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Microcontroller Based Fan Speed Regulator with Continuous Monitoring using LCD Display

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Abstract - Design and implementation of Microcontroller based automatic Fan speed regulator using temperature sensor is represented here. Most of the available Fans today are controlled manually by voltage regulators which have different stages of speed. During summer nights, especially the room temperature is initially quite high, as time passes, the temperature starts dropping. Also, after a person falls asleep, the metabolic rate of one's body decreases, and one is expected to wake up from time to time to adjust the speed of the Fan. 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 automatic Fan speed control system that automatically changes the speed level according to the change in environment / room temperature which is more comfortable than manual system. This project has been designed in such a way that the required components are available in local market. Therefore an indigenous low cost control scheme has been developed which can be used in real life application.

Keywords: ***Temperature Control Fan; Speed Regulator; Microcontroller.***

Introduction

Today, Fan is always used in the daily purposes. It is used to control the room temperature. All the activities of Fan can be controlled by using centrifugal switch [1]. The user can select the interested speed by switching the appropriate level in switch centrifugal. Normally, a ceiling Fan has six speeds' switches. There are speed 0, speed 1, speed 2, speed 3, speed 4 and speed 5. The speed 0 is especially for switching off the ceiling Fan. The slowest is for speed 1 and the fastest is speed 5. During the night, the metabolic rate of one's body decreases, and one is expected to wake up from time to time to adjust / regulate the speed of the Fan (with respect to room temperature). Many people who are disabled / physically challenged persons are affected the most because of the inconveniences associated in changing the Fan speed level manually [2]. Thus electricity usage by Fan about 100watts~80watts (depending on the make) is more than what is required for the desired low speed operation of Fan (approximately 10 watts to 30watts).

So, an efficient and reliable system that automatically changes the Fan speed level according to the change in room temperature was built to solve the problems and shortcomings associated with manually method of Fan speed control [3].

Before fan is invented, bird feather had been used. As year goes by, human being very creative by the creative technology which make human's life easier. Nowadays, fan and air conditioner has been a must appliance to each home, offices and the industries. Mostly each invention will be the modified from years for a change. The same thing goes to fan. Basically, fan has been run manually. To change the speed one has to push the speed button at the control panel of the fan. There are so many machines or electrical appliances that can function automatically. With the invention of the fan automated system using temperature sensor, one does not have to change fan speed manually. It can change fan speed to lower or higher speed according to the temperature. Nowadays, the usage of fan is controlled manually by pressing on the switch button. This non-innovative feature makes it unable to turn on automatically according to temperature changes. So, an automatic temperature control system technology is applied for the switching purpose in this circuit.

Due to its advantages, many researches focusing on automatic temperature control system application in different fields will gain the benefits. For examples, Room Temperature based Fan Speed Control System using Pulse Width Modulation Technique [4], Design an Automatic Temperature Control System for Smart Electric Fan Using PIC [5],an automatic temperature controller for multi element array hyperthermia systems [6],multi loop automatic temperature control system design for fluid dynamics [7],design of automatic temperature- control circuit module in tunnel microwave heating system [8], an automatic temperature controller for multi-element array hyperthermia systems [9], multi-loop automatic temperature control system design for fluid dynamics [10], automatic temperature control for transport airplanes [11], design of automatic temperature control system on laser diode of erbium-doped fiber source [12], design of

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automatic temperature-control circuit module in tunnel microwave heating system [13].

This paper proposes an invention of Smart Electric Fan for various applications. It has an automation operation by using a microcontroller. It uses a TRIAC instead of relay that reduce cost. It changes speed with one degree temperature variation. This is to enhance its functionality to become more efficient and effective and also we can save more electricity. The circuit provides a comfort for human's life, especially for senior and physically handicapped citizens. It really helps to solve the problem of handicapped person when to switch on the fan.

Block presentation of project

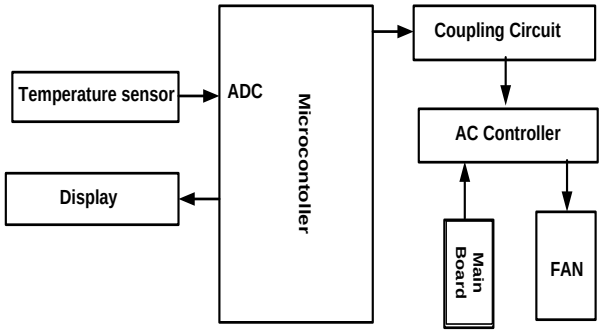

Fig.1: Block diagram representation of the project.

The above diagram is the basic block diagram of the whole project. The temperature sensor is employed to sense the temperature from atmosphere. It produces voltage if rises temperature. The output of the Temperature sensor (analogue signal) is fed to the input of the ADC, which converts the analogue temperature value to digital equivalent required by the micro-controller. Thus, the output of the ADC is directly coupled to the microcontroller whose main task is to control / regulate the Fan speed via the actuators. The LCD made available in the system is used to display all the information of the system like: - the Fan speed and the room temperature (at any point in time).

Flow Chart

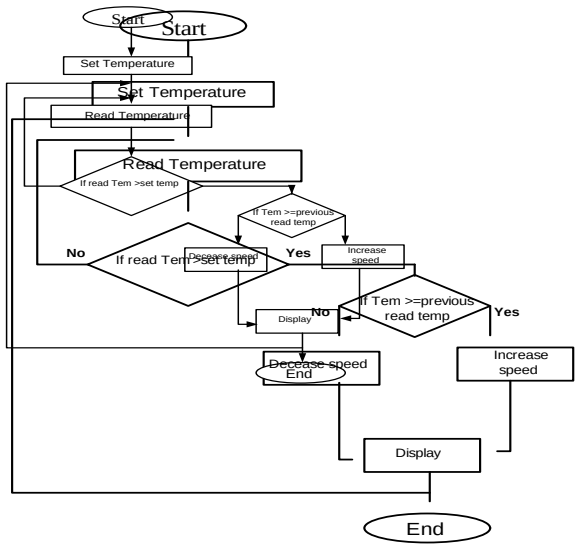

Fig.2: Flow Chart of the Project

Figure-2 shows the flowchart of the logic implemented in the modeled system. First set Temperature than The temperature is read from the temperature sensor and the condition is checked and the following processes are done:

- If read temperature is greater than set temperature, going next step.
- If read temperature is smaller than set temperature, than again read temperature.
- If temperature is greater than previous temperature, increase seed and display.
- If temperature is small than previous temperature, decrease seed and display.

Simulation of the project

The circuit presents the design, construction, development and control of automatic switching electric fan. The idea is based on the problem occurs in human's life nowadays by improving the existing technology. The microcontroller based automatic fan system is applied to upgrade the functionality to embed automation feature. The electric fan will automatically switch on according to the environmental temperature changes [4]. The circuit is using a microcontroller to control the fan

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according to the temperature variation. Microcontrollers play a very important role

in the development of the smart systems as brain is given to the system [5]. Microcontrollers have become the heart of the new technologies that are being introduced daily.

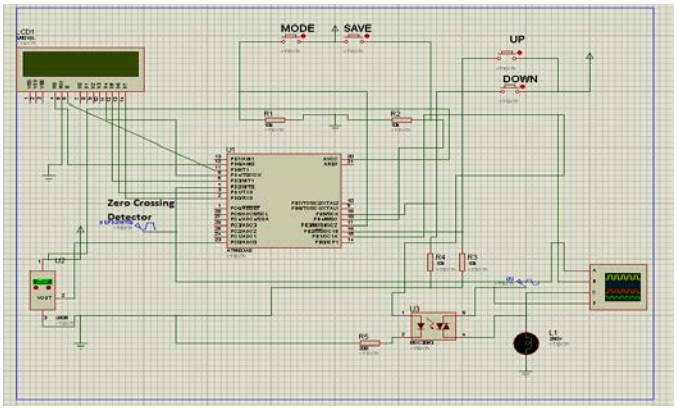

Fig.3: Proteus simulation of project.

The simulation of the system has been done on Proteus Professional Software v8.0. Atmega8 microcontroller based on Modified Harvard architecture is used in the system. Coding of the system has been done in Embedded C language. 16X2 LCD display has been used which is connected to PORT B of the microcontroller. The simulation of the circuit is shown in Figure-3. The temperature sensor senses the room temperature and it is displayed on the LCD. The speed of the fan is controlled by using zero crossing technique according to the room temperature. For processing analog signals, microcontroller has analog to digital converter which converts analog signals to digital ones. The temperature sensor LM 35 interfaced to the analog port acquires the room temperature and converts it into digital voltage signal.

The Arduino v1.6.6 was used for this project. The Arduino belongs to an entire family of single-chip microcomputers, all of which have the same processor design. They use the same instruction set, but differ slightly in Memory mapped special function registers (SFRs) and on-chip ROM and RAM. The assembler is a software tool- a program-designed to simplify the task of writing computer programs. It performs the clerical task of translating symbolic code into executable object code. This object code may then be programmed into one of the ATmega8 microcontroller to which belongs to Atmel Corp.

The steps taken in assembling the program is summarized as follows:

1. Type the program in Arduino.
2. Save it as “Temperature_control_fan_speed.ino” in drive C:/Document/Arduino
3. Launch the “compile” command from the sketch menu.

In case of syntax error in program code, program will not be compiled and HEX file will not be generated. Errors need to be corrected in the original program file (the one typed in Notepad) and then the source file may be compiled again. The best approach is to write and test small, logical parts of the program to make debugging easier.

Complete circuit diagram

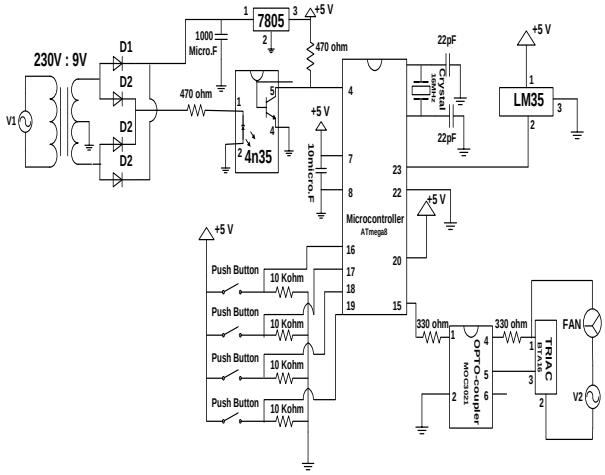

Fig.4: Complete circuit diagram of project.

The practical implementation of any idea is quite challenging and difficult as well. Besides those difficulties, the proposed automatic temperature control fan by using microcontroller is implemented.

Above Figure-4, shows the complete circuit diagram of the prototype system. Here, V_1& V_2 is the supply voltage 230V. The temperature sensor LM35 senses the temperature and converts it into an electrical (analog) signal, which is applied to the micro controller through ADC. The analog signal is converted into digital format by the analog-to-digital converter (ADC). The sensed and set values of the temperature are displayed on the 16x2-line LCD. The microcontroller drives Triac to control the fan speed with the help of high wattage tagged wire wound resistor.

This project uses regulated 5V, 500mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/9V step down transformer.

The circuit maintains the temperature of the system in a particular range. A fan is used for controlling the temperature of the system. The fan RPM increases with increase in temperature and vice versa. The working of the heater is also the same. The current temperature within the server room is

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measured by using a temperature sensor. When the current temperature is below the lower limit of the desired range, the system must stop the fan.

When the current temperature is below the lower limit of the desired range, the system must be cooled by using a fan. When the current temperature is within or successfully turned back to the required range, no control action is needed. The current temperature of the room must be continuously displayed on the LCD. The controller should use LEDs as backup display to indicate the current state of temperature .This makes user is easily to know current temperature of the system. The Temperature Sensor detects the temperature of the system.

The Temperature Sensor consists of an LM35 IC. The temperature sensor is connected to the ADC input of the AVR microcontroller. It converts the analog input to a digital value. The AVR is connected to a switching device relay. It is used to switch on the heater. The AVR generates gate pulse according to the temperature sensor value. The GATE PULSE generated output control signals are sent to the Triac BTA16. Triac BTA16 is fed with the GATE PULSE generated output from AVR after detecting the zero points using zero crossing detector 4n35. By using Triac BTA16, one single phase ac motor can be connected. The speed of the fan is controlled by the duty cycle controlled by the GATE PULSE generated by the controller. By shifting the gate pulse the speed of the fan reduces the temperature of the system. The LCD module is also connected to the AVR microcontroller. The LCD module displays the current temperature.

Fabrication

A general purpose PCB board is used for the control scheme. The required components were collected from the local market. The components were fixed on the general purpose PCB board and the control scheme is obtained. This is shown in bellow in Figure-5.

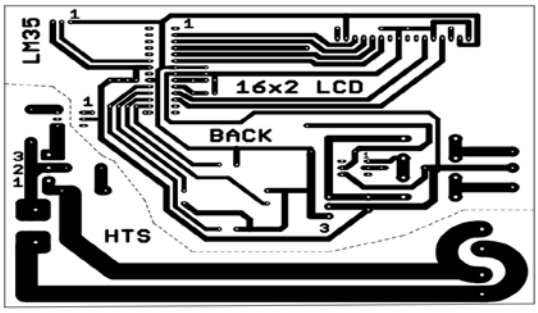

Fig.5: Printed Circuit Board (PCB) design for fabrication of the project.

Experimental Set Up

After completing the project some test were done in the lab such as measuring speed of the fan in rpm, output current, output voltages and power consumption. Here shown this picture.

Fig.6: Complete experimental setup of project.

Experimental Data Table

Measured data during complete experimental setup with respect to temperature are given bellow.

Temperature (deg. C)	Speed (rpm)	Current (amp)	Voltage (volt)	Power Consumption (W)
20	**1750**	**.12**	**118**	**14.16**
21	**2210**	**.14**	**136**	**19.04**
22	**2515**	**.15**	**152**	**22.8**
23	**2640**	**.15**	**170**	**25.5**
24	**2705**	**.16**	**185**	**29.6**
25	**2750**	**.16**	**202**	**32.32**
26	**2775**	**.17**	**215**	**36.55**
27	**2785**	**.17**	**224**	**38.08**
28	**2795**	**.17**	**225**	**38.25**
29	**2800**	**.18**	**229**	**41.22**

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Output Curves

Various output curves obtained from using programming of MATLAB 10.0 are given bellow:

Temperature vs Speed Curve: Temperature vs speed (rpm) curve is given bellow in Figure-7

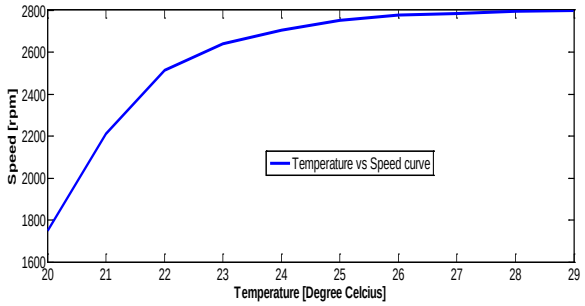

Fig.7: Temperature vs Speed Curve

Temperature vs Load Current Curve: Temperature vs load current curve is given bellow in Figure-8

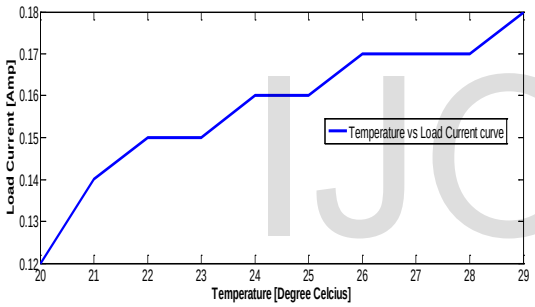

Fig.: Temperature vs load Current Curve

Temperature vs Power Consumption Curve: Temperature vs power consumption curve is given bellow in Figure-9

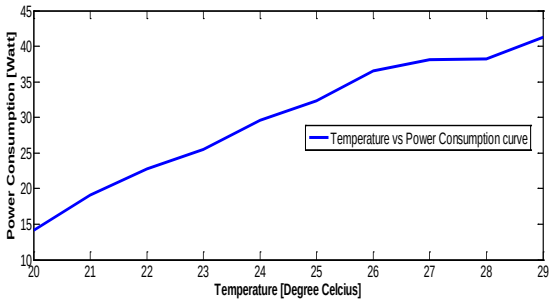

Fig.: Temperature vs Power Consumption Curve

Suitability of Proposed Technology: The practical implementation of any speculative idea in practical is quite challenging and difficult as well. Though those difficulties the proposed new gesture controlled technology serves many advantages. Those are given bellow

- Reduced Complexity.
- Low power loss & Reduce current consumption.
- It is efficient and effective for large space and hot weather condition.
- It really helps to solve the problem of handicapped person when to switch on the fan.
- By applying the circuit, it offers a better life for human.
- The equipment's used here are not so costly, also available. Thus the total implementation cost is small.

Conclusion

In conclusion, the process in developing this innovative circuit is successfully done. The hardware implementation and its operation is functioning accordingly and smoothly following the procedure. High priority has been given to make the circuit simple but efficient with high reliability. Some slight of modifications have been made from the current and existing technology features to improve its performance such as using TRAIC instead of relay, speed change with one degree temperature change. The circuit has fulfilled the main objective, which to control the speed of fan using the temperature controller with microcontroller. Various graphs have been plotted to show the varying relationships between different parameters. This circuit is really practical to be applied, especially in real life applications.

Future Scope: In the future, there are several improvements can be made in order to upgrade the features such as

1. It can be extended for three phase induction load.
2. It can be extended by interfacing with android mobile to show temperature and RPM of fan in mobile.

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