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PROJECT REPORT

TOPIC – FIRE ALARM DETECTOR CIRCUIT

SUBMITTED BY-

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FIRE ALARM DETECTOR CIRCUIT

ABSTRACT:

Our circuit detects the fire in ambiance at very early stage by sensing smoke or/ heat and raise an alarm which warns people about the fire and furnish sufficient time to take preventive measures. Here we are constructing a fire alarm system with the help of **555 Timer IC**, which will sense the fire and trigger the alarm.

The key component of the circuit is Thermistor, which has been used as fire detector or fire sensor. Thermistor is temperature sensitive resistor, whose resistance changes according to the temperature, its resistance decreases with the increase in temperature and vice versa. We have built the circuit using, mainly three components that is, Thermistor, NPN transistor and 555 Timer IC. Here the 555-timer circuit has been configured in an astable mode so that Alarm (Buzzer) can produce an oscillating sound. In an astable mode, capacitor C charges though resistance R1 and R2, till 2/3 Vcc and discharges through R2 till it reaches to 1/3Vcc. During the charging time OUT PIN 3 of 555 IC remains HIGH and during discharging it remains LOW, that's how it oscillates. We have connected a Buzzer to OUT pin, so that it produces beep sound, when 555 is high. We can control the oscillation frequency of the alarm by adjusting the value of R2 and/or capacitor C.

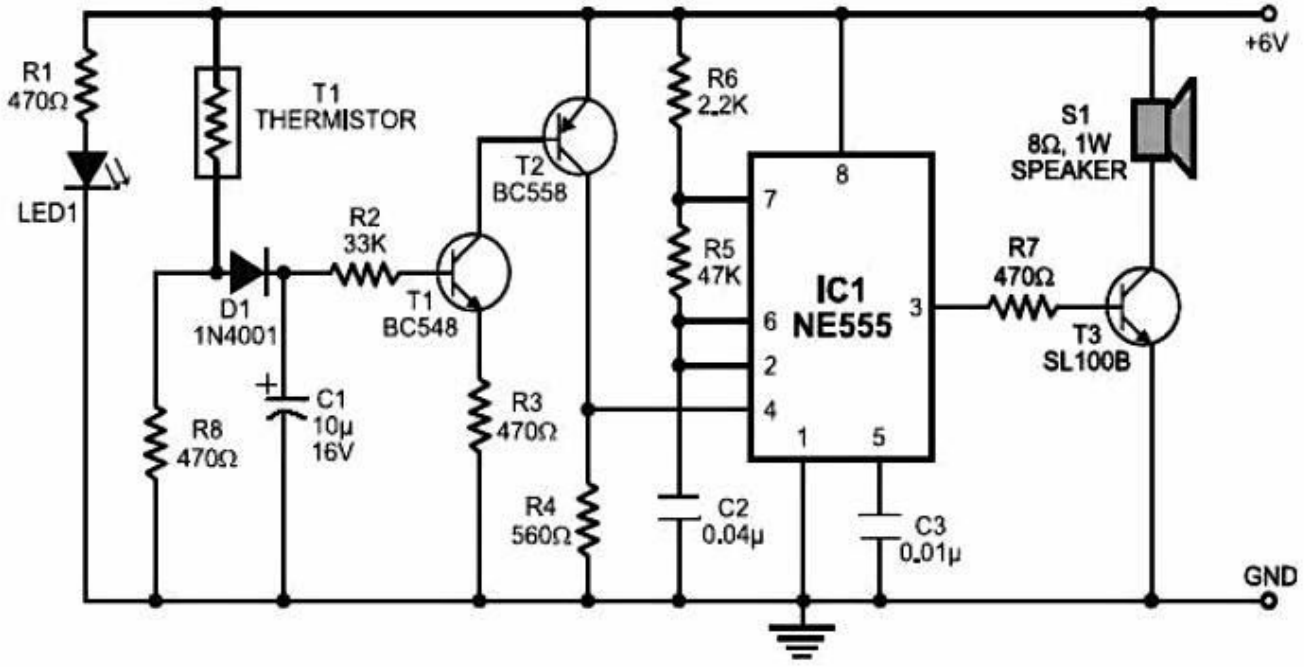
AIM:

To detect the fire in ambiance at very early stage by sensing smoke or/ heat and raise an alarm which warns people about the fire and furnish sufficient time to take preventive measures.

COMPONENTS REQUIRED:

Component	Specification & Quantity
Thermistor	**10K x 1**
555 timer IC	**NE555 x 1**
Transistor	**BC548 x 1, BC558 x 1, SL100B x 1**
Resistor	**470 Ω x 4, 33KΩ x 1, 560Ω x 1, 2.2KΩ x 1, 47KΩ x 1**
Capacitor	**0.01µ x 1, 0.04 µ x 1, 10 µ x 1**
Diode	**IN4001 x 1**
Buzzer	**(8 Ω, 1W) x 1**
Power Source	**6V x 1**

CIRCUIT DIAGRAM:



PROCEDURE:

The main component in detecting the fire is the 10 K Thermistor. As we mentioned in the component description, the 10 K Thermistor used here is a NTC type Thermistor. If the temperature increases, the resistance of the Thermistor decreases.

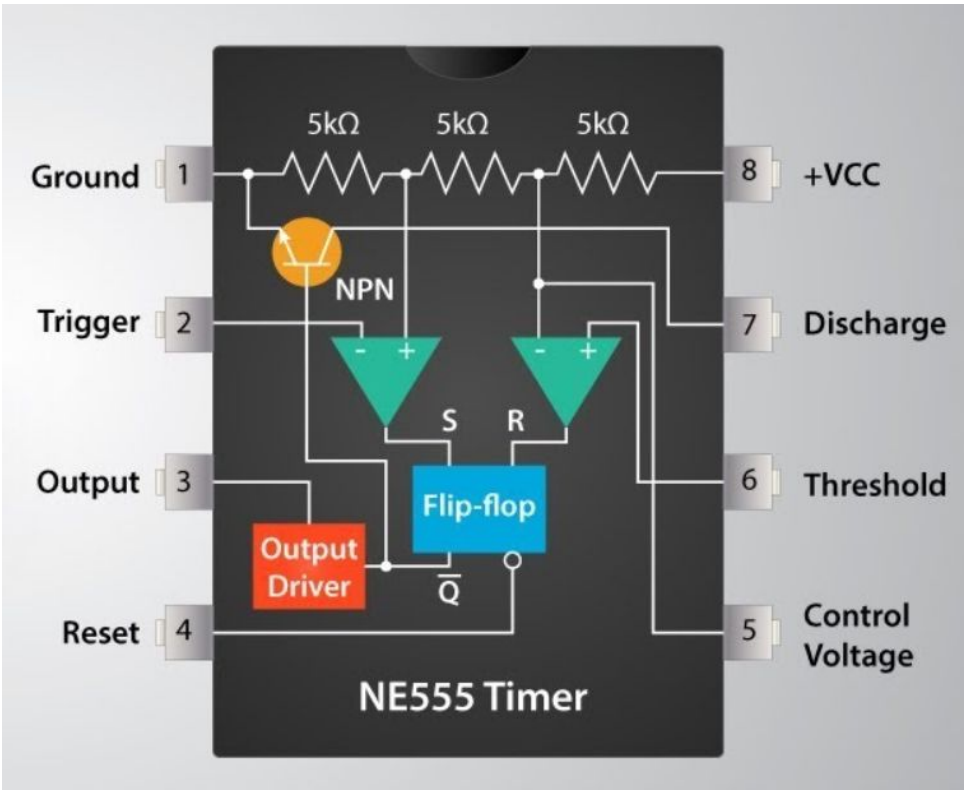
In case of fire, the temperature increases. This increase in temperature will reduce the resistance of the 10 K Thermistor. As the resistance decreases, the output of the voltage divider will increase. Since the output of the voltage divider is given to the non – inverting input of the LM358 Op – Amp, its value will become more than that of the inverting input. As a result, the output of the Op – Amp becomes high and it activates the buzzer.

The three main components of Fire alarm detector circuit are,

1. **Timer (IC 555)**
2. **Thermistor (10K)**
3. **Buzzer (1W)**

1) TIMER (IC 555)

The IC 555 timer is a one type of chip used in different applications like **an oscillator**, pulse generation, timer. The designing of IC 555 timers can be done by using various electrical and electronic components **like transistors**, resistors, diodes and **a flip flop.** The operating range of this IC ranges from 4.5V -15V DC supply. The functional parts of the 555 timer IC include flip-flop, voltage divider and a comparator. The main function of this IC is to generate an accurate timing pulse. In the monostable mode, the delay of this IC is controlled by the external components like a resistor and capacitor. In the astable mode, both the duty cycle & frequency are controlled by two external resistors and one capacitor.



555 Timer IC Pin Configurations:

The **555 timer IC** consist of 8-pins where each pin has some function. The pin configuration of this IC is shown below

GND Pin

Pin-1 is a GND pin which is used to supply a zero voltage to the IC.

Trigger Pin

Pin-2 is a trigger pin which is used to convert the FF from set to RST (reset). The output of the timer depends on the amplitude of the external trigger pulse that is applied to the trigger pin.

Output Pin

Pin-3 is an output pin.

Reset Pin

Pin-4 is an RST pin. When the negative pulse is applied to this pin to disable or reset, and false triggering can be neglected by connecting to VCC.

Control Voltage Pin

Pin-5 is the control voltage pin used to control the pulse width of the output waveform and also the levels of threshold and trigger. When an external voltage is applied to this pin, then the output waveform will be modulated

Threshold Pin

Pin-6 is the threshold pin, when the voltage is applied to threshold pin, then it contrasts with a reference voltage. The set state of the FF can be depending on the amplitude of this pin.

Discharge Pin

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

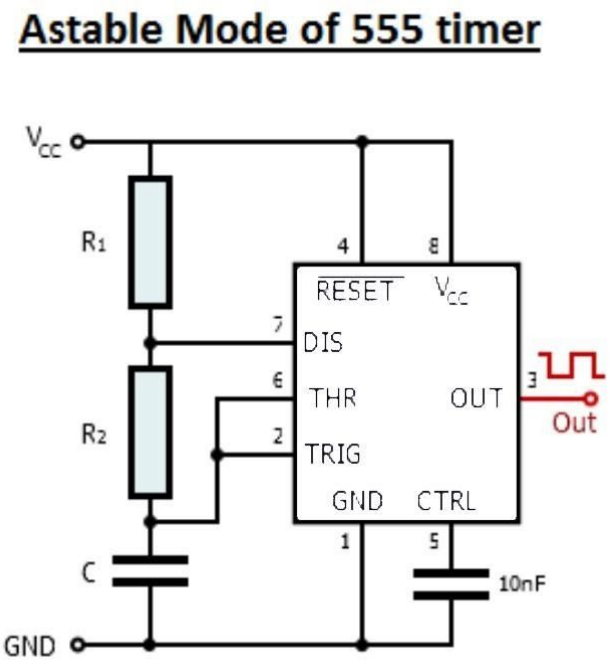
Supply Terminal

Pin-8 is the voltage supply pin which is used to supply the voltage to the IC with respect to the ground terminal.

Operating Modes of 555 Timer IC

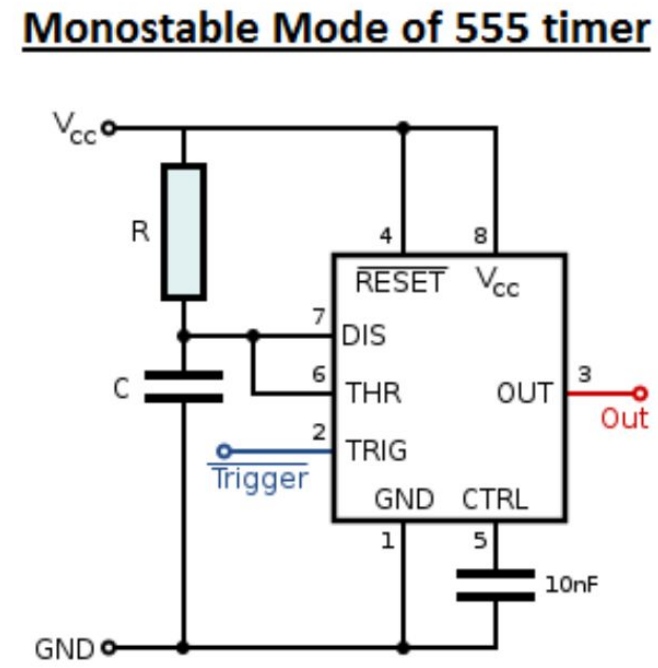
The operating modes of a 555 timer are astable, bistable and monostable. Each mode of operation signifies with a circuit diagram and its output.

Astable Mode Operation:



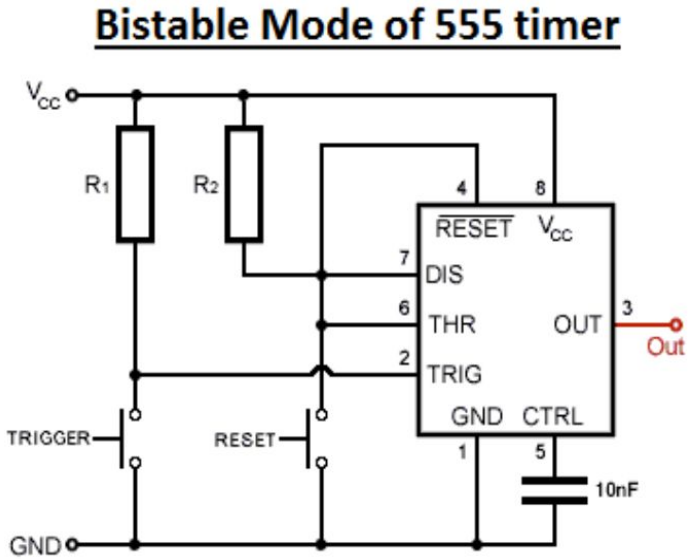
In this mode, the circuit of the IC 555 timer produces the continuous pulses with exact frequency based on the value of the two resistors and capacitors. Here the charging and discharging of the capacitors depends on a specific voltage. The circuit diagram of the 555 timer in astable mode is shown below. If the voltage is applied to the below circuit, **the capacitors** continuously gets charged through two resistors and generates pulses continuously. In the following circuit pins 2 & 6 are shorted together for endless re-activate the circuit. If the o/p trigger pulse is high, then capacitor in the circuit totally discharges. Long-time delays are accomplished by using the higher values of the resistors and capacitors.

Monostable Mode Operation:



In this mode, the circuit generates only single pulse when the timer gets an indication from i/p of the trigger button. Pulse duration can be depending on the **values of the resistor** and capacitor If an activating pulse is applied to the i/p of the circuit through a push button, then the capacitor gets charge and the **timer circuit** extends a high pulse, then it remains high until capacitor totally discharges. If it is necessary to enhance the time delay, then higher rate of capacitor and resistor are required.

Bistable Mode Operation:



In this mode, the circuit produces 2-stable state signals which are low and states. The o/p signals of low and high state signals are controlled by reset & activate the i/p pins, not by the charging & discharging of capacitors. If a low logic signal is given to active pin, then the o/p of the IC circuit goes to high level. If the low logic signal is given to the RST pin, then the o/p of the circuit goes to low level.

2) THERMISTOR (10 K)

Thermistors are composed of materials with known resistance. As the temperature increases, an NTC thermistor's resistance will increase in a non-linear fashion, following a particular "curve." The shape of this resistance vs. temperature curve is determined by the properties of the materials that make up the thermistor.

Selecting the thermistor:

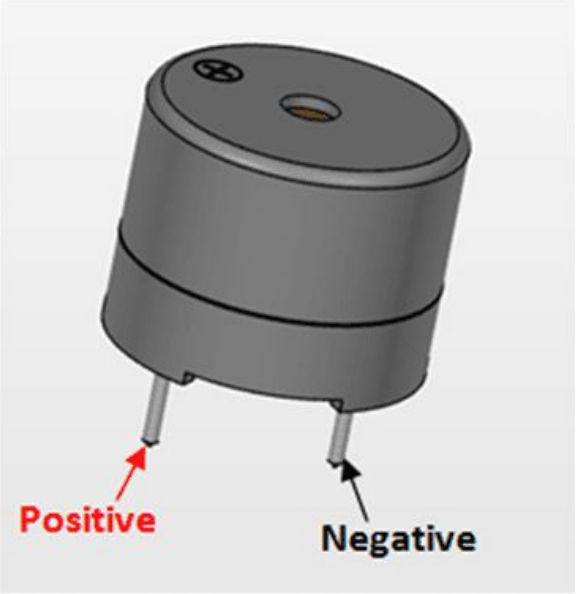
We selected our thermistor to be of 10KΩ by checking the resistance versus temperature chart that accompanies the thermistor. It should list the resistance value of the thermistor at 25 degrees centigrade (about 77 degrees Fahrenheit).

Wiring the thermistor:

Connect the positive terminal of the power supply to one end of the thermistor. Connect the other end of the thermistor to the resistor. Then Connect the resistor to the negative terminal of the power supply. Now connect the thermistor cum resistor to the actual fire alarm circuit.

3) BUZZER (1W)

A **buzzer** is a small yet efficient component to add sound features to our project/system. It is very small and compact 2-pin structure hence can be easily used on breadboard, Perf Board and even on PCBs which makes this a widely used component in most electronic applications.



Wiring:

This buzzer can be used by simply powering it using a DC power supply ranging from 4V to 9V. A simple 9V battery can also be used, but it is recommended to use a regulated +5V or +6V DC supply.

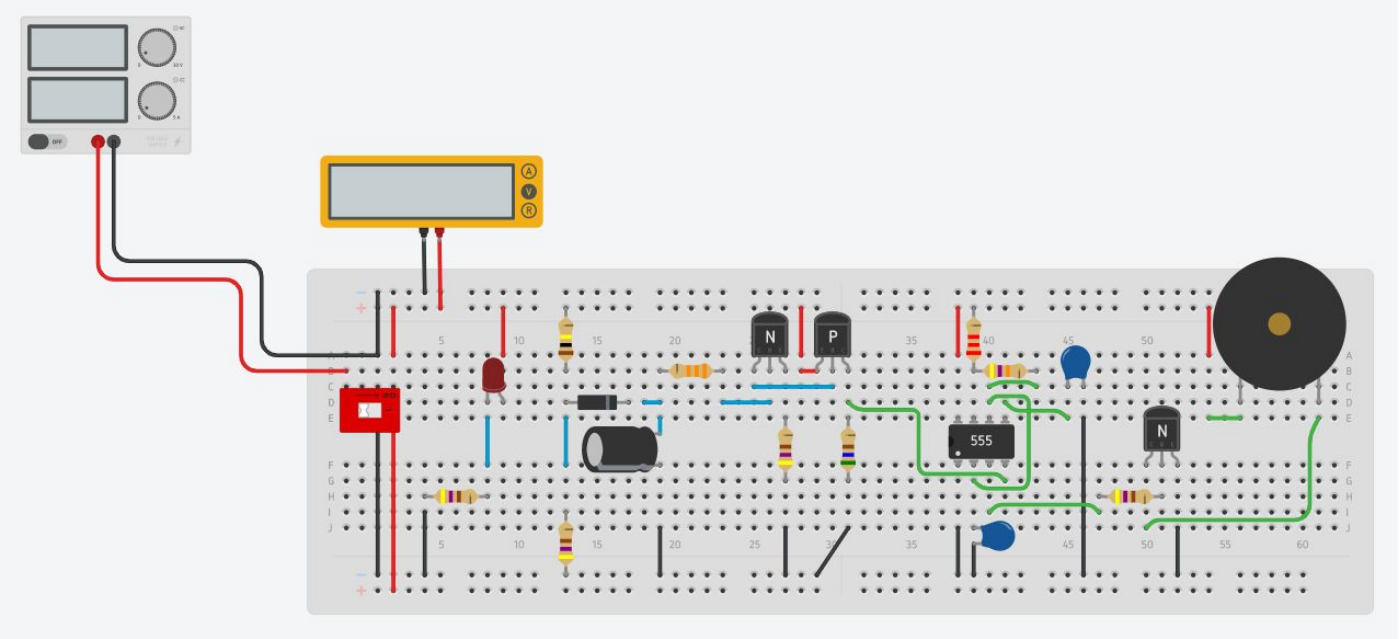
WORKING OF FIRE ALARM CIRCUIT:

This circuit uses IC1 (NE 555), Thermistor, Resistors, Capacitors and Transistors in it. The IC1 is configured as a free running oscillator at audio frequency. **Timer IC** (IC1) can produce continuous signal when used as an Astable Multivibrator. Thermistors are the special purpose ICs whose temperature varies significantly with temperature and here we are using NTC (Negative Temperature Coefficient) **Thermistors**. These Thermistors exhibit high resistance when temperature is low and low resistance when temperature is low. Thus, in this circuit this was used to sense the rise in temperature in the surroundings.

Initially when there is a fire break out the resistance of the Thermistor decreases and this allows the voltage to the base of the transistor through the diode D1. The function of the Diode is to allows the current in one direction through it. In this process the **capacitor** C1 get charges up and increases the time for which the alarm in ON. The larger the value of C1 larger the positive bias applied to the Transistor T1. As the collector of the Transistor T1 is coupled to the base of the Transistor T2 the transistor provides a voltage to the pin 4 (reset) of the **NE 555 IC**. It is the function of R4 which keeps the IC inactive unless positive voltage is given through transistor. It should be selected in such a way to keep the IC inactive. So thus, it makes the Speaker to give sound when there is a fire breakout in the building.

The same reverse process happens when there is reduction in temperature it cools out the Thermistor therefore it gives the high resistance path to the voltage flow thus inhibiting it from reaching the Transistor therefore it keeps the IC1 in inactive state therefore the alarm remains off.

TINKERCAD IMPLEMENTATION:



Link to our implementation in TINKERCAD:

https://www.tinkercad.com/things/iw8ipozxRI3-fire-alarm-circuit/editel?sharecode=C0Swf5fvXBVO3YS-O29Zo_QMbsWClZUytlg-EVKIM6U

(*Since there is no thermistor in components tray of TINKERCAD we placed a DPDT switch instead of a thermistor.)

APPLICATIONS:

- Fire Alarm Circuits are very useful in homes, offices, schools, labs, etc. to detect and prevent any disasters due to fire.
- Fire Alarm Systems can work as a stand – alone devices or be a part of a complex home security system with other security features like smoke detection, intruder alert, motion detection, etc.

CONCLUSION:

If there is a sense of fire or smoke it detects it and warns us by the buzzer. There is very little maintenance required and hardly any effect due to aging. Sometimes the aging of the components may cause the buzzer to sound a little less but still it helps us by warning us earlier to take preventive measures.

REFERENCES:

1) https://theorycircuit.com/fire-alarm-circuit/
2) https://appuals.com/how-to-make-a-simple-fire-alarm-circuit/
3) https://youtu.be/dkil3RCp_Dw