NEW HORIZON
COLLEGE OF ENGINEERING
New Horizon Knowledge Park, Ring Road, Marathalli
Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC
Accredited by NAAC with 'A' Grade, Accredited by NBA

MINI PROJECT REPORT ON

"TEMPERATURE BASED FAN CONTROL SYSTEM"

SUBMITTED BY:

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CERTIFICATE

Certified that the mini project work entitled **"Temperature Based Fan Control System "carried** out by **Anant Krishna (1NH17EE003), Jaydeep Maity (1NH17EE022)** and **Sangam Jain (1NH17EE050),** bonafide students of Electrical and Electronics Department, New Horizon College of Engineering, Bangalore.

The mini project report has been approved as it satisfies the academic requirements in respect of mini project work prescribed for the said degree.

Signature of HOD Dr. Ram Kumar S Professor and HOD, Dept of EEE, NHCE	Signature of Guide Mr. Vinod Kumar S Senior Asst. Professor Dept of EEE, NHCE

External Viva

Name of Examiner   Signature with Date

1.

2.

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) 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, 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.

ACKNOWLEDGEMENT

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We would like to express our deep and sincere gratitude to our project supervisor, Mr. Vinod Kumar S, Senior Assistant professor of EEE department, New Horizon College of Engineering for giving us the opportunity to do the project and providing invaluable guidance throughout this project. His dynamism, vision, sincerity and motivation have deeply inspired us.

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We are extremely grateful to our parents for their love, prayers, caring and sacrifices for educating and preparing us for our future.

We are thankful to our friends and staffs of EEE department who helped us directly or indirectly in this project.

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LIST OF ABBREVIATIONS

CPU: Central Processing Unit
ADC: Analog Digital Converter
LCD: Liquid Crystal Display
IOT: Internet of Things
LED: Light Emitting Diode
RPM: Revolutions Per Minute
PWD: Pulse Width Modulation
PCB: Printed Circuit Board

PLAG REPORT

TEMPERATURE BASED FAN CONTROL SYSTEM

ORIGINALITY REPORT

10%	%	10%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Tasneem Sanjana, Ferdus Wahid, Mehrab Masayeed Habib, Ahmed Amin Rumel. "Design of an Automatic Forward and Back Collision Avoidance System for Automobiles", Advances in Science, Technology and Engineering Systems Journal, 2018 Publication	3%
2	Tianhong Pan, Yi Zhu. "Designing Embedded Systems with Arduino", Springer Science and Business Media LLC, 2018 Publication	2%
3	Omveer Singh, Tushar Singh Sisodia. "Solar LED street light system with automatic scheme", 2017 International Conference on Energy,	2%

CHAPTER 1

1.INTRODUCTION

With the advancement in technology, intelligent systems are introduced each day. Everything is getting more sophisticated and intelligible. There is a rise within the demand of vanguard technology and smart electronic systems. Microcontrollers play a very important role within the event of the smart systems as brain is given to the system. Microcontrollers became the middle of the new technologies that are being introduced daily. A microcontroller is particularly one chip microprocessor fitted to regulate and automation of machines and processes. Today, microcontrollers are utilized in many disciplines of life for completing automated tasks during a more accurate manner. Almost every modern-day device including air conditioners, power tools, office machines employ microcontrollers for his or her operation. Microcontroller essentially consists of Central Processing Unit (CPU), timers and counters, interrupts, memory, input/output ports, analog to digital converters (ADC) on one chip. With this single chip microcircuit design of the microcontroller the size of instrument panel is reduced and power consumption is low. This project presents the design and simulation of the fan speed system using PWM technique supported the space temperature. A temperature sensor has been used to measure the temperature of the space and thus the speed of the fan is varied according to the space temperature using PWM technique. The duty cycle is varied from 0 to 100 to manage the fan speed depending upon the space temperature, which is displayed on LCD. This project could also be a standalone automatic fan speed controller that controls the speed of an electrical fan according to our requirement. The temperature sensor LM35 senses the temperature which converts it into an electrical signal and is applied to the microcontroller. The sensed temperature and set values of the temperature are displayed on the 16x2-line LCD. The micro controller drives transistor to manage the fan speed. This project uses regulated 12V, 2A power supply. This project is beneficial in process industries for maintenance and controlling of Boilers temperature.

CHAPTER 2

2.1 SCOPE OF THE PROJECT

The main aim of this project is, automatic fan speed controller that controls the speed of an electrical fan according to our requirement with the use of temperature sensor LM35, Arduino and LCD display. The future scope of this project are as follows:

I. We can monitor more parameters like humidity, light and at an equivalent time control them.
II. We can send this data to a foreign location using mobile or internet.
III. We can sketch graphs of variations in these parameters using computer.
IV. When temperature exceeds the limit, a call is to be dialled to the respective given number by an automatic Dialler system.

2.2 OBJECTIVE

Objectives are the goals that our project wants to achieve. The objectives for our project are as follows:

I. To automize the fan speed according to the temperature of the room.
II. To reduce the human effort.
III. To understand the working of Arduino UNO.
IV. To understand the process of IOT and Home Automation.

I. CHAPTER 3

3. TOOLS REQUIRED

We designed the circuit using following components. And the description about each component is explained below.

I. LED
II. Arduino UNO
III. LM35 Temperature Sensor
IV. 2N2222 Transistor
V. 16X2 LCD
VI. 12V DC Fan
VII. 1K Resistor
VIII. 1N4007 Diode
IX. 10uF Electrolytic Capacitor
X. 12 Volt Battery/ Adapter
XI. Breadboard
XII. Jumper Wires

3.1 LED’s

Fig (1): LED

A light emitting diode (LED) may be a 2 lead semi-conductor source of illumination. It is a contact diode that emits light-weight once activated. When an acceptable current is applied to the leads, electrons are able to recombine with the electron holes inside the device, releasing energy within the variety of the photons. This effect is called electroluminescence, and the color light is determined by the energy band gap of the semi-conductors.

3.2 ARDUINO UNO (ATmega328)

Fig (2): Arduino UNO

The Arduino UNO is a microcontroller board supporting the ATmega328. It has twenty digital input/output pins (of that half-dozen may be used as PWM outputs and half-dozen may be used as analog inputs), a sixteen-rate resonator, a USB connection, an influence jack, AN in-circuit system programming (ICSP) header, and a push. It contains all things required to support the microcontroller; merely connect it to a laptop and other devices with a USB cable or power it with a AC-to-DC adapter or battery to urge started. The ATmega328 provides UART TTL (5V) serial communication, that is obtainable on digital pins zero (RX) and one (TX). The hardware reference style is distributed below an imaginative Commons Attribution Share-Alike a pair of.5 license and is obtainable on the Arduino web site. Programs may be loaded on to that from the easy-to-use Arduino bug. The Arduino has an intensive support community, that makes it awfully simple thanks to start operating with embedded natural philosophy. The R3 is that the third, and latest, revision of the Arduino UNO.

SPECIFICATIONS:

Operating Voltage: 5V

Input Voltage (recommended): 7-12V

Input Voltage (limits): 6-20V

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: Bootloader SRAM :2 KB EEPROM :1 KB Clock Speed :16 MHz

3.3 LM35

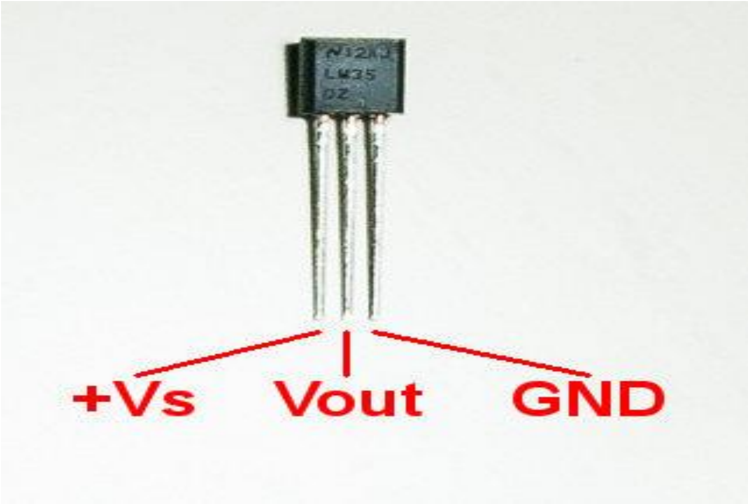


Fig (3): LM35

LM 35 may be a precision temperature sensor whose output is linearly proportional to Celsius Temperature. LM35, temperature measuring device having an analog output voltage proportional to the temperature. The LM35 is rated to work from -55° Centigrade to 150° Centigrade with a linear multiplier of +10mv/° C. LM35 gives temperature output which is more accurate than thermistor output.

FEATURES:

I. Calibrated directly in degree Celsius (centigrade)
II. Linear +10.0 mV/ degree Celsius
III. 0.5-degree Celsius accuracy (at +25degree Celsius)
IV. Rated for full -55 to +150-degree Celsius range
V. Suitable for remote applications
VI. Low cost due to wafer-level trimming
VII. Operates from 4 to 30 volts
VIII. Less than 60 Micro ampere current drains
IX. Low self-heating, 0.08 degree Celsius in still air
X. Nonlinearity only +/- 1/4 degree Celsius typical
XI. Low impedance output, 0.1 Ohm for 1mA load

3.4 2N2222 TRANSISTOR

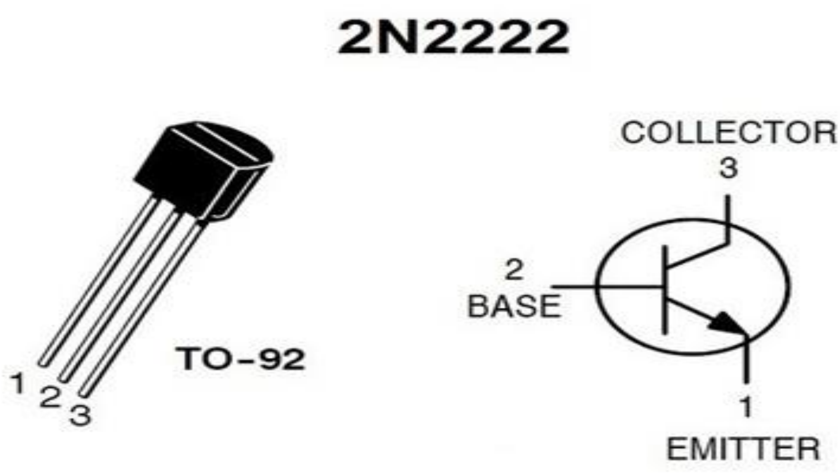


Fig (4): 2N2222 Transistor

2N2222A can be called, NPN transistor hence the collector and emitter are going to be left open (Reverse biased) when the bottom pin is held at ground and can be closed (Forward biased) when a sign is provided to base pin. 2N2222A features a gain value of 110 to 800, this value determines the amplification capacity of the transistor. the utmost amount of current that would flow through the Collector pin is 800mA, hence we cannot connect loads that consume quite 800mA using this transistor. To bias a transistor, we've to provide current to base pin, this current (IB) should be limited to 5mA. When the transistor is fully biased then it can allow a maximum of 800mA to flow across the collector and emitter. This stage is named Saturation Region and therefore the typical voltage allowed across the Collector-Emitter (V-CE) or Base-Emitter (VBE) might be 200 and 900 mV respectively. When base current is removed the transistor becomes fully off, this stage is named because the Cut-off Region and therefore the Base Emitter voltage might be around 660 mV.

APPLICATIONS

I. Can be used to switch high current (up to 800mA) loads.
II. Can also be used in the various switching applications.
III. Speed control of Motors.
IV. Inverter and other rectifier circuits.
V. Can be used in Darlington Pair.

3.5 16X2 LCD

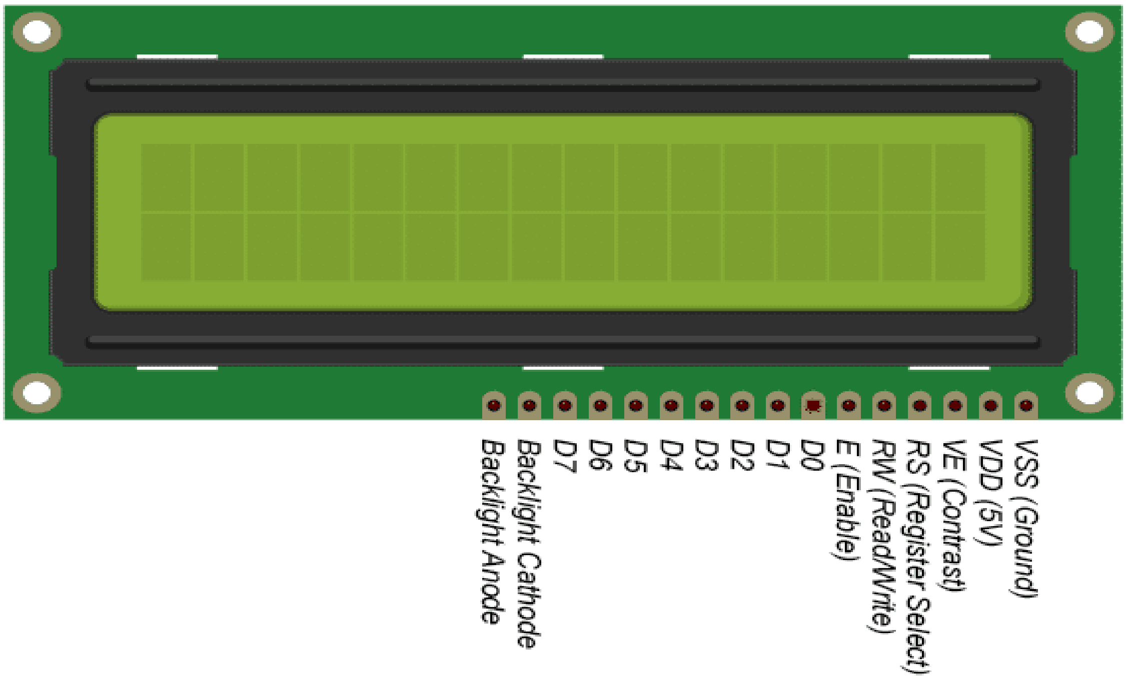


Fig (5): 16X2 LCD

The LCD may be a matrix liquid display that displays alphanumeric characters and symbols. 16 X 2 LCD alphanumeric display has been utilized in the system to point out the space temperature. Liquid Crystal monitor is an electronic display module and find a wide range of applications. A 16 X 2 LCD display is very basic module and is extremely commonly utilized in various devices and circuits. These modules are highly preferable over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; not having any limitation of displaying unique & even custom characters (unlike in seven segments), animations then on. A 16 X 2 LCD implies it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5 X 7-pixel matrices. This LCD contains two registers, namely, Command and Data. The command register holds the command instructions given to the LCD. A command is an instruction given to LCD to try to a present task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the info to be displayed on the LCD. The data is the ASCII value of the alphabet to be displayed on the LCD.

3.6 12V DC FAN

Fig (6): 12V DC Fan

SPECIFICATION:

I. Size: 3 × 3-inch (80 x 80 x 25mm)
II. DC: 12V 0.20A.
III. Speed: 3000 RPM
IV. Blades: 7 blade cooling fans.
V. Very less noise
VI. Material: hard plastic.
VII. Colour: black.
VIII. Higher quality PCB FR4 Grade with FPT Certified.

3.7 1K RESISTOR

Fig (7): Resistor

A resistor is a passive two-terminal electrical components that implements electrical resistance as a circuit element. In physics circuits, resistors area unit accustomed scale back current flow, adjusting signal levels, to divide voltage, bias active elements and terminate transmission lines. High power resistors that may dissipate several watts of wattage as heat, is also used as a part of motor controls, in power distribution systems, or as take a look at load for generators.

3.8 1N4007 DIODE

Fig (8): 1N4007 Diode

A diode may be a device which allows current flow through just one direction. That is the present should be due the Anode to cathode. The cathode terminal are often identified by employing a grey bar as shown within the picture above. For 1N4007 Diode, the utmost current carrying capacity is 1A it withstands peaks up to 30A. Hence, we can use this in circuits that are designed for less than 1A. The reverse current is 5uA which is negligible. The power dissipation of this diode is 3W.

FEATURES:

I. The average forward current is 1A.
II. The non-repetitive Peak current is 30A.
III. The reverse current is 5uA.
IV. The Peak repetitive Reverse voltage is 1000V.
V. The Power dissipation is 3W.
VI. It is available in DO-41 Package.

APPLICATIONS:

I. It can be used to prevent reverse polarity problem.
II. It can be used as Half Wave and Full Wave rectifiers.
III. It can be used as a protection device.
IV. It can be used as current flow regulators.

3.9 10uF ELECTROLYTIC CAPACITOR

Fig (9): 10uF Electrolytic Capacitor

A capacitor can be called as a passive electronic component that stores energy within the sort of an electric field. In its simplest form, a capacitor consists of two conducting plates separated by an insulant called the dielectric. The capacitance is directly proportional to the surface areas of the plates, and is inversely proportional to the separation between the plates. Capacitance also depends on the dielectric constant of the substance separating the plates within.

3.10 BATTERY

Fig (10): Battery

When A battery is supplying electrical power, its positive terminal is that the cathode and its negative terminal is that the anode. A twelve-volt battery has six single cells serial producing a totally charged output voltage of 12.6 volts. A battery cell has two lead plates a positive plate covered with a mixture of lead dioxide and a negative made from sponge lead, with an insulant (separator) in between. This is the rationale lead acid batteries are called storage batteries, because they only store a charge. The size of the battery plates and amount of electrolyte determines the quantity of charge lead acid batteries can store.

3.11 BREADBOARD

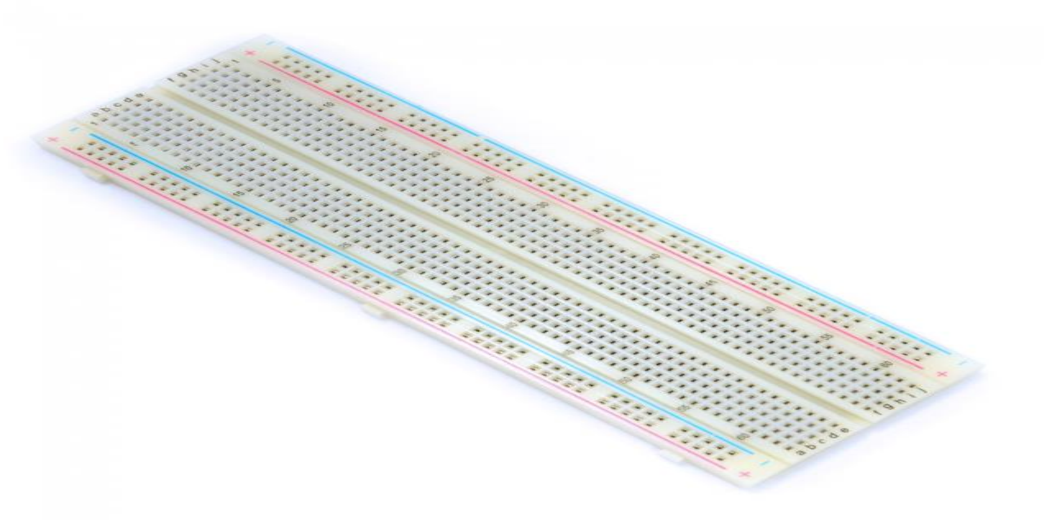


Fig (11): Breadboard

Breadboard is a solderless device for temporary connection of all electronic components and circuits. Most complex electronics components can be interconnected using breadboard including integrated circuit and board has strip of metal which connect holes in the top. It is easy to use and it is easy to create temporary circuit in it. This type breadboard is designed in 1970 AD.

3.12 JUMPER WIRES

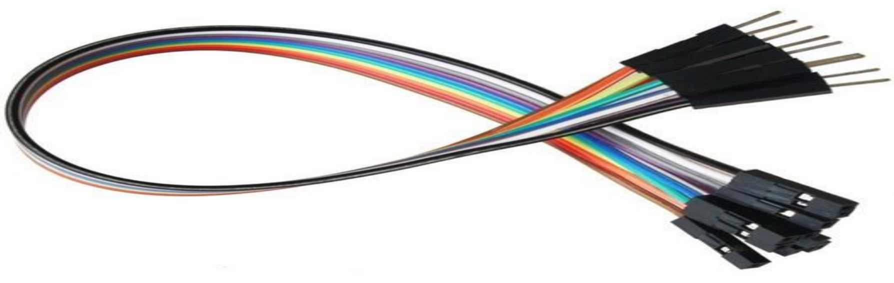


Fig (12): Jumper Wires

Jumper wires are simply wiring that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are generally used with breadboards and different prototyping tools so as to form it simple to vary a circuit as required.

CHAPTER 4

4.1 CIRCUIT DIAGRAM

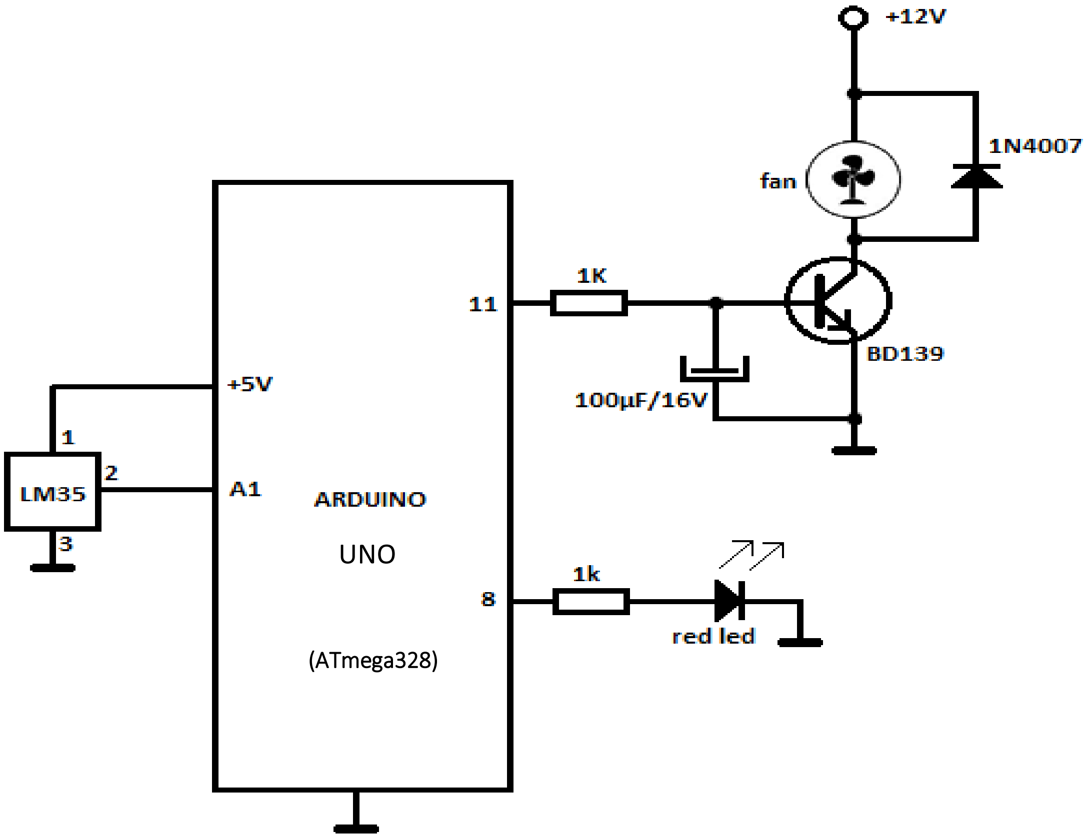


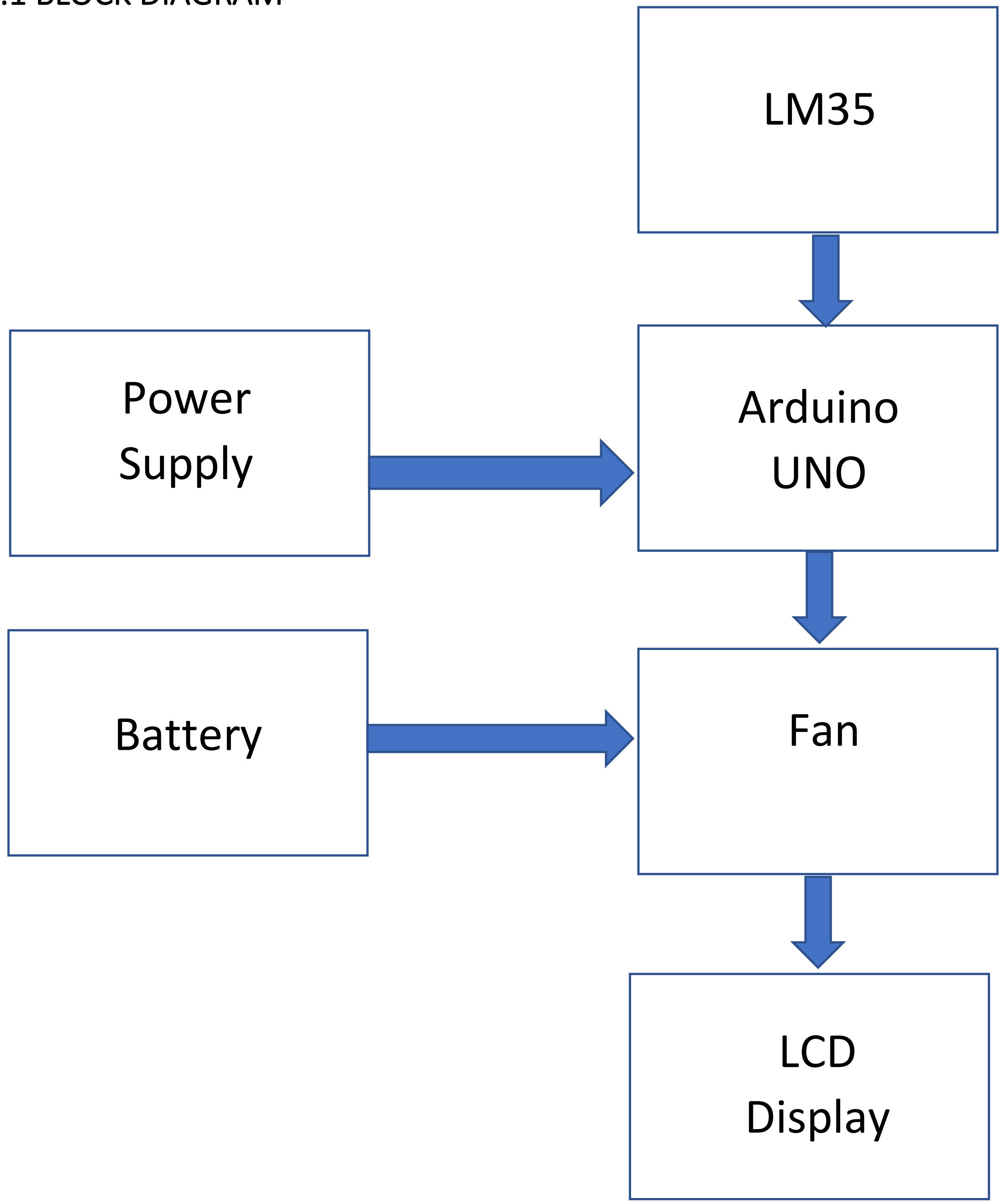
Fig (13): Circuit Diagram

4.2 CONSTRUCTION

Bring all components as per the circuit diagram. Connect the LM35 sensor to the Arduino UNO board. Give 5V supply to LM35 sensor through the VCC output of Arduino. Connect the LED and resistors in the breadboard. Give the supply to the LED through Arduino. Then connect the capacitor and the diode as per the circuit diagram. Connect the Fan and give the supply of 12V DC battery. Program the Arduino. Then connect the LCD as per the pin specified in the program. Connect the ground for all the components. Give 12V supply to the Arduino through the battery.

CHAPTER 5

5.1 BLOCK DIAGRAM



5.2 PULSE WIDTH MODULATION (PWD)

Pulse Width Modulation, or PWM, may be a technique for getting analog results with digital means. Digital control is employed to make a square wave, a sign switched between on and off. This on-off pattern will 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 named the heart beat width. To get varying analog values, we can change, or modulate, that pulse width. If we repeat this on-off pattern fast enough with an LED for instance, the result's as if the signal may be a steady voltage between 0 and 5v controlling the brightness of the LED. In the graphic below, the green lines represent a daily period of time . This duration or period is that the inverse of the PWM frequency.

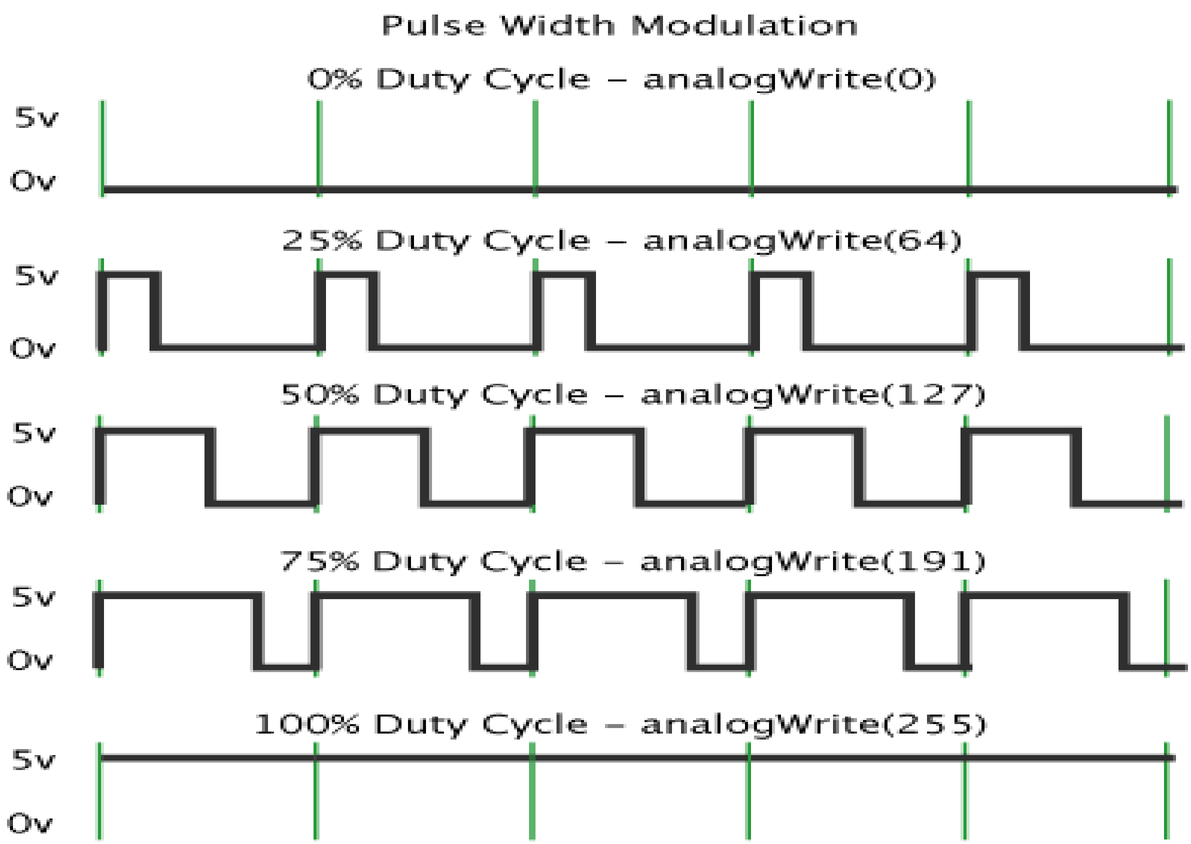


Fig (14): PWD

5.3 WORKING

We 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 may select the transistor by the type of fan that you use. In my case we 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 by 5V from the Arduino board. As you can see in the sketch on the first line, we included the Liquid Crystal library (header) that includes useful functions to use when an LCD is connected to the Arduino board. Then we 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 Temp Min and lower than the temp Max and if so, then use the map () function to re-map the temp value from one to another. In our case fan Speed will have a value of 32 in 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. The rest of the explanation can be read in the comments area of the Arduino sketch. In the next project we will make a temperature protection circuit that will turn off the power of equipment when its temperature has reached a certain value.

5.4 PROGRAM

```
#lnclude <LiquidCrystal.h>

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

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

lnt fan = 11; // the pin where fan is

lnt led = 8; // led pin
```

```
lnt temp;

lnt tempMin = 15; // the temperature to start the fan 0%

lnt tempMax = 35; // the maximum temperature when fan is at 100%

lnt fanSpeed;

lnt fanLCD;

vold setup() {

plnMode(fan, OUTPUT);

plnMode(led, OUTPUT);

plnMode(tempPin, INPUT);

lcd.begln(16,2);

Serlal.begin(9600);

}

vold loop()

{

temp = readTemp();

Serlal.print( temp );

lf(temp < tempMin)

{

fanSpeed = 0; // fan ls not spinning

analogWrite(fan, fanSpeed);

fanLCD=0;

digltalWrite(fan, LOW);

}

lf((temp >= tempMin) && (temp <= tempMax))

{
```

```
fanSpeed = temp;

fanSpeed=2.5*fanSpeed;

fanLCD = map(temp, tempMln, tempMax, 0, 100);

}

lf(temp > tempMax) // if temp is higher than tempMax }

dlgitalWrite(led, HIGH); // turn on led

}

else // eise turn of led

{

dlgitalWrite(led, LOW);

}

lcd.prlnt("TEMP: ");

lcd.prlnt(temp); // display the temperature

lcd.prlnt("C ");

lcd.setCursor(0,1); // move cursor to next llne

lcd.prlnt("FANS: ");

lcd.prlnt(fanLCD); // display the fan speed

lcd.prlnt("%");

deiay(200);

icd.clear();

}

lnt readTemp() {

temp = analogRead(tempPln);

return temp * 0.48828125;

}
```

5.5 PROJECT FIGURE

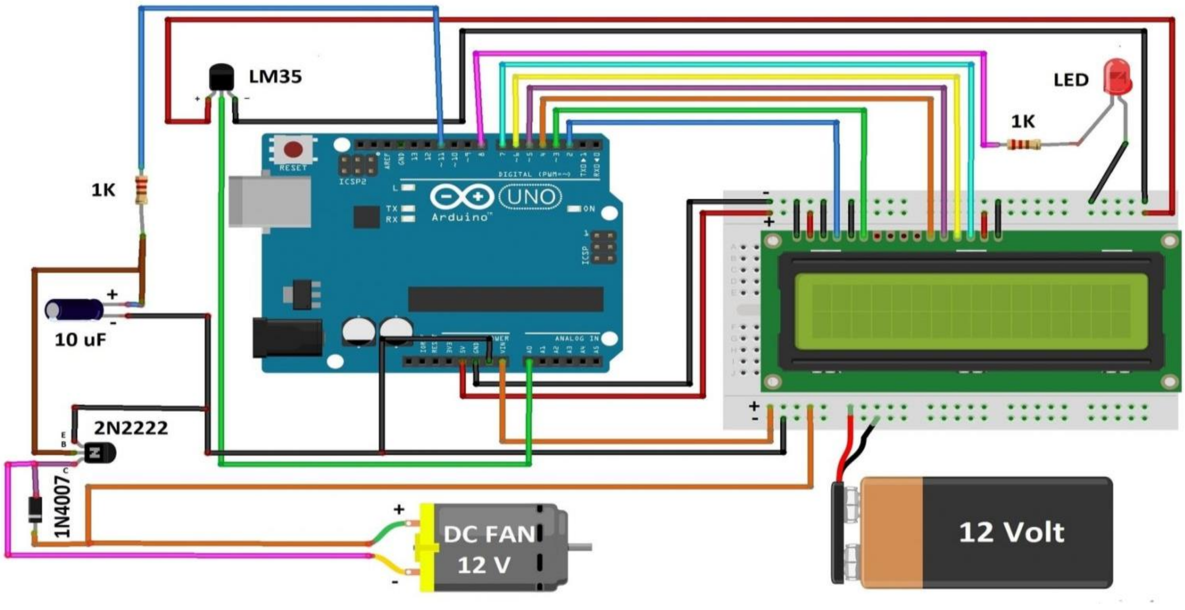


Fig (15): Project Figure

5.6 VERIFIED FIGURE FROM TINKERCAD

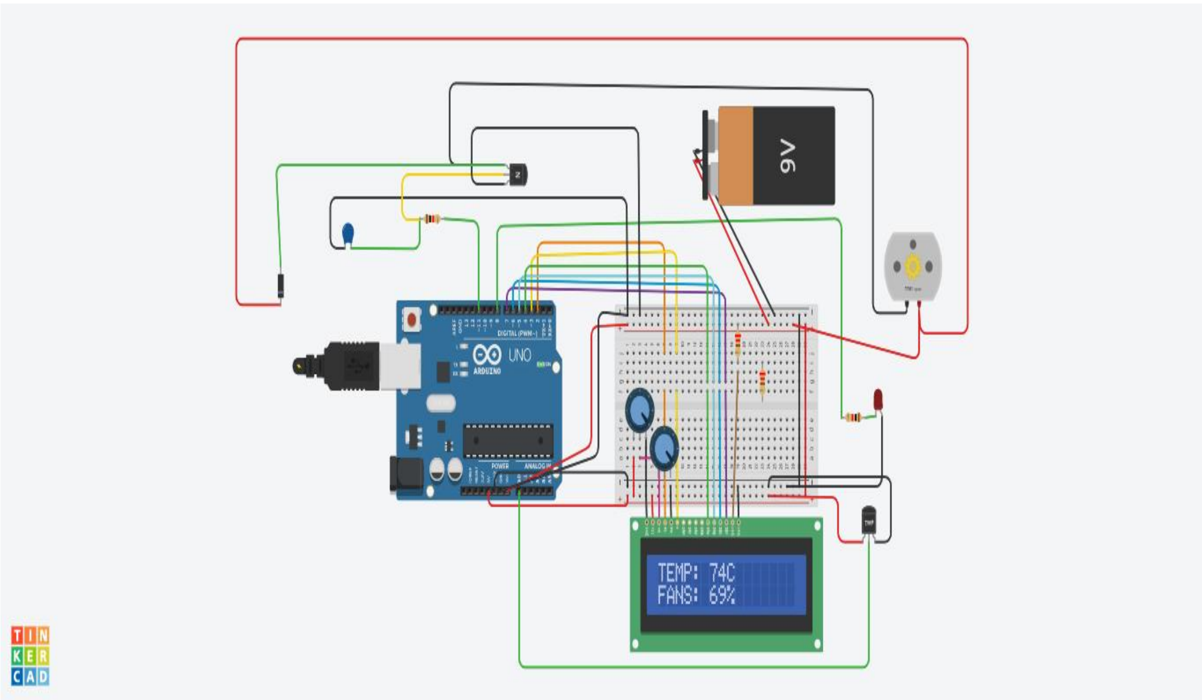


Fig (16): Verified Figure from Tinker CAD

CHAPTER 6

6.1 ADVANTAGES

I. This project can be used in Home.
II. This project can be used in Industry.
III. This may help in saving the energy / electricity.
IV. To watch the environments that's not comfortable, or possible, for humans to watch, especially for extended periods of your time.
V. Prevents waste of energy when it’s not hot enough for a fan to be needed.
VI. To help people that are disabled to regulate the fan speed automatically.

6.2 DISADVANTAGES

I. It can only be maintained by technical person. Thus, it becomes difficult to be maintained.
II. Because of temperature variation, after sometimes its efficiency may decrease.

6.3 APPLICATIONS

I. Temperature based fan speed controller is useful for cooling the processor in the laptops and personal computers “more efficiently”. Usually, fan in laptop comes with only two or three possible speeds. So, it results in more power consumption.
II. The fan designed in this project, has different values of speed according to temperature change. This can be also utilized in small scale industries for cooling the electrical/mechanical equipment. The whole circuit except motor and fan are often manufactured on one PCB, and it are often used for temperature-based control operations.

CHAPTER 7

7.1 CONCLUSION

This project is a prototype to bring the cheapest and trustworthy, home automation system i.e. controlling the speed of the fan automatically according to the room temperature. This project helped us in knowing the working process of Arduino UNO. We got the idea about IOT and Home automation. By this project, we have tried to reduce the human effort. This project can be used in industries for boilers as well.

7.2 LITERATURE SURVEY

a. Applied Research of the Intelligent Temperature-Controlled Speed Adjustable Motor in Radiator Fan

Authors:

Shengwei Dai ,Yanlin Li

Under the characteristics of the temperature monitoring under complex working situation, this paper suggests a kind of practical, simple and cheap control method for the intelligence motor. This method uses AT89S52 and a few periphery components as a control system, and has two control modes. And the other Mode 2 provides how of using remote infrared control to manually achieve an equivalent goal. Through the sensible operation, this system shows its effectiveness and stability. And because of its low cost, it is often used widely in radiator fans.

b. Data Driven Electricity Management for Residential Air Conditioning Systems: An Experimental Approach

Authors:

Wen-Tai LiSai, Ram Gubba

Effective control of air con systems (ACs) has the potential of serious electricity savings and demand response management for a whole power grid . In this context, this paper shows some key experimental results on controlling the electricity consumption of ACs. The main goals were to scale back the consumption of electricity by the compressors, and to research of getting residential ACs as interruptible loads to work within the electricity market. The algorithm used for controlling is explained intimately , and therefore the users' experiences during the experiments are briefly discussed.

7.3 REFERENCE

I. https://ieeexplore.ieee.org/document/8081904

II. https://ieeexplore.ieee.org/document/8692304

III. https://circuitdigest.com/microcontroller-projects/automatic-temperature-controlled-fan-project