Temperature Controlled Air Cooler

Maulesh Gandhi (2020112009)
Electronics and Communications Department
Electronics Workshop - I
maulesh.gandhi@research.iiit.ac.in

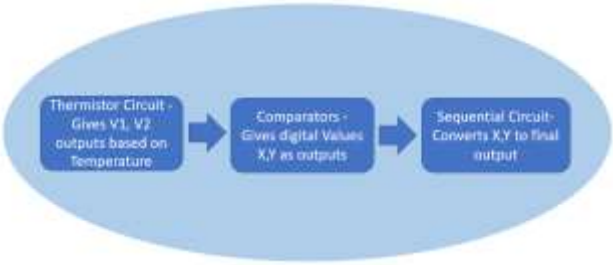
Rohan Gupta (2020112022)
Electronics and Communications Department
Electronics Workshop - I
rohan.gu@research.iiit.ac.in

***Abstract*—The main principle behind this project is the temperature dependency of thermistors and the hysteresis of operational amplifiers. Thermistors are resistors whose resistance depends on temperature. Hysteresis is the difference between an operational amplifier's upper and lower trip points.**

I. PROJECT DESCRIPTION

Our project aims to design a circuit that can automatically switch a cooler on and off based on the temperature of the room to keep it cool. To design such a circuit, we use the thermistor to vary input voltages to operational amplifiers since its resistance changes based on the temperature of its surroundings. Using the outputs of the operational amplifiers and sequential circuits, we can create a black box such that the device is switched on whenever the temperature rises above an upper threshold (35 C for this project), switched off whenever the temperature rises below an upper threshold (25 C for this project) and retains the previous state when the temperature lies between the two thresholds.

II. BLOCK DIAGRAM



III. COMPONENTS AND APPROACH

A. Components Used:

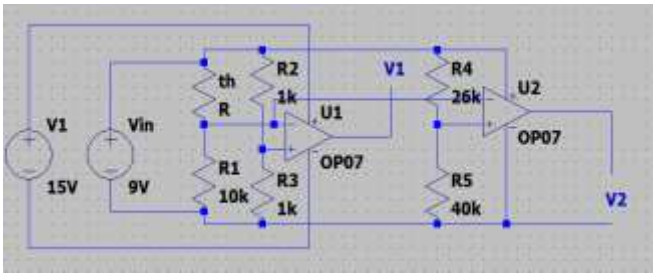
1. Resistors
2. NTC Thermistor
3. Op-Amps
4. LM339 Comparator
5. OR Gate
6. And Gate
7. Not Gate

B. Approach

We will use Thermistor to get varying resistor based on temperature. The resistance of the thermistor at 25 C is 10k. So the resistor at the other input terminal is also set as 10k, such that the voltage inputs to both the terminals is same and hence the output from the first op-amp is 0 at the lower threshold(i.e., 25 C). Now if the Voltage difference(Vd) in Op-Amp U1 is positive(above 25 C) then the output goes to 0V making V1 = 9V. If the vd is negative (below 25 C) then output Op-Amp is 15V so V1 is =-6V.
Similar thing happens for other op-amp at 35 C but in reverse manner V2 is positive if voltage is below 35 C and V2 is negative if voltage is above 35 C. The R4 and R5 are 26K and 40 K respectively to make the voltage at inverting terminal equal to the volatge drop across thermistor at 35 C. We will feed output voltages V1 and V2 to the LM339 comparator to get x,y as output and then we feed these to a sequential circuit to get the desired output.

IV. CIRCUIT DIAGRAM AND EXPLANATION

A. Circuit Diagram



B. Explanation

Below 25 C, since thermistance will be more than 10k, output of U1 is positive. Since the open loop gain of the amplifier is very high, output of U1 is much greater than 9V. Hence, V1 is negative and x is 0. Output at U2 is positive. Hence, V2 is positive and y is 1.
Between 25 C and 35 C, input of U1 is negative since thermistance is less than 10k. So, V1 will be positive and x is 1. However, input of U2 is still positive so V2 is positive and y is 1.
At 35 C, x will remain 1 but input of U2 will become zero. So, V2 is 0 and y is 1.
Above 35 C, x will remain 1 and input of U2 will become negative. So, V2 is negative and y is 0.
Using a flip-flop, we can design a sequential circuit that turns off the cooler when temperature is less than 25C, retains the previous state of the cooler when temperature is between 25 and 35C and turns the cooler on when temperature is above 35C.

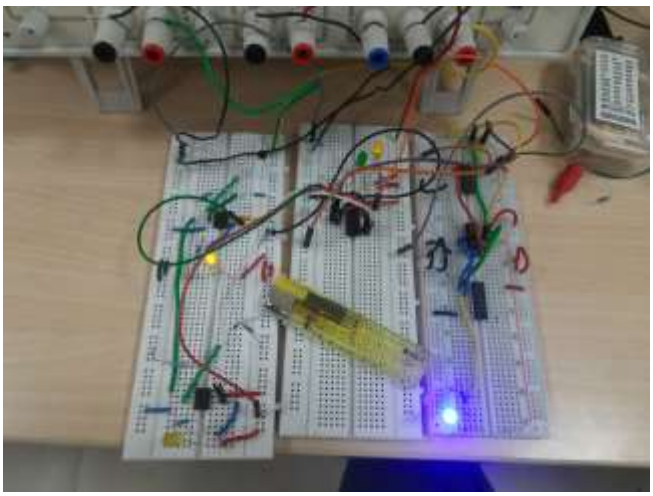
Table 1. X and Y for various temperatures

Temperature Range (C)	X	Y
< 25	0	1
25 – 35	1	1
> 35	1	0

Table 2. Example of iteration of seq circuit

X	Y	Out
0	0	0
1	0	0
1	1	1
1	0	1
0	0	0

V. ACTUAL CIRCUIT



VI. FURTHER MODIFICATIONS AND PRACTICAL APPLICATIONS

A. Further Modifications

We can change the Temperature Range to make temperature more range favourable.

B. Practical Applications

We have made a black box that switches on if temperature goes beyond 35 and goes off if temperature dips below 25. This can be used to control other temperature dependent devices.

We can modify the circuit to get a favourable temperature range.

It can be used in AC, Heater, Geyser, CPU fans etc.