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INFORMATION TECHNOLOGY
DELHI

Department
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Integrated Electronics - ECE214

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IE PROJECT

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Temperature to Voltage Converter

Aim:
To design a Temperature to Voltage Converter using Temperature Sensor (Thermistor) and Operational Amplifier.

Components:

1. Resistors
2. Wires
3. Voltage Source
4. DC Output Meter
5. NTC Thermistor
6. 4136 Quad OpAmp

Software Used:
Proteus 8 Professional

Link of Video:
https://www.youtube.com/watch?v=yQtd0mJ9frk

Theory:

By observing the Data Sheet of circuit contents:

1. We have selected IC4136 which is a quad IC of Op-Amp of LM741 as:
    - It has an operational range of temperature from 0°C - 70°C.
    - It works on an input supply of 10V-30V.
    - It has a very low power rating.

2. The NTC Thermistor provides 10K Ohms resistance to the current applied and works more efficiently in the circuit we have made.

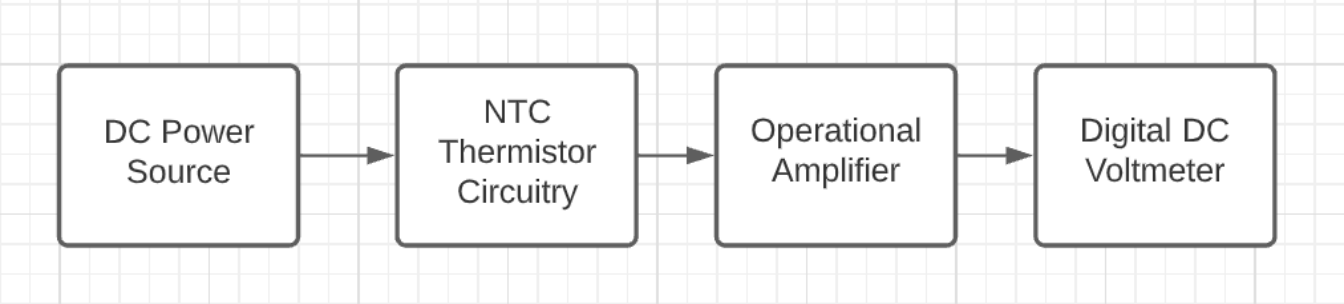
3. A Digital DC Voltmeter helps in viewing the change in voltage effectively.

4. The Op-Amp here is used as a differential amplifier whose function is to amplify the voltage difference between its inverting and non-inverting terminals so that the delta voltage is readable.

Operational amplifier:
An operational amplifier is a three-terminal, linear device. It has two input pins (Inverting and Non-Inverting input signals) and one output pin. Its function is to amplify the voltage difference between the two input pins. The output signal is amplified by an amplification factor 'A' known as Amplifier gain.

NTC Thermistor:
It is a thermally sensitive resistor whose physical resistance changes when exposed to variations in ambient temperature. NTC stands for Negative Temperature Coefficient. Resistance of any NTC thermistor decreases with an increase in ambient temperature. NTC gives precise reading when used in the temperature range of -55 °C to 200 °C. As Thermistor is a resistance; therefore, the self-heating effect may disrupt the precision of measurement.

Block Diagram:



The arrows depict the Signal Flow of the complete circuit.

HOW DOES THE CIRCUIT WORK:

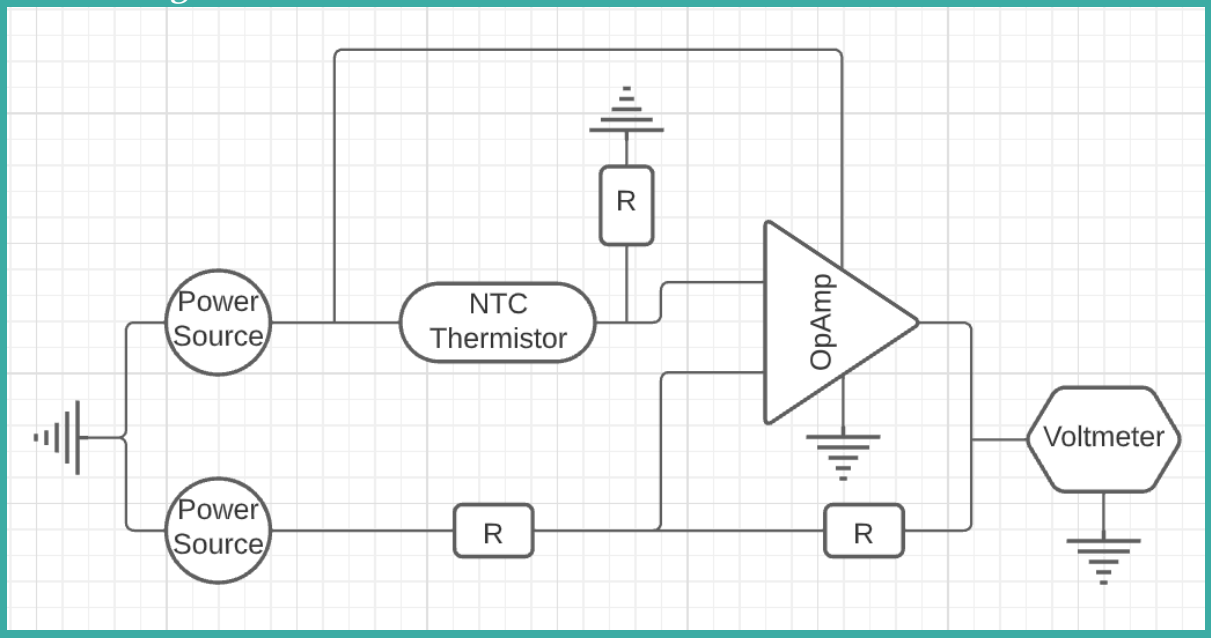
1. Block A (DC Power Source):
   - We needed this so that the Op-Amp in the circuit could operate.
   - Also, we have chosen this so that a Linear relationship can be seen between the temperature change and the output voltage.

2. Block B (NTC Circuitry):
   - An NTC is a device that reduces its Resistance when the temperature increases.
   - Due to this, a higher current can flow across the NTC, and we can achieve a higher delta voltage across the terminals.
   - But still, this voltage is relatively low for any practical use.

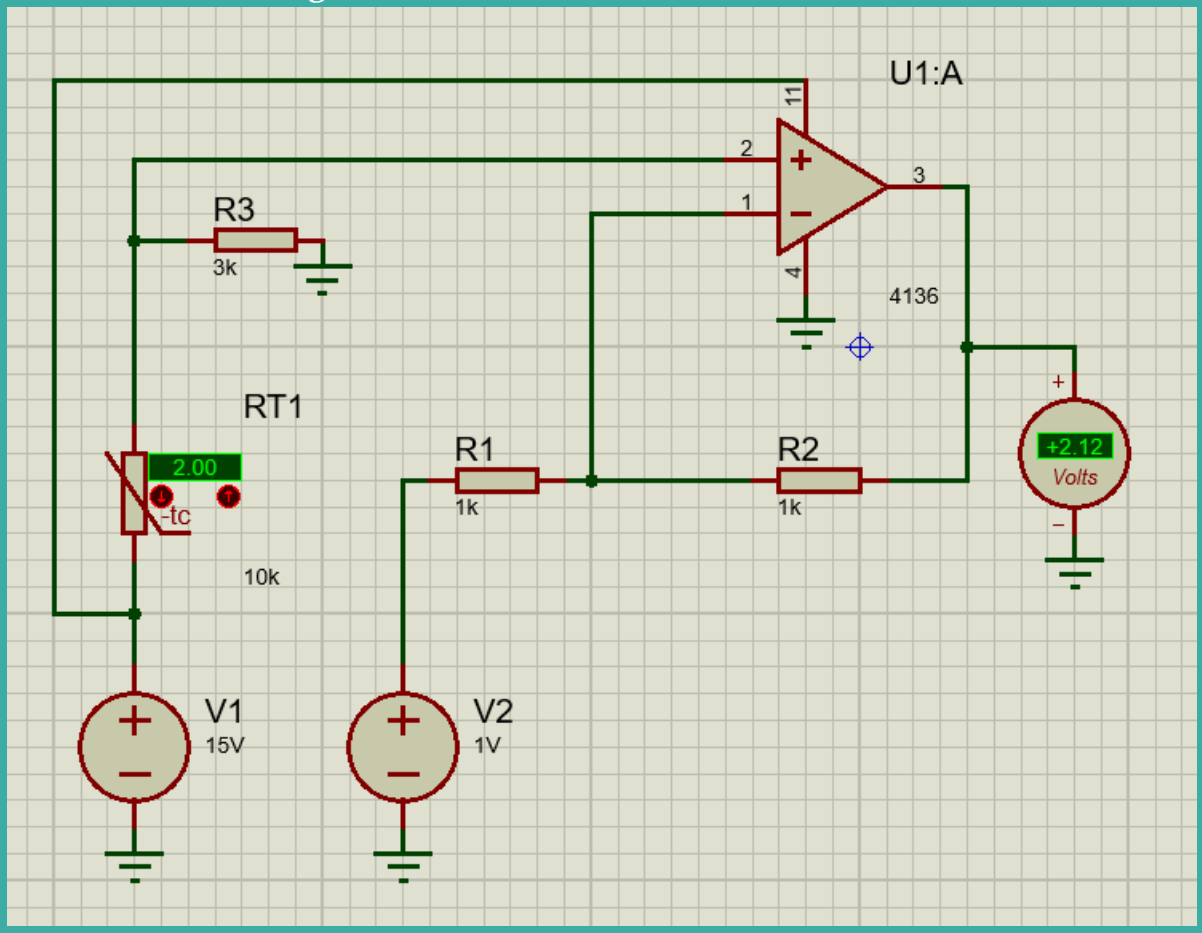
3. Block C (Op-Amp):
   Here, the operational amplifier comes to work, increasing the voltage and giving us a readable and applicable output voltage.

4. Block D (Digital DC Voltmeter):
   A digital DC voltmeter could provide us with real-time readable changes in voltage.

Circuit Diagram:

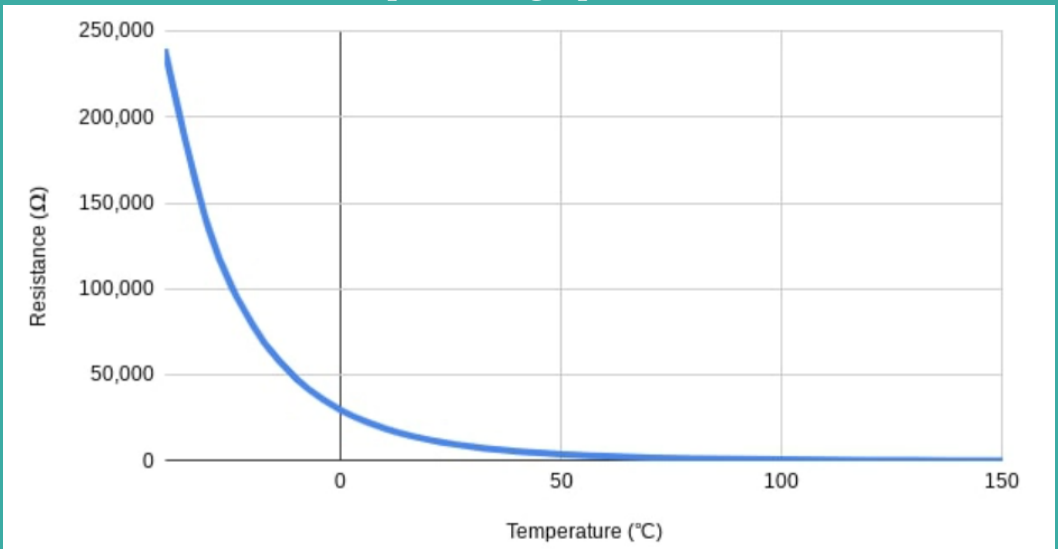


Detailed Circuit Diagram:



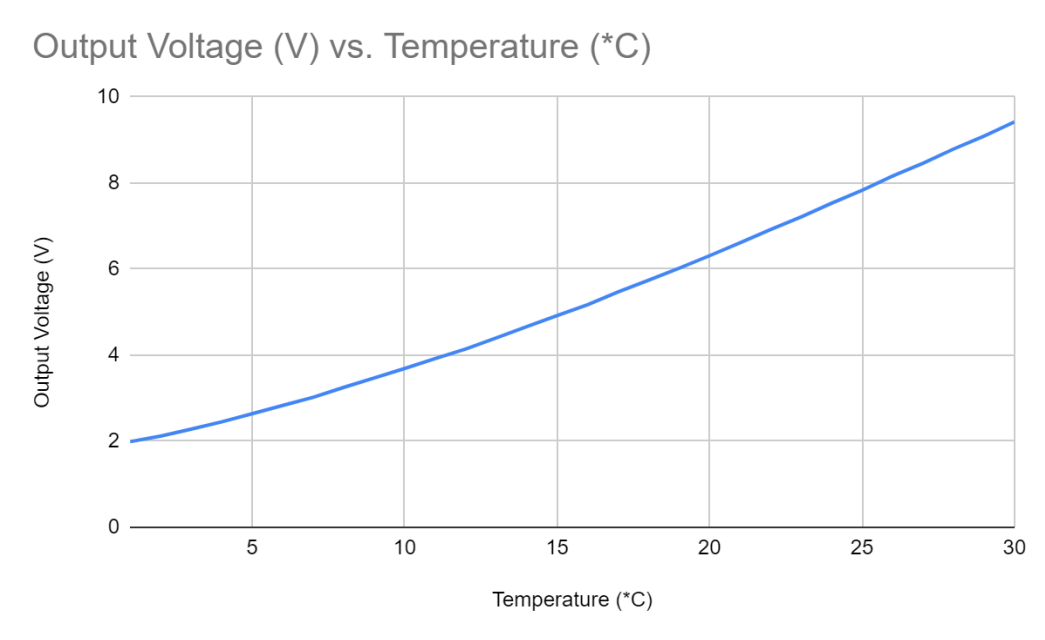
Graphs:

1. Resistance v/s Temperature graph of NTC Thermistor



We see that the graph is Inversely Proportional.

2. Temperature v/s Output Voltage of our circuit



We see that the graph is almost Linear.
Tan(θ) = 0.26

Observation:

1. The Resistance of NTC decreases with an increase in ambient temperature. Therefore, the Resistance of NTC is inversely proportional to temperature.

2. We observed that the output voltage increases with the increase in temperature at a Rate of 0.26V/°C. By this, we inferred that output voltage and temperature are linearly dependent.

Conclusion:

1. The output voltage increases linearly due to an increase in temperature.
2. The output voltage is amplified enough to be measured by any simple voltmeter.
3. Therefore we successfully devised a temperature to voltage converter.