ISSN:2321-1156

International Journal of Innovative Research in Technology & Science(IJIRTS)

# Automatic Temperature Controlled Fan Using Thermistor

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***Abstract:***

**Over the last decade, advances in electronics have made devices smaller, cheaper and faster. This project is about how the speed of a fan can be controlled, based on temperature sensor. It is also a part of smart home application where the fan will gradually increase its speed if the temperature is increasing. In general, home appliance fans need to be operated manually with the help of regulators with the variation of temperature, thus requires a repeatedly extra effort for regulating the fan speed which acts to our agony. So as to reduce this extra effort and to add comfort, it is intended in this paper designing an "Automatic Temperature Controlled Fan". In this project the main intension is to control the fan by heating the sensor, i.e. the thermistor, where the speed of the fan is dependent and controlled by any device's temperature like PC. As the temperature of the device increases or decreases, the speed of fan increases or decreases respectively. So it can be used mainly as a cooling device. By modifying the circuit slightly, it can also be used to control the room temperature, depending on the property of thermistor. The thermister used in the circuit here, decreases its resistance with increasing temperature, hence the electrical conductivity also increases, increasing voltage across it, resulting in an increment in the speed of the fan. Thus, it is possible to control the speed of the fan automatically when the device's temperature varies. Experiment can be followed to evaluate whether this circuit can save energy through the use of temperature sensor and thus promote efficiency.**

***Keywords:*** **Temperature controlled fan, Thermistor.**

## I. INTRODUCTION

### *A)* Brief discussion :

The circuit exploits the property of sensor to operate the DC Fan. A sensor is a type of transducer. In a broader sense, a transducer is sometimes defined as any device that

converts energy from one form to another. Besides that, the component that made up the temperature sensor is known as thermistor. Thermistor is a kind of temperature dependent resistor and its resistance varies depending on the temperature in its vicinity. There are two types of Thermistors- Negative Temperature Coefficient Thermistor (NTC) and Positive Temperature Coefficient Thermistor (PTC).

NTC Thermistor decreases its resistance when the temperature increases while PTC Thermistor increases its resistance when the temperature increases. Thermistors are bead like resistors available from 100 ohms to 10K or more values. In this circuit, a 1K (25°C) NTC Thermistor is used. A small DC fan increases or decreases its speed as per the temperature change. When the temperature decreases below a certain level, Fan automatically turns off.

## II. CIRCUIT DIAGRAM

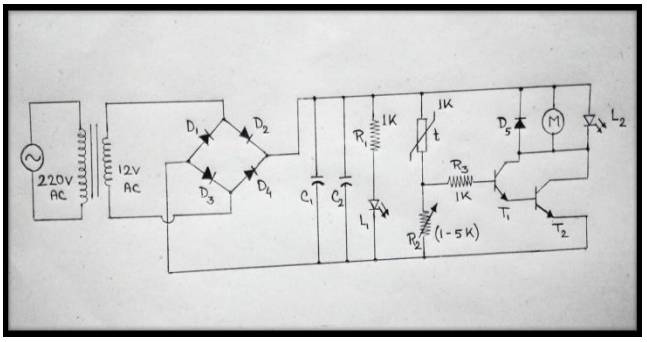
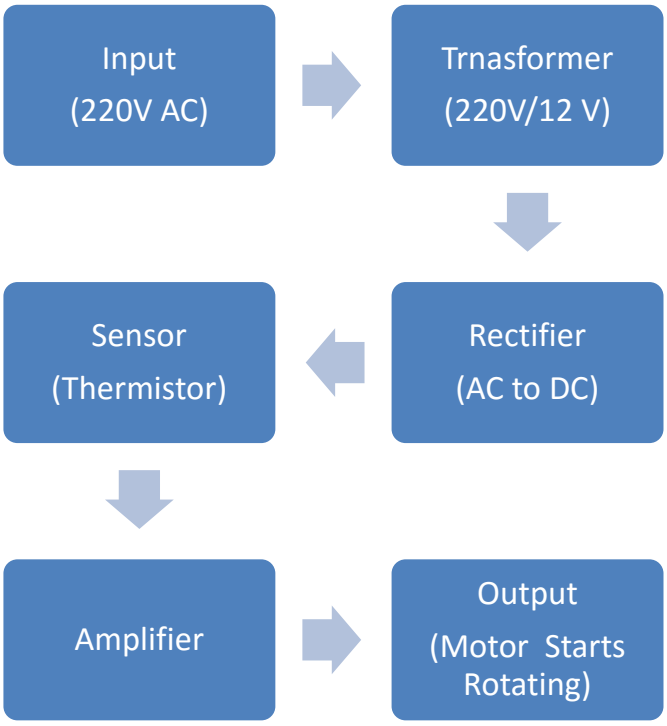



***Fig: Circuit Diagram of a temperature controlled Fan***

## III. BLOCK DIAGRAM




## IV. SENSER DESCRIPTION

### *A)* Thermistor:

A thermistor is an electronic component that exhibits a large change in resistance with a change in its body temperature. The word "Thermistor" is actually a contraction of the words "Thermal Resistor".

The thermistors, which are to be described herein are ceramic semiconductors and have either large positive temperature coefficient of resistance (PTC) devices or large negative temperature coefficients of resistance (NTC). Both types of thermistors (PTC and NTC) have definite features and advantages which make them ideal for certain sensor applications.

In this circuit, NTC type Thermistor of 1K at 25°C is used.

### *1)* NTC Thermistor

***Fig: NTC Thermistor***

The NTC thermistors are composed of metal oxides. The most commonly used oxides are those of manganese, nickel, cobalt, iron, copper and titanium. The fabrication of commercial NTC thermistors uses basic ceramics technology and continues today much as it has for decades. In the basic process, a mixture of two or more metal oxide powders are combined with suitable binders, are formed to a desired geometry, dried and sintered at an elevated temperature. By varying the types of oxides used, their relative proportions, the sintering atmosphere and the sintering temperature, a wide range of resistivity and temperature coefficient characteristics can be obtained.

### *2)* Thermistor Basic Operation

Assuming, as a first-order approximation, that the relationship between resistance and temperature is linear, then:

$$\Delta R = k\Delta T$$

Where,

$\Delta R$, change in resistance
$\Delta T$, change in temperature
$k$ , first-order temperature coefficient of resistance

Thermistors can be classified into two types, depending on the classification of $k$. If $k$ is positive, the resistance increases with increasing temperature, and the device is called apositive temperature coefficient (**PTC**) thermistor, or **posistor**. If $k$ is negative, the resistance decreases with increasing temperature, and the device is called a negative

temperature coefficient (**NTC**) thermistor. Resistors that are not thermistors are designed to have a $k$ as close to 0 as possible, so that their resistance remains nearly constant over a wide temperature range.

Instead of the temperature coefficient *k*, sometimes the *temperature coefficient of resistance* $\alpha_T$ (alpha sub T) is used. It is defined as:

$$\alpha_T = \frac{1}{R(T)}\frac{dR}{dT}.$$

This $\alpha_T$ coefficient should not be confused with the $a$ parameter below.

## V. SPECIFICATIONS OF THE CIRCUIT COMPONENTS

**TABLE I :** COMPONENT SPECIFICATION

| *SL. No.* | **Name of Components** | **Specifications** | **No. of Components Used** |
|---|---|---|---|
| ***1.*** | Resisters | 1K | 3 |
| ***2.*** | Variable Resister | (1 – 5) K | 1 |
| ***3.*** | Diodes | 1N4001 | 5 |
| ***4.*** | LEDs | 1.8 – 2.2 V DC | 2 |
| ***5.*** | NPN Transistors | BC548C | 2 |
| ***6.*** | Motor | Permanent Magnet DC, 12V, 6100 RPM, 0.06A | 1 |
| ***7.*** | Thermistor | 1K at 25°C | 1 |
| ***8.*** | Capacitor | 1000µF, Electrolytic | 2 |
| ***9.*** | Transformer | 220/12V, 600mA | 1 |
| ***11.*** | Vero Board | Striped Board | 1 |
| ***12.*** | Propeller | 3 bladed | 1 |

## VI. PRINCIPLE OF OPERATION

The circuit is an open loop system. In this circuit initially 220V AC is stepped down to 12V AC. Then this AC is converted into DC by a rectifier circuit consisting of 4 diodes $D_1$, $D_2$, $D_3$ and $D_4$. Two electrolytic capacitors $C_1$ and $C_2$ are connected Parallely to give more sensitivity to the circuit as they have the ability to smoothen the voltage across them. As the capacitor charges, the rate of change of voltage slows, and charge slows, as the charging current falls thus showing an exponential curve. An LED $L_1$, through a resistance $R_1$ is there across the capacitors to detect the flow of current.

Now it is seen that, the thermistor 't' and a variable resistor $R_2$ (Potentiometer used here) is divided by $R_3$ resistance of 1K. Initially $R_2$ resistance and that of the Thermistor is almost same and there is no potential difference, so there is no voltage difference thus no current flows though the circuit. and hence the motor does not rotate. When thermistor senses the temperature, as it is NTC (Negative Temperature Coefficient), its resistance decreases with the increase of temperature. As a result the current and voltage also increase creating a voltage difference across thermistor and the potentiometer $R_2$. Due to this potential difference, a current starts flowing through $R_3$. But this current is not sufficient to start the motor as the rated current of the motor is of high value. In order to amplify the current to a desired value Darlington pair is used. The Darlington transistor (often called a Darlington pair) is a constructed using two bipolar transistors (either integrated or separated devices) connected in such a way that the current amplified by the first transistor is amplified further by the second one. This configuration gives a much higher current gain than each transistor taken separately The current output from the Darlington Pair has sufficient high gain to drive the motor. The second LED, $L_2$ is used for the same purpose as $L_1$. Diode $D_5$ is used as a Suppression diode or Fly-back diode, to suppress the sudden voltage spike across the inductive load, i.e. the motor, when the voltage is suddenly increased or decreased, due to rapid temperature change sensed by thermistor.

When the motor starts, the LED $L_2$ glows. It glows more brightly as the speed of the motor increases and vice versa, and thus the increasing or decreasing speed can be identified.

The hardware implementation of this circuit justifies this circuit operation.

## VII. PROPOSED WORK

The circuit is designed considering simplicity as the first priority and secondly in an economic way. So the components are also taken as simple as possible, which are very cheap in cost and easily available in the market.

The purpose of this circuit is to vary the speed of a fan related to temperature with a minimum parts counting and avoiding the use of special-purpose ICs, often difficult to obtain.

To do so, first of all, a number of Temperature Sensing Circuits are being developed and their characteristics have been studied.

Thermistor as a main component has been chosen for sensing the temperature for designing the circuit. Other components are also there in the circuit design, which are already discussed briefly above.

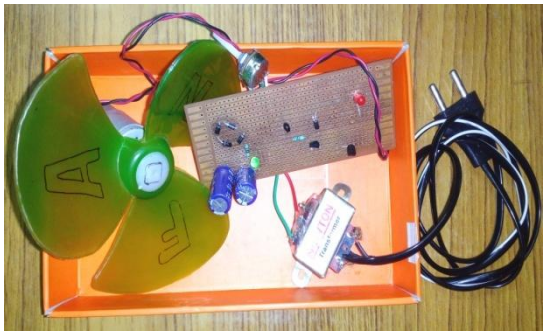


***Fig: The full hardware circuit in OFF State***

## VIII. CONCLUSION

The circuit is very simple and easy to build. This paper elaborates the design and construction of fan speed to control the temperature. Moreover, the fan speed will increase automatically if the temperature will increase. As conclusion, the system which is designed in this work performs very well for any temperature change and can be classified as automatic control.

## IX. FUTURE SCOPE

***A)*** This circuit can be expanded by incorporating a passive infrared sensor along with the temperature sensor. The passive infrared sensor can include a Fresnel lens for sensing a 360° circumference beneath the fan so that the fan can be turned on and off based the motion of persons approaching and leaving a selected area.

***B)*** A change over switch can be connected further using which the Fan can be controlled manually as well as automatically.

***C)*** This temperature controlled fan with some modifications can further be used in other Heater Circuits to maintain the constant temperature of the device.

***D)*** With this circuit, an alarm circuit can be added and used effectively in large equipments where the risk of being overheated and explosions are the serious problems, in various industries.

## X. ACKNOWLEDGEMENT

The success and final outcomes of this project required a lot of guidance and assistance from many people and the authors are extremely fortunate to have got this all along the completion of our project work. The authors also thank and appreciate the co-workers in developing this project and people who willingly helped as out with their abilities and owe profound gratitude to all the professors of *Department of Electrical Engineering* for their proper guidance and motivation for this project. Last but not the least, the authors are extremely thankful to the college, *Techno India College of Technology* for providing opportunity to use their resources and work in such a challenging environment.

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