Advanced Research in Electrical and Electronic Engineering
Print ISSN: 2349-5804; Online ISSN: 2349-5812 Volume 2, Number 8 April-June (2015) pp. 11-14

http://www.krishisanskriti.org/areee.html

Solar Driven Prototype Model of Automatic Temperature Controlled Exhauster

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Abstract—*This paper presents a prototype design of electric exhauster .This system is to ensure the cooling process more efficiently. Temperature sensing diode of model number 4148 efficiently senses little change in temperature to accordingly control the revolution per minute or in short rpm of motor. Variation of temperature is vividly notified by the intensity of used Light Emitting Diode (LED) in the aforesaid model. This is applicable in various industries as well as household appliances. End of this work will produce an advanced technology run by a solar system with uninterrupted power supply circuit .Where the speed of the fan is depending on the change in temperature of the room . Thus a prototype design of electric exhauster for efficient cooling process using renewable power has aptly avoided conventional electric power supply.*

Keywords*: Exhauster, Temperature sensor,4148Diode, solar system, uninterrupted power supply circuit, LED.*

1. INTRODUCTION

The Electric exhaust fan is one of the most energy efficient household as well as industrial electrical appliances .[1]This circuit is very simple and widely used in many applications due to its advantages like cost effectiveness and low power consumption. Exhaust fan can ventilate potentially dangerous fumes from industrial work areas.

Due to its wide application and advantages, many research works has been done focusing on automatic temperature control system in different fields. As example, a design of automatic temperature controlled system based on erbium-doped fiber with diode laser source[2], Design of automatic temperature controlled circuit module in tunnel microwave heating system[3], the automatic temperature controlled system with fuzzy logic based on self adaptive PID(Proportional Integral Derivative) controller[4], Automatic temperature and air ventilation system for controlling the humidity in transformer substation[5], Automatic temperature controller for multi element array hyperthermia systems[6], design of automatic regulating electric fan sensing the temperature and relative humidity[7], Design of automatic estimation of parameters of an electric fan with the use of ANN[8],Case study of Automatic Temperature Control for Transport Airplanes[9] , Automatic temperature control system based on diagnosable discrete event system [10] , Design of automatic control system od constant of 3G base station [11], Automatic control system of body temperature for animal studies using PI (Proportional Integral) having dual mode [12], Design of automatic controlled multiple input system for fluid dynamics facility with several long transport delays[13].

This paper follows as : II. Circuit diagram III. Experimental setup IV. Observation V. Analysis VI. Conclusion.

2. CIRCUIT DIAGRAM

The above circuit controls speed of a 12v fan very efficiently with the variation in room temperature. The different type of resistors are used, like the associated resistor R6 of 100 ohm , 2 watt type are just need to adjusted to set the circuit. Temperature of the concerned environment is adapted through 5 1N4148 diodes and the 2 and 3 no. of pins presented at the differential type 741 op amp. R7 resistor of 10K is used to create a voltage difference between inverted and non inverted input pins 2 and 3 of the 741 op amp .

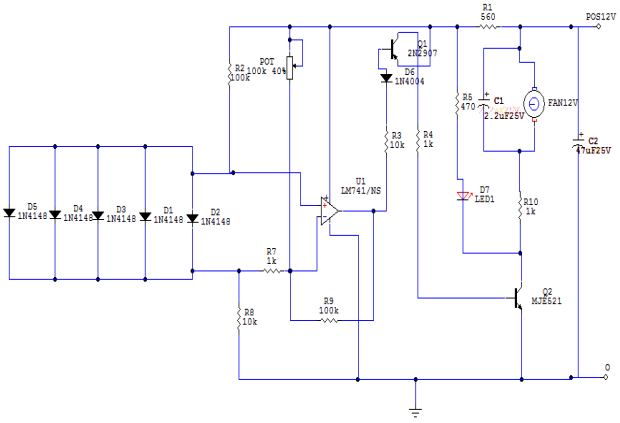

Fig. 1: Circuit diagram of the prototype model

The input pins are very important. The input signals presented at pin 2 will be inverted on the output pin 6. When pin 2 goes

more positive than pin 3, the output pin 6 of the 741 goes high and the base of transistor Q1 goes into forward bias and it switches on transistor Q2 and the Led. The fan gets 12V on the output pins. R9 is used as a as feedback for the 741.

The temperature sensor is made up using five easily available 1N4148 signal diodes mounted parallely. The 1N4148 diode as a temperature sensor is very accurate when used within the specifications. Only DC fans are applicable for this schematic diagram without any further modifications. The corresponding circuit diagram is shown in the fig.1below.

3. EXPERIMENTAL SETUP

The The Entire hardware setup is classified into 3 parts as storage unit and solar panel, sensor unit, control circuit. Different temperature have been recorded by using digital non contact laser thermometer. Corresponding r.p.m. of the exhauster has been recorded by using tachometer. The hardware circuit is as follows (Fig.2):

Fig. 2: Hardware circuit of entire setup.

A. Storage unit and solar panel

The UPS circuit consisting of one 230/12V transformer, bridge circuit, three 1N4007 diodes, 7805 regulator IC and a rechargeable 12V battery. Here the main functions of capacitors are to smooth the ripple in the waveforms. Bridge circuit consists of four 1N4007 diodes to create a rectifier. LED is used for indication purpose and two resistors are used to make voltage divider circuit,the associated resistors are 220 ohm and 1kilo ohm ab. 1210 Solar panel of 18V is used in the circuit. The main voltage is stepped down to 12V AC by the transformer and then it rectified by the bridge. Then the rectified signal is smoothed through the used capacitor. In the presence of the mains supply, the battery will be charged through diode and the regulator IC gets supply via diode. At the output terminals we can get12V and 5V DC. When the main supply is not available, the regulator IC and the 12V DC terminal gets supply from the battery . The reverse flow of current is blocked by the diode during battery mode. The corresponding circuit of storage unit is shown in the Fig.3

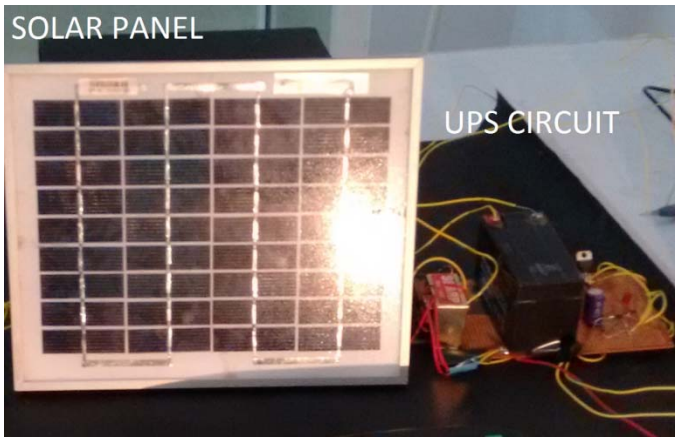

Fig. 3: Circuit of storage unit.

B. Sensor unit

1N4148 diodes are mounted parallel to setup the sensor unit in the circuit. 1N4148 diode has high speed and it is of 100V and current of 450 mA. It is Silicon Epitaxial Planar diode and it has high switching speed. 1N4148 diode is used as a temperature sensor diode due to its characteristic of having negative temperature coefficient of resistance. Hence resistance of diode decreases with the increment of temperature. One 100K POT has been used to set the lowest temperature. Here 26^0C temperature has been taken as lowest temperature. The corresponding circuit of sensor unit is as follows (Fig.4):

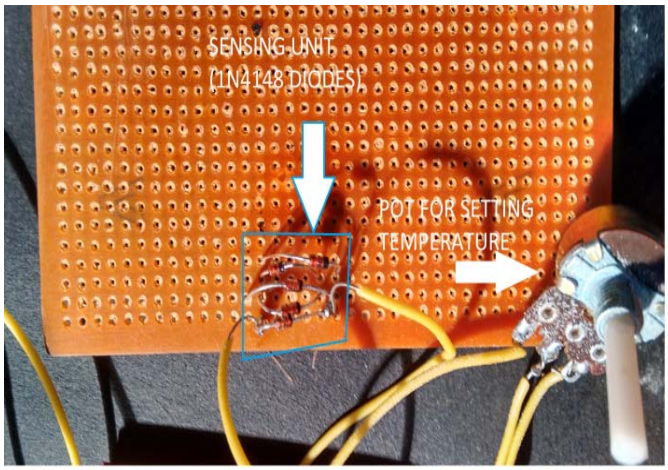

Fig. 4: Circuit of sensing unit.

C. Control circuit

The control unit used to control the speed of the fan automatically according to the temperature. It consist of some resistance from R1 to R9(1K,10K,100K,470K), one IC(741),one npn transistor(MJE521),one pnp transistor (2N2907),one 1N4004 diode and a LED. Here LED has been used for indication purpose as well as this is resembling as if

one light source in is connected with the renewable power supply , shown in Fig.5.

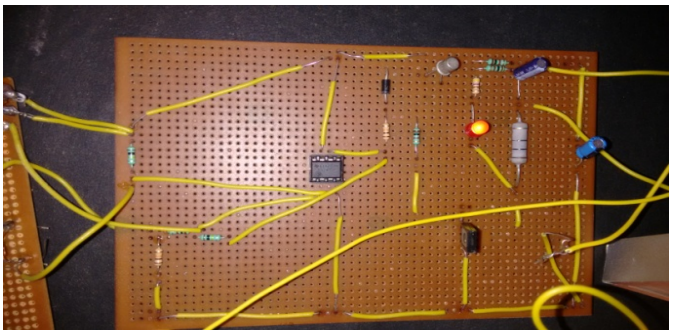

Fig. 5: Circuit of control unit.

4. OBSERVATION

Table 1: Voltage Across the Motor Terminal and RPM with different Temperature

Temperature (0C)	Revolution per minute	Voltage across the motor (Volt)
26	1609	3.5
30	1760	3.74
33	1870	3.8
37	1910	3.89
44	1950	3.98
50	1960	4.06

Here Table I shows the lowest temperature as 26^0C and gradually temperature has been increased and correspondingly RPM of motor and voltage available across the motor have been recorded. Form the table above, it is seen that RPM and voltage across motor are decreasing with the increment of temperature.

5. IV. ANALYSIS

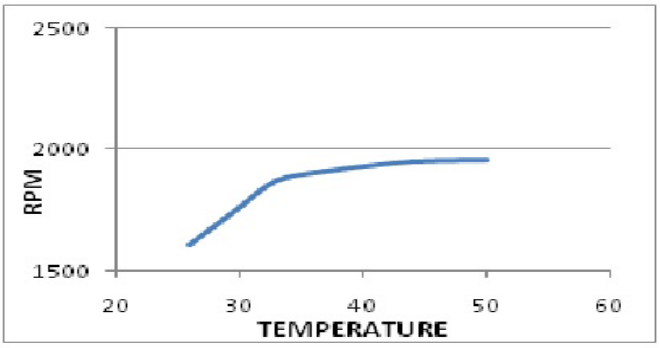

Fig. 6: Graph of Temperature Vs. R.P.M. of the exhauster.

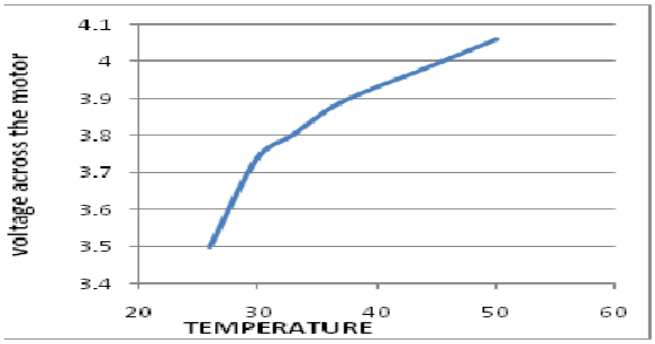

Fig. 7: Graph of Temperature Vs. voltage available across the motor.

The graphs of Temperature Vs RPM and Temperature Vs Voltage across motor shown above, are vividly showing that RPM is increasing significantly with the increment of ambient temperature . So, this phenomena can be applied in efficient cooling process in industry as well in various applications.

6. CONCLUSION

This work is very useful to control the temperature of an enclosed area. Due to the application of renewable energy(solar panel) in controlling the temperature as well as supplying light in a work field, is totally avoiding conventional supply. Thus, continuous process of controlling the ambient temperature without depending on the conventional electric supply is implemented with significant low cost. This prototype project is very much reliable and applicable with simple circuit containing very common components. So, this prototype project can be implemented with less difficulty.

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