A

Project Report

ON

Implementation of Temperature Based FanSpeed Controller Using Arduino

Submitted to

Rajiv Gandhi University of Knowledge Technologies,

RK Valley, KADAPA.

in partial fulfillment of the requirements for the award of the Degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

Submitted by

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August – 2022.

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the project report entitled **"Implementation Of Temperature Based FanSpeed Controller Using Arduino "** a bonafide record of the project work done and submitted by

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

We hereby declare that the project report entitled "**Implementation of Temperature Based Fanspeed Controller using Arduino** " submitted to the Department of **ELECTRONICS AND COMMUNICATION ENGINEERING** in partial fulfillment of requirements for the award of the degree of **BACHELOR OF TECHNOLOGY.** This project is the result of our own effort and that it has not been submitted to any other University or Institution for the award of any degree or diploma other than specified above.

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ACKNOWLEDGEMENTS

We are thankful to our guide **Mr.B.Madhan Mohan** for his valuable guidance and encouragement. His helping attitude and suggestions have helped us in the successful completion of the project.

We would like to express our gratefulness and sincere thanks to **Mr.P.Janardhan Reddy**, Head of the Department of **ELECTRONICS AND COMMUNICATION ENGINEERING**, for his kind help and encouragement during the course of our study and in the successful completion of the project work.

We have great pleasure in expressing our hearty thanks to our beloved Director **Dr. SANDHYA RANI** for spending her valuable time with us to complete this project.

Successful completion of any project cannot be done without proper support and encouragement. We sincerely thanks to the Management for providing all the necessary facilities during the course of study.

We would like to thank our parents and friends, who have the greatest contributions in all our achievements, for the great care and blessings in making us successful in all our endeavors.

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ABSTRACT

This 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. 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 microcontroller 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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LIST OF ABSERVATION

BJT	BIPOLAR JUNCTION TRANSISTOR
PWM	PULSE WIDTH MODULATION
LED	LIGHT EMITTING DIODE
LCD	LIQUID CRYSTAL DISPLAY

1. INTRODUCTION

One of the major advancement in technology, intelligent systemsare 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 technologiesthat 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.

In the proposed systems, microcontroller plays a vital role in the smart systems development.Microcontrollers have becomean essential part in the present technologies that are being presented daily. This article discusses temperature based fan speed control and monitoring system using an Arduino system.This system is used to control the cooling system automatically based on the room temperature.The system uses an Arduino board to implement a control system. Since this system is proposed to control the cooling system and it is very important to know Arduino controlled system well.

2. COMPONENT DISCRIPTION

2.1.ARDUINO

2.1.1.What is Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino Boards are able to read inputs light on a sensor, a finger on a button etc and and turn it into an output - activating a motor, turning on an LED, Arduino Can be used in Offiline and online also.

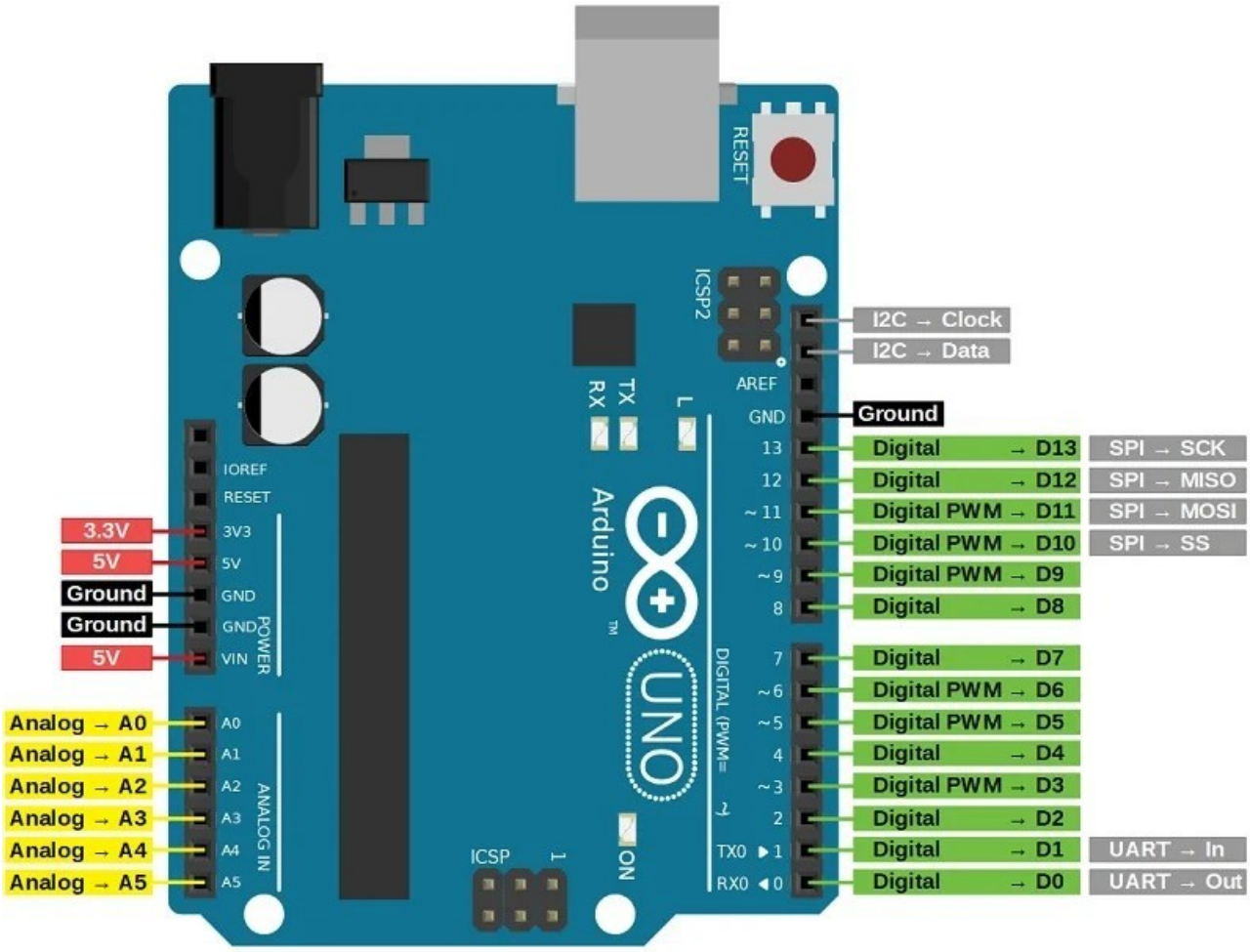
2.1.2.Why is Arduino

Inexpensive Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled hand, and even the pre-assembled Arduino modules cost less by than $50.

Cross-platform The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows. Simple, clear programming environment - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well.

Open source and extensible software - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries Open source and extensible hardware - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it.

2.1.3.Pin Description:(Arduino UNO)



Vin: This is the input voltage pin of the Arduino board used to provide input supply from an external power source.

5V: This pin of the Arduino board is used as a regulated power supply voltage and it is used to give supply to the board as well as onboard components.

3.3V This pin of the board is used to provide a supply of 3.3V which is generated from a voltage regulator on the board

GND: This pin of the board is used to ground the Arduino board.

Reset: This pin of the board is used to reset the microcontroller. It is used to Resets the microcontroller.

Analog Pins: The pins A0 to A5 are used as an analog input and it is in the range of 0-5V.

Digital Pins: The pins 0 to 13 are used as a digital input or output for the Arduino board.

Serial Pins: These pins are also known as a UART pin. It is used for communication between the Arduino board and a computer or other devices. The transmitter pin number 1 and receiver pin number 0 is used to transmit and receive the data resp.

External Interrupt Pins: This pin of the Arduino board is used to produce the External interrupt and it is done by pin numbers 2 and 3.

PWM Pins: This pins of the board is used to convert the digital signal into an analog by varying the width of the Pulse. The pin numbers 3,5,6,9,10 and 11 are used as a PWM pin.

SPI Pins: This is the Serial Peripheral Interface pin, it is used to maintain SPI communication with the help of the SPI library.

SPI pins include:

1.SS: Pin number 10 is used as a Slave Select

2.MOSI: Pin number 11 is used as a Master Out Slave In

3.MISO: Pin number 12 is used as a Master In Slave Out

4.SCK: Pin number 13 is used as a Serial Clock

LED Pin: The board has an inbuilt LED using digital pin-13. The LED glows only when the digital pin becomes high.

AREF Pin: This is an analog reference pin of the Arduino board. It is used to provide a reference voltage from an external power supply.

2.2.LM35 Temperature Sensor

2.2.1.What is Temperature Sensor

LM35 is a temperature sensor that outputs an analog signal which is proportional to the instantaneous temperature. The output voltage can easily be interpreted to obtain a temperature reading in Celsius. The advantage of lm35 over thermistor is it does not require any external calibration. The coating also protects it from self-heating.

2.2.2.LM35 Temperature Sensor Features

Linear at 10.0 mV/°C scale factor.

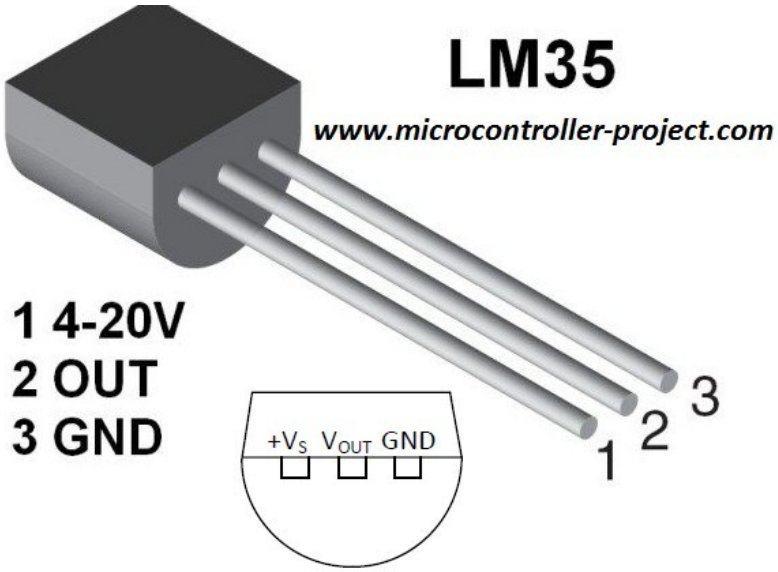
• 0.5°C accuracy guarantee-able (at a25°C)

• Rated for full -55°C to a 150°C range.

• Suitable for remote applications.

• Low cost due to wafer-level trimming.

• Operates from 4 to 30 volts.



2.2.3.Formula to convert voltage to temperature

Centigrade Temperature = Voltage Read by ADC / 10 mV(mills Volt).

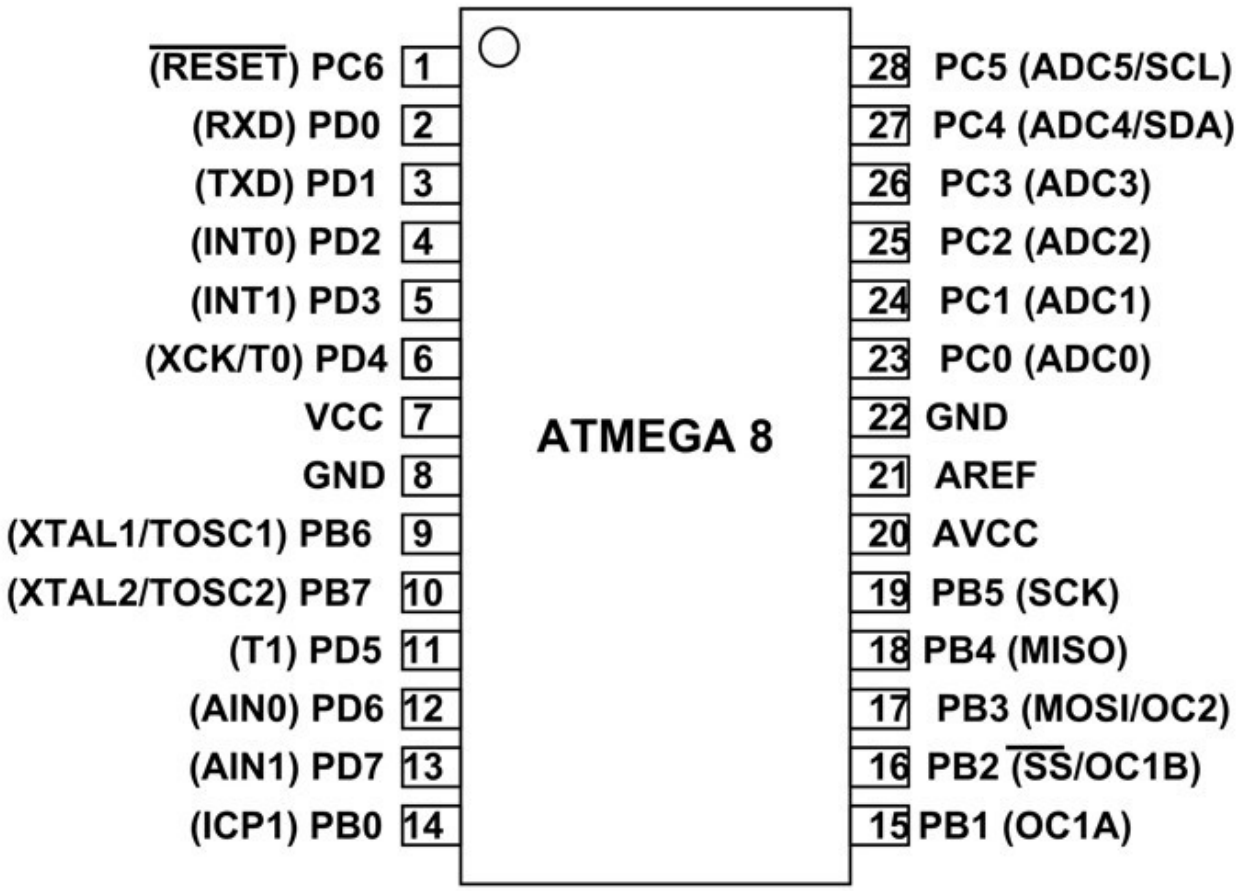
I divided by 10 mV because Linear scale factor is for LM35 is 10mV.

2.3.ATMega 328P Microcontroller

2.3.1.What is ATMega 328P Microcontroller

ATMega Microcontrollers belong to the AVR family of microcontrollers and is manufactured by Atmel Corporation. An ATMega Microcontroller is an 8-bit microcontroller with Reduced Instruction Set (RISC) based Harvard Architecture.

2.3.2.Pin Discription(ATMega 328P Microcontroller)



Pin -1 is the RST (Reset) pin and applying a low-level signal for a time longer than the minimum pulse length will produce a RESET.

Pin-4 and pin-5 are used as an external interrupt. One of them will activate when an interrupt flag bit of the status register is set and the other will activate as long as the intrude condition succeeds.

Pin-9 & pin-10 are used as a timer counters oscillators as well as an external oscillator where the crystal is associated directly with the two pins.

Pin-10 is used for low-frequency crystal oscillator or crystal oscillator. If the internal adjusted RC oscillator is used as the CLK source & the asynchronous timer is allowed, these pins can be utilized as a timer oscillator pin.

Pin-19 is used as a Master CLK o/p, slave CLK i/p for the SPI-channel.

Pin-18 is used as Master CLK i/p, slave CLK o/p.

Pin-17 is used as Master data o/p, slave data i/p for the SPI-channel. It is used as an i/p when empowered by a slave & is bidirectional when allowed by the master. This pin can also be utilized as an o/p compare with match o/p, which helps as an external o/p for the timer/counter.

Pin-16 is used as a slave choice i/p. It can also be used as a timer or counter1 comparatively by arranging the PB2-pin as an o/p.

Pin-15 can be used as an external o/p of the timer or counter compare match A.

Pin-23 to Pins28 have used for ADC (digital value of analog input) channels.

Pin-27 can also be used as a serial interface CLK & pin-28 can be used as a serial interface data

Pin-12 and pin-13 are used as an Analog Comparator i/ps.

Pin-6 and pin-11 are used as timer/counter sources.

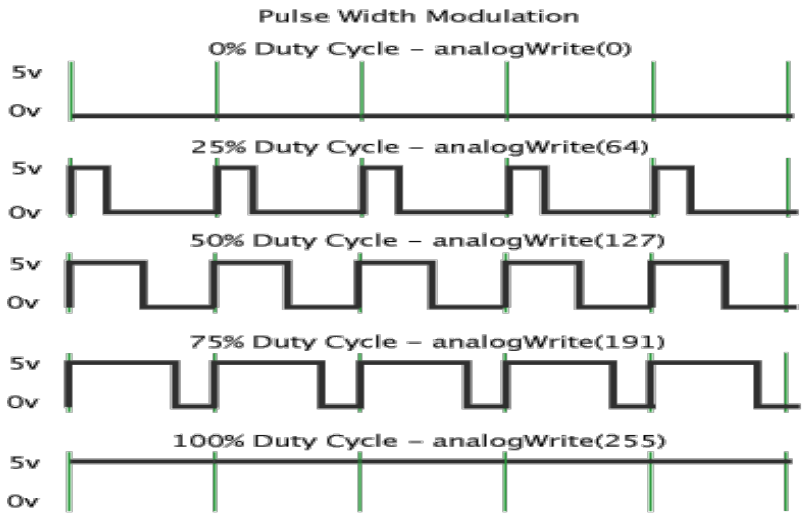
2.4.PWM(Pulse Width Modulation)

The Fading example demonstrates the use of analog output (PWM) to fade an LED. It is available in the File->Sketchbook->Examples->Analog menu of the Arduino software.

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 the full Vcc of the board (e.g., 5 V on Uno, 3.3 V on a MKR board) 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, you change, or modulate, that pulse width. If you 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 Vcc 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. In other words, with Arduino's PWM frequency at about 500Hz, the green lines would measure 2 milliseconds each. A call to analogWrite() is on a scale of 0 - 255, such that analogWrite(255) requests a 100% duty cycle (always on), and analogWrite(127) is a 50% duty cycle (on half the time)

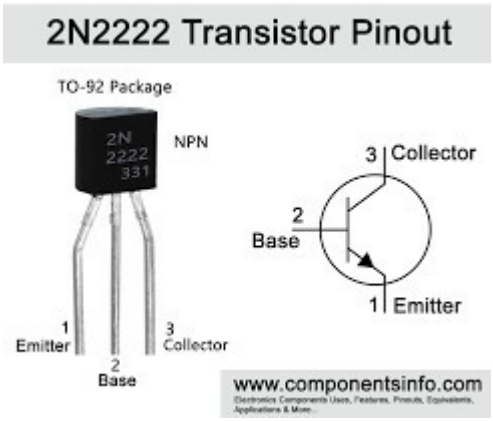
for example.



2.5.Transistor

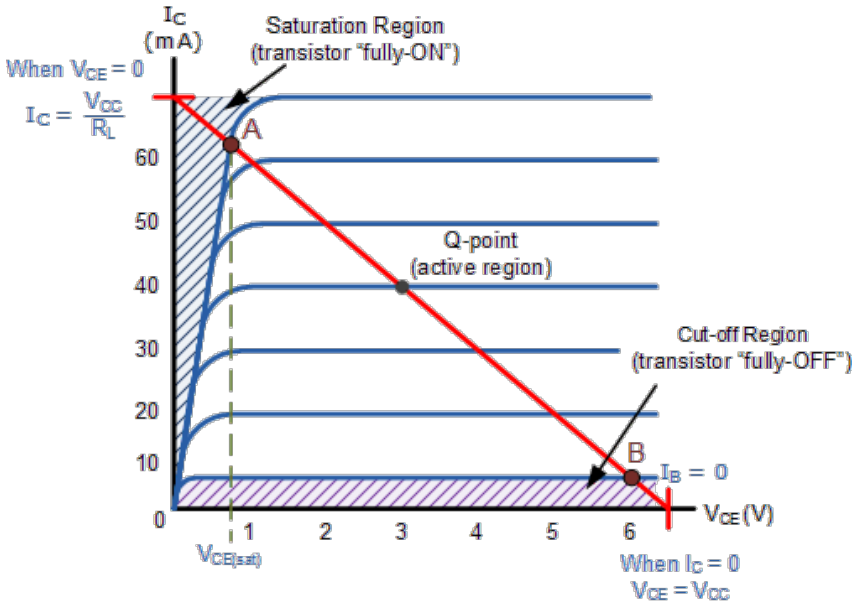
2.5.1.What Is Transistor

The 2N2222 is a common NPN bipolar junction transistor (BJT) used for general purpose low-power amplifying or switching applications. It is designed for low to medium current, low power, medium voltage, and can operate at moderately high speeds.



2.5.2.Regions Of Transistor

Where IC= collector current,IE = emitter current, and IB = base current.



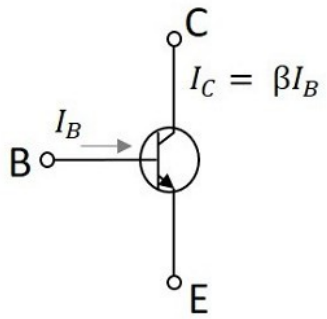
Active region This is the region in which transistors have many applications. This is also called as linear region. A transistor while in this region, acts better as an Amplifier. This region lies between saturation and cutoff. The transistor operates in active region when the emitter junction is forward biased and collector junction is reverse biased. In the active state, collector current is β times the base current, i.e.,

IC=βIB

IC = collector current

β = current amplification factor

IB = base current

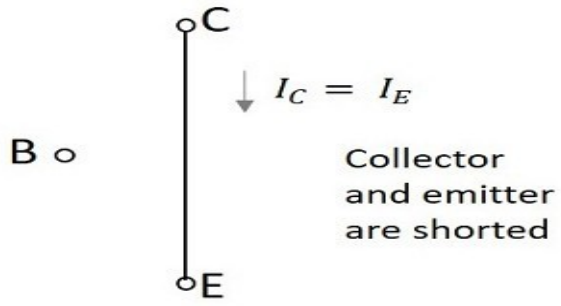


In Active region

Saturation Region This is the region in which transistor tends to behave as a closed switch. The transistor has the effect of its collector and Emitter being shorted. The collector and Emitter currents are maximum in this mode of operation.

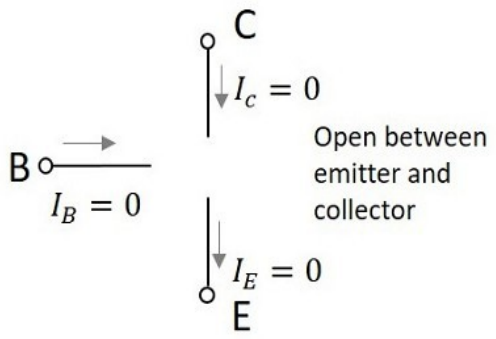
IC=IE

IC= collector current andIE= emitter current.



In Saturated region

Cutoff Region This is the region in which transistor tends to behave as an open switch. The transistor has the effect of its collector and base being opened. The collector, emitter and base currents are all zero in this mode of operation.The transistor operates in cutoff region when both the emitter and collector junctions are reverse biased. As in cutoff region, the collector current, emitter current and base currents are nil, we can write as



In Cutoff region

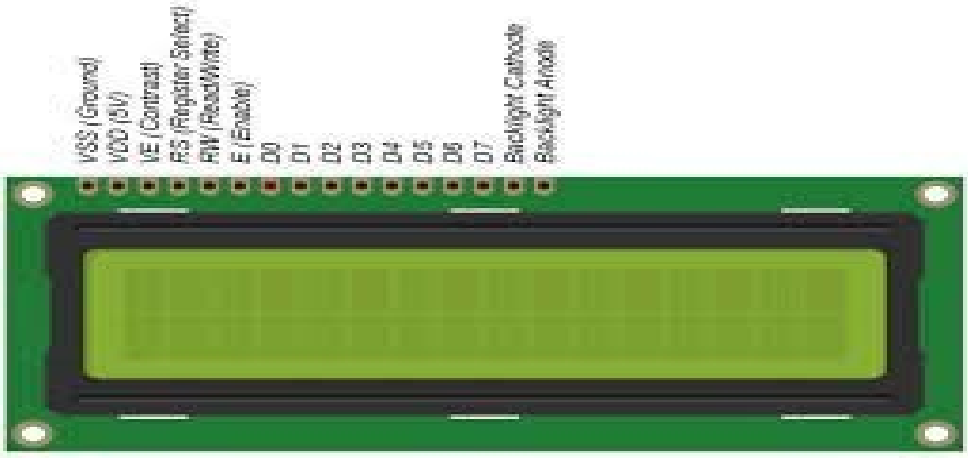
IC=IE=IB=0

2.6.LCD(Liquid Crystal Display)

2.6.1.What is LCD(Liquid Crystal Display)

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

2.6.2.LCD 16*2 PIN Discription



The 16×2 LCD pinout is shown below.

•**Pin1 (Ground/Source Pin):** This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.

•**Pin2 (VCC/Source Pin):** This is the voltage supply pin of the display, used to connect the supply pin of the power source.

•**Pin3 (V0/VEE/Control Pin):** This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.

•**Pin4 (Register Select/Control Pin):** This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).

•**Pin5 (Read/Write/Control Pin):** This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).

•**Pin 6 (Enable/Control Pin):** This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.

•**Pins 7-14 (Data Pins):** These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.

•**Pin15 (+ve pin of the LED):** This pin is connected to +5V

•**Pin 16 (-ve pin of the LED):** This pin is connected to GND.

2.7.Buzzer

2.7.1What Is Buzzer

An audio signaling device like a beeper or buzzer may be electromechanical or peizoelectric or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.

2.7.2.Buzzer Specifications

The frequency range is 3,300Hz

•Operating Temperature ranges from – 20° C to +60°C

•Operating voltage ranges from 3V to 24V DC

•The sound pressure level is 85dBA or 10cm

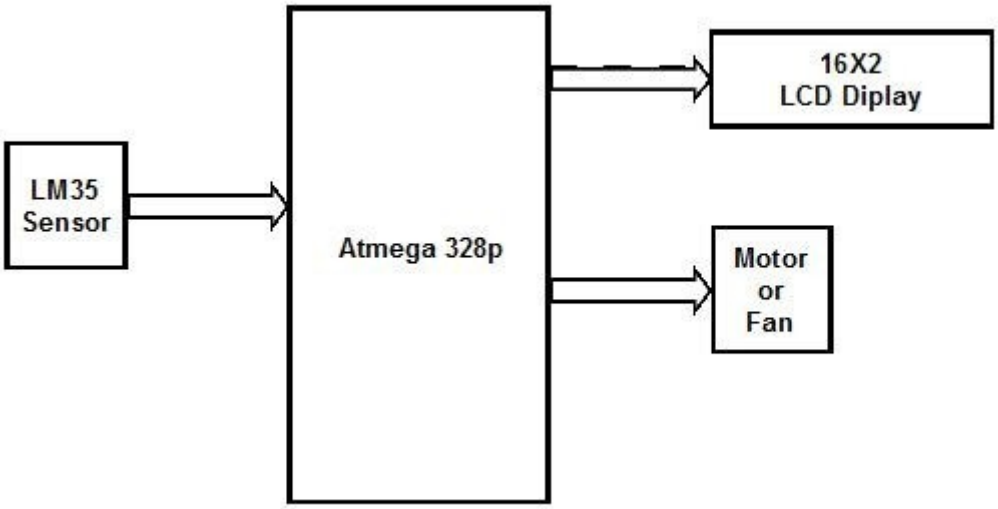
•The supply current is below 15mA

2.8.LED(Light Emitting Diode)

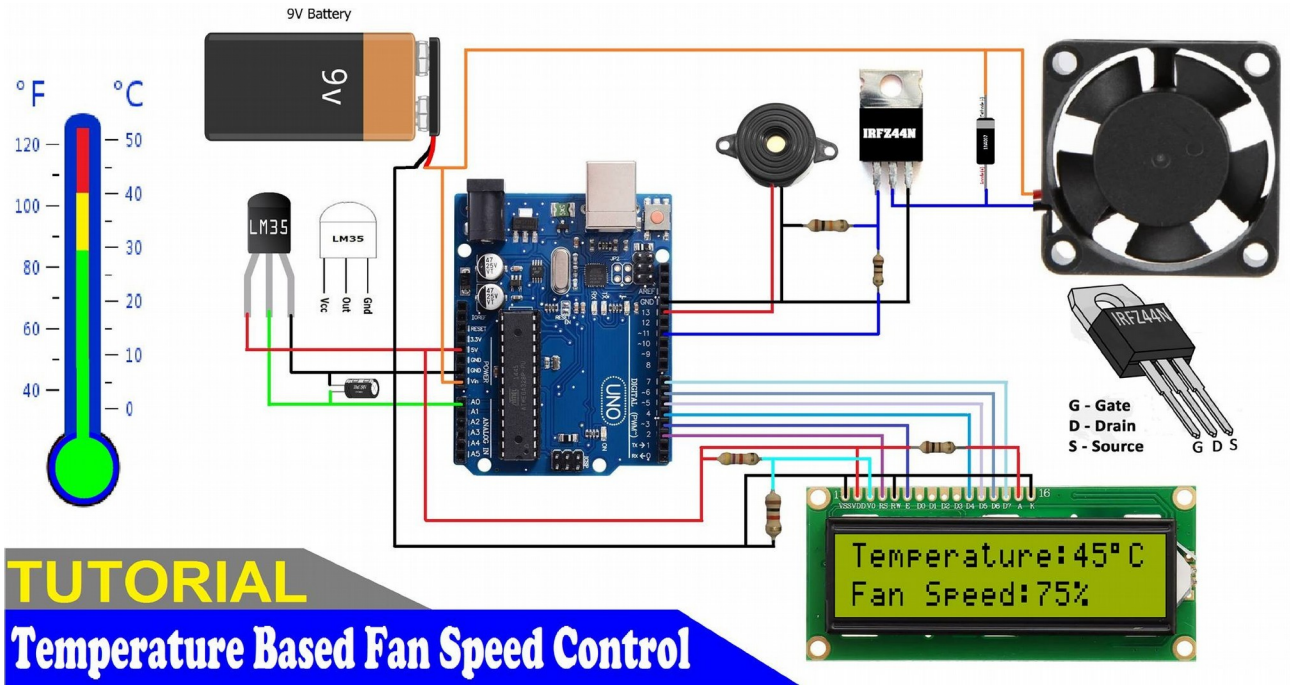
2.8.1.What Is LED(Light Emitting Diode)

Infrared Transmitter is a light emitting diode (LED) which emits infrared radiations called as IR LED's. Even though an IR LED looks like a normal LED, the radiation emitted by it is invisible to the human eye.

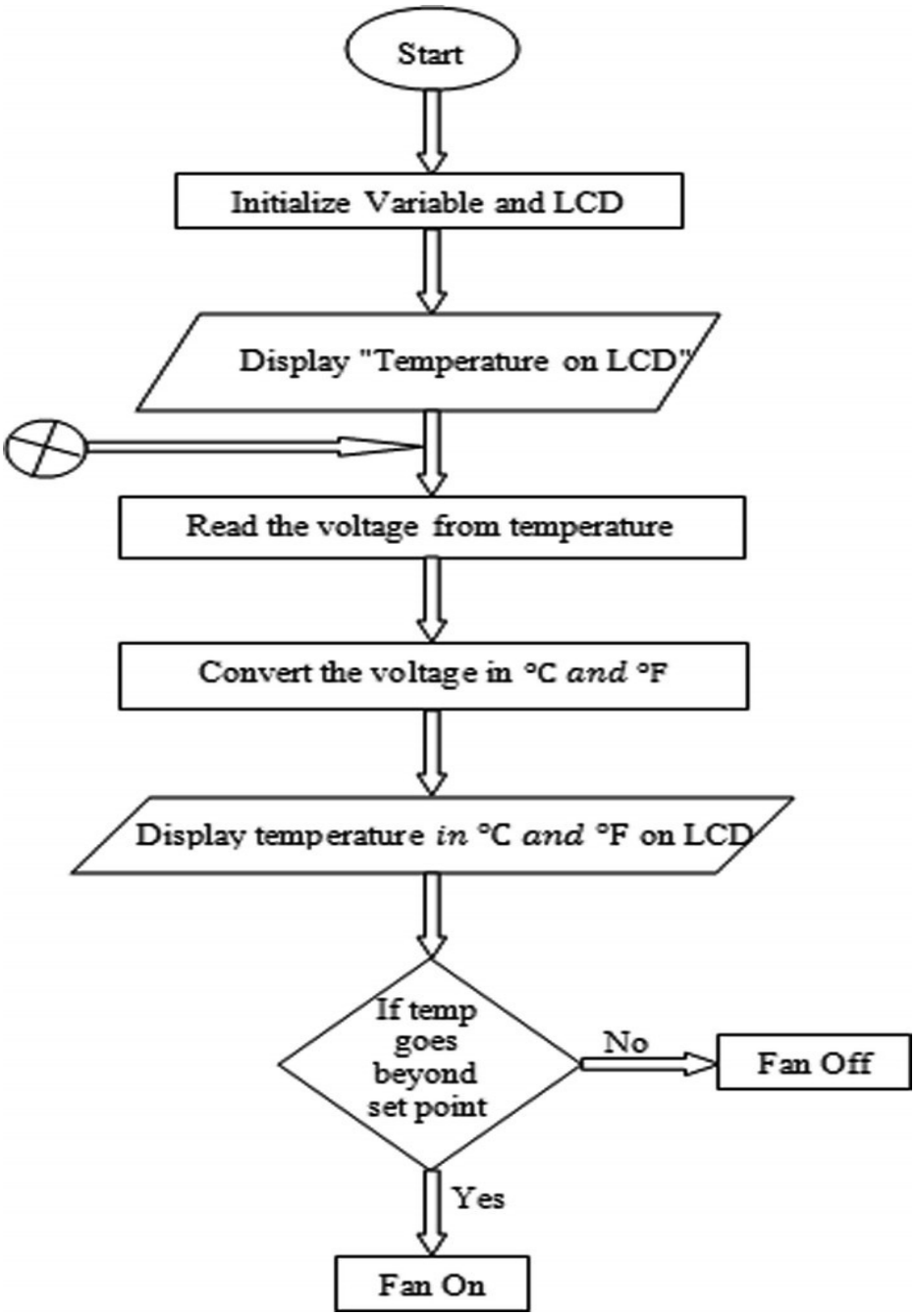
3.BLOCK DIAGRAM



4.CIRCUIT DIAGRAM



5.FLOW CHART


Start
Initialize Variable and LCD
Display "Temperature on LCD"
Read the voltage from temperature
Convert the voltage in °C and °F
Display temperature in °C and °F on LCD
If temp goes beyond set point
No
Fan Off
Yes
Fan On

6.WORKING PROCESS

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 LiquidCrystal library (header) that includes useful functions touse 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 andtemp Max is the temperaturewhen the red led lights warning you that the maximum temp was reached. For example if you set tempMin at 30 and tempMax 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 tempMin and if so let temperature the is fan OFF higher (LOW). Than the The next if() is minTemp and to lower check than if the tempMax and if so then use the map() function to re-map the tempvalue from one value to another. In our case fanSpeed will have a value of 32 at tempMin and 255 at tempMax. These values are 27Temperature based fan speed controller 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 fanSpeed 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 tempMax the fan will be at its maximum spinning velocity and the LCD will display FANS: 100% even though the temperature might increase above tempMax. The rest of the explanation can be read in the comments area of the Arduino sketch.In the next project I will make a temperature protection circuit that will turn off the power of equipment when its temperature has reached a certain value .

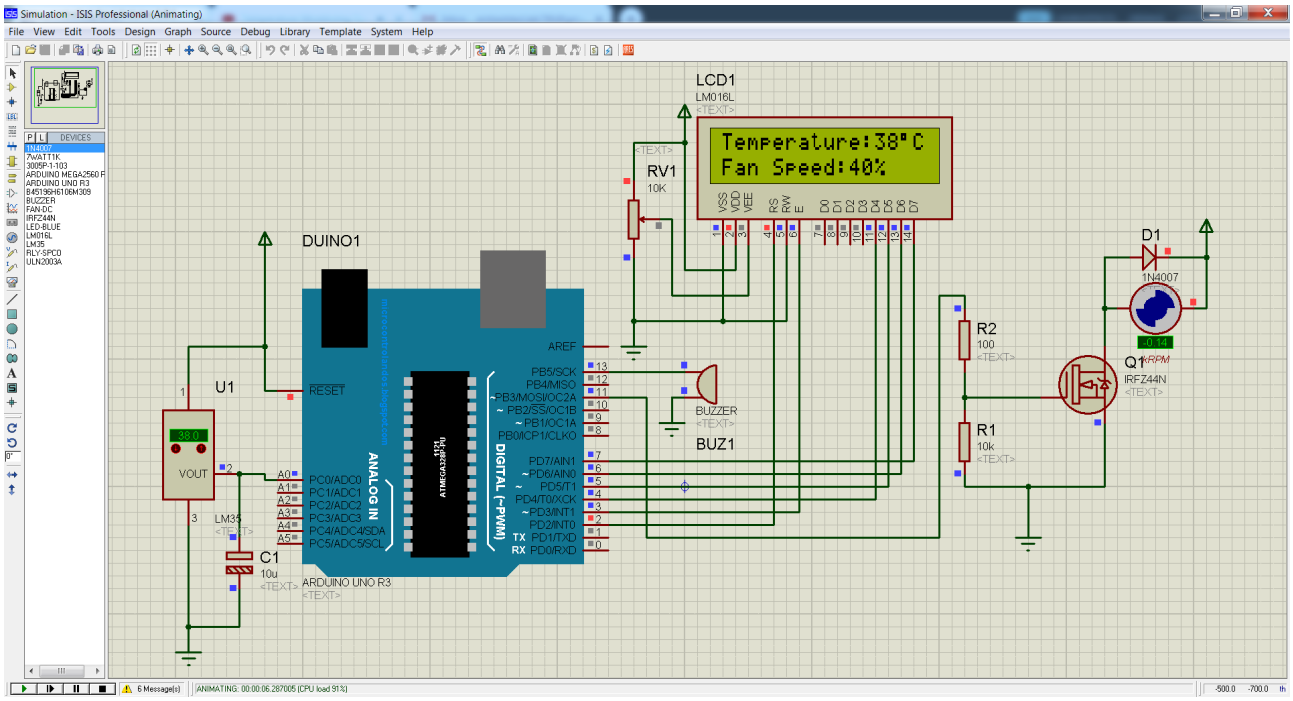
7.FIRMWARE(DESIGNING CODE)

```
#include <LiquidCrystal.h>

LiquidCrystal lcd(2,3,4,5,6,7);

int tempPin = A0; // the output pin of LM35

int fan = 11;

int buzzer = 13;

// the pin where fan is

// buzzer pin

int temp;

int tempMin = 30; // the temperature to start the fan

int tempMax = 50; // the maximum temperature when fan is at 100%

int fanSpeed;

int fanLCD;

void setup() {

pinMode(fan, OUTPUT);

pinMode(buzzer, OUTPUT);

pinMode(tempPin, INPUT);

lcd.begin(16,2);

lcd.setCursor(0,0);

lcd.print(" WELCOME To My ");
```

```
lcd.setCursor(0,1);

lcd.print("Channel YouTube");

delay(2000);

lcd.clear();

}

void loop() {

temp = readTemp();

// get the temperature

if((temp >= tempMin) && (temp <= tempMax)) { // if temperature is higher than

minimum temp

fanSpeed = map(temp, tempMin, tempMax, 32, 255); // the actual speed of fan

fanLCD = map(temp, tempMin, tempMax, 0, 100); // speed of fan to display on

LCD

analogWrite(fan, fanSpeed); // spin the fan at the fanSpeed speed

}

if(temp < tempMin) { // if temp is lower than minimum temp

fanSpeed = 0;

// fan is not spinning

fanLCD = 0;

digitalWrite(fan, LOW);}
```

```
if(temp > tempMax) {
// if temp is higher than tempMax
digitalWrite(fan, HIGH);
digitalWrite(buzzer, HIGH); // turn on buzzer
} else {
// else turn of bubber
digitalWrite(buzzer, LOW);}
lcd.setCursor(0,0);
lcd.print("Temperature:");
lcd.print(temp); // display the temperature
lcd.write(223);
lcd.print("C ");
lcd.setCursor(0,1); // move cursor to next line
lcd.print("Fan Speed:");
lcd.print(fanLCD); // display the fan speed
lcd.print("% ");
delay(200);}
int readTemp() { // get the temperature and convert it to celsius
temp = analogRead(tempPin);
return temp * 0.48828125;}
```

8.HARDWARE(SIMULATION)



9.CONCLUSION

Arduino based temperature controlled fan is implemented. Thus the fan speed is controlled by using PWM(pulse) width modulation) and arduino board according to the temperature sensed by the help of temperature. The speed of the fan depends on the temperature and there is no need for regulating the fan speed manually again and again.