

A
PROJECT REPORT ON
TEMPERATURE CONTROLLED DC FAN PCB

Submitted By
AKSHAY PATIL (BE19S03F008)
From

**GOVERNMENT COLLEGE OF ENGINEERING
AURANGABAD**



Under The Guidance Of



1 INTRODUCTION

1.1 Overview

The “ temperature controlled dc fan “ project automates the process of turning on the exhaust fan whenever internal heat is more and automatically turns off the fan when the internal heat is normal.

For completing this process, the project uses an op-amp to compare the reference value of voltage set by a potentiometer with the voltage of the potential divider formed by connecting a resistor and negative temperature coefficient thermistor resistor in series. When the temperature increases the resistance of the thermistor decreases which is sensed by the op amp and it turns on the fan.

The key part of this project is to design the pcb for this circuit so that the mechanical strength of the project will increase and the circuit will be permanently available for instant or long term use.

1.2 Purpose

The use of this project. What can be achieved using this.

The purpose of this project is to automate the process of heat removal by exhaust fan so that there is no need to manually turning on and off the fan depending upon the heat. Also there would be great power saving as the circuit will turn off the fan whenever not required and will avoid unnecessary running of fan and wastage of power.

The circuit needs to be mounted on the pcb so that the components remain connected together for long term use.

2 LITERATURE SURVEY

2.1 Existing problem

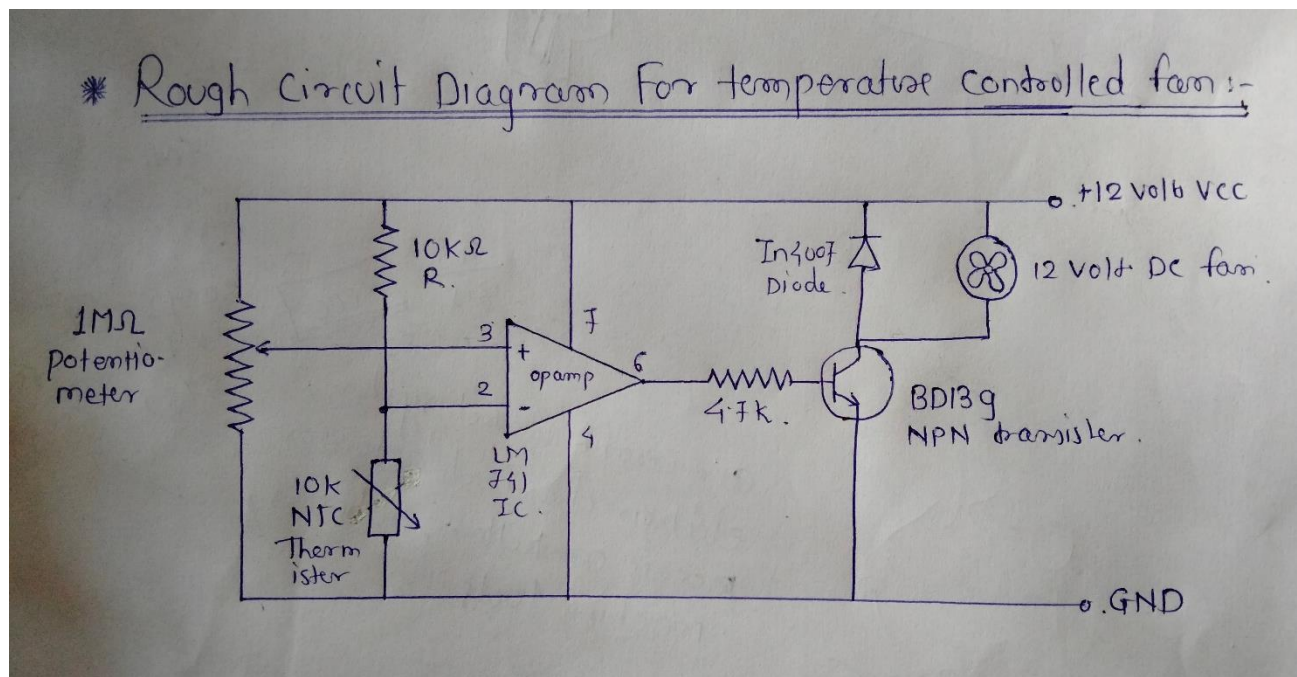
We generally use the exhaust fans in manual mode. They manually need to be turned on when the temperature is more than normal. Also even if the temperature is reduced the fan keeps running if we do not turn it off.

2.2 Proposed solution

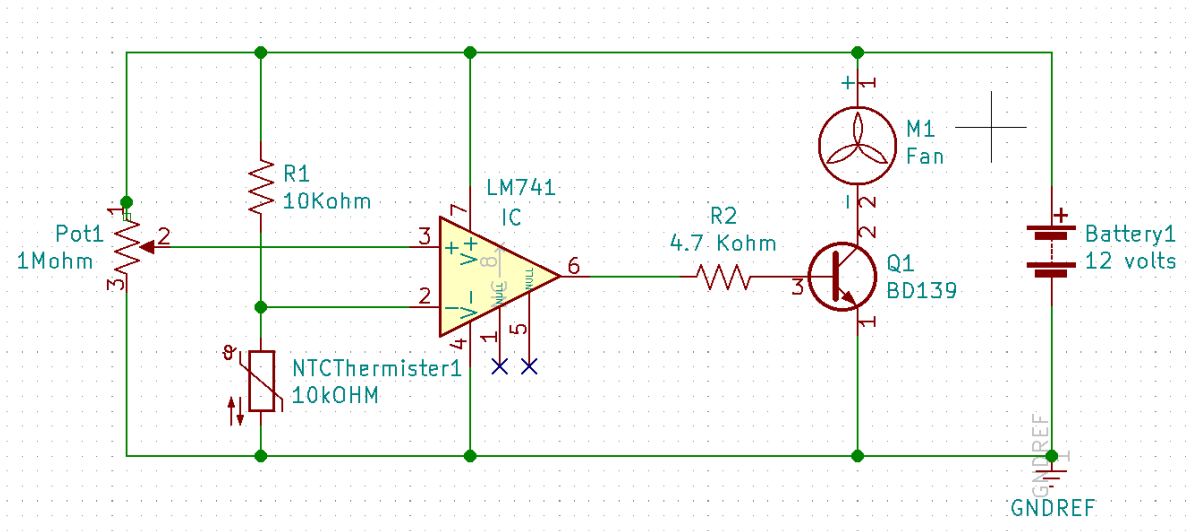
To solve this problem we are using a temperature sensor i.e. the thermistor which senses the temperature for us and if the temperature is above normal the exhaust fan is turned on using the op amp. The exhaust fan will then throw the hot air out of the room. In this way we do not need to constantly monitor the temperature ourselves. Also there is no need to turn on and off the switch of fan to turn on and off the fan. The circuit will do it for you. It will also provide great power saving.

3 THEORITICAL ANALYSIS

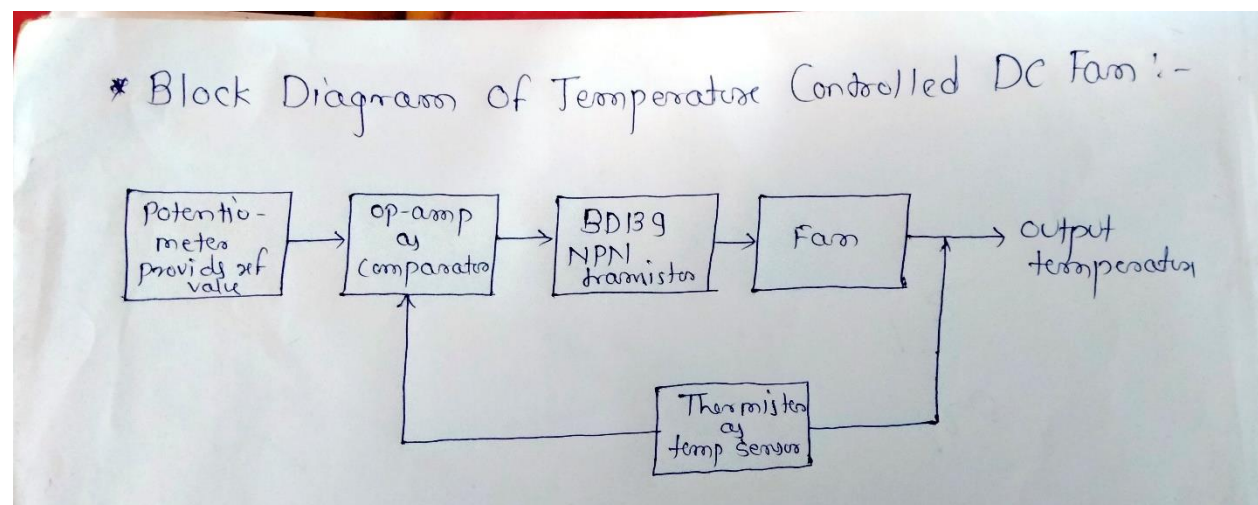
3.1 Circuit Diagram:-



3.2 Kicad schematic



3.2 Block diagram:-



3.2 Hardware / Software designing

The project includes following hardware components

Op amp

1 mega ohm potentiometer

10 Kilo ohm, 4.7 Kilo ohm resistor

BD139 npn transistor

12 volt dc fan

Power supply of 12 volt and ground.

The op amp ic 741 pin 7 is connected to 12 volt and pin 4 is connected to ground. Pin 2 is connected to potentiometer moving leg. And pin 3 is connected to the voltage divider of resistor and NTC thermistor.

A voltage across NTC thermistor is $(\text{Thermistor resistance} \times V_{cc}) / (\text{Thermistor resistance} + \text{series resistance})$

Therefore greater the thermistor resistance greater is the voltage across it. Thus when the temperature increases thermistor resistance reduces and the voltage across it reduces which reduces the voltage on op amp pin 3 ie inverting input pin of op amp. And when the temperature decreases the voltage across thermistor increases.

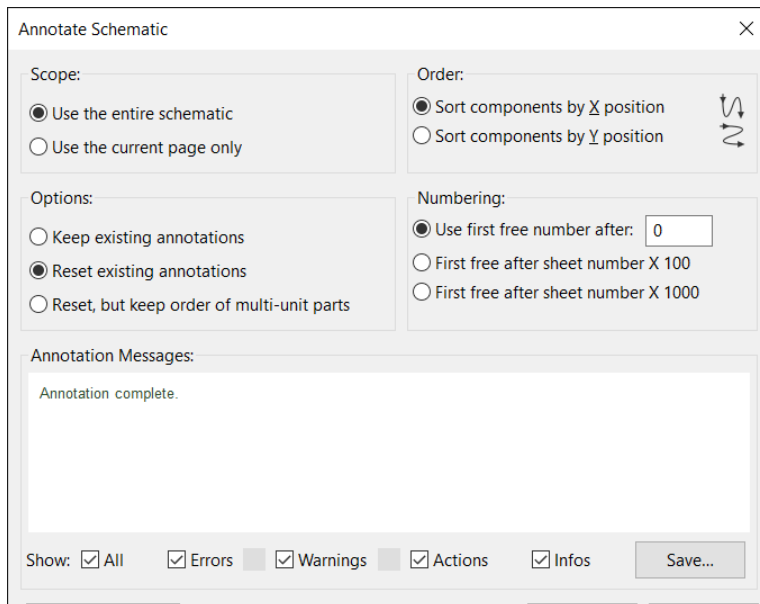
The op amp is connected to operate in comparator mode. In comparator mode the op amp compares the voltage on pin 2 & 3. If voltage on pin 2 is greater then voltage on pin 3 then op amp output is = vcc.

This voltage is provide to the base of the transistor ,which turns on the transistor and provides a low resistance path for current to flow from collector to emitter which turn on the fan.

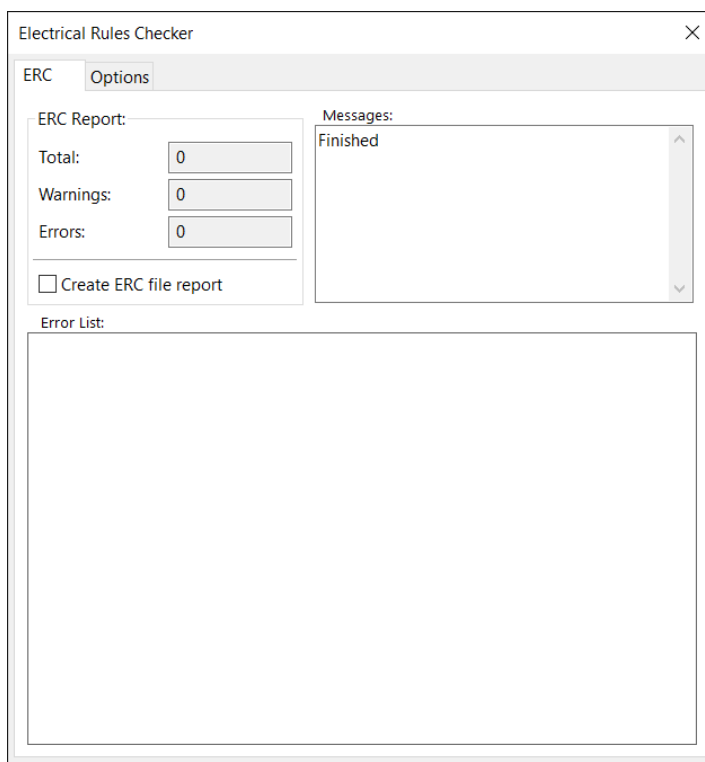
The fan thus cools the room by throwing hot air out of the room. Once the room is cooled the temperature comes to a normal level and the voltage at pin 3 will become more than voltage at pin 2 set by potentiometer. Thus the output of the op amp will be 0 as inverting pin voltage is more than non inverting pin voltage. As the op amp output is 0 volts, the npn transistor remains cut off and does not allow current to flo through it. Thus fan turns off.

Pcb designing

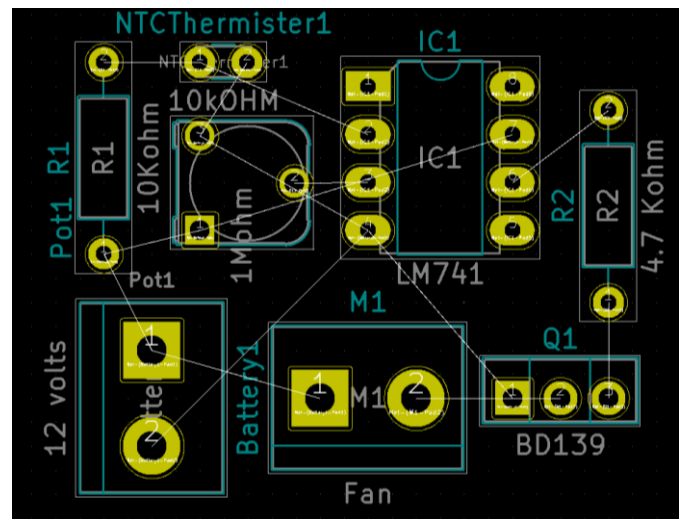
1. Make a schematic diagram in ki cad schematic editor by adding each component and wiring them up using wire tool.
2. Assign footprint to each component in symbol properties.
3. Annotate the schematic.



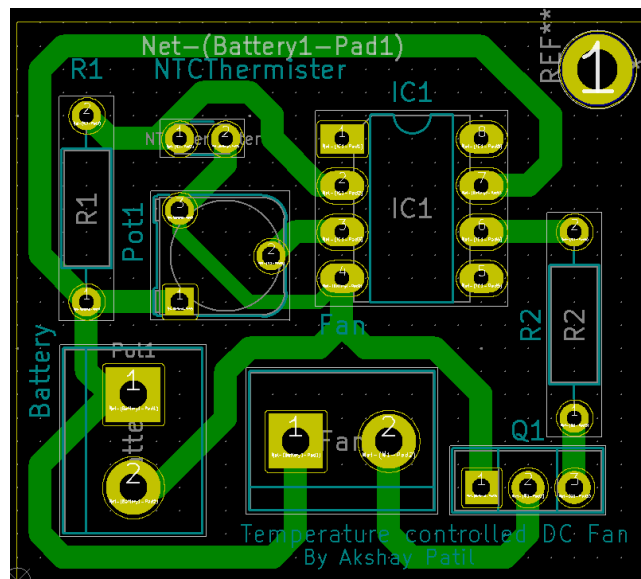
4. Perform design rule check.



6. update schematic to pcb.



7. Rearrange components and Route the nets.



8. Enter the required text on silkscreen.

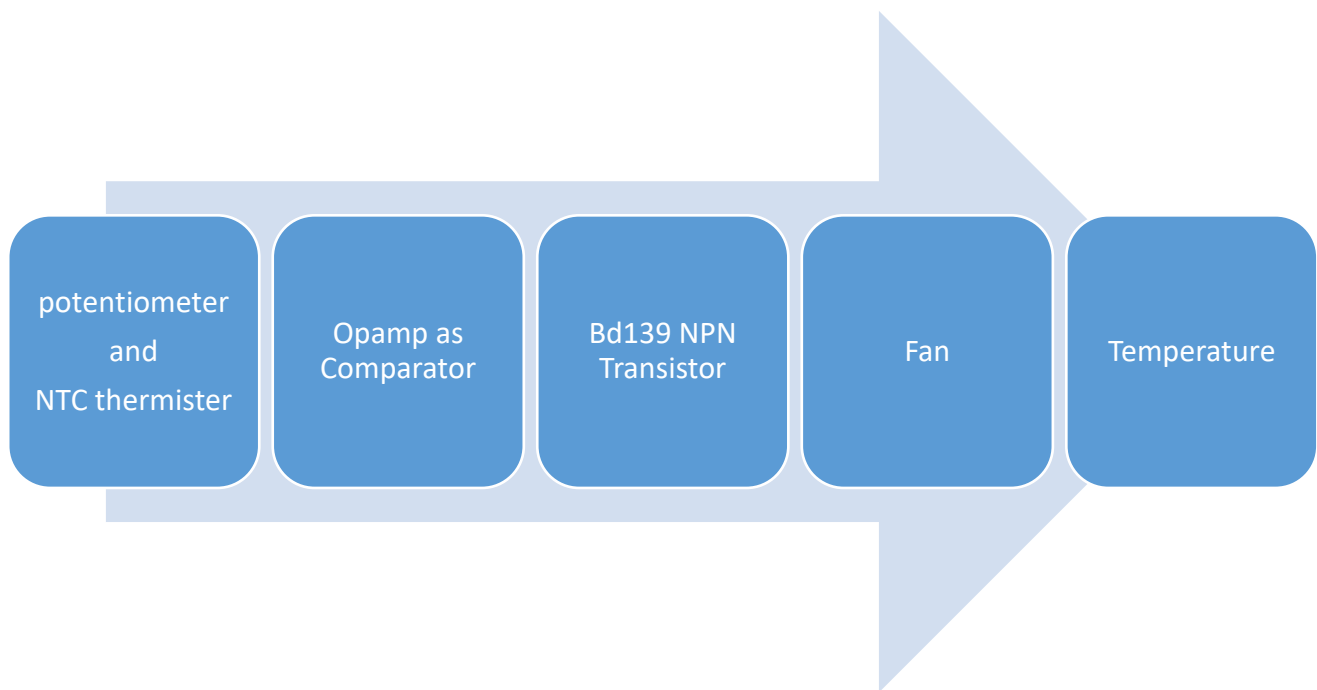
9. Add marking holes if any.

10.Generate Gerber files.

4 EXPERIMENTAL INVESTIGATIONS

While working on the solution it was observed and verified that NTC thermistor has good sensitivity to temperature variations and the sensitivity is further more increased by the very high gain of operational amplifier which allows it to compare voltages even of few mili volts. This allows the project to work well and as expected. Also it is observed that greater the resistances of potentiometer and voltage divider resistance lesser is the bypass current flowing through them and lesser will be the power consumption of the circuit. And since the input current requirements of op amp is in the range of nano amperes, we can use very high resistances at potentiometer and voltage divider to reduce power consumption, so that battery will last long.

5 FLOWCHART

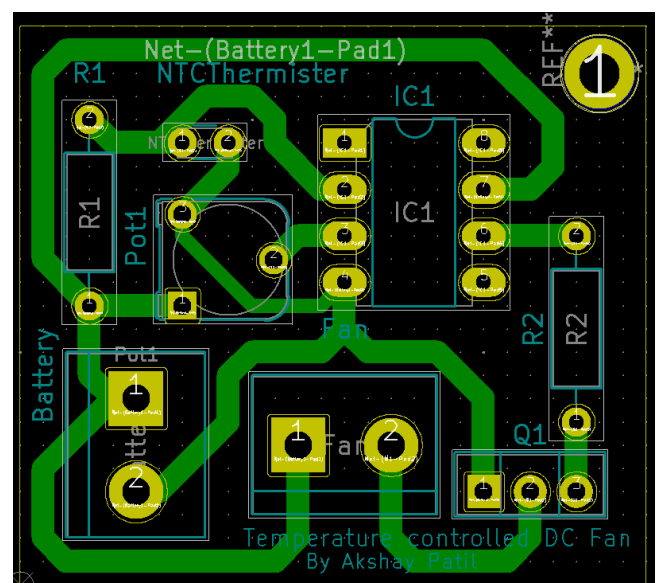
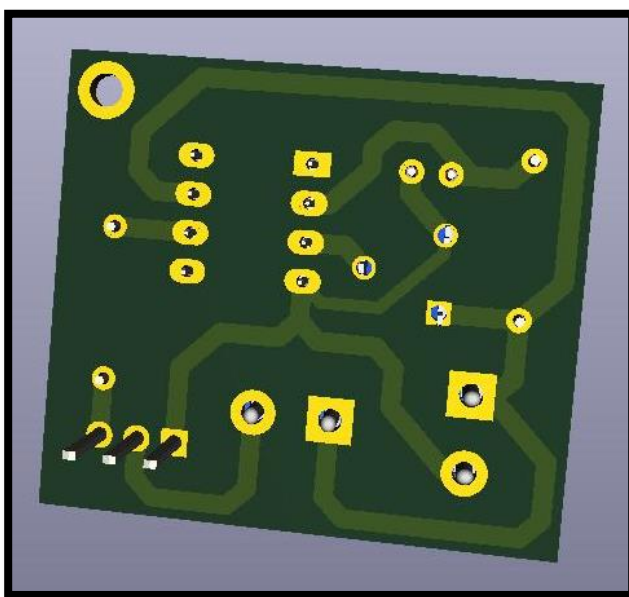
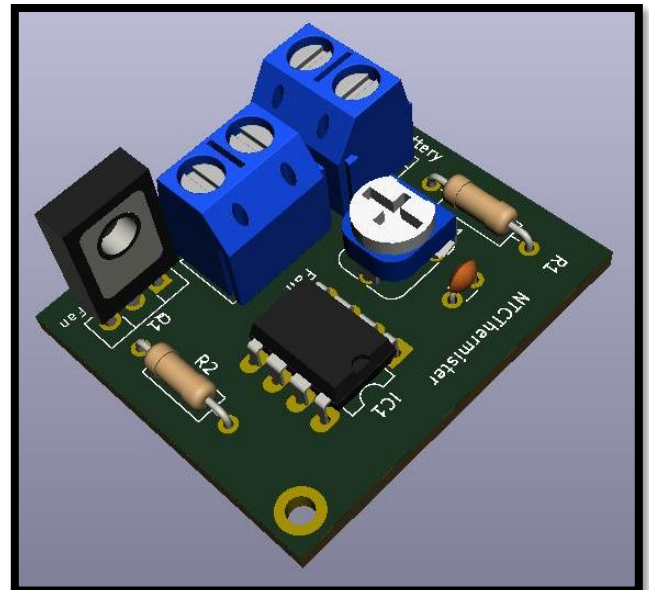
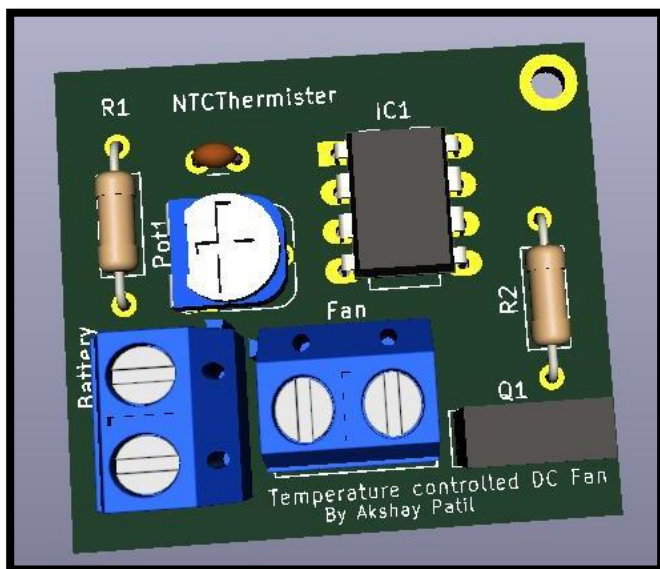


6 RESULT

The project works as desired. It turns on the fan as the temperature rise above set temperature by the potentiometer and also turns off the fan when the temperature falls back to normal.

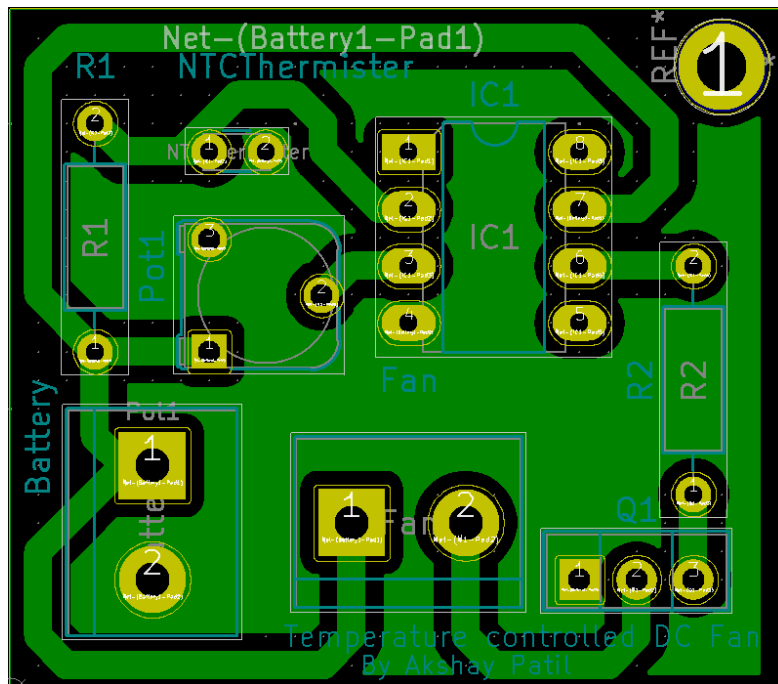
The pcb also works fine. The NPN transistor heats a bit on prolonged on time. But the heat is disipated through air as the transistor is mounted vertical and has a heat disipation mosfet like package.

The final 3d pcb looks like below.



Note:- If pcb is to be build by additive technique then above pcbs without gnd plane and less copper area need to be used. But if pcb is to be built by subtractive technique then we should add the ground plane to increase the copper area and reduce the etching area so that time required to make the pcb will be reduced.

Pcb with Ground plane for subtractive technique:-



7 ADVANTAGES & DISADVANTAGES

7.1 Advantages

- It is very economical and easy to handle by the user.
- Operation is automatic and no need of human intervention.
- It is help full to disabled people.
- It is very easy to install in offices, houses etc.
- Save energy by turning off the fan when temperature is normal.
- Power consumption of circuit is less.

7.2 Disadvantages

- Speed of operation is less.
- Temperature accuracy is not very high.

8 APPLICATIONS

Typical applications include automotive, telecom equipment, laptops, server, and many other portable and non-portable electronic devices, exhaust fans, normal room fans, Acs. Sometimes you could find fans used in conjunction with a heat sink to increase overall airflow. This is known as a forced air system.

9 CONCLUSION

The temperature controlled dc fan provides the required operation successfully and can be used to operate devices as per temperature variations.

10 FUTURE SCOPE

Further the project can be modified to control any ac equipment by incorporating a relay in place of transistor.

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