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Design and Simulation of Fan Speed Control using Arduino UNO and LM35DZ

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ABSTRACT

This paper shots to attain automatic control solution is suggested to control the fan speed. Arduino micro controller is the heart of the circuit as it controls all the functions. The temperature sensor LM35DZ senses the temperature and converts it into an electrical signal, which is forwarded to the microcontroller. 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 quicker control and the LCD makes the system user-friendly. Sensed temperature and fan speed levels are concurrently shown on the LCD board.

Key Words: *Arduino UNO, ATMega8/168/328, LM35DZ, LCD, Relay.*

1. INTRODUCTION

Many researches focusing on automatic temperature control system application in different fields will gain the benefits. The temperature-based fan speed control system can be done by using an electronic circuit using an Arduino board. Now Arduino board is very advanced among all electronic circuits, thus we working Arduino board for fan speed control [3].

Fan can be controlled manually by demanding 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. 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 [4]. 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. 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.

2. THEORY BACKGROUND

Electronic 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. This project is based on Arduino UNO which communicates here with LM35**,** temperature sensor, 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 numbers in Celsius scale which is done by Arduino, third 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. 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.

2.1 Arduino UNO

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. The Uno contains a trace that can be cut to disable the auto-reset. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). 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) [2, 3].

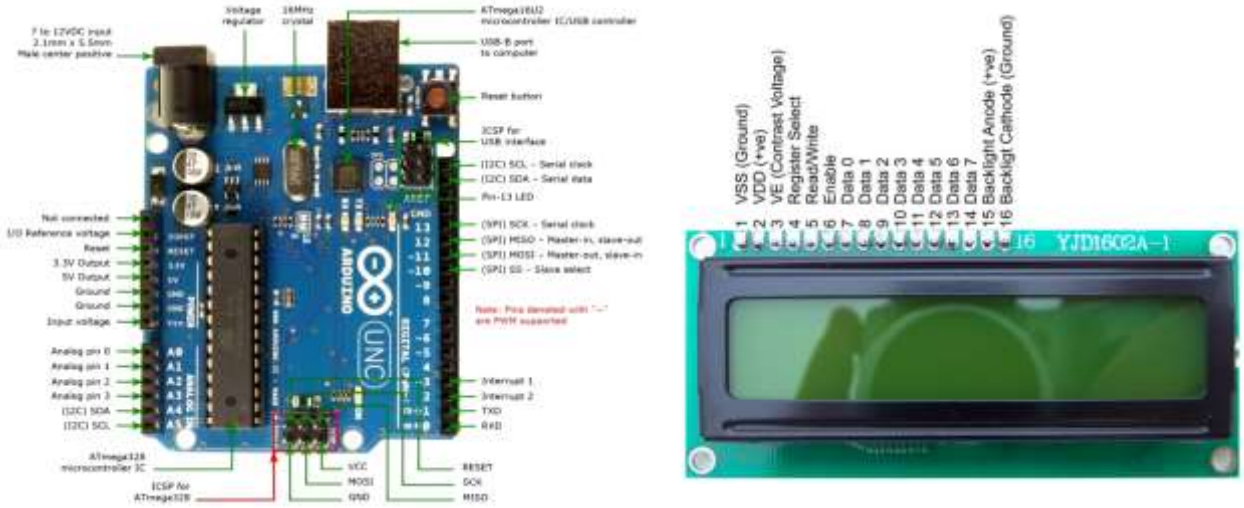

Figure 1: Arduino UNO and Liquid Crystal Display (LCD)

2.2 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. 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. LCD (Liquid Crystal Display) screen is an electronic display module and find and wide range of applications. These modules are preferred over seven segments and other multi segments LEDs. The alphanumeric LCD that we are going to interface is a 20 x 4 alphanumeric LCD. It means the LCD can display 20 characters in each row and it has four rows. It is a HD44780 controller based LCD. [6].

2.3 LM35 Temperature Sensor

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear 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. LM35 is a precession Integrated circuit Temperature sensor, whose output voltage varies, based on the temperature around it. It is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C. It can easily be interfaced with any Microcontroller that has ADC function or any development platform like Arduino.

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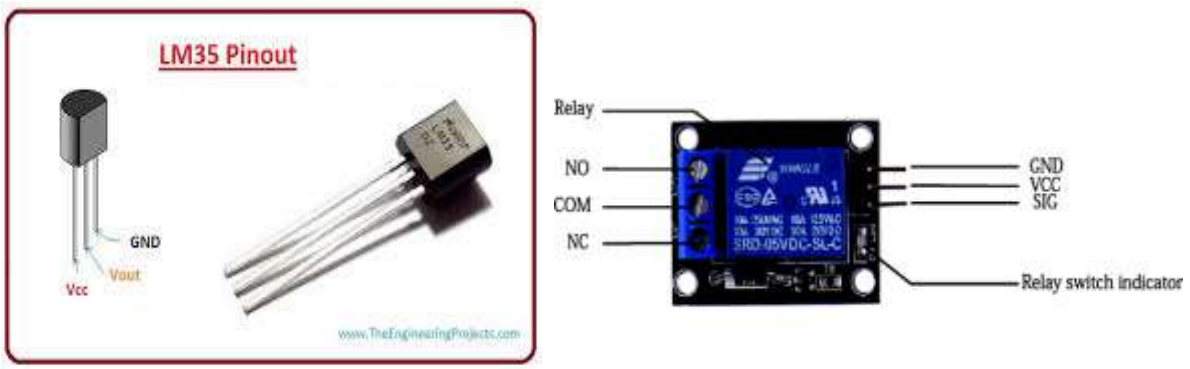

Figure 2: LM35DZ temperature sensor and Relay

2.4 Relay Module

Relays can control High Voltage electronic devices. The 5V Relay module has three high voltage terminals (NC, C, and NO) which connect to the device you want to control [8]. There are various types of mechanical relays (General-purpose Relays). A device designed to cause a sudden, predicted change in a single or multiple electrical output circuits when certain conditions are satisfied by the electrical input circuit that controls the relay device. The other side has three low voltage pins (GND (0V), VCC (+5V), and S(Signal)) which connect to the Arduino board**.** 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.

3. PROPOSED SYSTEM FOR FAN SPEED CONTROL

In this section, we have termed how to project Temperature Based Fan Speed Control with Arduino and LM35 Temperature Sensor. The microcontroller controls the speed of an electric fan according to the necessity & lets dynamic and faster control and the LCD makes the system easy. Sensed temperature in Celsius Measure and fan speed in percentage are concurrently displayed on the LCD panel. 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. All of these can be summarized in a diagram as shown in Figure 3.

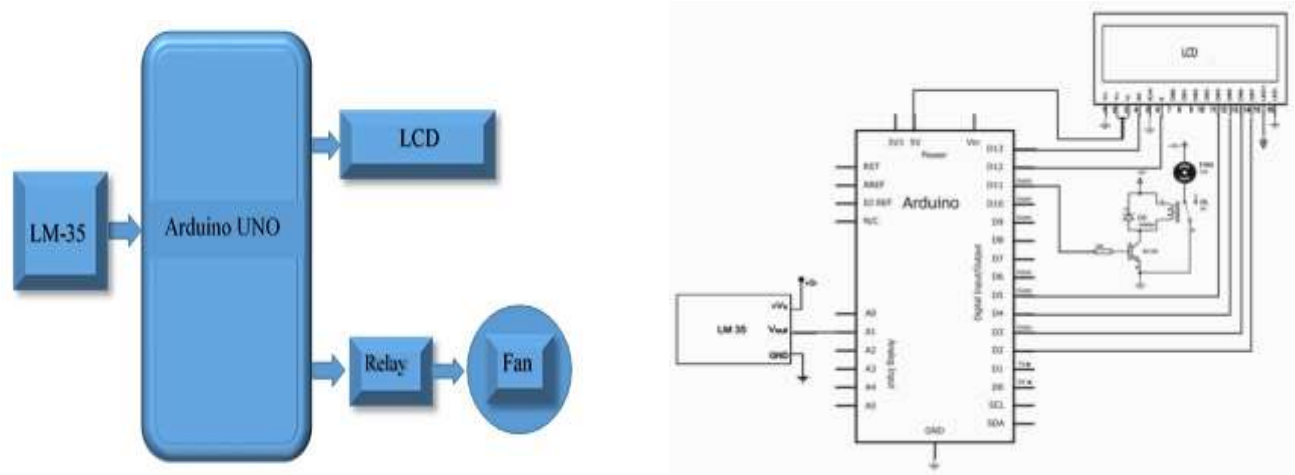

Figure 3: System Block Diagram of the Fan Speed Control and Circuit Diagram

3.1 Hardware Implementation Process

The schematic circuit diagram of fan speed control system shown in Figure 4. It is assembled around Arduino Uno board (Board1), 16×2 LCD (LCD1), temperature sensor LM35DZ and a few other modules. Temperature sensor LM35DZ senses the temperature.For processing analog signals, microcontroller has analog to digital converter which converts analog signals to digital ones. Sensed values of the temperature and speed of the fan are displayed on the LCD. All the operations are controlled by the

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

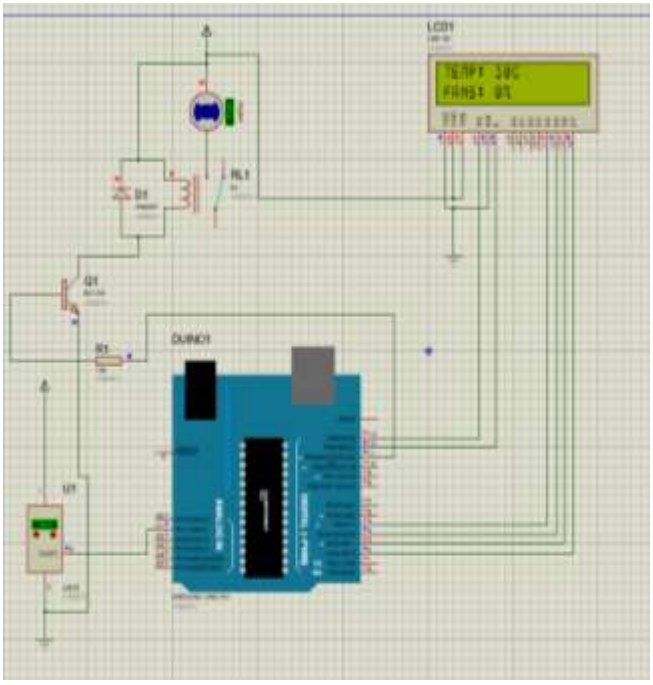
3.2 Software Procedure for Controlling the Whole System Function

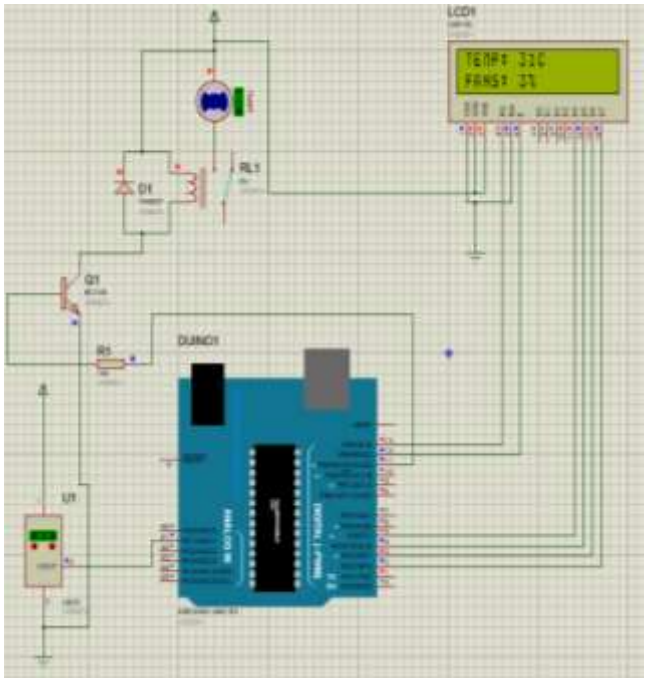
ARDUINO 1.8.4 the open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux [2, 3]. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. Refer to the Getting Started page for Installation instructions. 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).

4. DISCUSSION AND SIMULATION RESULTS

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.

The circuit presents the design, building, and control of automatic moving 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 system, 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.





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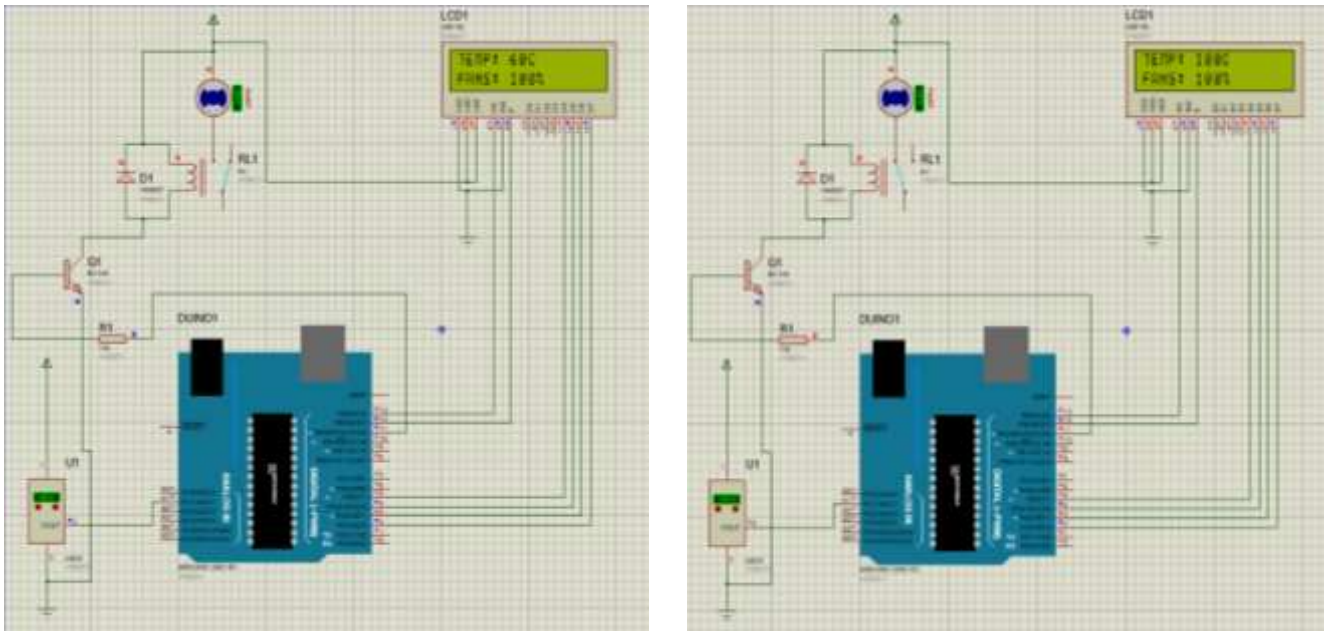

Figure 4: Simulation results using Proteus software

5. CONCLUSIONS

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. In this paper, fan speed control has been designed using an Arduino as the heart of the system. The fans are generally available with speed control, depending on the requirement the speed is set. 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%.Conclusion of this system designed in this work was perform very well, for any temperature change and can be classified as automatic control. The temperature-based fan speed control system can be done by using an electronic circuit using an Arduino board.

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