Bangladesh University of Engineering and Technology

Department of Electrical and Electronic Engineering

EEE 208

Electronic Circuits II Laboratory

Report on Project

Project Title:

Room Thermometer:
Using LM35 temperature sensor and 7 segment Displays

Submitted to:

Dr. Mahbub Alam
Associate Professor, Department of EEE, BUET

I.K.M. Reaz Rahman
Lecturer, Department of EEE, BUET

Submitted by:

Name: Shoumik Debnath Student ID: 1706050

Name: Sariha Noor Azad Student ID: 1706051

Name: Nazmus Salehin Student ID: 1706052

Name: Saleh Ahmed Khan Student ID: 1706053

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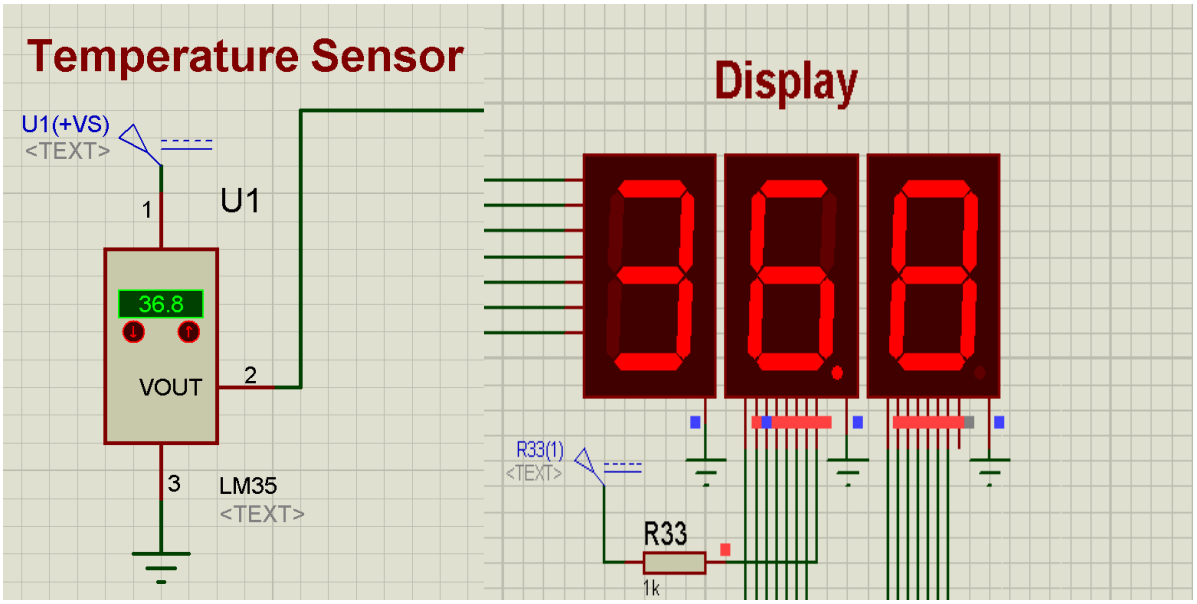
Goals of the project:

- Using the voltage output of LM35 temperature sensor and converting the voltage level to a voltage response proportional to the current temperature.
- Using the proportional voltage response to create a readable output using 7 segment displays so that the thermometer can function independently without using any voltmeters.
- Accurately predict the room temperature up to 0.1 degree centigrade within the range 0 to 70.0 degree centigrade.

Overview:

Input Output

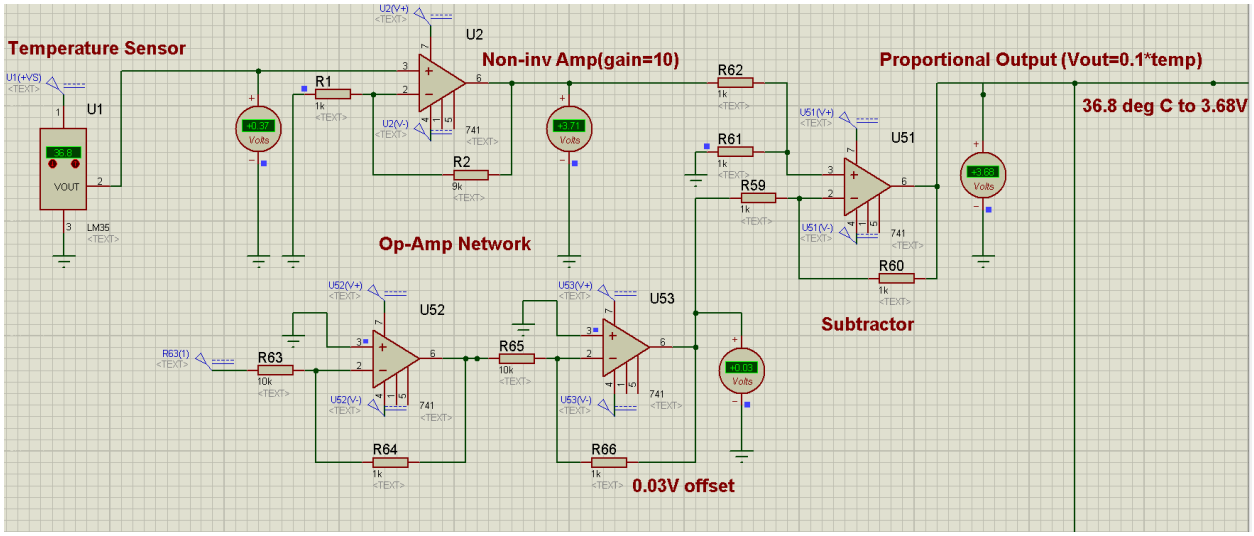


Working Principle:

LM35 temperature sensor has a linear (y=mx+c) output voltage with respect to temperature. The first part of the circuit converts this relation into a directly proportional relationship (Vout = 0.1 x Temperature) using amplifiers and adding offsets, so that the temperature can be easily predicted using the output voltage. The second part of the circuit extracts the voltages in decimal positions and uses them to display the appropriate digits in the 7 segment displays.

The biases needed for the project is +11V and -11V. Other voltage levels are also needed between this range (1,2,3,4,5,6,7,8,9V and -1.5V for ADC comparators and biases) and they can be easily provided using a voltage divider from the main bias.

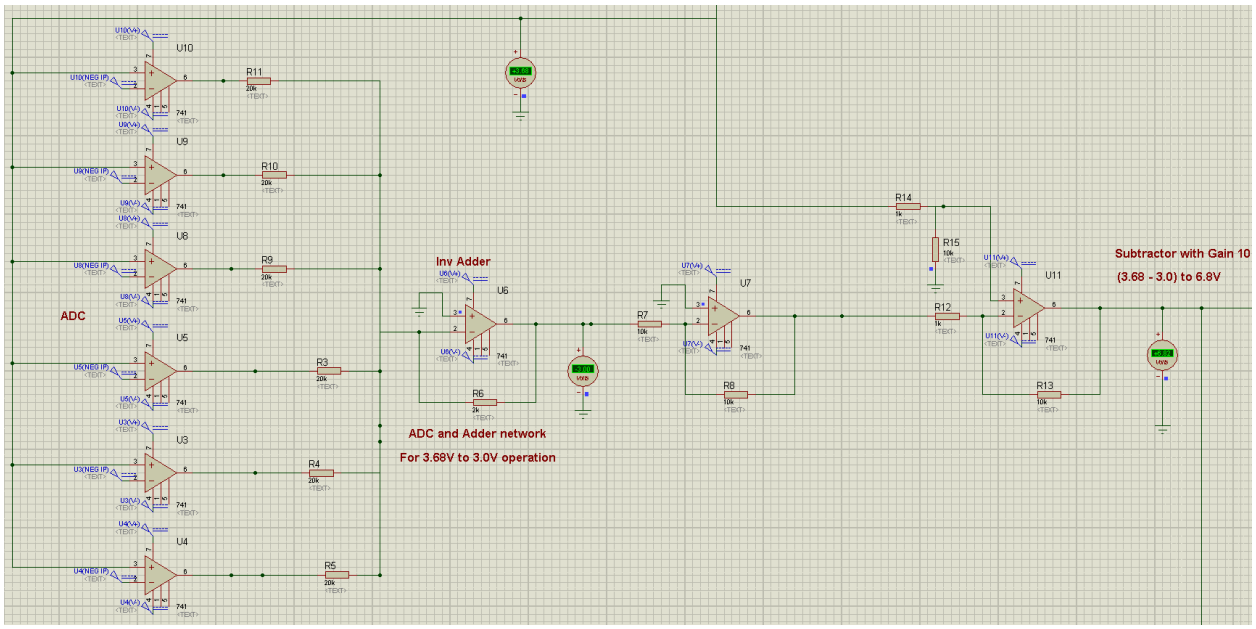
1. Op-Amp Network for Proportional Output:



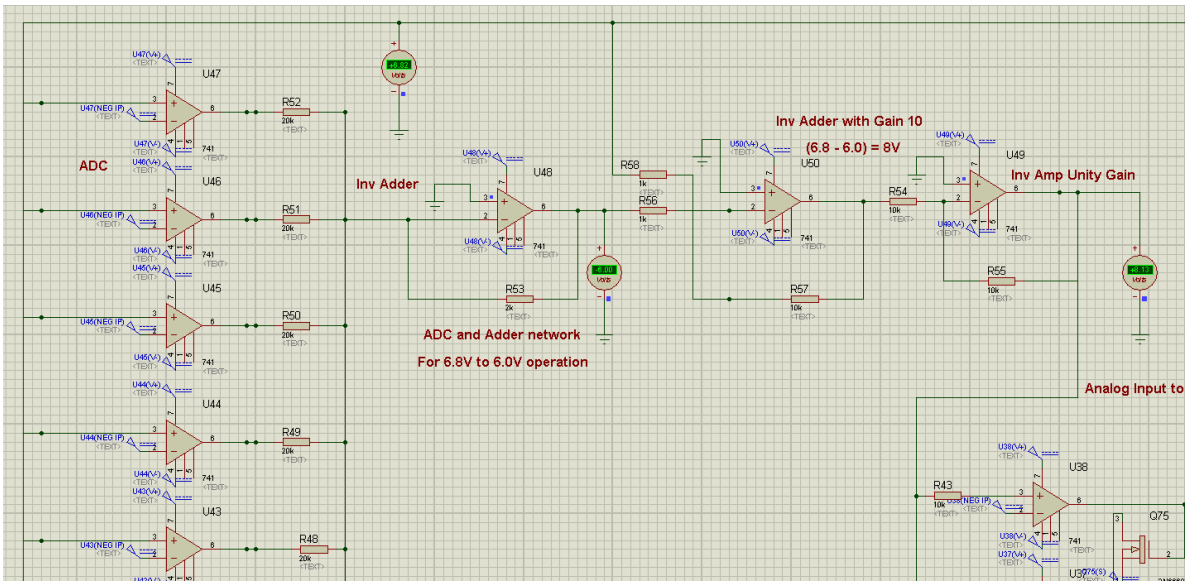
As an example, Temperature 36.8 degree C results in voltage 371 mV. It is multiplied by 10 and then 0.03V is subtracted, resulting in a voltage output of 3.68V .

2. Extracting the decimal positions:

In order for the 7 segments to work, we need to break down 3.68V into 3,6,8V respectively. This is done using an ADC and an Adder circuit with gain 1/10 (3.68V to 3.0V) and subtracting it (3.68V – 3.0V) to 6.8V (subtractor gain 10)

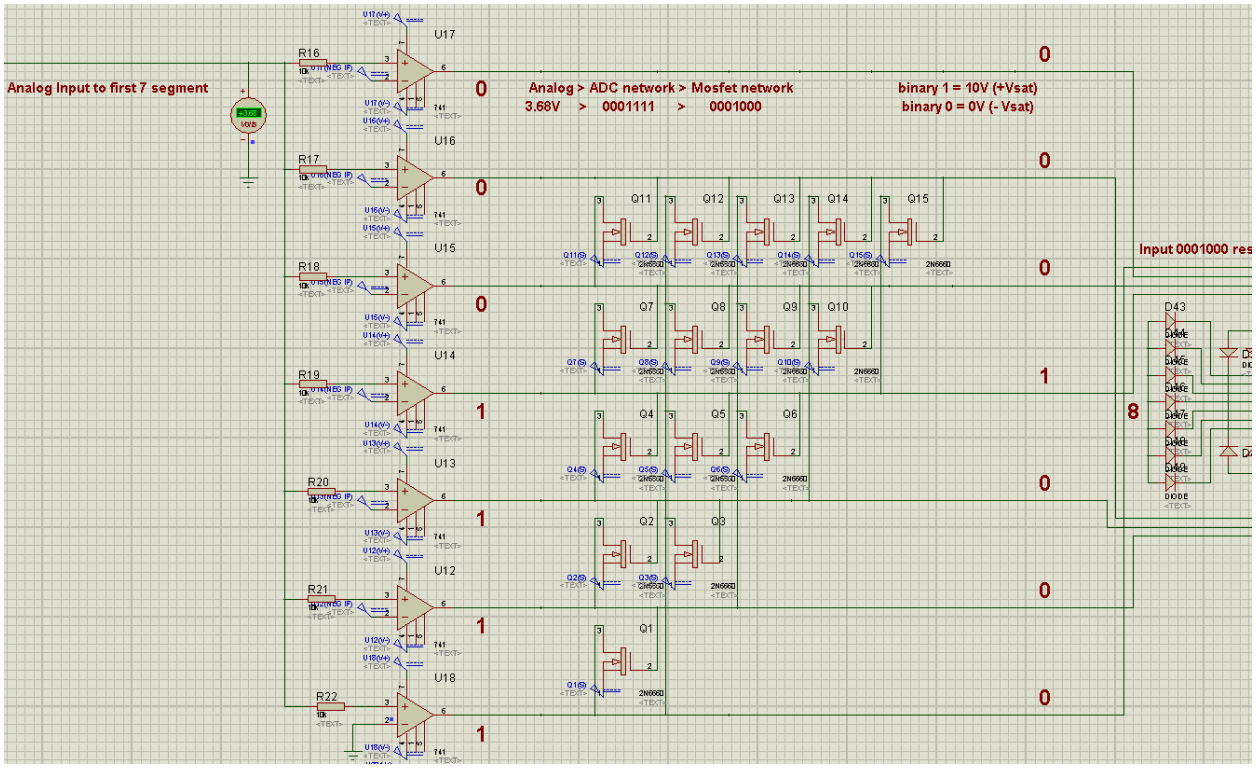


Similarly, for the last digit, 6.8V to 6.0V is done first and then (6.8V – 6.0V) to 8V.



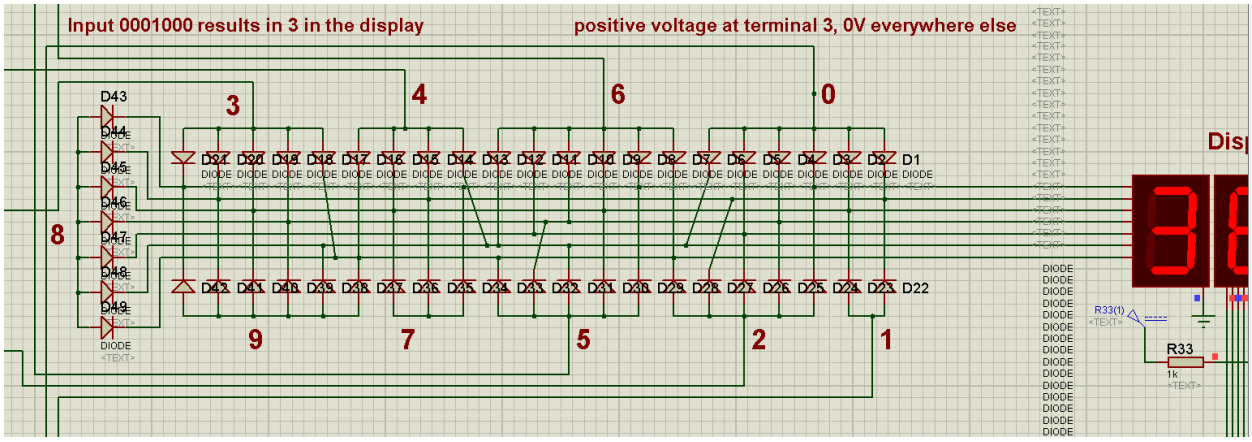
3. Analog to Binary Conversion:

The extracted voltages and then fed into another ADC circuit which converts them into a binary sequence and afterwards a MOSFET network is used to transform it into a suitable sequence to be used in the 7-segment display. MOSFETs operated no the basis of applying a positive voltage to the gate results in a short circuit between the source and drain, this allows only one terminal to be at 1 and the rest is forced to 0 V.



4. 7 segment display to visual numbers:

The diode network of the 7-segment display allows it display the appropriate number when the corresponding terminal has a positive voltage. The diodes help prevent any short circuit in the internal connections and ensures only the terminals corresponding to that number has positive voltage.



Final Circuit