



RESEARCH ARTICLE

FAN SPEED CONTROLLED SYSTEM BY TEMPERATURE USING PULSE WIDTH MODULATION (PWM)

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ABSTRACT

This work is a standalone automatic fan speed controller that controls the speed of an electric fan according to our requirement. Use of embedded technology makes this closed loop feedback control system efficient and reliable. Microcontroller (ATMega8 / 168 / 328) allows dynamic and faster control. Liquid crystal display (LCD) makes the system user-friendly. The sensed temperature and fan speed level values are simultaneously displayed on the LCD panel. It is very compact using few components and can be implemented for several applications including air-conditioners, water-heaters, snow-melters, ovens, heat-exchangers, mixers, furnaces, incubators, thermal baths and veterinary operating tables. ARDUINO micro controller is the heart of the circuit as it controls all the functions. The temperature sensor LM35 senses the temperature and converts it into an electrical (analog) signal, which is applied to the microcontroller. The sensed and set values of the temperature are displayed on the 16x2-line LCD. The micro controller drives Transistor to control the fan speed. This project uses regulated 12V, 2A power supply. This project is useful in process industries for maintenance and controlling of Boilers temperature.

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INTRODUCTION

With advancing in Technology, systems are getting more intelligent each day. The increase in the demand of cutting edge technology in the recent years have been drastic. Micro controllers have been playing an important role in the development of smart systems. A micro controller, being a single chip microprocessor is suited for automation and control of processes. Micro controllers are used in many different spheres of life to carry out automated tasks in a more accurate manner. Micro controller essentially consists of Central Processing Unit (CPU), timers and counters, interrupts, memory, input/output ports, analog to digital converters (ADC) on a single chip. With the current single chip integrated circuit design of the given micro controller, power consumption is low and the size of the control board is reduced. This paper presents the work for the design of the fan speed control system using Pulse Width Modulation by establishing a connection between a micro controller and a temperature sensor. 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 PWM technique.

The duty cycle is varied from 10 to 100 in accordance with the room temperature.

Pulse Width Modulation (PWM)

Pulse Width Modulation, or PWM, is a technique for getting analog results with digital means. Digital control is used to create a square wave, a signal switched between on and off. This on-off pattern can simulate voltages in between full on (5 Volts) and off (0 Volts) by changing the portion of the time the signal spends on versus the time that the signal spends off. The duration of "on time" is called the pulse width. To get varying analog values, we change, or modulate, that pulse width. If we repeat this on-off pattern fast enough with an LED for example, the result is as if the signal is a steady voltage between 0 and 5v controlling the brightness of the LED. In the graphic below, the green lines represent a regular time period. This duration or period is the inverse of the PWM frequency.

Temperature Sensor: We are using LM 35 as temperature sensor. LM 35 is a precision temperature sensor whose output being directly proportional to Celsius Temperature. The LM35 is rated to operate from -55° Centigrade to 150° Centigrade with a linear scale factor of +10mv/° C.

Features

- Calibrated directly in degree Celsius (centigrade)

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Specifications

Microcontroller: ATmega328

Operating Voltage: 5V

Input Voltage (recommended): 7-12V

Digital I/O Pins: 14 (of which 6 provide PWM output)

Analog Input Pins: 6

DC Current per I/O Pin: 40 mA

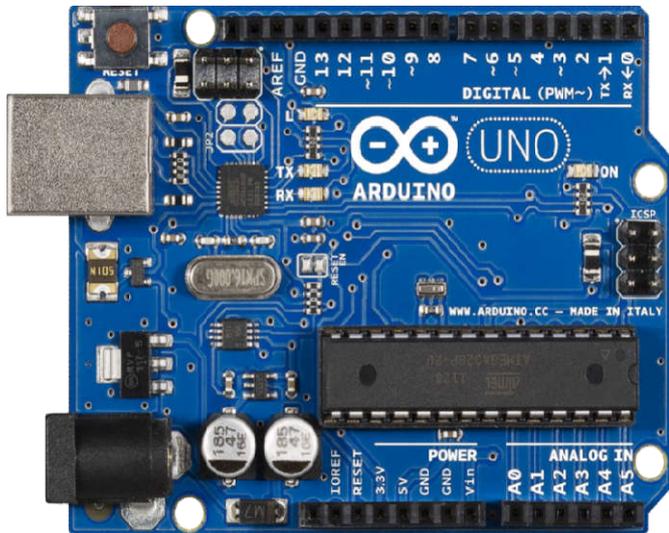
DC Current for 3.3V Pin: 50 mA

Flash Memory: 32 KB of which 0.5 KB used by Boot loader

SRAM: 2 KB

EEPROM: 1 KB

Clock Speed: 16 MHz

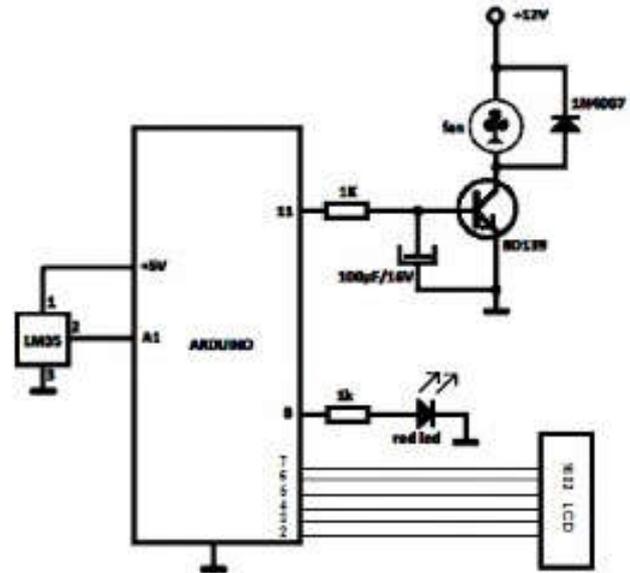


Some of the key features of the Arduino Uno

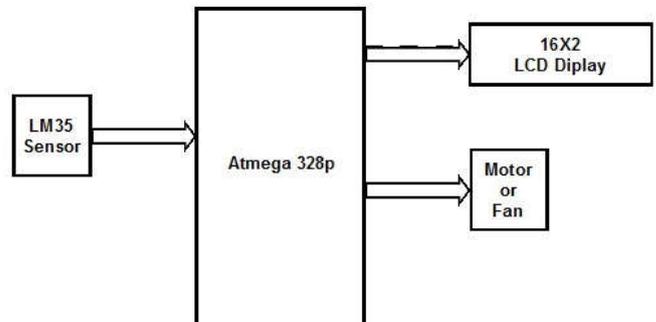
- An open source design. The advantage of it being open source is that it has a large community of people using and troubleshooting it.
- An easy USB interface. The chip on the board plugs straight into our USB port and registers on our computer as a virtual serial port. This allows us to interface with it as through it were a serial device. The benefit of this setup is that serial communication is an extremely easy (and time-tested) protocol, and USB makes connecting it to modern computers really convenient.
- Very convenient power management and built-in voltage regulation. We can connect an external power source of up to 12v and it will regulate it to both 5v and 3.3v. It also can be powered directly off of a USB port without any external power.
- A 16 MHz clock. This makes it not the speediest microcontroller around, but fast enough for most applications.
- 32 KB of flash memory for storing code.

- 13 digital pins and 6 analog pins. These pins allow us to connect external hardware to our Arduino. These pins are key for extending the computing capability of the Arduino into the real world. Simply plug our devices and sensors into the sockets that correspond to each of these pins and we are good to go.
- An on-board LED attached to digital pin 13 for fast an easy debugging of code.
- And last, but not least, a button to reset the program on the chip.

Circuit Diagram



Block Diagram



Conclusion

I used an LCD shield to display the current temperature and speed of the fan, but you can use the circuit without the LCD display. You also need to select the transistor by the type of fan that you use. In my case I used the well-known BD139 transistor and a 9V battery to provide power to the fan and transistor. The LM35 temperature sensor and red led are powered with 5V from the Arduino board. As you can see in the sketch on the first line I included the Liquid Crystal library (header) that includes useful functions to use when an LCD is connected to the Arduino board. Then I set the pins for the sensor, led and fan. The most important part is to set the variables temp Min and temp Max with your desired values. Temp Min is the temperature at which the fan starts to spin and temp Max is the temperature when the red led lights warning you that the maximum temp was reached. For example if you set temp Min at 30 and temp Max at 35 then the fan will start spinning at 30°C and reach its maximum speed at 35°C. We store the temperature value in the temp

variable and then use some if () functions to check if temp is lower than temp Min and if so let the fan OFF (LOW). The next if () is to check if temperature is higher than the min Temp and lower than the temp Max and if so then use the map () function to re-map the temp value from one value to another. In our case fan Speed will have a value of 32 at temp Min and 255 at temp Max. These values are used to control the speed of the fan using PWM and the analog Write (). The fan LCD re-maps the temp to allow the display of fan Speed in a 0 to 100% range so you can say that the speed of the fan is directly dependent of the LM35's temperature. When the temperature reaches the value set in temp Max the fan will be at its maximum spinning velocity and the LCD will display FANS: 100% even though the temperature might increase above temp Max.

Application

- Home.
- Industry for furnace automation.

Advantages

- Simple
- Cost effective
- Automatic Control

Future Scope

- Can control more parameters like humidity.
- We can send this data to a remote location using mobile or internet.
- We can draw graphs of variations in these parameters using computer.

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