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Design and Fabrication of Automatic Fan Speed Control

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***Abstract*:** The aim of this paper is to control the speed of dc fan based on room temperature using pulse width modulation technique with microcontroller. To get rid of the problem of Obscurity to control temperature in industries a microcontroller based controller has been proposed. A temperature sensor has been used to measure the temperature of the room and the speed of the fan is varied according to the room temperature using pulse width modulation technique. Controller is used to control the speed of AC Fan and temperature is varied through the Temperature sensor and data is sent to pic16f877 microcontroller using analog to digital converter. The duty cycle has been varied from 0 to100% to control the fan speed depending upon the room temperature, which is displayed on liquid crystal display. There results of the research and Output waveforms have been investigated. Various design criteria, performance characteristics, comparison with different parameters have been plotted in mp software system and other simulation results have been discussed in detail in this paper

Keywords—Control, Pulse Width Modulation,

INTRODUCTION

Electric fan is one of the most popular electrical devices due to its cost effectiveness and low power consumption advantages. It is a common circuit and widely used in many applications. It is also one of the most sensible solutions to offer a comfortable and energy efficient. In fact, the fan has been long used and still available in the market. Nowadays, the demand for accurate temperature control and air freshening control has conquered many of industrial domains such as process heat, automotive, industrial places or office buildings where the air is cooled in order to maintain a comfortable environment for its occupants. One of the most important concerns involved in heat area consist in the desired temperature achievement and consumptionoptimization. Fan can be controlled manually by pressing on the switch button. where in this method, any change in the temperature will not give any change in the fan speed. except the usage change the speed of the fan which is manually. So, an automatic temperature control system technology is needed for

the controlling purpose in the fan speed according to the temperature changes.

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I. SSYSTEM ANALYSIS

A. EXISTING SYSTEM

Automatic Temperature Controller for Multielement Array Hyperthermia Systems.Multi-loop Automatic Temperature Control System Design for Fluid Dynamics. Facility Having Several Long Transport Delays Temperature-Control Circuit Module in tunnel Microwave Heating System.

PROPOSED SYSTEM

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 is discussed briefly below.

ADVANTAGES OF PROPOSED SYSTEM

It is very economical and easy to handle by the user. Speed varies automatically, so that it controls the speedwithout using it manually.It is help full to disabled people.It is very easy to install in offices, houses etc.

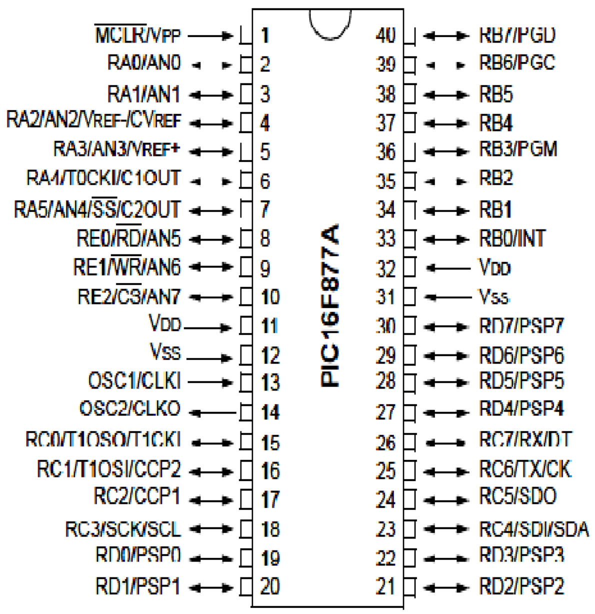
II. SSYSTEM SPECIFICATION

- LM35 TEMPERATURE SENSOR
- PIC16F877A MICROCONTROLLER DEMO BOARD
- STEPDOWN TRANSFORMER

- RESISTORS
- LCD DISPLAY
- TRIMPOT
- TRIAC
- AC FAN
- CONNECTING WIRES

*LM35:*Transducers convert physical data such as temperature, light intensity, flow, and speed to electrical signals. Temperature sensor's output voltage is linearly proportional to the Celsius (centigrade) temperature. Depending on the transducer, the output produced is in the form of voltage, current, resistance, or capacitance. The complexity associated with writing software for nonlinear devices is very high. So we use a linear temperature sensor to respond for a temperature change.

PIC16F877A: The microcontroller incorporates all the features that are found in microprocessor. Microcontroller may be called computer on chip since it has basic features of microprocessor with internal ROM, RAM, Parallel and serial ports within single chip. This is widely used in washing machines, microwave oven, androbotics or in industries. Microcontroller can be classified on the basis of their bits processed like 16 bit MC. This powerful 200 nanosecond instructionexecution. Yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC® architecture An 40- or 44-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and*PIC16C7X devices*



A microcontroller is a computer control system on a single chip. It has many electronic circuits built into it, which can decode written instructions and convert them to electrical signals. The microcontroller will then step through these instructions and execute them one by one. As an example of this a microcontroller could be used to control the fan speed according to the temperature of the room. Microcontrollers are now changing electronic designs. Instead of hard wiring a number of logic gates together to perform some function we now use instructions to wire the gates electronically.

TRIMPOT: A TRIMPOT or trimmer potentiometer is a small potentiometer. It is used for adjustment, tuning and calibration in circuits.

PWM: The pulse width modulation speed control function is a function that externally controls the rotation speed of the fan by changing the duty cycle of the input pulse signal between the control terminal and GND as shown in Figure 3. Here the conduction time to the load is controlled. Let for a time t1, the input voltage appears across the load i.e. ON state and for t2 time the voltage across the load is zero. The average voltage at output

$Va = 1/T \int$

$vodt = t1/T$

$Vs = ft1$

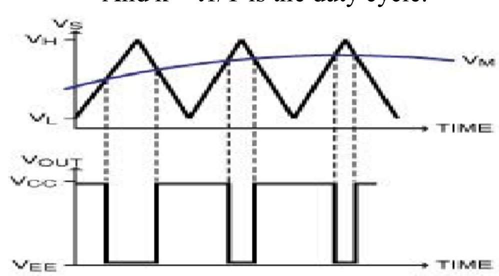
$Vs = kVs$

$VOUT = \alpha VIN$

Where, α = Duty cycle

T total time period = $t1+t2$

And $k = t1/T$ is the duty cycle.



PROJECT DESCRIPTION

OVERVIEW OF THE PROJECT

Nowadays, the humankind is moving towards the new technologies by replacing the manual operations to automatic controlled devices. One of the basic requirements of the people during hot weather is a cooling fan. But, the speed of the fan can be controlled by manual operation using a manual switch namely fan regulator or dimmer.

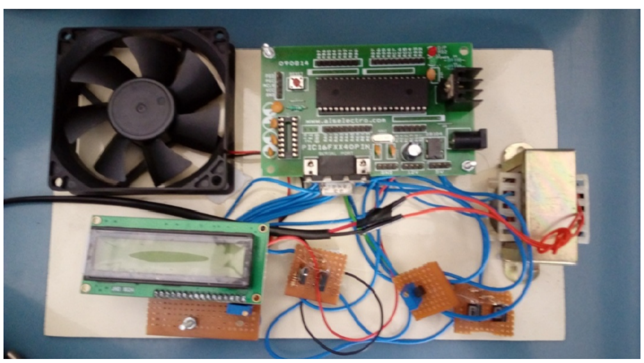
By turning the dimmer, the fan speed can be altered. It can be watch in some places like where the temperature is high during the morning though the temperature falls down radically at night time. The users do not understand the difference in temperature.

So to overcome the speed of the fan here is a solution to vary according to temperature. This concept is particularly applicable for the areas like where temperature changes radically during day and night time. This project will convert the manual fan into automatic fans.

The automatic fans will change its speed according to the temperature in the room. This article discusses about temperature controlled fan block diagram, working of each block and properties.

The proposed system temperature controlled fan using microcontroller is used to control the speed of the fan according to the temperature and specify the temperature in the display. The required components are microcontroller, temperature sensor, motor; seven segment display, power supply, operational amplifier.

HARDWARE IMPLEMENTATION

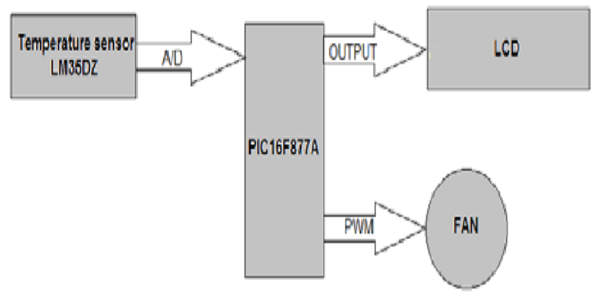


The Hardware implementation of the system has been done on 8051 Microcontroller Development board. It is widely used till now because it is cheap and can work for the same result as other microcontroller development board can do.

Connections are provided according to interfacing of all the components such as LM35, ADC0804, AT89S52, L293D, AC fan, LCD. One bulb is there to increase the temperature around temperature sensorLM35.

BLOCK DIAGRAM

The microcontroller PIC16F877A, is the heart of the system. It accepts inputs from the temperature sensor, LM35 which allows for the measurement of the current room temperature, then the controller will give the action to maintain the required fan speed. LCD is used to display the fan speed and room temperature.



CIRCUIT DIAGRAM

The temperature sensor chosen for the design is the popular LM35 IC temperature sensor as shown in Fig. 4. LM35 is a three terminal integrated circuit temperature sensor giving a linear voltage output of 10mv per degree Celsius. Available in two versions one operating from 0°c to 100°c (DZ version), the other is from -40°c to +110°c (CZ version). These devices are housed in TO-92 plastic packages and provide a low cost solution to temperature measurement.

The function is that it gives an analog voltage output per degree change in temperature Brushless AC Motors are commutated electronically; they do not use brushes so called brushless AC motor. These motors provide better speed versus torque characteristics, noiseless operation and high efficiency over brushed AC motors. Magnetic field generated by stator and rotor have same frequency, so motors are synchronous motors.

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determined. This commutation sequence is important in rotating motors as they use electronically controlled commutation.
The LM35 gives 10mv for each 1°c change in the temperature; this value is analog value and should be converted to digital. Any change in the temperature will be send to the microcontroller via PORTA pin 2, which have been specified by us in the program using TRISA.
The microcontroller PIC16F877A, is the heart of the system. It accepts inputs from the temperature sensor, LM35 which allows for the measurement of the current room temperature, then the controller will give the action to maintain the required fan speed. LCD is used to display the fan speed and room temperature.

The microcontroller used in this system has inbuilt PWM module which is used to control speed of the fan by varying the duty cycle. According to the readings from the temperature sensor, duty cycle is varied automatically thus controlling fan speed. The microcontroller will send the PWM signal via pin RC2 in port C to the transistor which working as switch to the fan.

Crystal oscillator is connected in between pin 13 (osc1) and pin 14 (osc2) of PIC16F877A, those are pins if we want to provide external clock to the microcontroller. 0.1 µF bypass capacitor used on the output pin +5 V of the voltage regulator to smooth out the supply voltage to microcontroller and LCD.

Vout pin of temperature sensor LM35 is connected on pin RA2 which is ADC0 of all ADC input pins. Pin 3 of LCD is connected to ground via 1Kohm resistor to set the contrast of the LCD to display temperature on LCD. Pins from RB2 to RB7 are connected to remaining LCD pins used for data and control signals between LCD and microcontroller PWM output is given to gate terminal of Transistor NPN KSP2222A from microcontroller.

Transistor NPN KSP2222A is high switching speed power switch. This switches on and off at PWM frequency and controls the voltage across motor.

When KSP2222A is on, the motor starts to gain speed and off then motor loses speed. The hardware circuits that have been designed for the controlled fan speed system in this research, which consists of the LM35, PIC microcontroller.

FLOWCHART OF THE SYSTEM

The logical representation of the software code has been presented in the flowchart form. Fig 6.4 shows the flowchart of the logic implemented in the modeled system. The temperature is read from the temperature sensor and the condition is checked and the following processes are done:

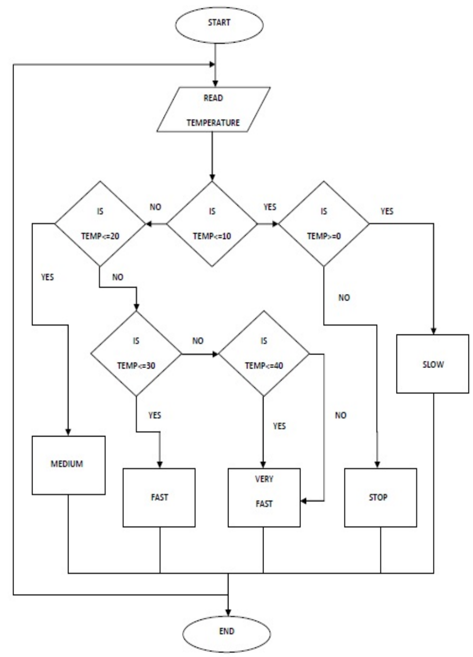
1. When temperature is greater than zero and less than 10 degree Celsius, the fan speed is slow.

2. When temperature is greater than 10 and less than 20 degree Celsius, the fan speed is medium.

3. When temperature is greater than 20 and less than 30 degree Celsius, the fan speed is fast.

4.When temperature is greater than 30 and less than 40 degree Celsius, the fan speed is very fast.

5. When temperature is less than zero degree Celsius, the fan stops.



Pulse for temperature above 20□ and below 40□. Here variation in pulse is with Duty cycle 25% and at the same time fan speed is slow and showing 200 rpm. At this time temperature range is greater than 20 and less than 40 degree Celsius.

Temperature above 20□ and below 40□. Here the variation of pulse is with Duty cycle 65%and at the same time fan speed is fast and showing 480 rpm. At this time temperature range is greater than 40 and less than 60 degree Celsius.

Pulse for temperature above 60□. Here the variation of pulse is with Duty cycle 95% and at the same time fan speed is very fast and showing 770 rpm. At this time temperature range is greater than 60 degree. The temperature sensorsenses the room temperature and it is displayed on the LCD.

The speed of the fan is controlled by using PWM technique according to the room temperature. For processing analog signals, we have analog to digital converters interfaced with microcontroller, which converts analog signals to digital ones.

The temperature sensor LM35interfaced to the analog input port of ADC0804 acquires the room temperature and converts it into digital voltage signal. Figure 10 shows the relationship between digital voltage and the temperature.

OPERATION

1) Power supply of 5v is given to the microcontroller

2) The temperature sensor senses the temperature and gives the

3) Analog input signal. ADC converts analog signal to digital form.

4) The output from the sensor is given to the microcontroller and it Controls thePWM with the program and due to it speed changes.

5) Trimpot is an adjustable screw type which is used for manual speed control.

6) The speed of the fan has been controlled using PWM technique according to the room temperature. The simulation of the system has been done on Proteus Professional v 8.0 software packages and it is running in good agreement.

7) The logic used in the system is verified and shown in the flowchart form. The duty cycle has been varied according to room temperature and speed of the fan was controlled accordingly.

8) The graphs showing the relationship between duty cycle and the room temperature are plotted in MP LAP and accuracy of the system was validated. The design of the system presented in this paper is appropriate according to the modern technology.

RESULT AND ANALYSIS

Table 5.1 Results of Duty cycle and Speed with Temperature in software Proteus

	Temperature (in °C)	Duty Cycle	Speed (rpm)
1	Less than 20	0	0 (Zero)
2	20 to 40	25	200 (Slow)
3	40 to 60	50	480 (Fast)
4	Above 60	95	770 (Very fast)

Now According to the readings from the temperature sensor, duty cycle has been varied automatically thus controlling fan speed on hardware. Speed has been measured using “digital Tachometer”. Table 2 shows the duty cycles and corresponding Speed varying with the temperature.

Table 5.2 Results of Duty cycle and Speed with Temperature taken from hardware

	Temperature (in °C)	Duty Cycle	Speed (rpm)
1	Less than 20	0	0 (Zero)
2	20 to 40	25	187 (Slow)
3	40 to 60	50	474 (Fast)
4	Above 60	95	919 (Very fast)

Now According to the readings from the temperature sensor, duty cycle has been varied automatically thus controlling fan speed on hardware. Speed has been measured using “digital Tachometer”. Table 2 shows the duty cycles and corresponding Speed varying with the temperature.

CONCLUSION

This paper elaborates the design and construction of fan speed control system to control the room temperature. The temperature sensor was carefully chosen to gauge the room temperature. Besides, the PIC microcontroller had been used to control the fan speed using the PWM, the fan speed in rpm and the room temperature was successfully programmed using C Language and their values displayed on LCD.

As calibration process, two methods were used, where the results of the calibration showedthat the temperatures of the room were close to each other using the LCD, the thermometer and the voltmeter in each test time.

Moreover, the fan speed will increase automatically if the temperature room is increased. As conclusion, the system which designed in this work was perform very well, for any temperature change and can be classified as automatic control.

SCOPE OF FUTURE WORK

This circuit can be expanded by incorporating a passive infrared sensor along with the temperature sensor.

A) 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 equipment's where the risk of being overheated and explosions are the serious problems, in various industries

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