

Computer Fan Speed Control Using Arduino UNO and LM35DZ

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Abstract— This paper attempts to achieve automatic control solution is suggested to control the fan speed. A circuit with LM35DZ temperature sensor, Arduino UNO as a main processor, and few of electronic components is designed and implemented to control the fan speed automatically. A fan speed control has been designed and constructed based on LM35DZ as the temperature sensing device. The microcontroller (MCU) ATmega8/168/328 allows dynamic and faster control and the LCD makes the system user-friendly. Sensed temperature and fan speed levels are simultaneously displayed on the LCD panel.

Keywords— Arduino UNO, LM35DZ, LCD, Relay, Fan

I. INTRODUCTION

This paper is a standalone automatic fan speed controller that controls the speed of an electric fan according to the requirement. Use of embedded technology makes this close-loop feedback-control system efficient and reliable. The temperature-based fan speed control system can be done by using an electronic circuit using an Arduino board. Now Arduino board is very progressive among all electronic circuits, thus we employed Arduino board for fan speed control [3].

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.

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. LCD shield is used to display the current temperature and speed of the fan.

A Background Theory

Arduino is at the heart of the circuit as it controls all functions. LM35DZ is a precision integrated circuit whose output voltage is linearly proportional to Celsius (Centigrade) temperature. It is rated to operate over a 30°C to 100°C temperature range. It 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. This project will help save energy/electricity. This project is based on Arduino UNO which communicates here with LM35, temperature sensor, a 16x2 display unit and relay. We can divide this Arduino based fan speed control into four sections - The first senses the temperature by using temperature sensor LM35DZ, second section converts the temperature value into a suitable number in Celsius scale which is done by Arduino, third section senses of system displays temperature on LCD, and last part of a temperature controlled relay that is used to turn on a dc fan. The same is demonstrated in below block diagram.

Microcontroller can be regarded as a single

-chip special-purpose computer dedicated to execute a specific application. As in general-purpose computer, microcontroller consists of memory (RAM, ROM, and Flash), I/O peripherals, and processor core. However, in a microcontroller, the processor core is not as fast as in general purpose - computer, the memory size is also smaller. Microcontroller has been widely used in embedded systems such as, home appliances, vehicles, and toys etc. There are several microcontroller products available in the market, for example, Intel's MCS - 51 (8051 family), Microchip PIC, and Atmel's Advanced RISC Architecture (AVR). We discuss Arduino UNO and LM35DZ temperature sensor in this section.

B The Proposed Fan Speed Control

The Arduino is the heart of the system. It accepts inputs from the temperature sensor, LM35DZ which allows for the measurement of the current room temperature, and then the controller will give the action to maintain the required fan speed. LCD is used to display the fan speed and room temperature. If the room temperature is more, then the speed of the fan will increase. If the room temperature is less, then the speed of the fan will automatically decrease by the control circuit. All of these can be summarized in a diagram as shown in Fig. 1.

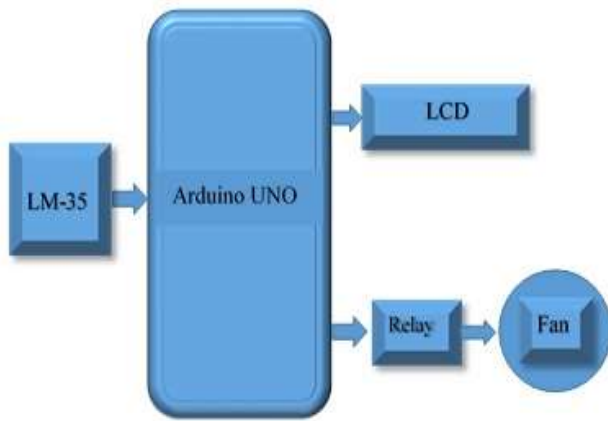


Fig. 1 System Block Diagram of the Fan Speed Control

C Hardware Implementation Process

Circuit diagram of the temperature fan speed control and monitoring is shown in Fig. 2. It is built around Arduino Uno board (Board1), 16x2 LCD (LCD1), temperature sensor LM35DZ and a few other components.

Temperature sensor LM35DZ senses the temperature and converts it into an electrical (analogue) signal, which is applied to the MCU through an analogue-to-digital converter (ADC). The analogue signal is converted into digital format by the ADC. Sensed values of the temperature and speed of the fan are displayed on the LCD. Temperature and monitoring using Arduino the MCU on Arduino drives the motor driver to control fan speed.

The amounts of temperature are displayed on the LCD display system. The whole reading and controlling is done by Arduino UNO software.

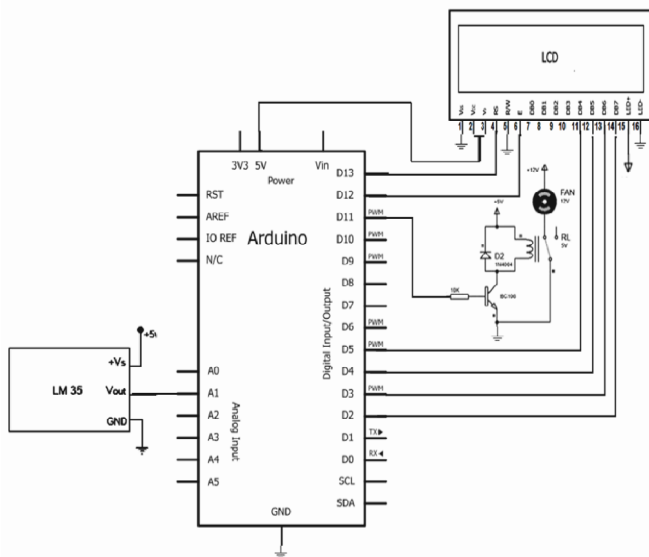


Fig. 2 Overall Circuit Diagram

A1 pin of Arduino UNO is configured by input pin and 2,3,4 & 5 are configured as digital output to send data to 16x2 character dot matrix LCD (Liquid Crystal Display).

1) Arduino UNO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, 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 Atmega8U2 programmed as a USB-to-serial converter.

"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; for a comparison with previous versions, see the index of Arduino boards.

Arduino UNO is used as a main processing unit. A1 of Arduino UNO connected vout of LM35DZ. Pin 5, 4, 3, 2 and 11 is connected to fan, 13 & 12 of Arduino are configured as digital output pins to send data to 16x2 character dot matrix LCD (Liquid Crystal Display).

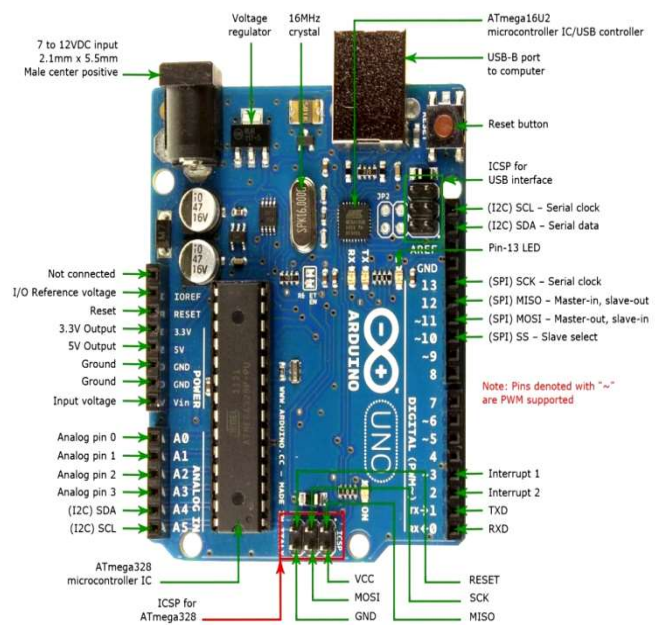


Fig. 3 Arduino UNO

2) Liquid Crystal Display (LCD)

The 2 line 16 characters LCD, is used to display current temperature. It is also used to display temperature in Celsius and Fahrenheit changing time to see easily which digit is changing.

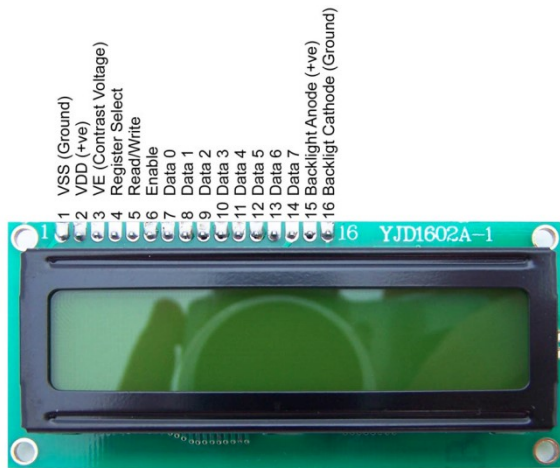


Fig. 4 Liquid Crystal Display (LCD)

The LCD is configured as 4-bit data interface D4 to D7 pins are used for data inputs. R/W(5) pin and VSS(1) pin of LCD is pulled to ground. The E(6) pin of LCD is controlled by Arduino to store the data. The RS(4) pin of LCD is controlled by Arduino to select whether the input data is command or data. V0(3) pin is used to adjust LCD brightness by using variable resistor, R2.

The LCD employed is a 16 x 2 type capable of displaying 32 characters in alphanumeric form. It has a wide range of LCD driver power from - 3 to 1V with high speed MPU bus interface of 2MHz when the supply voltage is $V_{cc} = 5V$. It can also be configured as 4 bit or 8 – bit interface enabled to transmit or receive data in either 4 bits or 8 bits. It consumes very small power with automatic reset circuit that initializes the controller/driver after power on. Internally there is an oscillator that has external resistors (LCD Data book).

The LCD was configured to drive its dot - matrix under the control of 4-bit output of the microcontroller. A regulated supply of 5V was used to supply the chip which is within the recommended supply voltage of the chip. A 10k Ω resistor was included as a current limiting resistor. The pin 16 of the chip is the K(16), VSS(1) and R/W(5), are the ground and was connected to the 0 line of the supply. While pins 11 to pin 14 were connected to receive the 4 - bit data from the main micro. A variable resistor is provided to adjust the brilliance of the LCD. The value as recommended in the datasheet is from 10k to 30k. For this project, a 10k variable resistor was used to vary the brightness of the LCD. Pin 4 is the reset pin that is used to clear the registers of the LCD.

3) LM35 Temperature Sensor

The fundamental necessity of the research is the conversion of the measured temperature into a corresponding electrical signal. There are many transducers capable of performing this, among which are thermocouple, thermostat and LM35DZ IC series. For convenience, availability and many inherent advantages a version of the LM35DZ series is chosen for this project. The LM35DZ series are precision integrated - circuit temperature sensors, whose output voltages are linearly proportional to the Celsius (Centigrade) temperature. The LM35DZ thus has an advantage over other temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35DZ does not require any external calibration or trimming and has low output impedance, linear output, and precise inherent calibration that make interfacing to readout or control circuitry especially easy. As it draws only 60 μA from its supply, it has very low self -heating (LM35 Data book, 2010).

One common temperature sensor in the LM35 series available in the market is LM35DZ. There are other temperature sensing components in the same series like LM334, DS1820 etc. This project has made use of the LM35DZ; this is because of its availability and the range of temperature it can handle. The LM35DZ is a precision semiconductor temperature sensor giving an output of 10mV per degree Centigrade rise. According to its data sheet (LM35 Data book, 2010) an RC circuit should be connected across the output and ground of the LM35DZ, if a long cable is used. This is to reduce the capacitive effect of the cable. A capacitor of 1 μF and a resistor of 100 ohms were connected across the IC as shown in Fig. 5.



Fig. 5 LM35DZ temperature sensor

4) Relay

We can control High Voltage electronic devices using relays. The 5V Relay module has three high voltage terminals (NC, C, and NO) which connect to the device you want to control. The other side has three low voltage pins (GND (0V), VCC (+5V), and S(Signal)) which connect to the Arduino board [4]. A Relay is actually a switch which is electrically operated by

an electromagnet. The electromagnet is activated with a low voltage, for example 5 volts from a microcontroller and it pulls a contact to make or break a high voltage circuit.

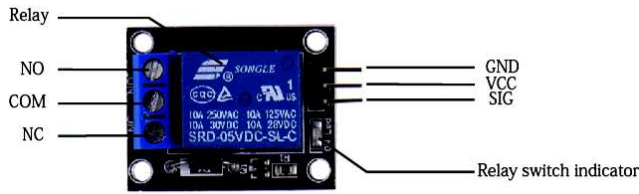


Fig. 6 5V Relay Module

D Software Procedure for Controlling the Whole System Function

ARDUINO 1.8.4 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. Refer to the [Getting Started](#) page for Installation instructions.

E Overall Discussion

The aim of this project is circuit implementations fan speed control by using a Arduino UNO. The microcontroller is used to get user input from LM35 temperature sensor to calculate and display temperature value, to send display data for the LCD module. If the room temperature is more, then the speed of the fan will increase. If the room temperature is less, then the speed of the fan will automatically decreases by the control circuit.

F Simulation Circuit

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 [6]. The circuit is using a microcontroller to control the fan according to the temperature variation. The simulation of the system has been done on Proteus Professional Software v8.0. ATmega328 microcontroller based on Modified Harvard architecture is used in the system. Coding of the system has been done in Embedded ASSEMBLY language. 16X2 LCD display has been used which is connected to Arduino UNO. The temperature sensor senses the room temperature and it is displayed on the LCD. The simulation of the circuit is shown in Fig. 6. In this paper, the temperature is greater than 30 °C, the fan speed is increases and then temperature is greater than equal 60°C fan speed is highest.

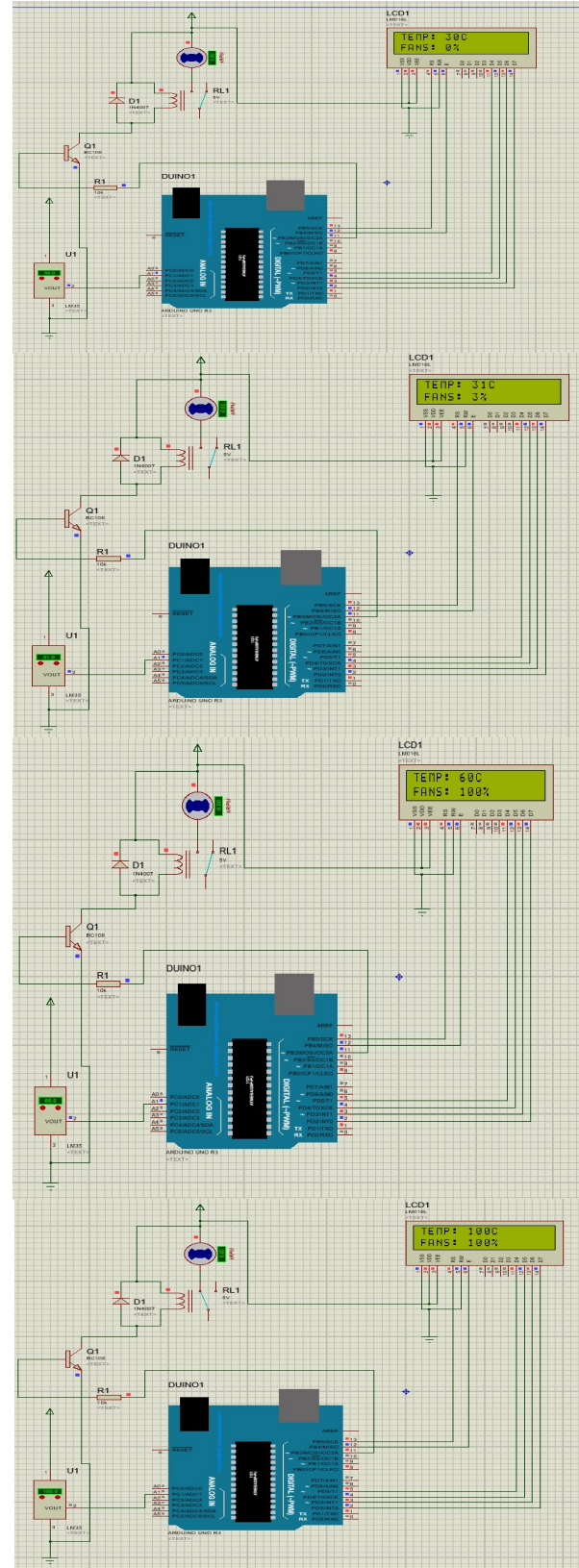


Fig.6 Proteus simulation circuit

II. CONCLUSIONS

In this paper, fan speed control has been designed using an Arduino as the heart of the system. To sense the temperature to be measured and LM35 sensor was employed. The measured temperature is then converted to digital format by an ADC located internally in the Arduino and displayed on an LCD. If the room temperature is grater than 30°C fan is start, then the speed of the fan will increase. If the room temperature is greater than or equal 60 °C speed of fan is 100%.As conclusion, the system which designed in this work was perform very well, for any temperature change and can be classified as automatic control.

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