NEW HORIZON
COLLEGE OF ENGINEERING
Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade.

"Fire Alarm System using IC 555 and Thermistor"

A MINI PROJECTREPORT

Submitted by

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In partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION

ACKNOWLEDGEMENT

The satisfaction that accompany the successful completion of any task would be, but impossible without the mention of the people who made it possible, whose constant guidance and encouragement helped us succeed.

I thank **Dr. Mohan Manghnani**, Chairman of **New Horizon Educational Institution**, for providing necessary infrastructure and creating good environment.

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I sincerely acknowledge the encouragement, timely help and guidance to us by our beloved guide **Ms. Divya Rajan** to complete the project within stipulated time successfully.

Finally, a note of thanks to the teaching and non-teaching staff of electronics and communication department for their co-operation extended to us, who helped us directly or indirectly in this successful completion of mini project.

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ABSTRACT

Fire alarm are basic requirements in constructions of buildings and other centers of public usage. The vital significance of fire alarms is to detect fire in and around our surroundings at an early stage. This is done by detecting heat or smoke and hence raising an alarm which makes people aware about the fire and provides them adequate time to take measures of preventions. In this manner, fire alarms prove to be useful because they not only prevent the occurrence of big losses, but also proves to be life savers.

In this project, a simple fire alarm system with 555 IC and Thermistor has been constructed, which will sense the fire and triggers the alarm.

The main component used in the circuit is the Thermistor, which acts as the fire detector/fire sensor. The other important components are NPN Transistor, IC 555 timer.

Applications:

- Offices and commercial
- Apartments
- Shopping and retail
- Educational institutions
- Hotels and leisure
- Hospitals and health

CHAPTER 01

INTRODUCTION

The Fire alarm system is designed to detect the fire by watching the changes in environment associated with combustion. It is used to detect and warn public about the presence of fire, smoke, in the building and help them to evacuate the building on time. The fire alarm systems used today involve smart sensors, control panels and other integrated building services that help the occupants of the building for early evacuation and warning about the fire. Some advantage of fire alarm is early detection of fire and help in saving the life and property, it's of low cost, and it can be placed in desired locations due to its compact size. Here they are building a simple fire alarm circuit with the help of 555 Timer IC, which will detect fire (temperature rise in surrounding), and trigger the alarm.

The main component of the system is Thermistor, which has been used as a fire detector of fire sensor. They have built the Fire alarm using 3 main components that is Thermistor, Transistor and 555 Timer IC. Firstly it should provide a means to identify a fire developed manual or automatic methods and alert the building occupants. Another function is to transmit the information to nearby fire department and other emergency organizations. They might also shut down electric supplies, air equipment and suppress the on going automatic tasks like lefts of the building.

CHAPTER 02

LITERATURE SURVEY

PAPER NO	TITLE	AUTHOR AND YEAR OF PUBLICATION	OUTCOME
1.	Research on electronic fire alarm	Manav Jain and Dr.Mohammad Jawaid 2014	Information on the various circuits for detecting fire and circuit for the fire alarm using ic555 was obtained.
2.	Smart automation on basis of IC555	Krishna Sarath Chandra, Vamsi Bharadwaj Reddy 2016	Information on basis, components, advantages and applications of IC555 were obtained which helped us understand the working of IC.
3.	Transistors	Michael Riordian,Lillian Hoddeson , Conyers Herring 1999	Information on Importance, applications and working of the transistor in the circuit were obtained to analyze the circuit better.
4.	Study of MC based fire alarm using temperature sensor	Alishetty Ramu,Bathula,Kiran Kumar,Mamilla Bhavani 2017	Details on the requirement and function of thermistor used in the circuit were imbibed.

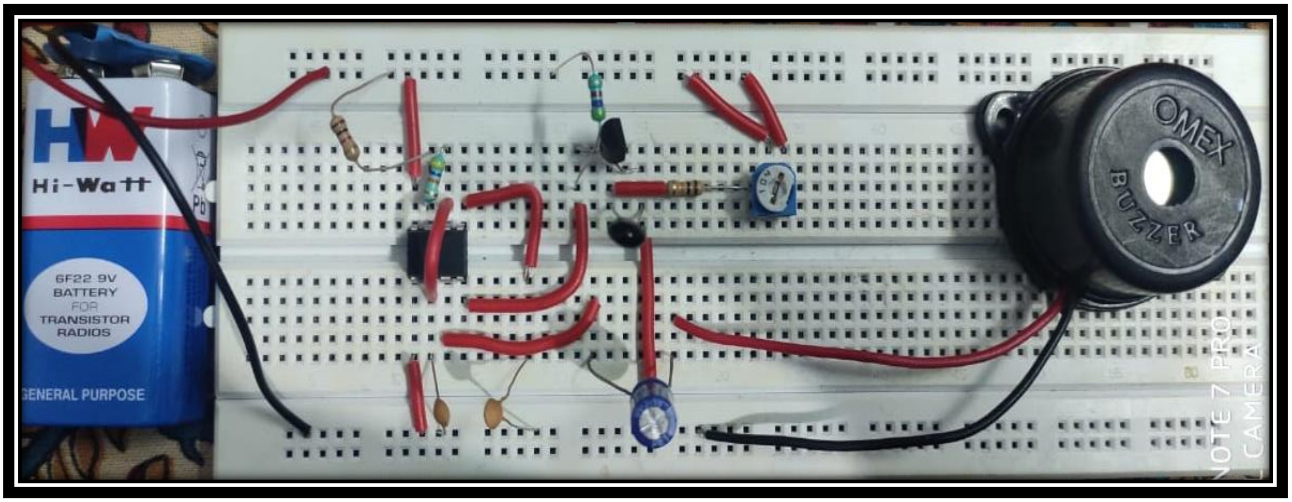
CHAPTER 03

PROPOSED METHODOLOGY

Mini project topics were suited for consideration. Mini project topic was finalized as Fire alarm. The components for making the working model were purchased, that includes:

- 555 IC –NE555
- Resistors
- Capacitors- 0.01µ Ceramic, 100µ Electrolytic (16V)
- Thermistor-10k ohm (Negative Temperature Coefficient)
- Transistor-BC548
- PCB, Speaker, Socket, Preset-100k ohm

Working model preparation was commenced. 50% of working model was completed. (Circuit connection on Breadboard is shown below)



Connection of Circuit on Bread Board

Working on presentation commenced. Report making commenced. 50% Report was completed. 90% working model was completed on PCB. 100% of the project working model along with project report is done.

CHAPTER 04

PROJECT DESCRIPTION

Fire Alarm System using IC 555 and Thermistor

The circuit of a fire alarm is simple that detects the fire and activates the siren sound or a buzzer. These circuits are very important devices to detect the fire in the right time and it will prevent any damage to the people or the property. These fire alarm circuits and smoke sensors are the past of security systems which will help in detecting or preventing the damage.

We have built the circuit using, mainly three components that is, 555 IC Timer, Thermistor, BC548 NPN transistor.

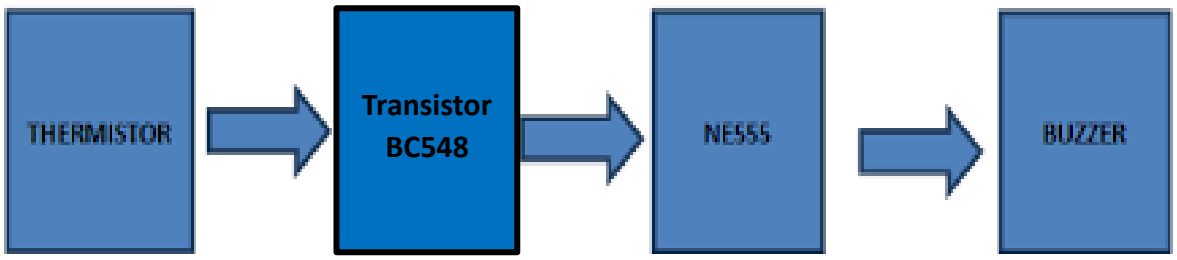


Fig 4.1:BASIC BLOCK DIAGRAM OF FIRE ALARM

The above given Block diagram explains the working of the project in very brief manner. The project contains mainly these four components, Thermistor, Transistor BC548, IC 555 Timer, Buzzer.

Some of the other components used are resistors, capacitors, and a preset. The circuit for the project is given below, and the circuit connections are maid according to the given circuit.

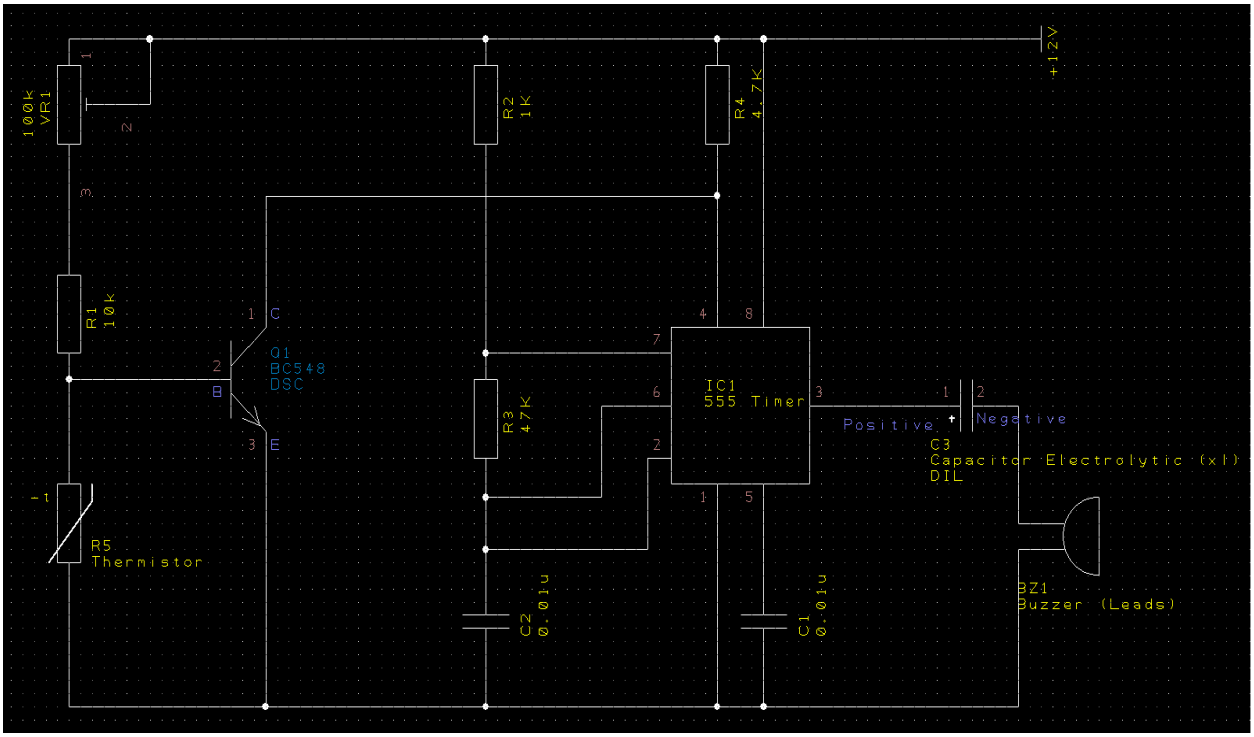


Fig 4.2: Circuit Diagram

The components used in the circuit are,

- IC 555 timer
- Thermistor
- Transistor BC548
- Resistors
- Capacitors
- Preset
- Buzzer

4.1 IC 555 Timer:

The IC 555 timer is a chip used in different application like oscillator, timer, pulse generator. The design for 555 timer can be done using various electronic and electrical components like transistors, diodes, resistors and flipflops. This IC works in the range of 4.5V to 15V DC Supply.

The 555 timer mainly contains a flip flop, voltage divider and a comparator. The function of this IC is to generate a timing pulse.

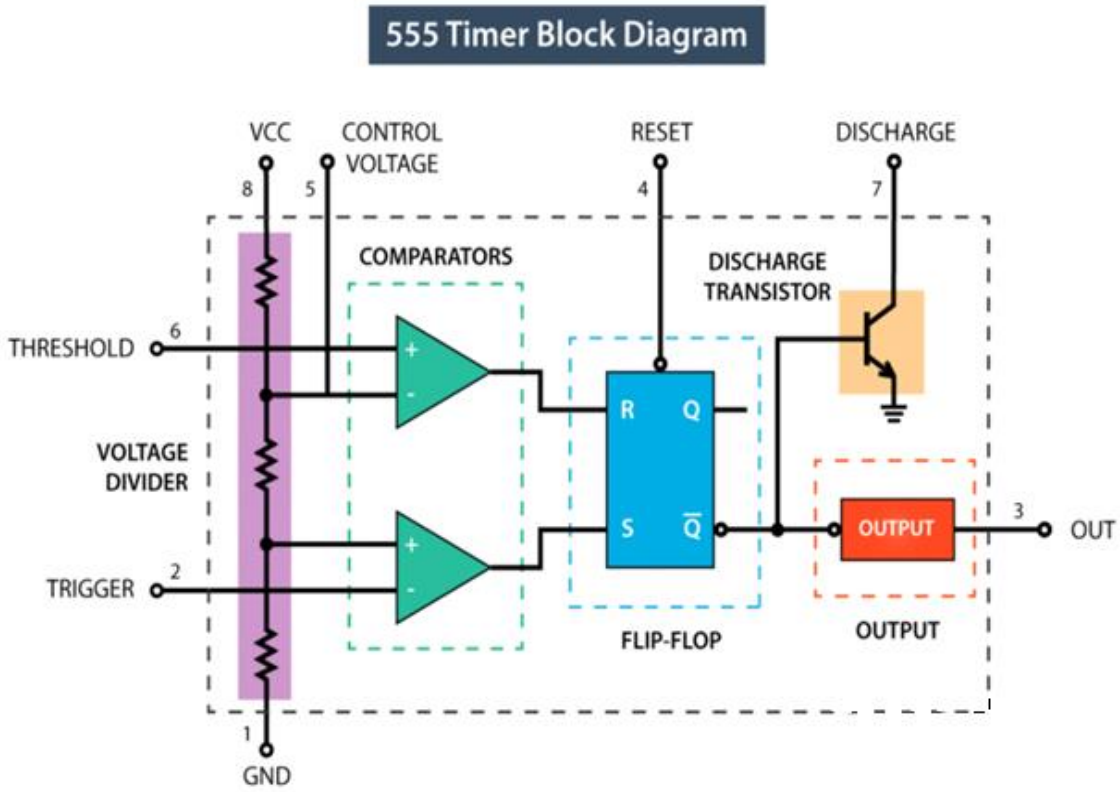


Fig 4.3: 555 Timer Block Diagram

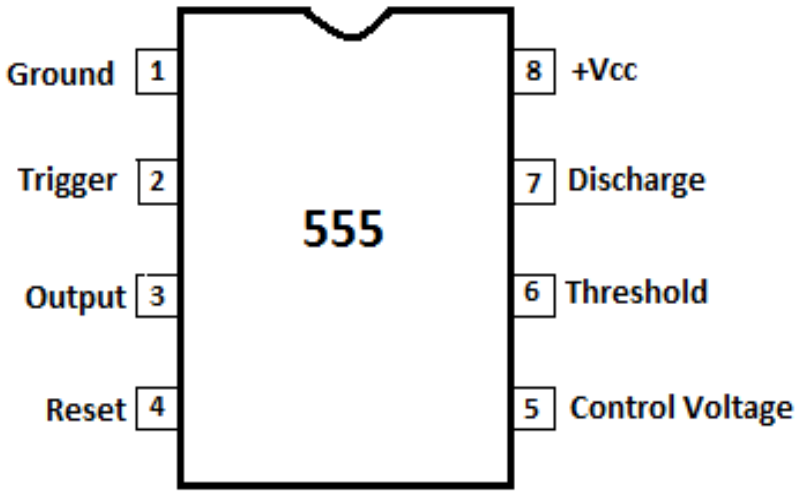


Fig 4.4: IC 555 Timer Pin Configuration:

The IC 555 timer has 8 pins each pin will serve a purpose in the IC, The pin configuration of the IC is given below:

GND PIN

Pin 1- Is the GND pin that is used to supply zero voltage to the IC.

TRIGGER PIN

Pin 2- Is the trigger pin used to convert the flip flop from set to reset. The output of the timer depends on the amplitude of the triggering pulse that is given at the trigger pin.

OUTPUT PIN

Pin 3- This is the output pin

RESET PIN

Pin 4- it is the reset pin, when the negative pulse id given to this pin it is disabled or it is reset and false triggering can be avoided by connecting it to DC supply (VCC).

CONTROL VOLTAGE PIN

PIN 5- It is the control voltage pin used to control the width of the output waveform and also levels of the threshold and trigger. When the external voltage is given to this pin, then the output waveform is modulated.

THRESHOLD PIN

Pin 6- it is the threshold pin, when voltage is applied or given to threshold pin, it contrasts with a reference voltage. The set state of the flip flop can depend on the amplitude of this pin.

DISCHARGE PIN

Pin 7- it is the discharge pin, when output of the open collector discharges a capacitor in between the intervals, then it toggles output from high to low.

SUPPLY TERMINAL

Pin 8- is voltage supply pin used to supply the DC voltage of 4.5v to 15v to the IC with respect to the GND Pin.

555 Timer Working

There are 3 modes to operate 555 timer,

They are:

1. A-stable mode
2. Mono-stable mode
3. Bi-stable mode

A-stable mode:

A-stable mode configuration:

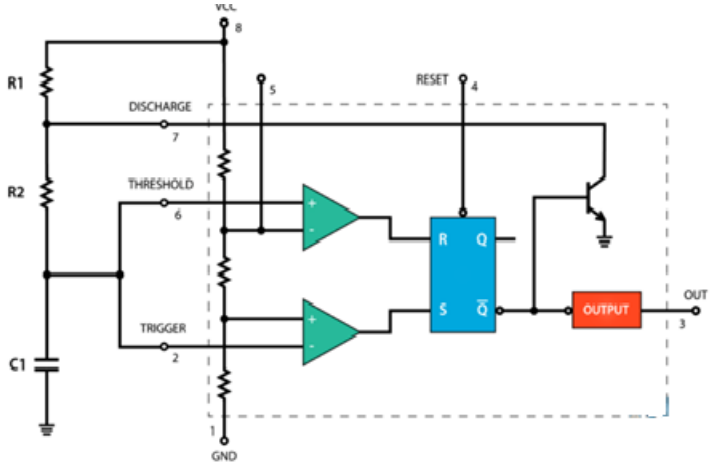


Fig 4.5.A: A-stable mode

In this A-stable mode, circuit of 555 timer IC will produce continuous pulses with exact frequency based on the values of the resistor and capacitors. Here the discharging and charging of the capacitor depends on specific voltage. The circuit diagram of IC 555 timer in a-stable mode is given above. If the voltage is applied, the capacitors gets continuously charged through the resistors and generate pulses continuously. In the following circuit pin 2 and 6 are shorted together for endless re activate the circuit. If the output trigger pulse is high, then the capacitor in the circuit totally discharges. Long time delays can be achieved using high values of resistor and capacitors.

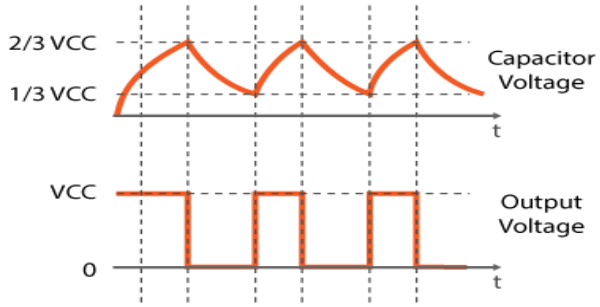


Fig 4.5.B: Waveform of A-stable mode

Mono-stable mode:

Mono-stable mode configuration:

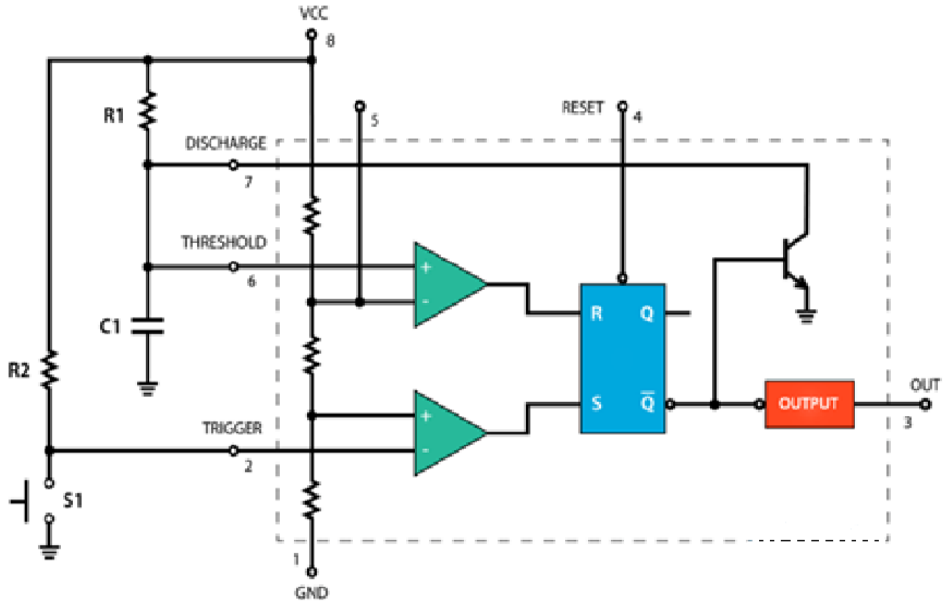


Fig 4.6: Mono stable mode

In the mono-stable mode, the circuit generates single pulse when the timer gets an signal from input of the trigger button. Pulse duration can be controlled using the values of resistors and capacitor if the activating pulse is applied to the input the circuit through a push button, then capacitor gets charged and timer extends a high pulse, them it remains high untill the caoacitor gets totally discharged. If it is necessary to enhance time delay in the circuit, higher values of the capacitor and resistors are required.

Bi-stable mode:

In the Bi-stable mode, the circuit produces 2 stable state signals which are high and low states. The output signals of low and high state are controlled by reset and set input pins, not by the charging and discharging of the capacitors. If low signal is given to active pin, then the output of the IC circuit goes to High. If the low signal is given to reset pin the output of the circuit will go to low levels.

Bi-stable mode configuration:

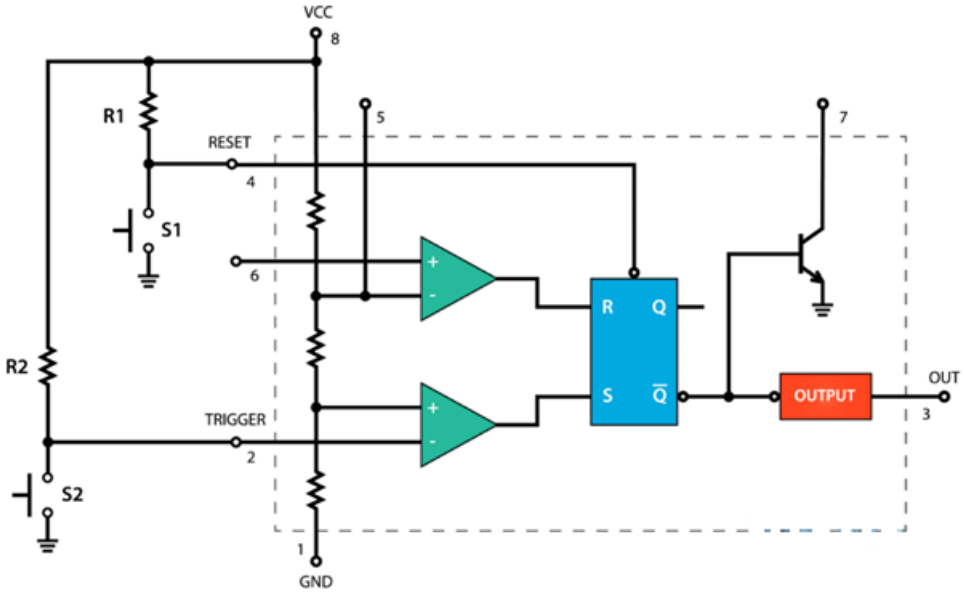


Fig 4.7: Bi-stable mode

Some important features of IC 555 timer:

IC 555 timer is used in most of electronic circuits today. For a IC 555 timer to work as a flip flop or multi-vibrator or pulse generator, it has a particular configurations. Some of the major features of the timer is given below:

- It will work with vide range of voltage i.e., from 4.5V to 18V volts of DC voltage supply.
- Sourcing 200mA of load current.
- The 555 timer IC can be driven as a transistor-transistor logic(TTL) due to its high current outputs.
- The selection of the external components will affect the timing intervals changing it to several minutes along with the frequencies to several kilohertz.
- It has temperature stability of 50 ppm(parts per million) per degree Celsius change in temperature of the surrounding which is equivalent to 0.005% per degree Celsius.

- The cycle of the timer is adjustable and also the maximum power dissipation of the circuit.

Applications of IC 555 Timers:

- IR Obstructer
- IC 555 Tester
- 60 Seconds Timer
- Cat and Dog Repellent Circuit

Advantage of IC 555 timer:

- IC 555 is most widely used integrated circuit.
- It is of Low cost.
- It has Large number of applications
- Useful for creating different time delays, pulse generation, oscillator purposes.

Disadvantages of IC 555 timer:

- It will draw a large pulse of current during output transitions which might introduce noise in the power supply.
- It is a poor clock source for counters because it doesn't produce smooth transition between output states.

4.2 Thermistor:

A thermistor is a type of resistor whose electrical resistance changes with respect to the temperature. Though all the resistors, resistance will be fluctuated slightly with respect to temperature, a thermistor is particularly sensitive to temperature change, Thermistor is also known as thermal resistor.

Fig 4.8: Thermistor

A thermistor will act a passive component in the circuit. It is very accurate, cheap, and robust way to measure temperature. They do not work well in extreme cold and hot temperatures, they are choice for many applications. They are ideal for precise reading of temperature. The circuit symbol for a transistor is given by:

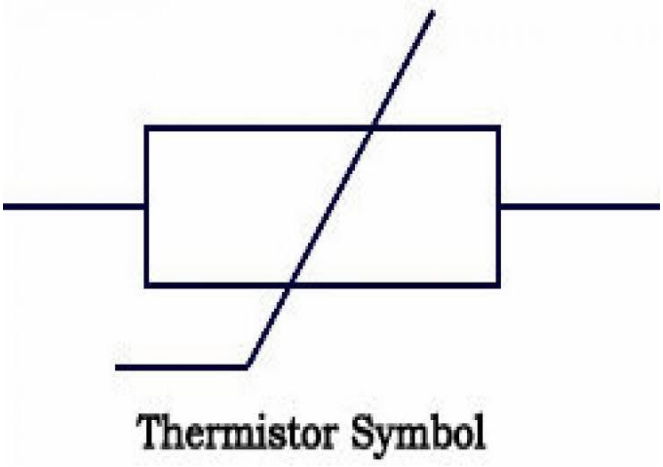


Fig 4.9: Thermistor symbol

Working of a thermistor:

The basic working of thermistor is nothing but resistance is dependent on its temperature. By using ohm meter, you can measure the resistance of thermistor.

By measuring the thermistor resistance we can derive its temperature if we know the relation between how changes in temperature will effect the resistance of the thermistor. The change is

resistance depends on the type of material used in thermistor. The graph of thermistors temperature and resistance is non-linear.

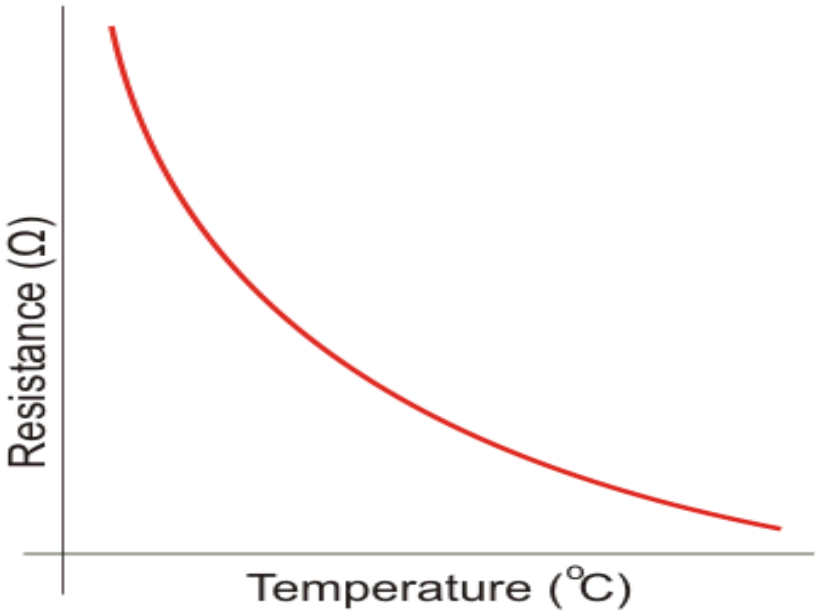


Fig 4.10: relation of resistance and temperature in thermistor

Types of thermistor

- Negative temperature co-efficient thermistor
- Positive temperature co-efficient thermistor

Negative temperature co-efficient thermistor:

In negative temperature co-efficient thermistor, resistance of the component will decrease with increase in temperature, and when the temperature decreases resistance of the component will increase. Hence in the NTC thermistor, temperature and resistance are inversely proportional.

Positive temperature co-efficient thermistor:

A positive temperature co-efficient thermistor has a direct relationship with the temperature and resistance. Resistance of the component will increase with the increase in temperature and when

the temperature drops even the resistance of the component will decrease. Hence in the positive temperature co-efficient thermistor, temperature and resistance are directly proportional to each other.

Uses of a thermistor:

Thermistor has wide range of applications. They are widely used to measure the temperature of the surrounding, as in thermistor thermometer for many different liquid and ambient air environment. Some of the uses of a thermistor are as follows:

- Digital thermometers
- To measure oil and coolant temperatures in cars & trucks
- Household appliances in microwaves, fridges, and ovens
- Circuit protection
- Rechargeable batteries to ensure the correct battery temperature is maintained
- Maintain resistance for effects caused by changes in temperature in another part of circuit.
- Used in Wheatstone circuit combinations.

Advantages of thermistor:

- Thermistor is more sensitive compared other temperature sensors
- They have very fast response.
- They are of low cost and replacing with the new component is easy.
- Because of their high sensitive nature is easy to work in low temperatures.
- Very easy to use in circuits.

Disadvantages of Thermistor:

- It is not recommended for large temperatures
- To avoid self heating excitation current should be minimum

- They need shielding power lines
- Characteristic of temperature and resistance are non linear

4.3 BC548 - NPN Transistor:

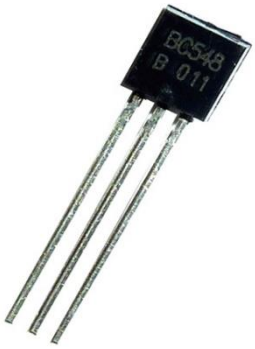
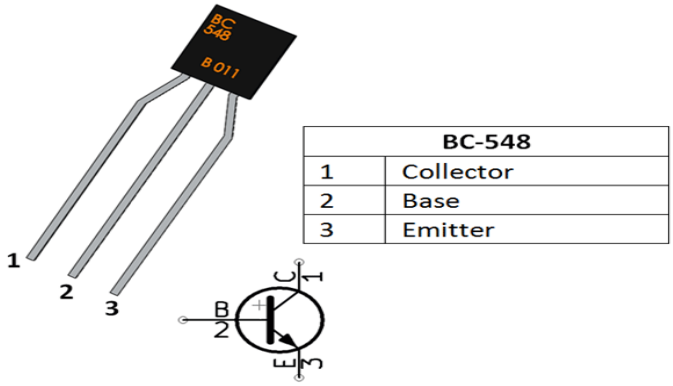


Fig 4.11: Transistor



BC-548	
1	Collector
2	Base
3	Emitter

Fig 4.12: Transistor Pin Configuration

It is a NPN transistor, the collector and emitter will be left open i.e, reverse biased when the base pin is connected to ground and will be closed i.e, forward biased when a signal will be provided to the base pin. The transistor BC548 has a gain of 110 to 800, it determines the amplification capacity of a transistor. The maximum current that will flow through a collector pin is 500mA, so we cannot connect that consumes more that 500mA by using this transistor. We need to supply the current to the base pin to bias the transistor, this current should be limited to 5mA. When a transistor is fully biased, it can allow a maximum of 500mA to flow across the collector and emitter. This is called saturation region and the typical voltage that allowed across the collector-emitter or base-emitter will be 200 and 900mv respectively. The transistor becomes off when the

base current is removed. This is called the cut-off region and the base-emitter voltage will be around 660mV.

Transistor as a switch:

When Transistor is used as a switch is operated in saturation and cutoff region. A transistor will act as a open switch during forward bias and as a closed switch during reverse bias, this biasing can be achieved by giving a certain amount of current to the base pin. The bias current should be maximum of 5mA anything more than 5mA will kill the transistor; hence a resistor is always added in series to the base pin to cutdown on the current given to base pin.

Transistor as an amplifier:

A transistor will act as amplifier when operating in Active Region. It can amplify voltage, power and current for different configurations.

Some of modes used configurations of amplifier are:

- Common Emitter Amplifier
- Common Collector Amplifier
- Common Base Amplifier

BC548 Transistor Features

- Bi-Polar NPN Transistor
- DC Current Gain is 800 max
- Continuous Collector current is 500mA
- Emitter Base Voltage (VBE) is 5V
- Base Current is 5mA max

Applications

- Driver Modules like Relay Driver, LED driver.
- Amplifier modules like Audio amplifiers, signal Amplifier.

Advantages of transistor:

- Smaller in size and of low cost
- Low operating voltage is of greater safety
- They have extremely long life
- There is no much power consumption
- They have fast switching property

Disadvantages of transistor:

- It can be damaged by thermal runway or second breakdown.
- They cannot operate above switching frequency 15kHz.
- Reverse blocking capacity is of very low value.

4.4 Resistors:

Resistors are the electronic components who have a specific, constant electrical resistance. The resistor's resistance will limit the flow of the electrons in the circuit. It is a passive component that is the only consume power but can't generate the power. They are commonly used with the active components like op-amps, microcontrollers, and other integrated circuits. Commonly they are used to limit current, divide voltages.

The resistance of the resistor is measured in **ohms**. The symbol of the resistance is given by a Greek letter **omega: Ω**.

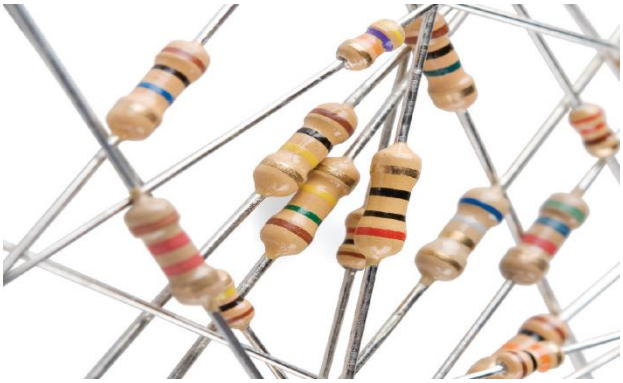


Fig 4.13: Resistors

Symbol for the Representation of Resistance:

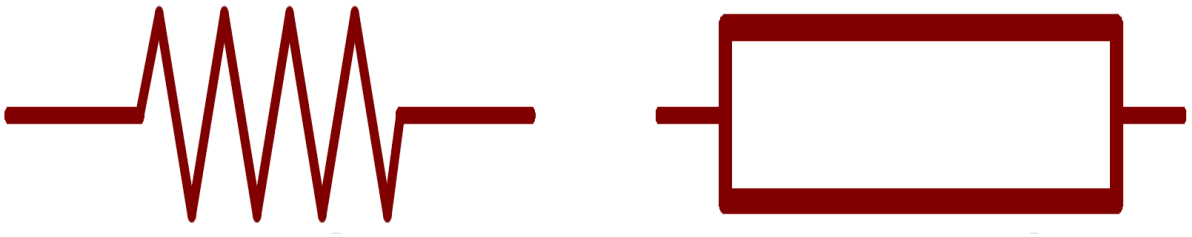


Fig 4.14: Resistor Symbols

Types of Resistors:

Resistors are of different shapes and sizes. They can be through-hole or surface-mount. They might static resistor, a pack of resistors, or a variable resistor.

Color coding of the Resistors:

The resistors in the market come with few color bands on them. The no of bands vary with different resistors, there are four band resistors, five and six band resistors.

Most commonly used resistors are four band resistors.

In a standard four band resistor, the first two band will indicate the significant digits of the resistance value. The third band will give the weight value, which will multiply the two significant digits by power of 10. The final band will indicate the tolerance of the resistor. The tolerance will explain how much more or less actual resistance of the resistor can differ to its nominal value. The method to find the resistance of the resistor is shown using an image below.

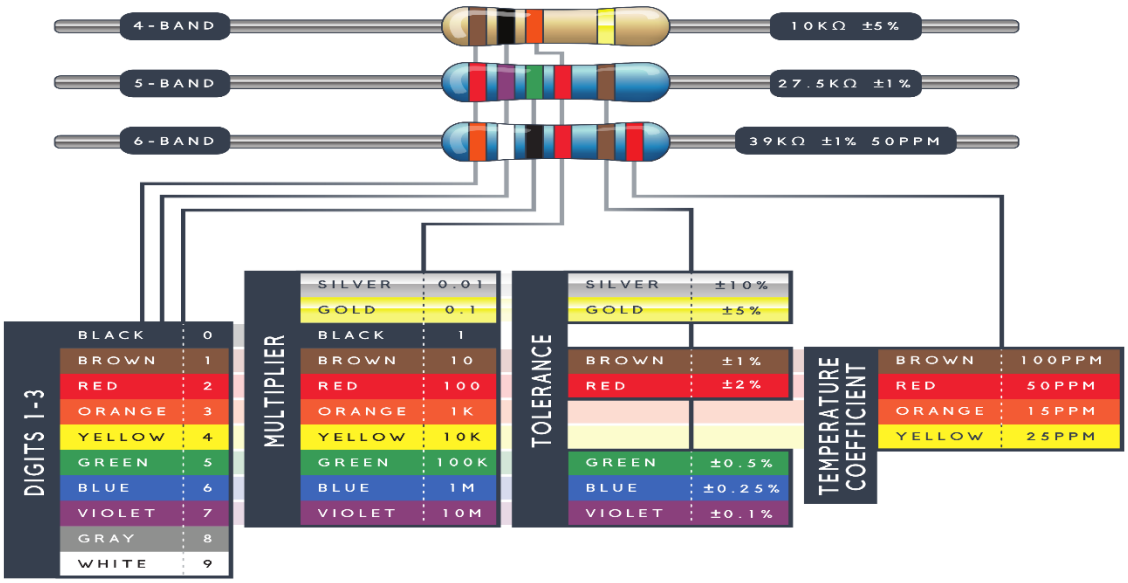


Fig 4.15: Color coding of Resistor

Application of the Resistor:

- To limit the flow of current in the circuit.
- Used as a voltage divider.

Advantages of Resistor:

- Wide range of resistance is available.
- They are of low cost.
- They are of small size easy to use in circuits.

Disadvantages of Resistor:

- They have very high tolerance and do not have precision.
- They get easily heated and might crackdown during soldering.
- They can't be used in applications where power value is above 5 watts.

4.5 Capacitors:

A capacitor is two terminal, electrical component. Along with resistor and inductor, they are the most fundamental passive element. You will find very hard time to find a circuit which do not have a capacitor in it.

Fig 4.16: Capacitor

Symbols and Units

There are two common ways to represent capacitor in schematic. The have two terminals, which is connected to rest of the circuit. The capacitors symbol has 2 parallel lines, either flat or curved; both the lines should be parallel to each other, but not touching each other.

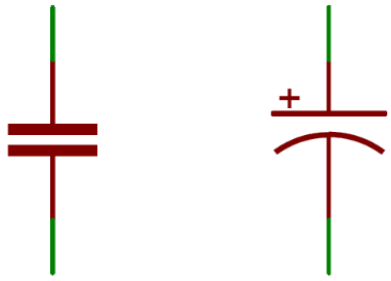


Fig 4.17: Symbol of Capacitor

The capacitor's capacitance tells us **how much charge it can store** in it, more the capacitance of a capacitor means more capacity to store energy. The unit of capacitance is called **farad,** which is represented by **F**.

How a Capacitor Is Made:

The symbol of the capacitor resembles how a capacitor is made. A capacitor is make out of 2 metal plates and an insulating material called dielectric. The metal plates are very closely placed to each other, in parallel, but he dielectric will sit in between them and make sure the metal pates do not touch each other.

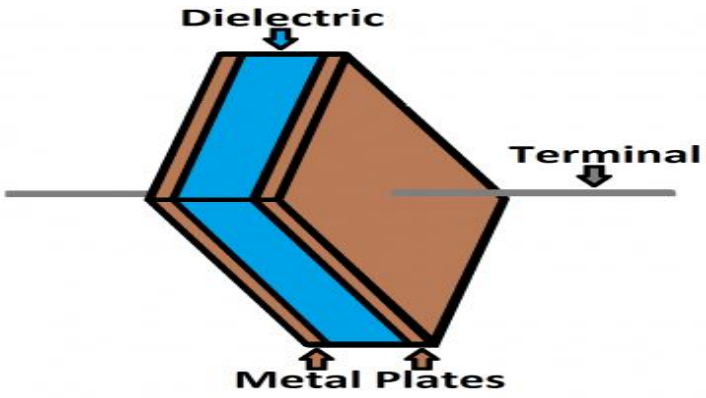


Fig 4.18: Two metal plates separated by an insulating dielectric material

The dielectric can be made from an insulating materials like paper, glass, ceramic, rubber, plastic, or anything that will not allow the flow of the current through them.

The plates of the capacitor are made of conductive material like aluminium, silver, tantalum or other metals, they have a terminal wire, that eventually connects to the rest of the circuit.

How a Capacitor Works

Flow of the electric charge is know as electric current. When electric charges flows into a capacitor, the charges get stuck on the plates because they can't pass through the dielectric medium. Electrons- the negatively charged particles gets stuck on one plate and the plate becomes negatively charged. The large amount of negative charges on one plate will push away charges on the other plate making the other plate positively charged.

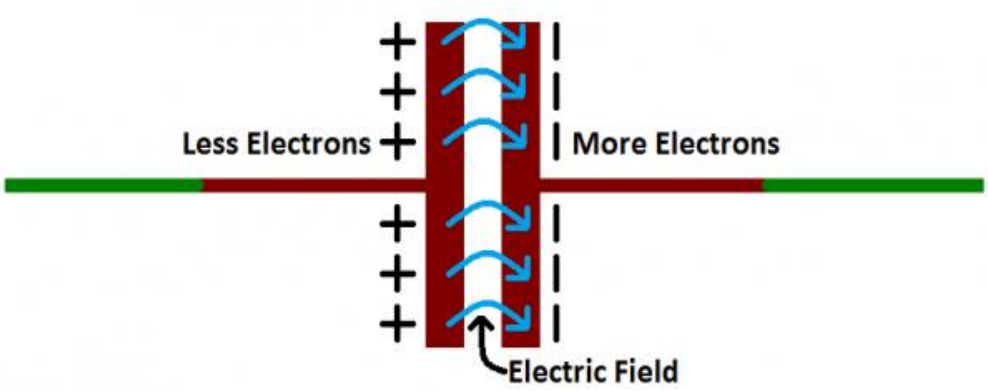


Fig 4.19: Working of Capacitor

The positive and negative charges on each of the plates will attract each other, because of the opposite charges. But with the dielectric sitting in between them no charges can come together, the charges will get stuck on the plate until they have somewhere to go. The charges on the plates create an electric field, which will influence electric potential energy and voltage. When charges get together on a capacitor like this, the capacitor will store energy just as a battery might store chemical energy.

Charging and Discharging

When the positive and negative charges collect on the capacitor plates, the capacitor gets charged. A capacitor will retain the charge because of the positive and negative charges on each of the plates attract each other but do not reach each other.

Some point of time in future the plates will be full of charges that just can't accept any more. There are enough negative charges on a plate that gets repelled by another that try to join. This is were the capacitance of the capacitor plays a role, which tells the maximum amount of the charge that the capacitor can store.

If a path is created in the circuit which will allow the flow of charges to take place then the capacitor will lose the charges on them and the capacitor gets discharged.

Types of the Capacitor:

- **Ceramic Capacitors:**

The most commonly used capacitor out there is the ceramic capacitor. The name for the capacitor comes from the material used to build the dielectric is made.

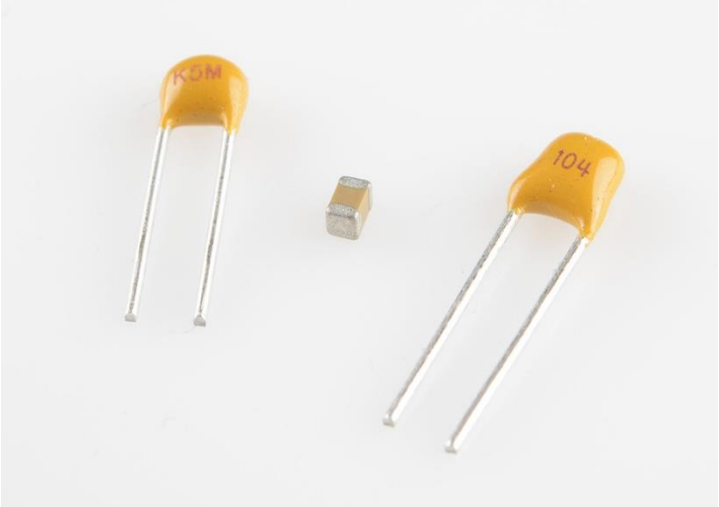


Fig 4.20: Ceramic Capacitor

- **Aluminum and Tantalum Electrolytic:**

These type of capacitor are great because they pack a lot of capacitance into a relatively small area. If wanted a capacitor of capacitance of the range of 1µF-1mF, you can choose electrolytic capacitors.

Fig 4.21: electrolytic capacitor

- **Supercapacitors:**

If the capacitor which can store the energy is needed, supercapacitors can be considered, they can store huge amount of charge in them. They have high capacitance, in the range of farads.

Fig 4.22: Supercapacitor

Advantages of Capacitor:

- Capacitors can charge and accumulate energy very quickly.
- Can discharge quickly.
- Losses are very small compared to other storage medium.
- Have very high life and of low maintenance.
- Capacitor are of small size and cost effective so can be used in normal projects without any difficulties.

Disadvantages of Capacitors:

- Energy storage capacity is very low compared to batteries.
- Limited energy storage for the cost paid.
- Storage of the capacitor will deplete eventually due to internal losses.

4.6 Preset:

A preset resistor is smaller version of potentiometer that can be mounted on PCB. These are useful where configuration and adjustment of the circuit has to be made during building a circuit.

Fig 4.23: Preset

4.7 Buzzer:

A buzzer is a signalling device that will produce sound when triggered, it is used to alert people about on going fire accident and help in evacuation of people as soon as possible.

Fig 4.24: Buzzer

4.8 Working:

When there is no fire, thermistor remains at 10k ohm. Transistor remains at ON state because there is sufficient voltage across the base-emitter junction of transistor, which makes it ON. When the transistor is ON, pin 4(RESET) is connected to the GND, and when Reset pin is Grounded ,555 IC doesn't operate.

Now when we start heating the thermistor through fire, its resistance starts to decrease, and when its resistance decreases, the voltage at the base of the transistor starts to decrease and when the voltage becomes less than the operating voltage (base-emitter voltage) of transistor, then transistor becomes OFF. And when transistor becomes OFF, Reset pin of 555 timer IC, gets positive voltage through R4, and 555 IC starts to work and buzzer beeps.

In transistor, usually 0.7v voltage is required across the Base and Emitter, to turn it ON. So we have to carefully adjust the value of variable resistance VR1 and thermistor, to make the circuit work properly. To do this remove the thermistor and let VR1 be grounded, now adjust the value of VR1 to that point , where even slight turning of VR1 starts the buzzer. Means from this point, if we decrease the resistance, even very little, buzzer starts to beep. Now at this point, connect the thermistor again.

CHAPTER 05

RESULT AND DISCUSSION

The project is working absolutely perfect on PCB.

Our fire alarm project starts to beep as soon as it senses fire, which heats up the thermistor and through the 555 IC the buzzer gives us the indication.

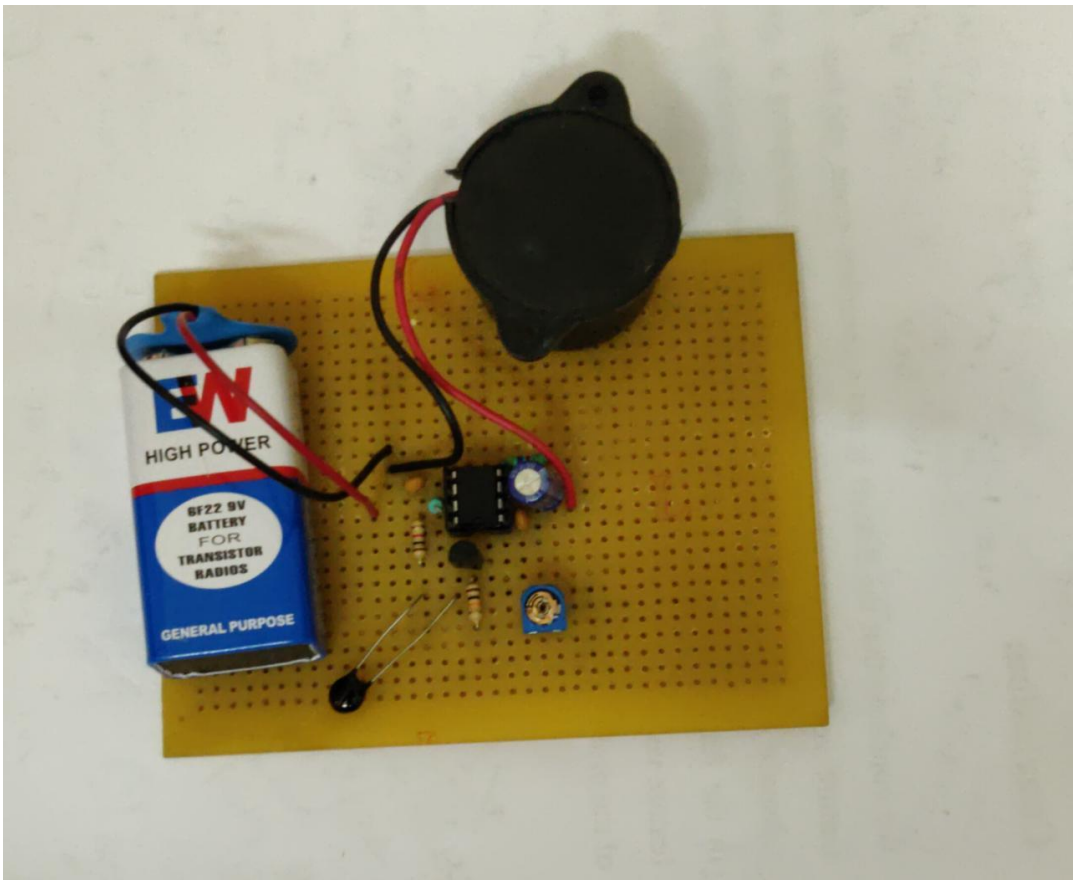


Fig 4.25: Model of Fire Alarm on PCB

It can sense fire to a maximum distance of 10^-2 to 10^-1 m, depending on the intensity of the fire.

CHAPTER 06

CONCLUSION AND FUTURE SCOPE

The fire alarm systems can be used in many places to detect fire accidents and warn people to evacuate the place on time to avoid any accidents caused by fire.

Our Project excessive heat or fire and provide an alert for that particular region where its placed to take specified action.

Applications:

- Offices and commercial
- Apartments
- Shopping and retail
- Educational institutions
- Hotels and leisure
- Hospitals and health

Future scope:

- To overcome disadvantages and looking for implementation of automatic fire detection.
- In the place of thermistor, we can use some sort of sensor that can detect fire accidents.
- Using speakers instead of buzzer with warning message and audio alert signal.
- In case of on going fire accident, the news should be sent to nearby fire stations immediately and to nearby emergency centers for future help.

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