BIRLA INSTITUTE OF TECHNOLOGY MESRA, JAIPUR CAMPUS

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

A PROJECT REPORT
on
OVER-TEMPERATURE INDICATOR USING SCR

EC375 INDUSTRIAL ELECTRONICS

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ABSTRACT

This project presents an innovative Over-Temperature Indicator system, incorporating components like an SCR, a transistor, and a thermistor. Initially, the system remains in a standby mode, with the SCR gate grounded by the transistor. However, as the temperature starts to climb, the decreasing resistance of the thermistor prompts the transistor to switch off, activating the SCR. This triggers the immediate illumination of an LED indicator, serving as a warning sign for high temperatures. The significance of this project lies in its ability to address the pressing need for real-time temperature monitoring across various settings. By offering a cost-effective solution with dependable performance, it stands as a crucial safety measure for industries, households, and electronic equipment alike.

OBJECTIVE

The aim of the project is to develop an **Over-Temperature Indicator System Using an SCR** to enhance safety and prevent damage by providing timely alerts of over-temperature conditions in various applications.

The objective of the project is to design and implement an Over Temperature Indicator Circuit utilizing an SCR and a thermistor, with a focus on achieving the following three key objectives:

1. Energy-Efficient Circuit: Design an optimized circuit for minimal power consumption during operation and standby, through careful component selection and efficient design.

2. Temperature Monitoring: Develop a precise system using a thermistor to detect and display temperature variation and responding promptly to temperature fluctuations to prevent overheating.

3. Equipment Protection: Create a robust mechanism with LED warnings to prevent damage from high temperatures, extending the lifespan of critical components.

By addressing these objectives, the project aims to contribute to the development of efficient, reliable, and cost-effective solutions for temperature monitoring and equipment protection applications.

COMPONENTS USED

- SCR (TYN612M - 12A)
- BC547 – NPN Transistor
- Resistors (3.3KΩ, 10KΩ (x2), 1KΩ)
- Potentiometer (4.7KΩ)
- NTC Thermistor (10KΩ)
- Capacitor (1µF 25 Volt)
- LED (3.3 Volt)
- 12 Volts DC Power Supply
- Breadboard with connecting wires

METHODOLOGY

Design the circuit as shown in Fig.1. After construction, supply the adequate voltage, which is 12 Volts. However, here we have provided 13 Volts. Once circuit is running, adjust preset so that the **Transistor Q1** (refer to circuit diagram Fig.1) remains switched ON when power is first switched ON. The BJT uses current of **I_B=0.5mA** to Turn ON. Given that Q1 is switched ON via R1 and R2 (10KΩ each) and RV1 (at 4.7KΩ), the SCR gate remains grounded and the SCR is unable to turn ON due to insufficient gate current to trigger it, which is **I_T =1.5mA**.

As the temperature increases, the resistance of the thermistor decreases. At a specific threshold, in this case at **1.1KΩ** at **Thermistor** and depending on the RV1 setting, the decreased resistance of the thermistor leads to a significant drop in the base bias of Q1 and Q1 is shut down (Turn OFF).

As soon as Q1 Turns OFF, the excess current previously flowing to the collector of Q1 now activates the SCR, receiving the required I_T = 1.5mA, through the 3.3KΩ resistor. Consequently, the SCR is promptly switched ON, thereby illuminating the LED. This action completes the connection between the anode (A) and cathode (K) terminals of the LED, effectively indicating an over-temperature condition.

CIRCUIT DIAGRAM

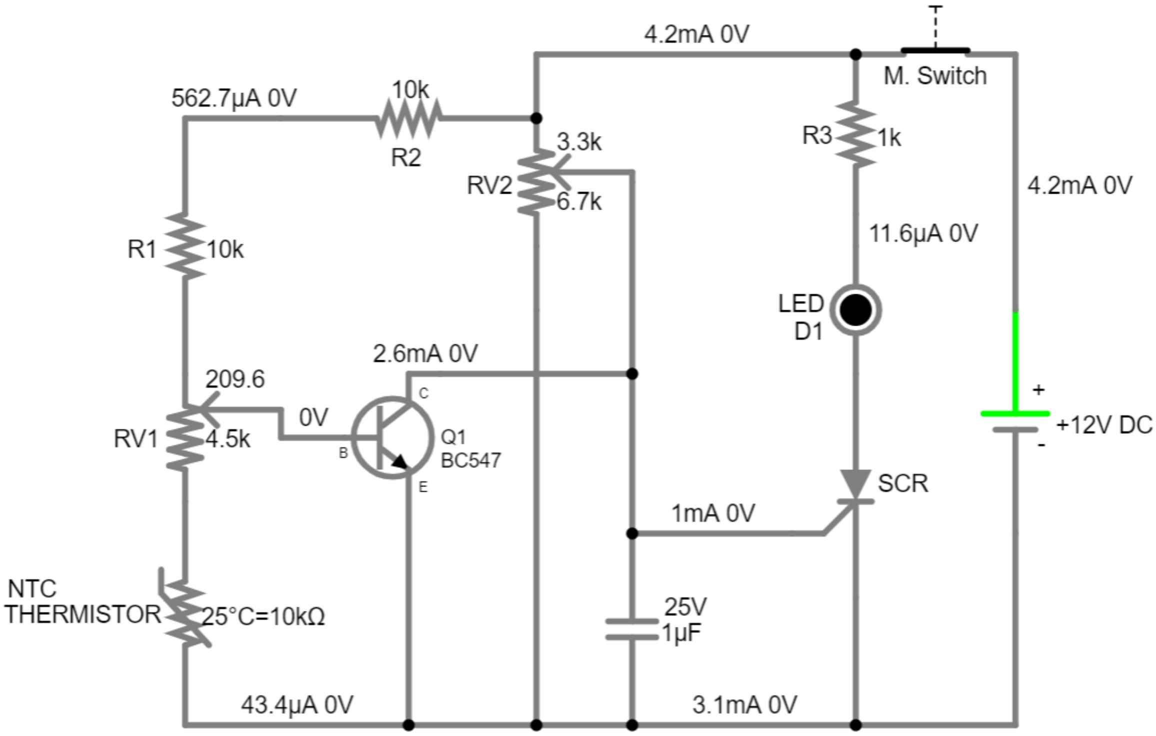


Figure 1: Circuit Diagram of Over Temperature Indicator using SCR

EXPERIMENTAL VALUES/OBSERVATION

The practical temperature of flame that we obtained to trigger circuit is: **<u>90°C</u>.**
Whereas theoretical temperature of the flame under ideal conditions is: **<u>85°C</u>**.

To calculate the percentage change between the practical temperature obtained and the theoretical temperature, you can use the following formula:

$$Percentage\ Change = \frac{Practical\ Temp. - Theoretical\ Temp.}{Theoretical\ Temp.} \times 100\%$$

Substituting the given values:

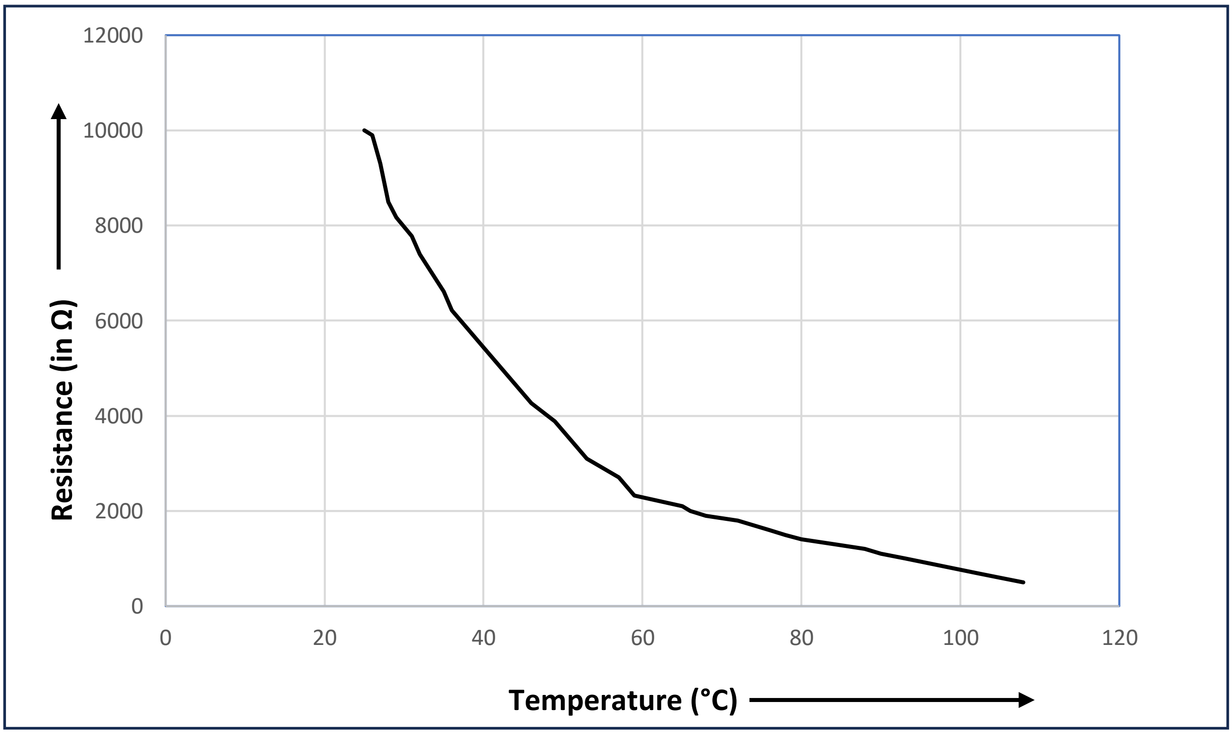
$$Percentage\ Change = \frac{90 - 85}{85} \times 100\% = 5.88\%$$

So, the percentage change is approximately **5.88%.**

To calculate the time constant for the given circuit, we need to determine the values of the resistor (R) and the capacitor (C) in the circuit. That is:
Capacitor (C) = **1µF = 1 x 10^{-6} F**
Resistor (R) = **3.3KΩ = 3.3 x 10^{3} Ω**
The time constant (τ) of an RC circuit is given by the formula:

τ = R x C

Substitute the values of R and C into the formula:
τ = 3.3 x 10^{3} Ω x 1 x 10^{-6} F
τ = 3.3 x 10^{-3} seconds
Therefore, the time constant for the given circuit is **<u>3.3 milliseconds</u>**.



<u>Graph 1 : NTC Thermistor Graph (Resistance vs Temperature)</u>

RESULTS

We obtained the results as followed:
Upon reaching temperatures exceeding **85°C** (theoretical), the resistance of the thermistor decreases below **1.1KΩ**, causing the **BJT (Q1)** to Turn OFF and triggering the SCR at a gate current of **1.5mA**. Also, the **1µF** capacitor in the circuit to control the time constant of the circuit with value of **3.3 milliseconds**, influencing the system's response time to temperature changes.

The flame temperature that we obtained practically is **90°C,** so the percentage change between theoretical and practical values is **5.88% .**

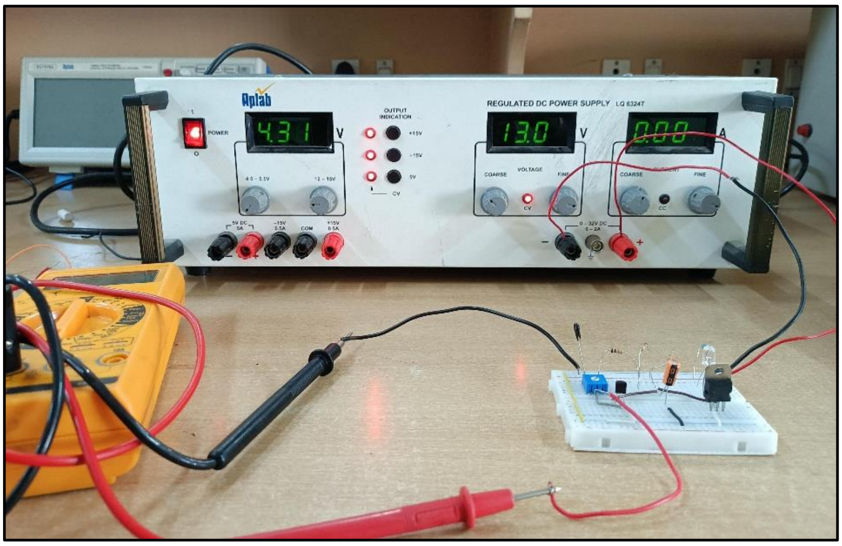


Figure 3: Complete Experimental Setup of Project

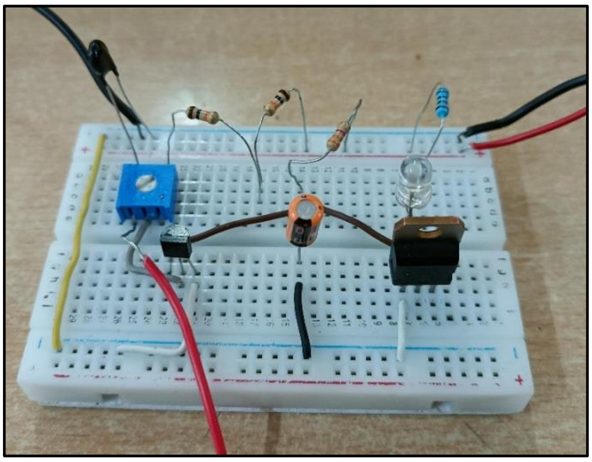


Figure 4: Temperature is ideal (Room Temp: 27°C) [NO LED GLOWS]

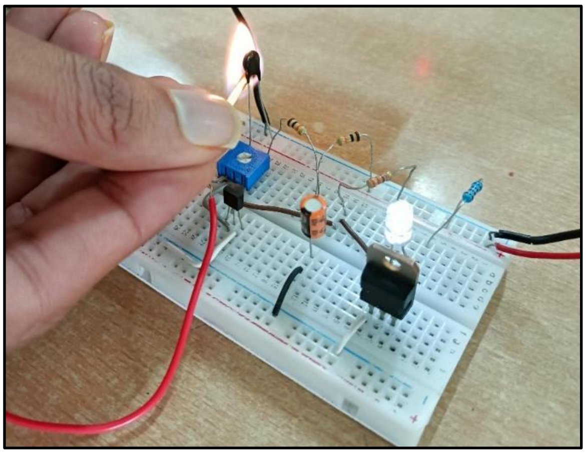


Figure 5: Heat Provided (Temp: 90°C) [LED GLOWS]

CONCLUSION AND FUTURE SCOPE

The Over-Temperature Indicator Using SCR project achieves its goal of providing a cost-effective solution for real-time temperature monitoring. By integrating SCR, transistor, and thermistor components, the system accurately detects temperature changes, triggering alerts above 85°C. Its findings offer practical insights for industrial electronics, emphasizing the importance of proactive temperature control to prevent equipment damage.

1. **Feasibility of Making It**: One of the most common feedback we gained was that it's totally doable to make this over temperature indicator using SCR. So, if we need to make a bunch of them, it shouldn't be a problem and hence fabricating it would help it’s practical implementation.

2. **Adjusting Temperature Range:** Professors told us how important it is to be able to change the temperature settings. Different situations might need different temperatures to trigger the indicator or the automatic shut-off. So, being able to tweak the temperature range based on what is needed is a big plus for this project.

3. **Doing More Than Just Indicating Temperature:** This over temperature indicator circuit can do more than just warn you. It could protect your stuff. By cutting off the current when it gets too hot, it can help keep things safe and prevent damage or accidents.

4. **Connecting with the Internet for Remote Checking:** Another suggestion was that implementation of circuit with IoT tech could make it even better. That way, you could check on things and control them from far away. Being able to see the temperature in real-time and adjust settings remotely could make it more useful and safer in different situations.

5. **Cost-Effectiveness for Household Implementation:** Another point raised was how cost-effective this project is. Since it does not require fancy materials or complicated assembly, it could easily be affordable for households. This means it has the potential to be implemented in every household, enhancing safety and peace of mind for homeowners.

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