A
Project Report
on

"Overheat Detector"

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ABSTRACT

This paper has been designed to build a Overheat Detector using LM358 to follow a designated path which is provided and runs over it.

ACKNOWLEDGEMENT

We wish to express our profound and deep sense of gratitude to Mr. B.G. Patil sir, Project Guide, Department of Electronics Engineering for sparing his valuable time to extend help in every step of our project work.

We are mainly indebted to the authors of many references and articles which were used as the reference.

Last but not the least we would like to thank our friends and family for their help in every way for the success of this project report.

CHAPTER 1

1. Introduction

In recent years, server overheating has become one of the most important concerns in large-scale data centres.

As a result, the increasingly high server and thus power densities can lead to some serious problems. First, the reduced server space may result in a greater probability of thermal failures for various components within the servers, such as processors, hard disks, and memories. Such failures may cause undesired server shutdowns and service disruption. Second, even though some components may not fail immediately, their lifetimes may be significantly reduced due to overheating.

1.1. Background

As technology becomes increasingly important in today's world, it is invaluable to not only learn how to use technology, but also to understand how to create it. Since being the engineer, one should have sound knowledge of the other discipline. Most of the projects have limited scope to only specific discipline. This would limit one's innovation and creativity. This project inspires to make connections across several disciplines rather than learning topics in isolation as it combines mechanical, electronic, electrical and programming skills.

1.2. Motivation

It is reported in that the lifetime of an electronic device decreases exponentially with the increase of the operating temperature. Finally, the generated heat dissipation can also lead to negative environmental implications. Therefore, it is important for each server component to run at a temperature below its overheating threshold.

However, in today's data centres, how to precisely detect whether any component in a server is overheating remains an open question. Hence, this mini project becomes crucial in today's world.

1.3. Problem Description

Many people face difficulties due to overheating of components, many of them are often met with accidents and risk. Overheating causes damage to the circuit components and can cause fire, explosion, and injury. We are building this project to prevent any damage from overheating and injury also. Damage caused by overheating is usually irreversible; the only way to repair it is to replace some components.

1.4. Objectives

The objectives of the project are:

- To build a simple Over Heat Detector with Auto Cut-Off System using Dual Op-Amp IC LM358.
- To sense heat in a device such as laptop, industrial machines, etc.
- To alert homeowners and business owners that there is a fire before the fire becomes irreversible.

1.5. Methodology

1. The NTC Thermistor along with Op-Amp LM358 has been used here for sensing temperature variations.
2. Op Amp is used as Non inverting Amplifier. A comparator circuit is basically an operational amplifier without feedback, that is, the op-amp is used in its open-loop configuration, and when the input voltage V_{IN} exceeds a preset reference voltage, V_{REF}, the output changes state.
3. The output signal is not enough to drive the 12V relay coil hence transistor BC549 is being used as a switch.
4. The collector of transistor is connected to relay coil and its signal becomes high. Hence the relay coil activates
5. This relay will activate the buzzer when the condition of overheating meets. This will also turn on the Red LED.
6. Then the buzzer will turn on and after normal temperature it will turn off automatically.

CHAPTER 2

2. Technology and Literature Survey

- **Prof. Mukesh Tiwari, Mr. Manish Shrivastava (2013)**

It was published to develop this project is from an machine overheat detection with alert blog known as “heat detector”. The heat detector is the heart of this project.

- **Sir Sayeed Ahmed (2016)**

Research into the current trend toward the development of fire detection algorithms and multi-sensor, multi-criteria fire detectors is prevalent in the literature in the last decade.

2.1. Basic Operation

Basic operations of overheat detector is that the op-amp compares the voltage across the potentiometer and thermistor and when comparison occurs the output of comparator goes high and relay circuit works.

2.2. Block Diagram

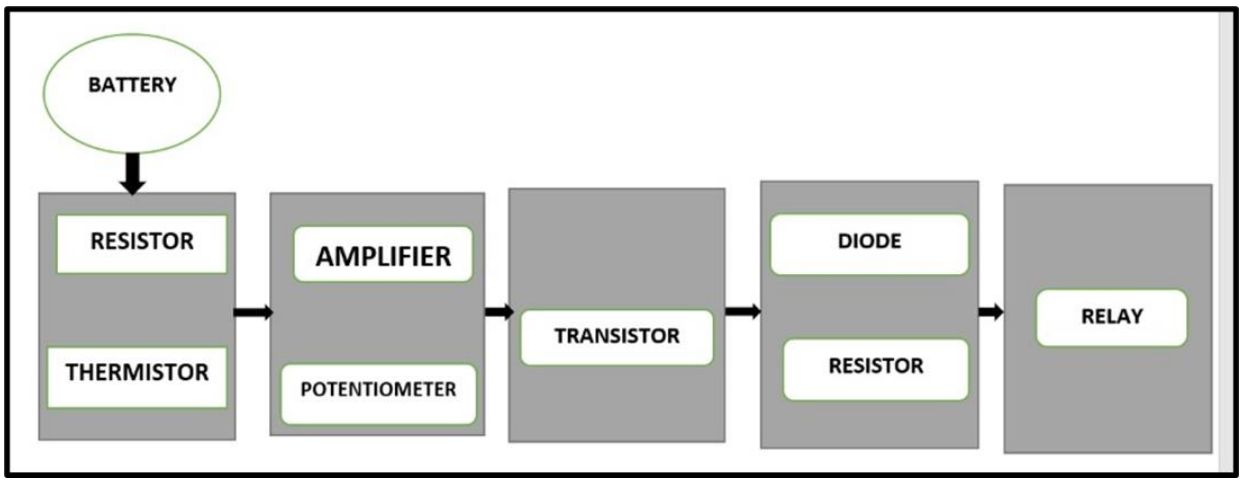


Fig 2.1 Block diagram for Overheat detector

2.3. Hardware Required

2.3.1. Potentiometer

Potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat.

The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name.

- Available in different resistance values like 500Ω, 1K, 2K, 5K, 10K, 22K, 47K, 50K, 100K, 220K, 470K, 500K, 1 M.
- Power Rating: 0.3W
- Maximum Input Voltage: 200Vdc
- Rotational Life: 2000K cycles

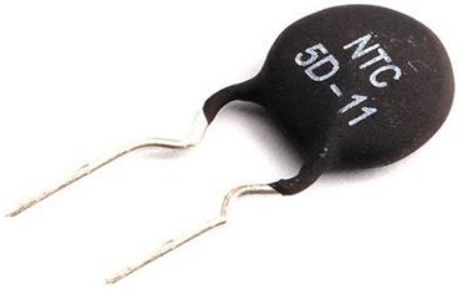
2.3.2. Thermistor

Thermal Sense Resistor or Temperature Dependent Resistor is known as a Thermistor. This device Resistance changes according to the temperature. Thermistor can be a NTC or PTC which means,

NTC – Negative Temperature Coefficient (Element Resistance Decreases when Temperature Increases)
PTC – Positive Temperature Coefficient (Element Resistance Increases when Temperature Increases)

Technical Specifications:

- Resistance at 25 degrees C: 10K +- 1%
- B-value (material constant) = 3950+- 1%
- Thermal cooling time constant <= (in air) 20 seconds
- Thermistor temperature range -55 °C to 125 °C



2.3.3. LM 358

LM358 IC is a dual operational amplifier integrated circuit with two Op-Amps powered by a common power supply. It consists of two independent compensated operational amplifiers with low power and high gain frequency.

Specifications:

- Integrated with two operational amplifiers in a single package
- Wider range of power Supply e.
- 3V to 36V in a single power supply
- ±1.5V to ±16V in a Dual power supply
- The large voltage gain is around 100 dB
- Wider bandwidth in 1 MHz
- Low supply current is 700µA
- Operating ambient temperature range is 0˚C to 70˚C
- Soldering pin temperature is 260 ˚

2.3.4. RELAY Circuit:

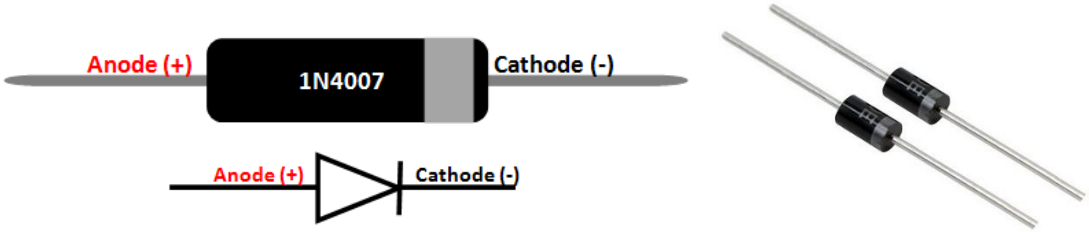
Relays are used where it is necessary to control a circuit by an independent low-power signal. Relays are electric switches that use electromagnetism to convert small electrical stimuli into larger currents.

2.3.5. Capacitor:

- Capacitor is a device which stores the charge.
- It is a device that stores electrical energy in an electric field.
- It is a passive electronic component with two terminals

2.3.6. Diode:

- The purpose of a diode connected in parallel to a relay coil (flywheel diode or freewheeling diode) is to avoid damaging some nearby components sensitive to high voltage.
- The diode will allow the current flowing through the coil to continue circulating when the relay is deactivated.
- The diode must withstand the amount of current that passes through the relay coil when it is active. This current passes through the diode when the relay is deactivated.

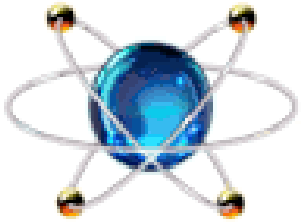


2.3.7. Electric Fan:

We will be using electric fan for cooling down the circuit to normal temperature.

2.4. Software Required

For the simulation of the circuit, Proteus software is used.



PROTEUS

CHAPTER 3

3. Design and Implementation

3.1. Schematic

The schematic of the "Overheat Detector" is shown in the figure. The main component is the LM358. Schematic is drawn by using Proteus. The main features incorporated into the hardware are given below:

- LM358.
- THERMISTOR
- POTENTIOMETER
- MOTOR
- BC549 TRANSISTOR
- RELAY
- 1N4007
- RESISTORS AND BATTERY

Each of the hardware is dissected and was designed/implemented separately for their functional and later incorporated as one whole application. This helped in the debugging processes.

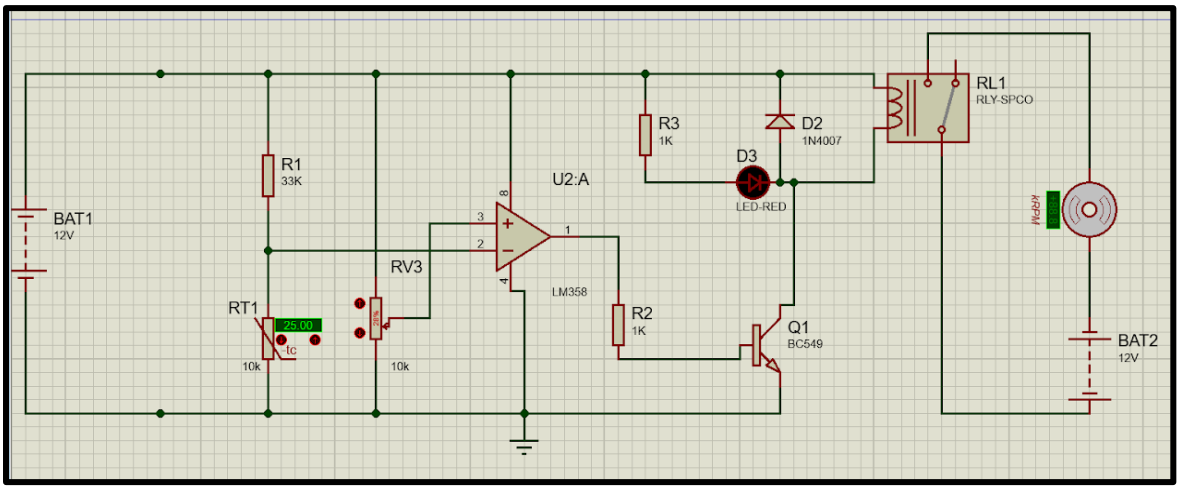


Fig. 2.1 Proteus Schematic diagram for Overheat detector

3.2. Circuit Explanation

The whole overheat detector can be divided into 3 sections: sensor section, control section and driver section.

3.2.1. Sensor section:

This section contains voltage divider circuit, thermistor, potentiometer. Potentiometer is used for setting reference voltage at comparator's one terminal and thermistor is used to sense the temperature and provide a change in voltage at comparator's second terminal. Then the comparator compares both voltages and generates the output.

3.2.2. Control Section:

LM358 is used for controlling the whole process of heat detection. The outputs of comparators are connected to the BC459 transistor. BC 549 transistor is used for driving the relay because Op-amp does not supply enough voltage and current to the relay.

3.2.3. Driver section:

Driver section consists of a relay, LED, 1N4007 and DC fan. The purpose of a diode connected in parallel to a relay coil is to avoid damaging some nearby components sensitive to high voltage. This voltage is generated in the coil when the current flow is interrupted. When the relay is deactivated, the coil tries to maintain the current flow. As there is no way for the current to circulate, a diode is placed parallel to the coil. In this way, the current circulates through the diode and voltage peaks are prevented from damaging other components of the circuit.

3.3. Working of Overheat detector

In this Circuit, 33K resistor and NTC (Negative Temperature Coefficient) 10k Thermistor are making a voltage divider circuit and the inverting terminal of LM358 op-amp IC is connected between the Resistors and thermistor. The 10k potentiometer's output pin is connected to the non-inverting terminal of LM358 op-amp IC. The potentiometer is used to set a reference voltage at the non-inverting terminal.

At room temperature, thermistor resistance is around 10K.When the Thermistor detects heat, its resistance starts to decrease, and the output of the voltage divider circuit is also decreased. This output goes to the inverting terminal. If this output voltage is less than the reference voltage at the non-inverting terminal. Then the LM358 IC gives High output to the output Pin. This High output voltage goes to the Base terminal of the BC549 Transistor through the 1k. Now the transistor starts conducting and it gives operating voltage to the LED and activates the Relay.

The dc fan connected to the relay starts operating and continues its rotation until the resistance of the thermistor becomes normal. As temperature decreases the resistance of the thermistor increases, then voltage of the inverting terminal of the op amp becomes greater than the non-inverting terminal and output of the op amp again becomes low. This is how the Over Heat Detector circuit works with the Auto Cut-Off System.

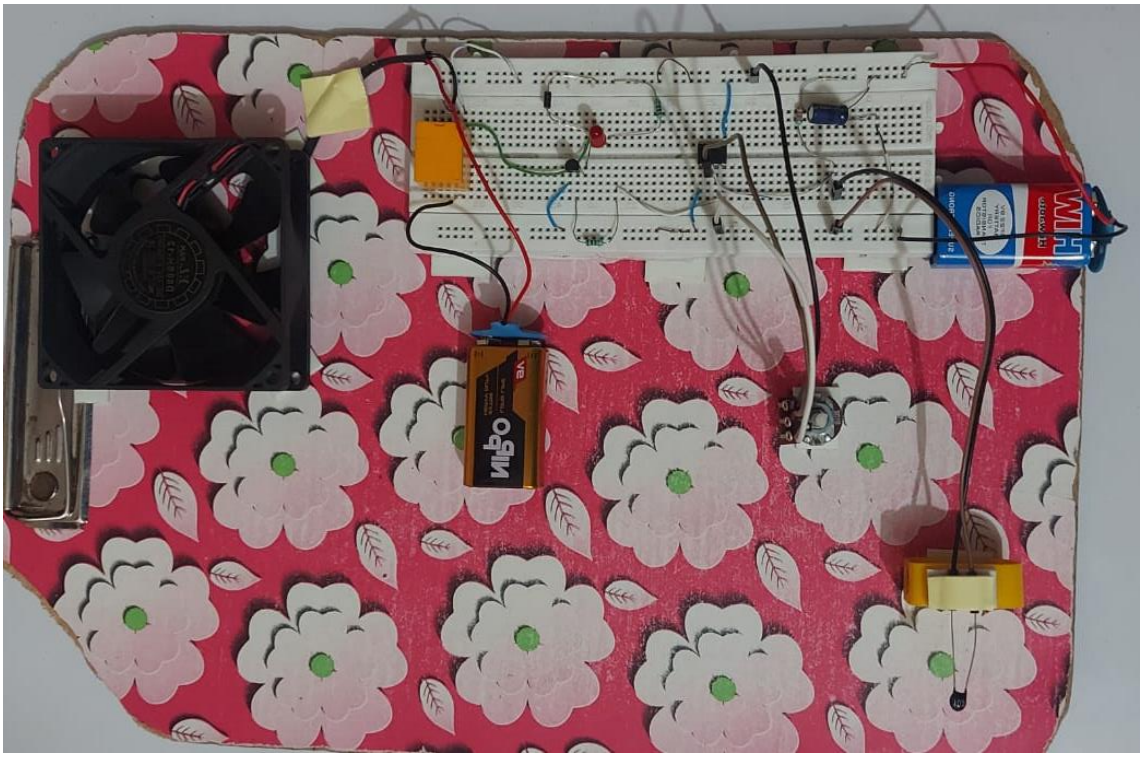


Fig 3.2 Hardware of Project

CHAPTER 4

4.1. Applications

- This project can be used in Industries, companies, and homes to monitor the high-temperature conditions.
- HVAC (Heating, Ventilation and Air Conditioning) Systems
- We can use this kind of project in such a farm that always needs a constant temperature.
- Human Safety is considered due to the automatic Cut-off system.

4.2. Advantages

- The circuit can help to completely shut down the working system after overheat is sensed.
- It is desired that it does not exceed a maximum temperature and prevent anything from burning.

4.3. Disadvantages

- We can't adjust the cut-off temperature frequently as it requires a calculation part.
- Sensitivity of the thermistor may change after a long time which may result in the error in the comparison.

4.4. Conclusion

The overheat detector project challenged the group to cooperate, communicate, and expand understanding of electronics, electrical components, and their behaviour.

COST ESTIMATION

Sr. No.	Name of Component	Quantity	Price Rs.
1	LM 358	1	10
2	Thermistor 103	1	10
3	Potentiometer 10k	1	15
4	Relay 5V	1	35
5	Power Supply 9V	2	40
6	Diode 1N4007	1	5
7	DC Fan	1	60
8	Transistor	1	15
		Total	190/-

Table 1: Cost of Project

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