

FIGURE 18 :REED SWITCHES AND REED RELAYS

Reed relays have faster switching response.

Require very little power from the control circuit.

They have low switching current and voltage ratings.

- **Mercury-wetted relay:**

A mercury-wetted reed relay is a type of reed relay in which the contacts are coated with mercury. A mercury wetted relay is employed to switch low-voltage signals because mercury is a material which reduces the contact resistance and thus the associated potential, for low-current signals These relays are expensive and toxic as well thus they are uncommon.

FIGURE 19: MERCURY WETTED RELAY

The mercury wetted relay are not much stable.

- **Mercury relay**

A mercury relay is a relay that uses mercury as the switching element. It is used where contact erosion would be a problem for conventional relay contacts. This kind or relay is not used much due to unavailability of mercury.

- **Polarized relay**

A **polarized relay** places the armature between the poles of a permanent magnet to increase its sensitivity. Polarized relays were earlier used for the detection of faint telephonic pulses and correct graphical distortion.

- **Machine tool relay**

A **machine tool relay** is a type of relay which is mostly used in industries for control processes. These have a large number of contacts which can be easily transitioned from normally-open to normally-closed status. These relays are of utmost importance in automation industries as they drive the PLCs.

- **Coaxial relay**

This kind of relay performs the task of switching the antenna from receiver to the transmitter when the antenna has the capability of behaving as receiver and transmitter both.

- **Time delay**

Relays having the characteristics to delay an operation are known as time delay relays. For a very short delay a copper disk is used whereas for a slightly larger delay, a dashpot is used. The time period for the delay can be varied by varying the flow rate of the dashpot used for delay. Modern microprocessor-based timing relays provide precision timing for a greater range of values.

- **Contactor**

A **contactor** is a type of relay used for working with electric motors and lighting loads, but these are not generally called as relays. High-current contacts are made with alloys containing silver.

A contactor is similar to a relay the only difference being that it is used for switching a power circuit with higher current rating. A contactor is controlled by a circuit which has a much lower power level than the switched circuit.

- **Solid-state relay:**

A **solid state relay** is a solid state electronic component that uses power transistors like thyristor or TRIAC instead of any magnetic material .They provides the same function as an electromechanical relay but does not have any moving parts

A SSR has low current handling capabilities because of the small potential difference. The minimum voltage drop depends on the material of the relay. Solid-state relays operating at 1,200 amperes have become commercially available. They can be suspected to get damaged by cosmic rays.

- **Solid state contactor relay**

A **solid state contactor** is a solid state relay working on high power ratings but including the necessary heat sink.These relays are used where frequent on/off mechanism is required, for example electric heaters, small electric motors, and lighting loads. They can get activated by AC signals or DC control signals from a Programmable logic controller (PLCs).

- **Buchholz relay**

A **Buchholz relay** is a device used for safety purposes by sensing the accumulation of gas in large oil-filled transformers, which will alarm on slow accumulation of gas or shut down the transformer if gas is produced rapidly in the transformer oil.

- **Forced-guided contacts relay**

  A **forced-guided contacts relay** has relay contacts that are mechanically linked together, so that when the relay coil is energized or de-energized, all of the linked contacts move together. If one set of contacts in the relay becomes immobilized, no other contact of the same relay will be able to move. The function of forced-guided contacts is to enable the safety circuit to check the status of the relay.

  A relay with several normally open (NO) contacts may stick when energised, with some contacts closed and others still slightly open, due to mechanical tolerances. Similarly, a relay with several normally closed (NC) contacts may stick to the unenergised position, so that when energised, the circuit through one set of contacts is broken, with a marginal gap, while the other remains closed.

- **Overload protection relay**

  The relays have applications when electric motors need over current protection to prevent damage from over-loading the motor, or to protect against short circuits in circuit or internal faults in the motor winding. The overload sensing devices are a form of heat operated relay where a coil heats a bimetallic strip, or where a solder pot melts, releasing a spring to operate auxiliary contacts. These auxiliary contacts are in series with the coil. If the overload senses excess current in the load, the coil is de-energized.

- **Vacuum relays**

  It is a very sensitive relay therefore it has its contacts mounted in a highly vacuum environment in a glass housing, such as to allow handling of radio-frequency voltages as large as 25,000 volts without flashover between contacts.

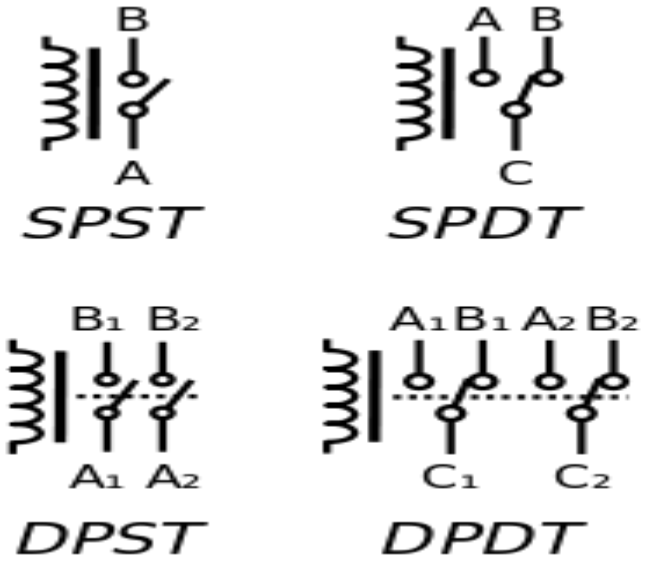

FIGURE 20: CIRCUIT SYMBOL OF RELAYS

Normally-open (NO) contacts connects the circuit when the relay is activated; the circuit is disconnected when the relay is not working

Normally-closed (NC) contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive

.

The following designations are commonly encountered:

- **SPST** – Single Pole Single Throw. These have two terminals which can be connected or disconnected. It has 4 terminals in total ,two being those of the coil .
- **SPDT** – Single Pole Double Throw. A common terminal connects to either of two others. Including two for the coil, it has five terminals in total.
- **DPST** – Double Pole Single Throw. These have two pairs of terminals. It is an equivalent to two SPST switches or relays actuated by a single coil. Including two for the coil, such a relay has six terminals in total.

- **DPDT** – Double Pole Double Throw. It Is similar to two SPDT switches or relays actuated by a single coil. Such a relay has eight terminals, including the coil.

3.15 TRANSISTOR BC 547:

A BC547 transistor is a NPN transistor thathas many applicationns. Integrating it with several other components, such as resistors, and capacitors, it can be used as an active component for switches and amplifiers. Like all other NPN transistors, this type of transistor also has 3 terminals which are as follows: an emitter terminal, a base terminal, and a collector terminal. In a typical transistor, the current flows from the base to the emitter and controls the current flowing from the collector region.

There are various types of transistors, in which the BC547 is of bipolar junction transistor (BJT) type.

The negative material inside an NPN transistor has an excess of electrons, while the positive material has a lack of electrons or excess of vacancy in place of electrons(holes), and this is achieved by a contamination process known as doping.

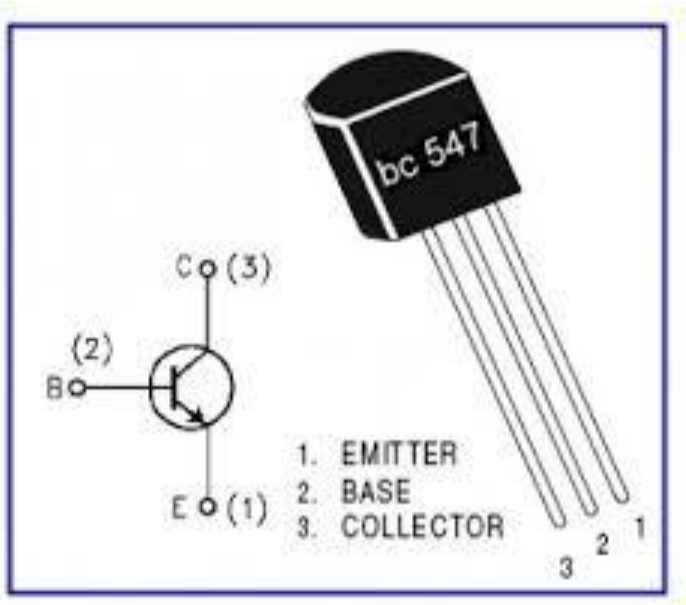

FIGURE 21: BC 547

3.16 Fast silicon rectifier diodes BY 399

It has a Forward Current rating of 3 A

Its Reverse Voltage range is 100 to 800 V

3.17 PRINTED CIRCUIT BOARD

A PCB connects electronic elements through semi conductive tracks, pdsa and alternative options graven from copper sheets laminated onto a non-conductive substrate. PCBs are often single sided, double sided or multi-layer. Conductors on completely different layers are connected with plated-through holes referred to as vias. Advanced PCBs could contain elements such as capacitors, resistors or active devices embedded within the substrate.

Alternatives to PCBs include wire wrap and point-to-point construction. PCBs need the extra style effort to get out the circuit however producing and assembly are often automatic. Producing circuits with PCBs is cheaper and quicker than with alternative wiring strategies as elements area unit mounted and wired with one single half.

DESIGN

A PCB inhabited with electronic elements is named a computer circuit assembly (PCA), computer circuit board assembly or PCB assembly (PCBA). The term PCB is employed informally for clean and assembled boards.

Initially PCBs were designed manually by making a photomask on a transparent plastic sheet, typically at a pair of or four times verity size, ranging from the schematic diagram the element pin pads were arranged out on the plastic and so traces were routed to attach the pads.. Traces were created with self-adhesive tape. To fabricate the board the finished photomask was photolithographically reproduced on resist coated on the blank copper-clad board. Nowadays PCB's square measure designed with dedicated layout software package, typically within the following steps.

- Schematic capture through an electronic style automation (EDA) tool.

- The position of the parts and warmth sinks square measure determined.

- Layer stack of the PCB is determined, with one to tens of layers counting on quality. Ground and power planes square measure determined. An influence plane is that the counterpart to a ground plane and behaves as an AC signal ground whereas providing DC power to the circuits mounted on the PCB. Signal interconnections square measure derived on signal planes. Signal planes will be on the outer in addition as inner layers. For optimum EMI performance high frequency signals square measure routed in internal layers between power or ground planes.

- Line electric resistance is set victimization stuff layer thickness, routing copper thickness and trace-width. Trace separation is additionally taken under consideration just in case of differential signals. Components square measure placed. Thermal issues and pure mathematics square measure taken under consideration. Vias and lands square measure marked. Signal traces square measure routed. Electronic style automation tools typically produce clearances and connections in power and ground planes mechanically.

- Gerber files square measure generated for producing.

MANUFACTURING

PCB production includes Manufacturing process starting from the PCB fabrication information generated by CAD. The subsequent functions Input of the Gerber data. Output of the digital tools are copper patterns, solder resist image, legend image, drill files, automatic optical review information and electrical check files. Typically a panel consists of one style however multiple styles area unit can be fixed on one panel. There are two sorts of panels: assembly panels - usually known as arrays - and vacant board producing panels. The vacant board are manufactured invariably using panels, so a

producing panel will incorporate a group of individual PCBs or of arrays, looking on what should be delivered. The panel is eventually broken apart into individual PCBs; this is often known as depaneling. Separating the individual PCBs is often motor-assisted by drilling or routing perforations on the boundaries of the individual circuits. Today depaneling is commonly done by lasers that cut the board with no contact.

COPPER PATTERNING

The first step is to copy the pattern within the fabricator's CAM system on a protecting mask on the copper foil PCB layers. Subsequent etching removes the unwanted copper .This method is additionally employed in the manufacture of hybrid circuits .The patterning technique rely on volume and other determination necessities. Silk screen printing uses etch-resistant inks to make the protecting mask. Photoengraving uses a photomask and developer by selection take away a UV-sensitive photoresist coating and so produce a photoresist mask.

PCB edge uses a 2 or three-axis mechanical edge system to mill away the copper foil from the substrate. A PCB miller operates in an exceedingly similar way as a plotter, receiving commands from the host package that manages the position of the edge head within the x, y, axis .Spray black paint onto copper clad laminate, place into CNC optical maser plotter. The optical maser raster-scans the PCB and ablates (vaporizes) the paint wherever no resist is needed. The method chosen depends on the quantity of boards to be made.

SILK SCREEN PRINTING

Print onto clear film and use as icon mask together with photo-sensitized boards. (i.e., pre-sensitized boards), then etch.

CHEMICAL ETCHING

Chemical etching is typically done with the help of finished ammonium ion persulfate or metallic element chloride. For PTH (plated-through holes), extra steps of electroless deposition are to be taken when the holes are trained, then copper is electroplated to make up the thickness, the boards are screened, and plated with tin/lead.

The simplest methodology, used for small-scale production and sometimes by hobbyists ,is immersion etching, within which the board is submerged in etching resolution like metallic element chloride. Compared with strategies used for production, the etching time is long. Heat and agitation will be applied to the bathtub to hurry the etching rate. In bubble etching, air undergoes the etchant bathtub to agitate the answer and speed up etching. Splash etching uses a motor-driven paddle to splash boards with etchant; the method has become commercially obsolete since it's not as quick as spray etching. In spray etching, the etchant resolution is distributed over the boards by nozzles, and recirculated by pumps.

As a lot of copper is consumed from the boards, the etchant becomes saturated and fewer effective; different etchants have different capacities for copper, with some as high as one hundred fifty grams of copper per cubic decimeter of resolution. The etchant removes copper on all surfaces exposed by the resist. "Undercut" happens once etchant attacks the skinny fringe of copper below the resist; this could scale back conductor and cause open-circuits. Careful management of print time is needed to forestall undercut. Wherever aluminous plating is employed as a resist, it will "overhang" which may cause short-circuits between adjacent traces once closely spaced. Overhang will be removed by wire-brushing the board when etching. The inner layers are given a whole machine review before lamination as a result of subsequently mistakes can't be corrected. The automated optical review system scans the board and compares it with the digital image generated from the first style knowledge.

LAMINATION

Multi-layer computer circuit boards have trace layers within the board. A technique to create a 4-layer PCB is to use a two-sided copper-clad laminate, print the electronic equipment on either side, then laminate to the highest and bottom layers and copper foil. Lamination is finished by putting the stack of materials in an exceedingly press and applying pressure and warmth for an amount of time. This ends up inassociate degree indivisible one piece product. It is then trained, plated, and graven once more to induce traces on prime and bottom layers. Finally the PCB is roofed with solder mask,

marking legend, and a surface end is also applied. Multi-layer PCBs provide abundant higher element density.

DRILLING

Holes through a PCB are generally trained with small-diameter drill bits manufactured from solid coated atomic number 74 inorganic compounds. Coated atomic number 74 inorganic compounds is usually recommended since several board materials are terribly abrasive and drilling should be high rev and high feed to be price effective. Drill bits should additionally stay sharp therefore as to not mar or tear the traces. Drilling with high-speed-steel is solely not possible since the drill bits can uninteresting quickly and so tear the copper and ruin the boards. The drilling is performed by machine-driven drilling machines with placement controlled by a drill tape or drill file. These computer-generated files are referred to as numerically controlled drill (NCD) files or "Excellon files".

Holes is also created conductive , by electroplating or inserting metal eyelets (hollow), to electrically and thermally connect board layers. \
When terribly little vias are needed, drilling with mechanical bits is dear attributable to high rates of wear and tear and breakage. During this case, the vias is also optical device drilled—evaporated by lasers. Laser-drilled vias generally have associated degree inferior surface end within the outlet. These holes are referred to as small vias. It is additionally potential with controlled-depth drilling, optical device drilling, or by pre-drilling the individual sheets of the PCB before lamination, to supply holes that connect just some of the copper layers, instead of passing through the complete board. The hole walls for boards with two or a lot of layers will be created conductive and so electroplated with copper to make plated-through holes. These holes electrically connect the conducting layers of the PCB. For multilayer boards, those with three layers or a lot of, drilling generally produces a smear of the heated composition product of bonding agent within the laminate system. Before the holes will be plated through, this smear should be removed by a chemical de-smear method, or by plasma-etch. The de-smear method ensures that a decent association is created to the copper layers once the

outlet is plated through. On high dependability boards a method referred to as etch-back is performed with chemicals with a permanganate of potash based mostly etchant or plasma. The etch-back removes organic compound and also the glass fibers in order that the copper layers extend into the outlet.

PLATING AND COATING

PCBs are plated with solder, tin, or gold over nickel as a resist for etching away the supererogatory.

After PCBs are graven and so rinsed with water, the solder mask is applied, and so any exposed copper is coated with solder, nickel/gold, or another anti-corrosion coating. Matte solder is typically coalesced to produce an improved bonding surface or stripped to reveal copper.Treatments, like benzimidazolethiol, forestall surface chemical reaction of vacant copper. Historically, any exposed copper was coated with solder by hot air solder levelling (HASL). The HASL end prevents chemical reaction from the underlying copper, thereby guaranteeing a solderable surface. This solder was a tin-lead alloy, but new solder compounds are currently accustomed win compliance with the RoHS directive within the EU and U.S., that restricts the employment of lead. One in all these unleaded compounds is SN100CL, created of 99.3% tin, 0.7% copper, 0.05% nickel, and anominalof60ppm semiconductor.

Other plating used are OSP (organic surface protectant), immersion silver (IAg), immersion tin, electroless nickel with immersion gold coating (ENIG), electroless nickel electroless Pd immersion gold (ENEPIG) and direct gold plating (over nickel). Edge connectors, placed on one fringe of some boards, are typically nickel plated then gold plated. Another coating thought is speedy diffusion of coating metal into Tin solder. Tin forms intermetallics like Cu5Sn6 and Ag3Cu that dissolve into the Tin liquidus or solidus(@50C).

Electrochemical migration (ECM) is that the growth of conductive metal filaments on or in an exceedingly computer circuit board (PCB) under the influence of a DC voltage bias. Silver, zinc, and atomic number 13 are well-known to grow whiskers below the influence of an electrical field. Silver additionally grows conducting surface ways within the presence of salt and alternative ions, creating it a poor selection for physical

science use. Tin can grow "whiskers" owing to tension within the plated surface. Tin-Lead or Solder plating additionally grows whiskers, solely reduced by the proportion Tin replaced. Reflow to soften solder or sheet metal to alleviate surface stress lowers whisker incidence. Another coating issue is tin disease, the transformation of tin to a powdery element at temperature.

SOLDER RESIST APPLICATION

Areas that ought not to be soldered are also coated with solder resist (solder mask). One of all the foremost common solder resists used these days is termed LPI (liquid photoimageable).A photograph sensitive coating is applied to the surface of the PWB, then exposed to light-weight through the solder mask image film, and at last developed wherever the unexposed areas are washed away. Dry film solder mask is comparable to the dry film accustomed image the PWB for plating or etching. While being laminated to the PWB surface it is imaged and developed as LPI. Once common however now not normally used attributable to its low accuracy and backbone is to screen print epoxy ink. Solder resist additionally provides protection from the atmosphere.

LEGEND PRINTING

A legend is commonly written on one or either side of the PCB. It contains the element designators and the switch settings .There are 3 strategies to Y print the legend.

Silk screen printing epoxy ink was the established methodology. It absolutely was therefore common that legend is commonly misnamed silk or silkscreen. Liquid photograph imaging may be a better methodology than screen printing. Unpopulated boards are sometimes bare-board tested for "shorts" and "opens". A brief may be a association between 2 points that ought to not be connected. Associate degree open may be a missing association between points that ought to be connected. For high-volume production a fixture or a rigid needle adapter is employed to create contact with copper lands on the board. Building the adapter may be a vital fixed charge and is

simply economical for high-volume or high-value production. For Small or medium volume production flying probe are used wherever test probes are stirred over the board by associate degree XY drive to create contact with the copper lands. The CAM system instructs the electrical tester to use a voltage to every contact purpose and to visualize that this voltage seems on the suitable contact points and solely on these.

ASSEMBLY

After the computer circuit board (PCB) is completed, electronic parts should be connected to make a purposeful computer circuit assembly ,or PCA (sometimes referred to as a "printed card assembly" PCBA). There are a range of attachment techniques accustomed attach parts to a PCB. High volume production is typically finished SMT placement machine and bulk wave attachment or reflow ovens , however practiced technicians are able to solder terribly little components by hand below a magnifier, victimization tweezers and a fine tip hand tool for tiny volume prototypes. Some components are also extraordinarily troublesome to solder by hand, like BGA packages.

3.18PCB DESIGNING OF MICROCOTROLLER BOARD USING ETCHING:

Procedure

The PCB layout was made by using the software Diptrace-

1 Take the printout of the PCB layout.

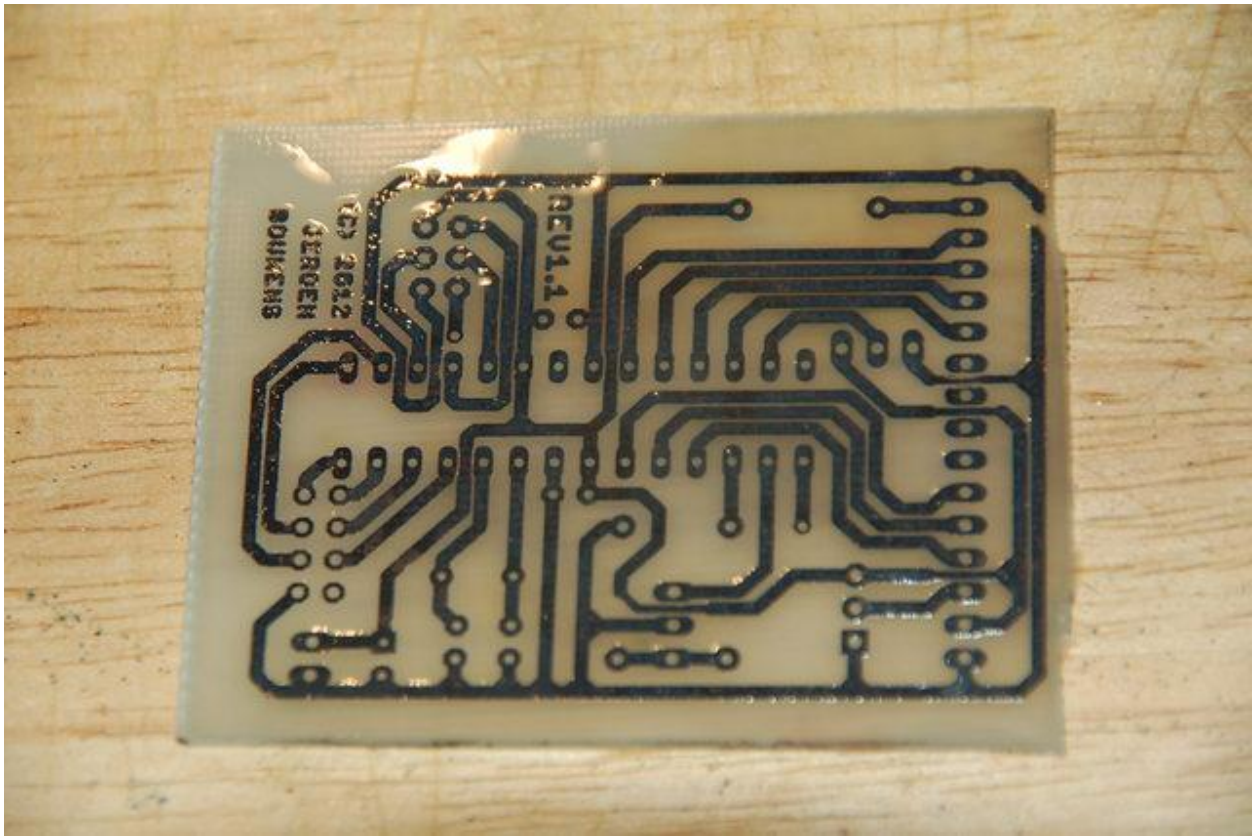

FIGURE 22 : PCB LAYOUT

2.Using iron we have to take the print of the layout on the PCB board .

3.Using etching solution (ferric chloride) etch the board after getting the print on the board Drill the points where necessary, to solder the components.

4.Insert the components at the desired position and solder the components accordingly.

FIGURE 23 : PREPARED PCB

CHAPTER-4

EXPERIMENTAL /COMPUTATIONAL

4.1 COMBUSTIBLE GAS SENSOR (ANALOG OUT)

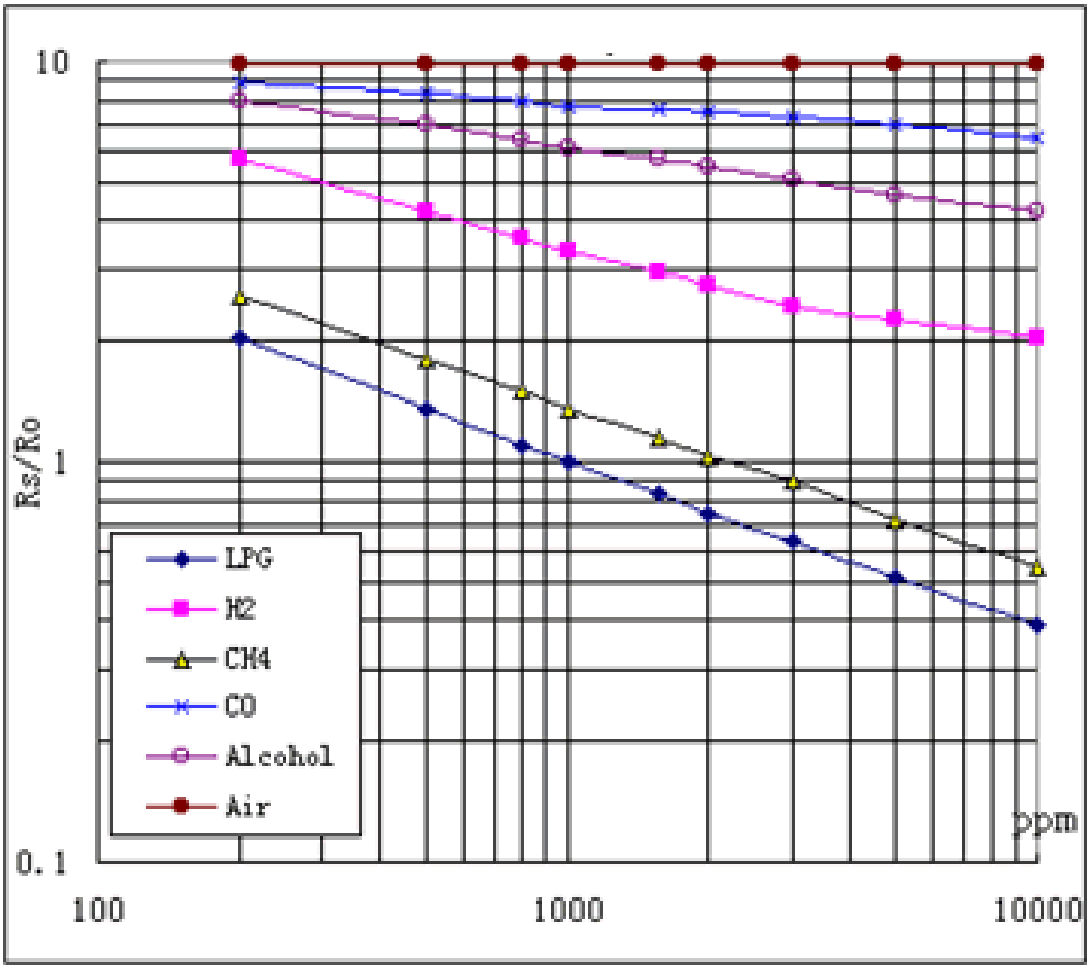

FIGURE 24 :GRAPH BETWEEN PPM AND Rs/Ro

The temperature ranges between 20 deg C

The maximum Humidity content on which it can work is 65%

It requires an Oxygen concentration of 21%

It has a Load resistance of 10K Ohm

Ro = Sensor resistance at 1000 ppm of LPG in clean air

Rs = Sensor resistance at various concentrations of gases

4.1.1Specification

Gases to be detected :Isobutane, Propane, LPG

It has a Detection Range of 100 to 10000 PPM PPM

The output Voltage Range varies between 0 to 5 VDC

Operates at a voltage of 5 VDC

Consumes a current of less than 180 mA

Requires 10 Minutes to start up

It is Calibrated for a Iso butane at 1000 ppm

Working Temperature range :-10 to 65C.

Storage Condition Temperature: -20-70 deg C

4.1.2 Warm Up Time:

The minimum warm up time is 10 minutes after power is applied.Only after 10 minutes he sensor will be able to take readings. During warm up time, there will be a variation in the output voltage between 4.5V to 0.5 V.

4.1.3 Using the Sensor

The sensor needs 5V to operate. The sensor will take around 180mA input current for its operation. The sensor will get heated to a little extent since it has an internal heater that warms up the sensing element.

4.1.4 Deriving Gas concentration from Output Voltage:

Equation for converting analog output to PPM gas concentration

PPM = Analog Voltage in mV x 2

Example: Gas sensor voltage is giving output as
3200mv (3.2V) thus the gas concentration in PPM = 3200x2 = 6400 PPM

4.1.5Testing the Sensor :

Output voltage is measured through a multi-meter between OUT and Ground pins or through a microcontroller to measure the voltage output. Take the sensor near flammable gas place like propane or deodorize the environment having flammable gaseous content .There will be a transition in analog voltage output since the gas concentration will increase.

Table:

PPM	240	260	360	1040	2400	2800	5100	9400	98000
Voltage(Mv)	120	130	180	520	1200	1400	2550	4700	4900

TABLE 3: VALUES SHOWING PPM AND CORRESPONDING VOLTAGE OUTPUT

4.2 FIRE SENSOR

4.2.1 Pin Configuration

Pin No.	Symbol	Description
1	o/p	Digital output
2	VCC	High input supply

3	GND	Low input supply

TABLE 4: PIN CONFIGURATION OF FIRE SENSOR

4.2.2 Maximum Ratings

Symbol	Minimum	Typical	Maximum
O/P	**4.2**	**4.5**	**4.7**
VCC	4.5	**5**	**5.5**
GND	**-**	**0**	**-**

TABLE 5: MAXIMUM RATINGS OF FIRE SENSOR

4.3 MODELLING OF CRSTAL OSCILLATOR

A quartz crystal can be modeled as a network with a low-impedance (series) and a high-impedance (parallel) resonance points packed densely together . The impedance of this network can be given as:

$$Z(s) = \left(\frac{1}{s \cdot C_1} + s \cdot L_1 + R_1\right) || \left(\frac{1}{s \cdot C_0}\right),$$

Or

$$Z(s) = \frac{s^2 + s\frac{R_1}{L_1} + {\omega_s}^2}{(s \cdot C_0)\left[s^2 + s\frac{R_1}{L_1} + {\omega_p}^2\right]}$$

$$\Rightarrow \omega_s = \frac{1}{\sqrt{L_1 \cdot C_1}}, \quad \omega_p = \sqrt{\frac{C_1 + C_0}{L_1 \cdot C_1 \cdot C_0}} = \omega_s\sqrt{1 + \frac{C_1}{C_0}} \approx \omega_s\left(1 + \frac{C_1}{2C_0}\right) \quad (C_0 \gg C_1)$$

where *s* is the complex frequency ($s = j\omega$),

ω_s is the series resonant angular frequency, and

ω_p is the parallel resonant angular frequency.

4.4 RF Modem:

4.4.1Baud Rate Setting

Setting of Baud rate is done when no power supply is given to the board. During power up jumper setting is used. To make any jumper on ,we have to short the jumper by soldering its legs. There is no use of jumper in default conditions.

There are two jumpers on PCB called B1 and B2. Normally they are left off so unit is in default 9600 baud rate.

Soldering the two pads will make them ON and so we can adjust baud rate as per settings below:

- B2 = OFF B1 = OFF is 9600 bps (Default)
- B2 = OFF B1 = ON is 4800 bps
- B2 = ON B1 = OFF is 2400 bps
- B2 = ON B1 = ON is 19200bps

4.4.2 Frequency channel setting

The Frequency Channel can be set according to our needs such that we can have multiple sets working at the same time without any interference. The pair having same Channel setting will be able to communicate with each other. Frequency channel can also be set when the unit is OFF, as the jumper are read only during power up. To make any jumper on, we have to short that jumper by soldering its legs By default unit is supplied with no jumpers set making it channel#1.

- F2 = Open F1 = Open is Channel #1 (Default)
- F2 = Open F1 =closed is Channel #2
- F2 = open F1 = Open is Channel #3
- F2 = Open F1 = closed is Channel #4

4.5 FREEWHEELING DIODE BY 399

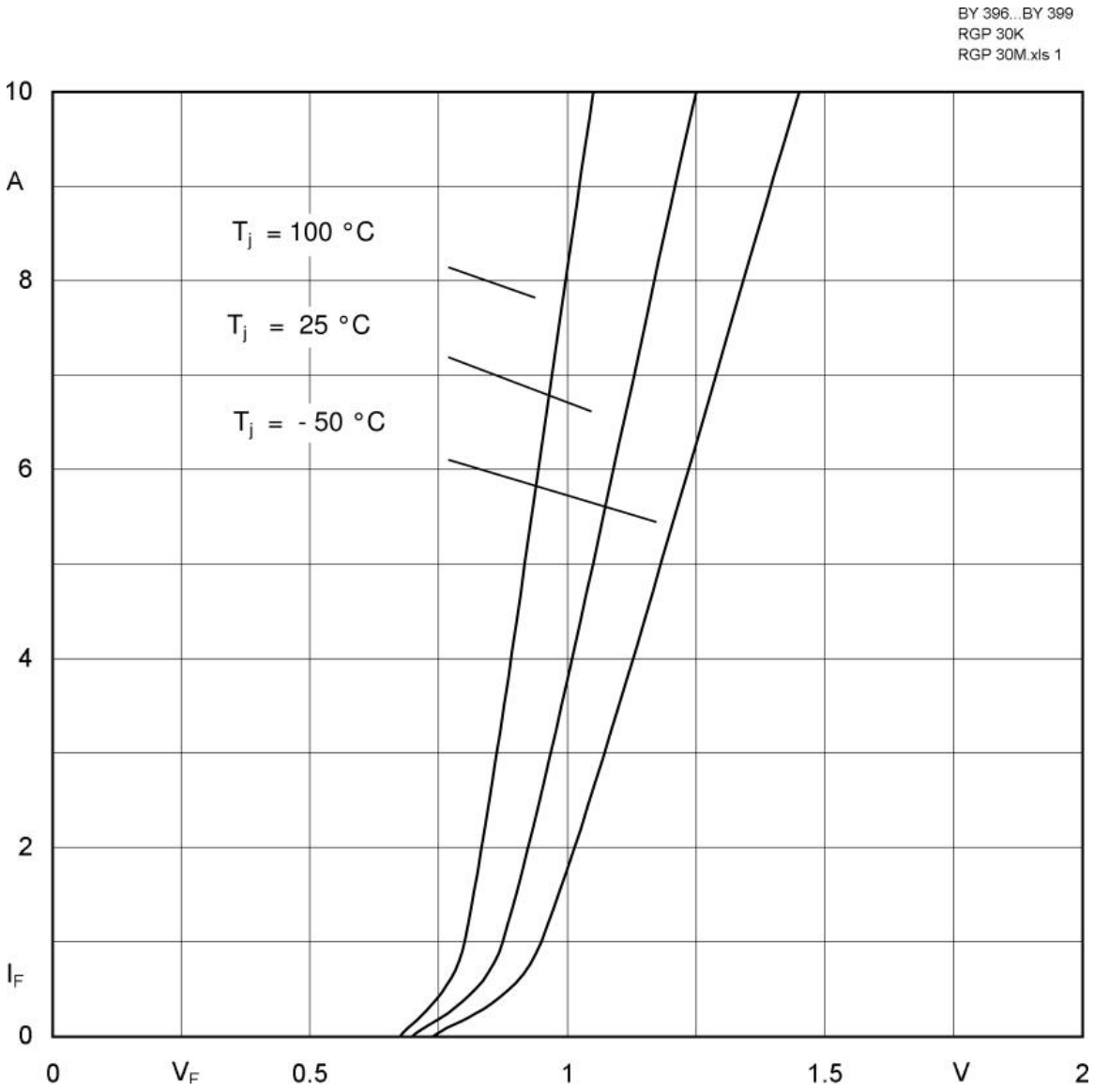

FIGURE 25: FORWARD CHARACTERISTICS(TYPICAL VALUES)

CHAPTER-5

RESULT AND CONCLUSION

5.1 RESULT

- The hooter gets activated as soon as the fire or the gases are detected.
- This project is helpful in mitigating fire conditions.
- It is a multipurpose project which will be supportive for many other tasks.
- The project has enriched our knowledge about the components used.
- It can be used for mock drills which is an integral part of fire safety engineering.
- This project will certainly help us in acquiring the knowledge of various sensors and the RF module.

5.2 CONCLUSION

- The project can also prove beneficial in fire safety areas by incorporating the technique of mock drills. In a mock drill the switches at the control room are pressed accordingly and the hooter is activated at the desired location .A mock drill thus enables or helps fire safety engineers to take measures to mitigate fire situations. Hooter is an electrical component which creates audible alarm to alert the people. In case of Fire the panel sends the signal to trigger the hooter.

- No wiring is required in this system and no need to conduct works on radio waves. Lot of complex wiring is required in case of wired system. In case of non working of particular detector it does not have any effect on the system. But in case of Wired System Complete system becomes affected due to damage in wiring or failure of connection.

- This project provides a economical solution to undesired conditions with features which are even not possible in wired systems.

- This equipment operates on low power consumption and works in real time.

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