AUTOMATIC TEMPERATURE CONTROLLED STANDING FAN

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Abstract

Electrical Energy has been seen to be the driving force of virtually all, which has necessitated its usage. Its importance has underlined reasons why its usage shouldn't be neglected. It has contributed immensely to the growth of any country's economy. One of its numerous applications is discussed in the design of an automatic temperature controlled standing fan. This paper discusses and emphasize a method for automatically controlling speed of a standing fan and temperature apparatus by detecting human presence. The design can be categorized into human detection circuit, using a temperature sensor (NTC) based speed control of fans along with its controlling circuits using a microcontroller and LCD to display the speed at a particular temperature. This would lead to the conservation of energy and prevent energy wastage. The design gives the user an automated mode of operation that is based on sensor against the conventional way of switching ON/OFF fans.

Keywords: Fan, Automatic, Speed, Temperature sensor, Microcontroller

1 Introduction

In industrial and residential applications, temperature control considered paramount. The conventional fan types use a manual method of speed control whereby the user turns the knob to the preferred section. A potentiometer is usually used whereby a change in the voltage changes the speed of rotation of the fan blade. Today, more sophisticated methods are used for speed control. This ranges from the use of temperature sensors, microcontrollers and so on. For this design a thermistor has been used for the control of the speed. This eliminates the human intervention, thereby making the operation seamless and user friendly. This paper design is premised on some problems recognized to have been encountered in using the conventional standing fan.

Many researches focusing on automatic temperature control system application in different fields will gain the benefits. For examples, an automatic temperature controller for multi element array hyperthermia systems (E. Gelvich and V. Mazokhin, 2002), multi-loop automatic temperature control system design for fluid dynamics (G.J. Fiedler, J. Landy, 1959), design of automatic temperature- control circuit module in tunnel microwave heating system (L. Zhang, 2012), the automatic temperature system with Fuzzy self-adaptive Proportional- Integral-Derivative (PID) control in semiconductor laser.

Many people who are disabled / physically challenged persons are affected the most because of the inconveniences associated in changing the Fan speed level manually when the room temperature changes. So, an efficient remote controlled Fan speed system that changes the speed level according to the change in environment / room temperature which is more comfortable than manual system is designed.

2 Materials and Methods

The system is made up of different components which when incorporated or interfaced gives the expected outcome which is the Automatic Temperature Controlled Standing fan. The components have been carefully selected with regards to the desired design work. The following components were used.

- Fixed resistors: 10kΩ

- 10k variable resistor
- 1000uF 50v electrolytic capacitor, 100nF, 22pF
- Non-electrolytic capacitor
- 240/12V transformer
- Bridge rectifier
- LM7805 regulator
- Atmega328p
- 16x2 LCD,
- 16mHz Crystal Oscillator
- NTC thermistor
- BD139 NPN Transistor
- 1n4007 diode
- 12V relay

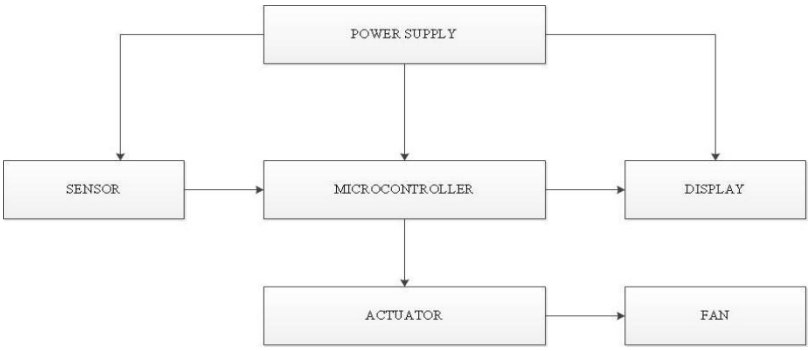


Figure 1: Block diagram of Automatic Temperature Controlled Standing fan.

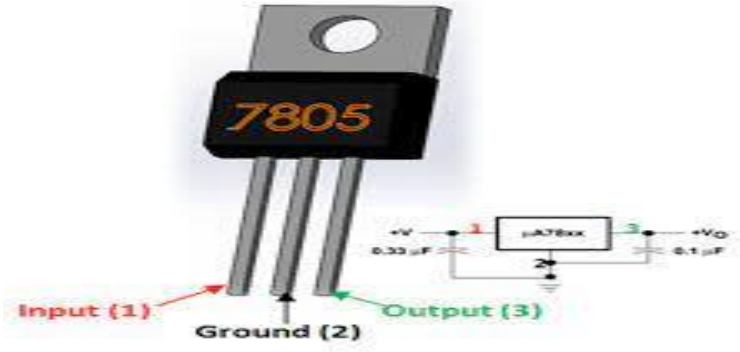


Figure 2: LM7805 Regulator

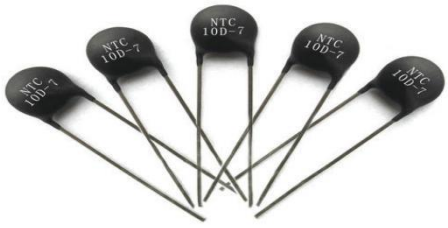


Figure 3: Sensor

3 Construction Procedure

The design of an Automatic temperature controlled standing fan encompasses the usage of the NTC thermistor sensor as the chief component. NTC thermistors are resistors with a negative temperature coefficient, which means that the resistance decreases with increasing temperature. They are primarily used as resistive temperature sensors and current-limiting devices. The temperature sensitivity coefficient is about five times greater than that of silicon temperature sensors (silistors) and about ten times greater than that of resistance temperature detectors (RTDs). This sensor keeps checking the temperature of the environment and reacts to any change observed. The temperature sensor was used in conjunction with the Arduino microcontroller. The hardware program written in the microcontroller was done in such a way that Three (3) different relays change the speed of the fan at three different temperature range. At speed 1, the relay triggers the fan to action at a temperature above 31°C to 34.96°C. At speed 2, the fan works at a temperature range of above 31.96°C to 36.62°C. The highest speed attainable for this design is speed 3 which has an equal temperature range of above 36.62. Any temperature below 31°C, the fan doesn't operate at all. All these are being displayed on the LCD.

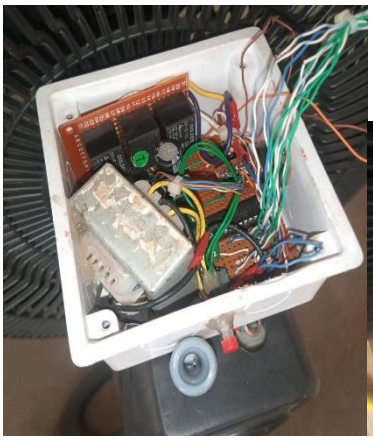


Plate 1: Connection of components

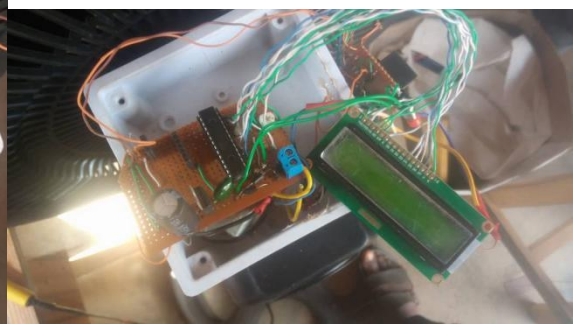


Plate 2: Connection of components

RESULTS AND DISCUSSION

4 Performance Test

After the implementation of the Automatic temperature controlled standing fan, the system was put to test and the result was satisfactory. Continuity test was done to every cable used to ensure no internal disconnection is seen. Also, at each node, the voltage and current measurements were done which all yielded positive results. In testing the relay, different temperatures were introduced and the relay reacted to this change by changing the speed of the fan.

Tools Used During Implementation

i. Multimeter: For taking measurements of voltage, current continuity etc.
ii. Computer: For programming microcontroller, designing and simulation of the circuit.
iii. Precision Screwdriver Set: For driving in and out of screws, bolts and nuts.
iv. Soldering Station: This consists of temperature-controlled soldering iron, heater etc. for the purpose of fusing and joining of wires of the hardware.
v. Bench Power Supply: This supplies the workstation with the required voltage for the purpose of soldering.

Presentation of Results



Plate 3: Automatic temperature speed controlled standing fan at default, state 1, speed 0, (below 31°C, not



Plate 4: Automatic temperature speed controlled standing fan at state 3, speed 2(at 34.96°C, operational)



Plate 5: Automatic temperature speed controlled standing fan at state 3, speed 2(at 34.96°C, operational)



Plate 6: Automatic temperature controlled standing fan at state 4, speed 3(at 36.62°C, operational

Table 1:Measured parameters of Automatic Temperature Controlled Standing Fan

Cc	LCD DISPLAY (NTC SENSOR READING)	THERMOMETER DISPLAY	SPEED OF THE ROTOR (TACHOMETER USED)	VOLTAGE AT THE RELAY (ACV)
RELAY 1	31°C	31.8°C	60 RPM	210
RELAY 2	34.96°C	34.98°C	90.8 RPM	220
RELAY 3	36.62°C	36.69°C	118.9 RPM	232

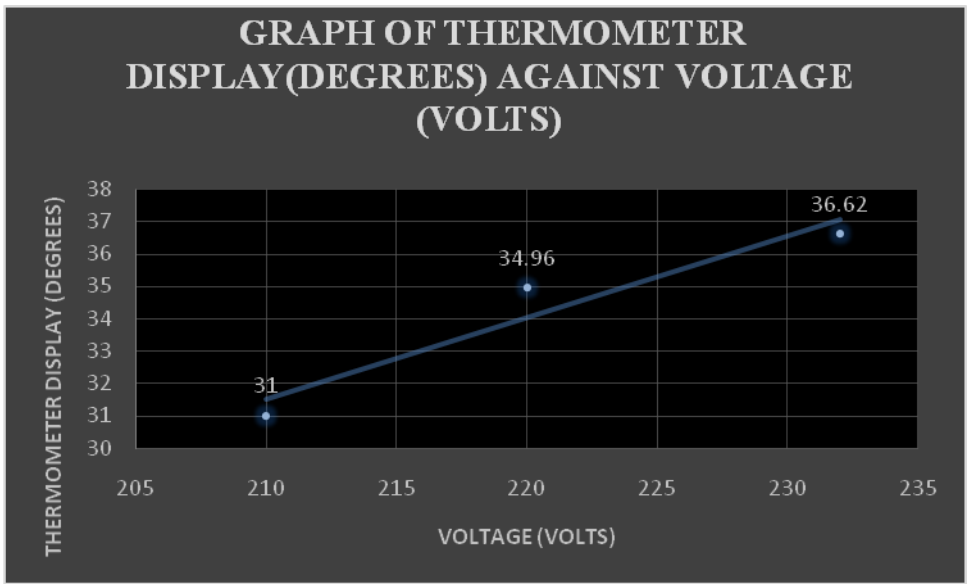


Figure 4: Graph A

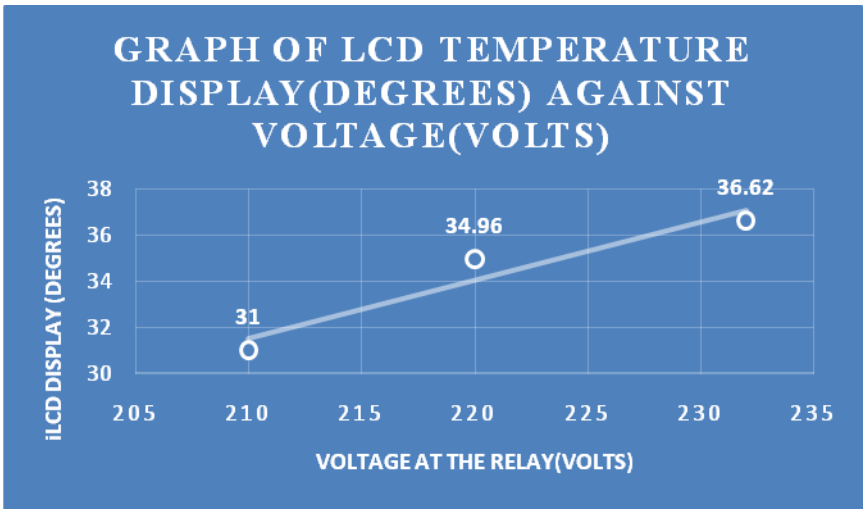


Figure 5: Graph B

Graph A shows the Thermometer reading against the voltage reading. Graph B shows LCD Temperature display against the voltage. In both displays, it is seen that as the temperature increased, the voltage also increased. This is evident on the change in speed encountered which has brought about the observed change in temperature.

5 Discussion of Results

As seen from the table above, at different relay operation, the temperature reading was compared with readings from the thermometer. A similarity was observed, and it was seen that the NTC thermistor functioned well with actual temperature measurement reading. Also, at these temperature reading, the voltage at the output of each relay varied because of the direct proportionality between speed and voltage which implies that at higher temperature, the speed of the fan changes and brings about a high voltage.

The system has four states;

State 1: Default state (Off state), when the temperature is below 31°C.

State 2: On state when the temperature is above 31°C, the fan automatically operates at speed 1

State 3: On state when the temperature is at 34.96°C, the fan automatically operates at speed 2

State 4: On state when the temperature is at 36.62°C, the fan automatically operates at speed 3

Conclusion

Automatic temperature speed controlled standing fan is implemented. Thus, here fan speed has been controlled by using Pulse Width Modulation and microcontroller (Atmega 328p) according to the temperature sensed by the help of Negative Temperature Coefficient Sensor (NTC Thermistor). The idea of the project is to change the fan temperature automatically. PWM technique is found to be the best technique for controlling the fan speed using the sensed temperature. The system is working properly. The speed of fan depends on the temperature and there is no need for regulating the fan speed manually again and again.

Automatic temperature controlled standing fan is very important in household application, it brings about comfort when controlling and operating household appliances. It makes life easy while trying to make switching operation of appliances. The temperature control for fan regulator is developed to make the switching of household appliances easy for the elderly, physically challenged, the young and anyone who, in any circumstance, needs comfort and security. With the advancement in technology, it's now possible for users to control and operate electrical appliance automatically at low cost. The development also brings in other advantages like cost effectiveness, User friendly. Portability and much needed efficiency.

Recommendations

Upon completion of this project the followings can be made to improve on the performance and rating;

- For additional performance improvement, the simple on/off, threshold-based fan cycling (even with hysteresis) can be upgraded to the well-known proportional-integral-derivative (PI and PID) closed-loop control strategies. This ensures the airflow closely maintains the desired set point temperature and does so without cooling undershoot or overshoot despite load changes.
- The size of the fan can be increased to enhance maximum functionalities
- To improve the performance of the system, the output of the device should be regulated to properly handle variation of power supply.
- Incorporating a unique sound alarm unit, that will come ON once there is unusual operations.

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