Temperature Based Speed Control of Fan Using Arduino

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Abstract- **In present scenario, availability of electricity is found to reach crucial stage. To protect and safeguard one's future we need to save the energy. As a slogan suggest "One unit saved is one unit generated". The project 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. Arduino microcontroller 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 as it is constructed by using few components and can be interfaced 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 signal, which is forwarded to the microcontroller. The sensed and set values of the temperature are displayed on the 16x2-line LCD. The microcontroller 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.**

Index Terms- Temperature, fan, lm35, speed, PWM

I. INTRODUCTION

With the advancement in technology, intelligent systems are introduced every day. Everything is getting more sophisticated and intelligible. There is an increase in the demand of cutting edge technology and smart electronic systems. Microcontrollers play a very important role in the development of the smart systems as brain is given to the system. Microcontrollers have become the heart of the new technologies that are being introduced daily. A microcontroller is mainly a single chip microprocessor suited for control and automation of machines and processes. Today, microcontrollers are used in many disciplines of life for carrying out automated tasks in a more accurate manner. Almost every modern day device including air conditioners, power tools, toys, office machines employ microcontrollers for their operation. Microcontroller 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 this single chip integrated circuit design of the microcontroller the size of control board is reduced and power consumption is low. This project presents the design and simulation of the fan speed control system using PWM technique based on the room temperature. 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 0 to 100 to control the fan speed depending upon the room temperature, which is displayed on Liquid Crystal Display.

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.

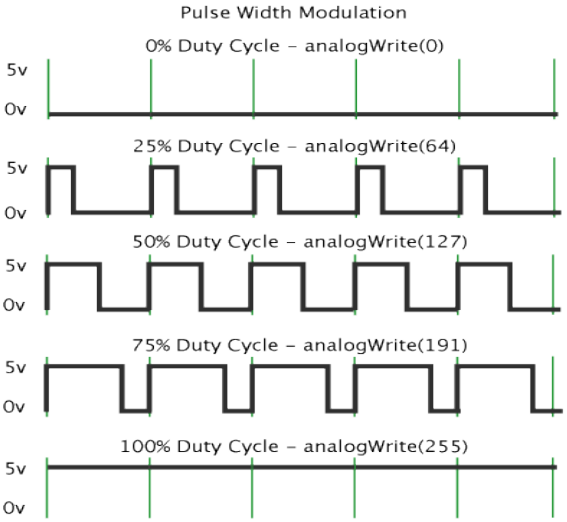

Fig. 1 Various duty cycle PWM signals

II. PROBLEM STATEMENT

Most human feels the badly designed about changing the fan rate level physically when the room temperature changes. Along these lines, the programmed fan framework that consequently changes the velocity level as indicated by temperature changes is prescribed to be fabricated for tackling this issue.

III. LITERATURE SURVEY

Power Consumption Rate of India

The U.S. Energy Information Administration provides data for India from 1980 to 2015. The average value for electricity consumption of India during that period was 15.1 billion kilowatt-hours with a minimum of 1.8 billion kilowatthours in 1980 and a maximum of 46.17 billion kilowatthours in 2014. [1]

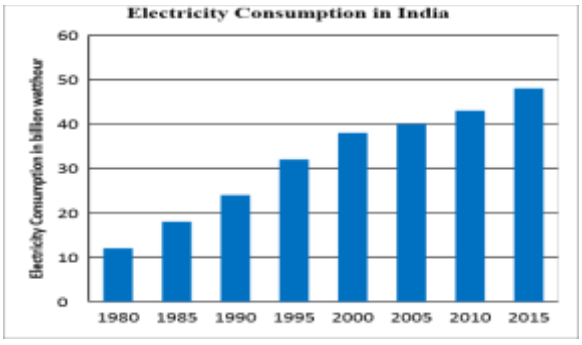

Fig. 2 Power Consumption in India

Review of Relevant projects

There are some abstractions of publications which are relevant to our proposed system. According to those publications we have included the information about existing system. The existing system has scope of upgrade. And existing system has some limitations. We have gathered lot of information from the literature and have discussed here. The information we have gathered which are about Automatic control fan using various electronic component and Arduino as well. We have got additional knowledge from particular publication about human sensing device. We have gathered knowledge about our proposed system from some article as well which has been published by an organization.

IV. OBJECTIVE

To develop an low cost, user friendly automated temperature controlled fan regulator which reduces power consumption and also assist people who are unable to control the speed of fan from their locations.

V. METHODOLOGY

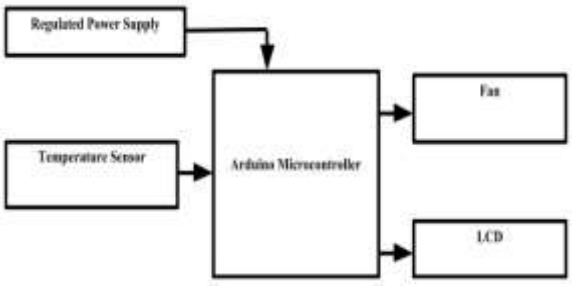

Fig. 1 Block diagram of the proposed concept

The above figure 1 represents the block diagram representation of the proposed concept. The temperature sensor DHT11 is interfaced with Arduino to fetch the data of temperature in the room. The data is processed if the temperature is high fan speed is more relatively if the temperature is low fan speed is low. Moreover if the temperature is below the threshold set then fan will be in off condition. The data related to temperature, fan speed is displayed on the LCD for user interaction. The fan speed is controlled relatively with the temperature using PWM pins available on the Arduino. As duty cycle of

PWM signal increases the fan speed increases and the same is true conversely.

VI. HARDWARE IMPLEMENTATION

A. Arduino

Arduino is an open-source platform used for building electronics papers. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

The Arduino is a microcontroller board based on the ATmega8. It has 14 digital -input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter. Revision 2 of the Uno board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode. Revision of the board has the following new features:

• 1.0 pinout: added SDA and SCL pins that are near to the AREF pin and two other new pins placed near to the RESET pin, the IOREF that allow the shields to adapt to the voltage provided from the board. In future, shields will be compatible with both the board that uses the AVR, which operates with 5V and with the Arduino Due that operates with 3.3V. The second one is a not connected pin that is reserved for future purposes.

• Stronger RESET circuit.

• ATmega 16U2 replace the 8U2.

"Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

Fig. 2 Arduino UNO

B. Arduino IDE.

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. The Arduino development environment contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

Software written using Arduino are called sketches. These sketches are written in the text editor. Sketches are saved with the file extension .ino. It has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino environment including complete error messages and other information. The bottom right-hand corner of the window displays the current board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

C. Liquid Crystal Display (LCD)

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

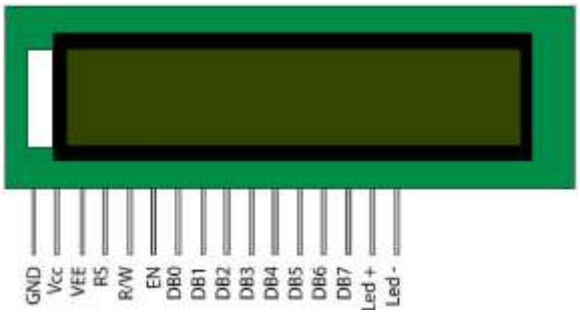

Fig. 3 Pin diagram of 16 x 2 LCD

D. DHT11 Temperature sensor

Fig.4 DHT 11 Temperature and Moisture sensor

This DHT11 Temperature and Humidity Sensor features a calibrated digital signal output with the temperature and humidity sensor capability. It is integrated with a high-performance 8-bit microcontroller. Its technology ensures the high reliability and excellent long-term stability. This sensor includes a resistive element and a sensor for wet NTC temperature measuring devices. It has excellent quality, fast response, anti-interference ability and high performance.

Each DHT11 sensors features extremely accurate calibration of humidity calibration chamber. The calibration coefficients stored in the OTP program memory, internal sensors detect signals in the process, we should call these calibration coefficients. The single-wire serial interface system is integrated to become quick and easy. Small size, low power, signal transmission distance up to 20 meters, enabling a variety of applications and even the most demanding ones. The product is 4-pin single row pin package. Convenient connection, special packages can be provided according to users need.

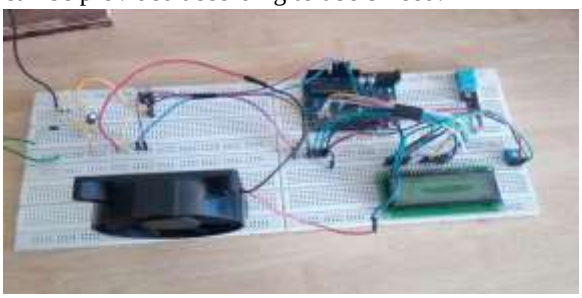

Fig. 5 Hardware implementation of the proposed concept

The above figure 5 depicts the hardware implementation of the proposed concept. It is at present in the rest state.

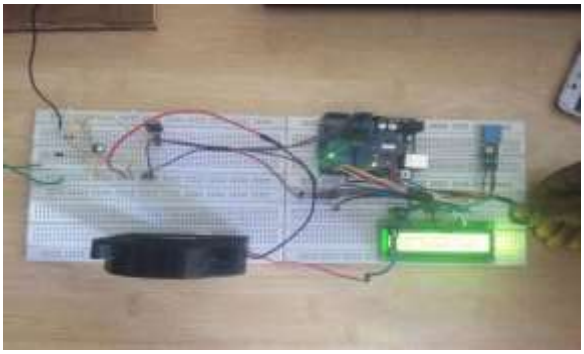

Fig. 6 Hardware implementation of the proposed concept

The above figure 6 depicts the hardware implementation of the proposed concept. The motor at present is running at maximum speed as the temperature is high.

VII.SOFTWARE IMPLEMENTATION

Algorithm:

- Set the baud rate as 9600 for serial communication.
- Include the LCD.h and DHT11 header file in the sketch.
- Read the value from the DHT11 temperature sensor and store it in a variable temp_sens.
- Compare the stored value with the threshold set to switch ON the fan.
- If temperature sensor value is less than 26°C motor will be in the OFF state.
- If temperature sensor value is equal to 26°C motor will be in the ON state and will be rotating at 20% of its maximum speed.
- If temperature sensor value is equal to 27°C motor will be in the ON state and will be rotating at 40% of its maximum speed.
- If temperature sensor value is equal to 28°C motor will be in the ON state and will be rotating at 60% of its maximum speed.
- If temperature sensor value is equal to 29°C motor will be in the ON state and will be rotating at 80% of its maximum speed.
- If temperature sensor value is greater than 29°C motor will be in the ON state and will be rotating at 100% of its maximum speed.
- Monitor the temperature continuously and take the necessary action depending upon the value of sensor.

VIII. RESULTS

The following table 1 depicts the results obtained by operating the prototype model at various different temperatures. It defines the behavior of the embedded system about how it reacts to variation of temperature at real time.

Table 1 Results of embedded system designed

Temperature	Duty Cycle	PWM Value	Fan Speed
In degree Celsius	In %		In rpm
Less than 26	0%	0	0
26	20 %	51	227
27	40%	102	428
28	60%	153	654
29	80%	204	826
Greater 29	100%	255	1000

The following represents graphical representation of tabulated data.

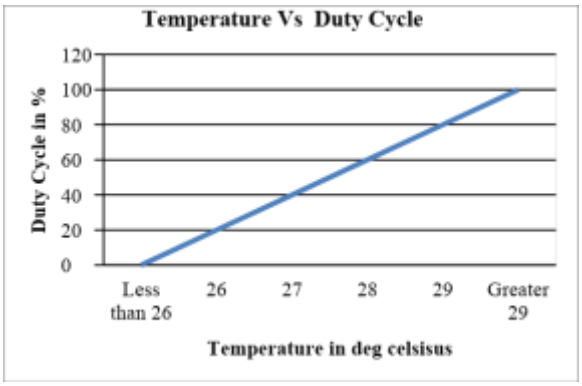

Fig. 7 Temperature Vs Duty cycle

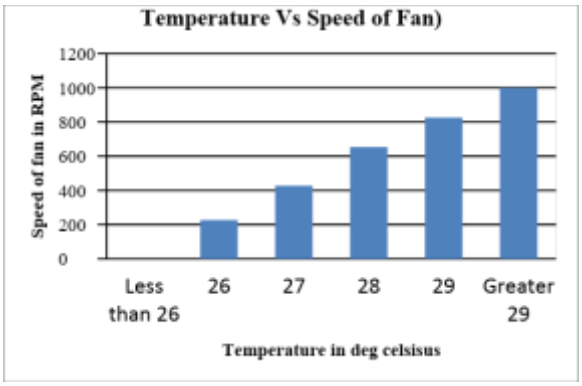

Fig. 8 Temperature Vs Speed of Fan

IX. CONCLUSION

Arduino based temperature controlled fan is implemented. Thus, here fan speed has been controlled by using Pulse Width Modulation and Arduino board according to the temperature sensed by the help of Temperature and Humidity Sensor (DHT22). 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.

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