DIY TEAM PROJECT

Temperature based Fan speed Controller and Adaptive Light System

TEAM 11

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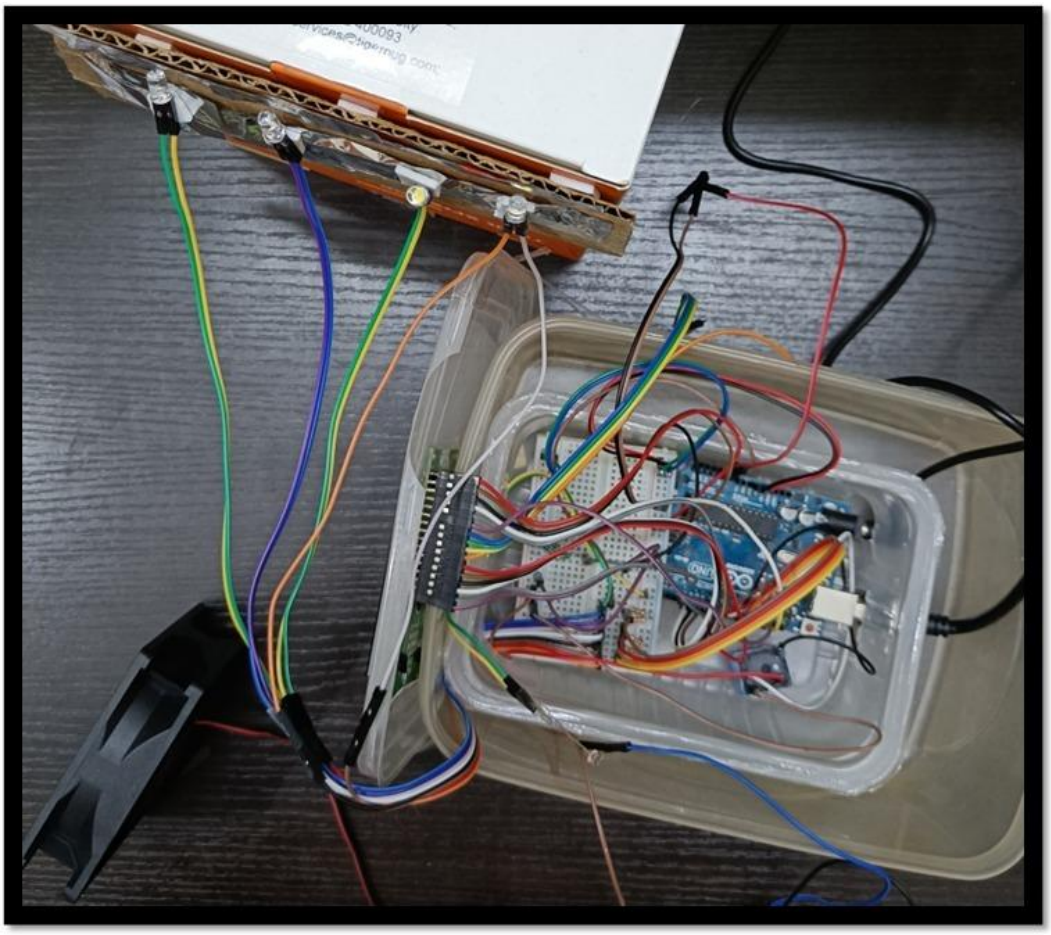

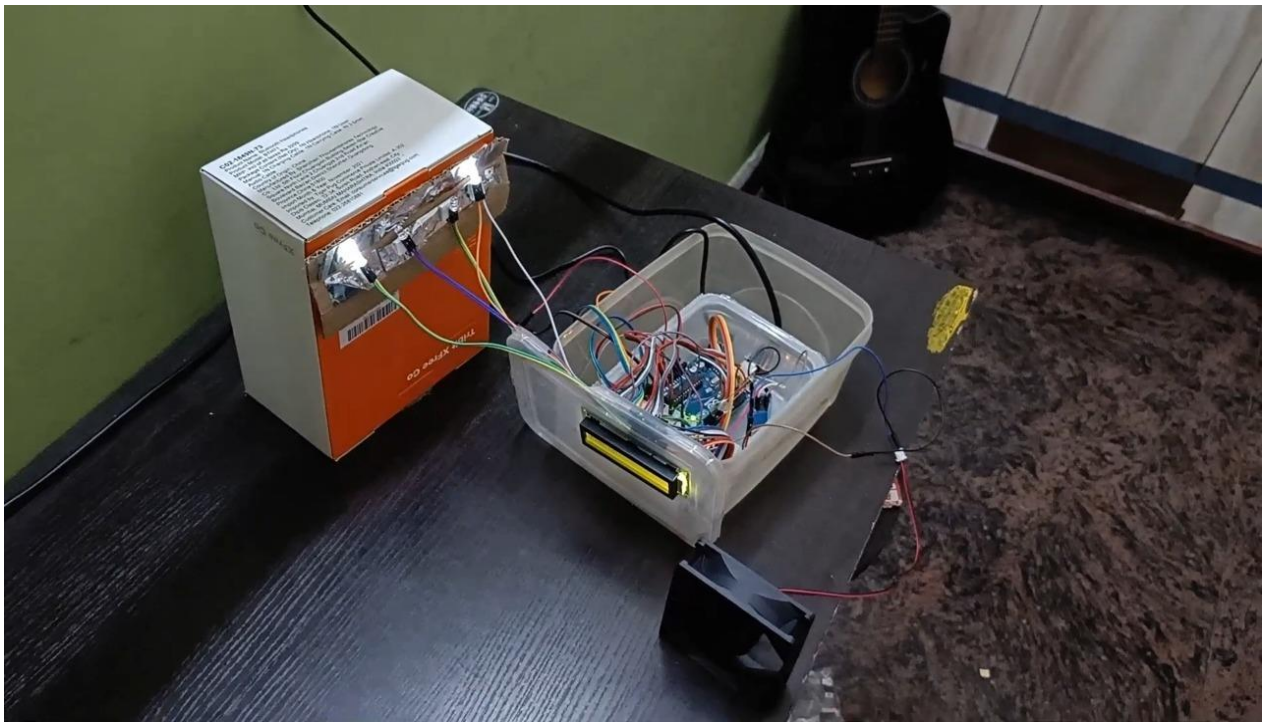

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Acknowledgment

We would like to express our special thanks of gratitude to our Professors, *Dr. Korak Sarkar*, *Dr. Sreeraj Puravankara*, and also our Teaching Assistants for allowing us to make this special project. Over the course of the last 4 weeks, we have learned a lot of things about Arduino Board & IDE, different sensors, and various electronic hardware components. We have also learned to work as a team, taking responsibility and getting things done on time. DIY lab by far has been the most interesting course in our semester and we are grateful to our professors and Teaching Assistants for that.

1. Introduction

The idea behind the project is to control the speed of the fan based on difference in temperature and control the light system based on the brightness of the room. The Temperature variation in the fan is a different way to deal with the speed of the motor. The Adaptive Light System changes its brightness corresponding to the brightness of the room.

This project involves the design and simulation of the fan speed control system by using PWM technique based on the room temperature and the Light system that changes the number of lights switched on based on the surrounding brightness which is measured by a photoresistor. In order to measure temperature of the room, a Temperature Sensor is used.

2. Objective

- To build a fan speed controller that changes its speed according to the surrounding temperature.
- To build an Adaptive light system that changes brightness according to the surrounding brightness.

3. Purpose

The main purpose of the project is power conservation. The project reduces wasteful use of electricity by enabling its optimised control.

In addition, our project enhances users' comfort by automating the system. We usually change the fan speed according to our comfort, which is mostly based on temperature. Likewise, we turn on or off lights based on the brightness of the room. Therefore, we developed a project that would automate these controls.

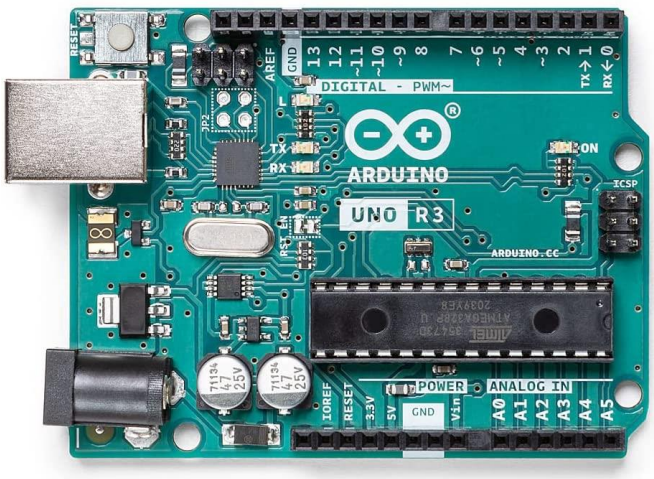
4. Components Used

1. Arduino UNO R3 and Adapter
2. LM35 Temperature Sensor
3. Photoresistor
4. 12V DC Fan
5. 16 x 2 LCD Display
6. White LEDs
7. Relay SPDT
8. Breadboard
9. Resistors
10. Jumper Cables

3.1. Arduino UNO R3:

Arduino UNO is a development board which contains microcontroller in the board itself. It is an open-source software. In the electronics platform, Arduino is easy to use hardware and software.

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, or a Twitter message – and turn it into an output – activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. Arduino UNO makes the working process simple with the microcontrollers.



Specifications:

1. Microcontroller- Atmega328
2. Operating Voltage- 5V
3. Input Voltage – 6 to 20V
4. Digital I/O Pins- 14
5. Analog Input Pins:6
6. DC Current for the 3.3V Pin- 50 mA
7. Flash Memory- 32 KB SRAM:2 KB
8. EEPROM- 1 KB
9. Clock Speed- 16 MHz

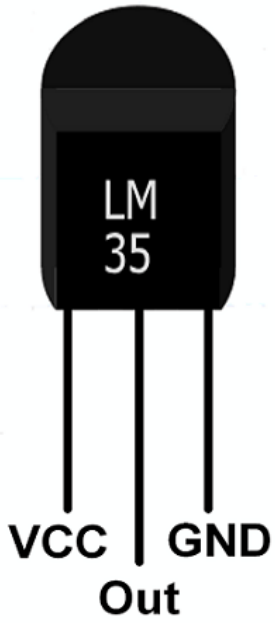
3.2. LM35 Temperature Sensor:

- LM35 is a temperature measuring device having an analog output voltage proportional to the temperature.
- It provides output voltage in Centigrade (Celsius). It does not require any external calibration circuitry.
- The sensitivity of LM35 is 10 mV/degree Celsius. As temperature increases, output voltage also increases.

  E.g., 250 mV means 25°C.

- It is a 3-terminal sensor used to measure surrounding temperature ranging from -55 °C to 150 °C.
- LM35 gives temperature output which is more precise than thermistor output.

Pin Description:



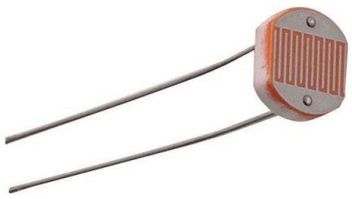
VCC: Supply Voltage (4V – 30V)

Out: It gives analog output voltage which is proportional to the temperature (in degree Celsius).

GND: Ground

3.3. Photoresistor:

- A special type of variable resistor whose resistance depends on the intensity of light falling on it.
- *Construction:* Made of semiconductor material that is photosensitive. *They do not have any PN junction.*
- *Working Principle:* When light falls on the photosensitive material (or on the Photoresistor), the valence electrons absorb the light energy and break free from the nucleus to become free electrons. These electrons lead to flow of current when an external force like an electric field is applied.



3.4. 12V DC Fan:

It is an electronic appliance used to flow the air around its environment. We all know that fan contains blades, they act on the air. The Impeller, rotor, or runner is the rotating assembly of blades.

Specifications:

1. Power connector type – 2-pin JST
2. Voltage – 12V (DC)

3.5. 16 x 2 LCD Display:

The LCD is a dot matrix liquid crystal display that displays alphanumeric characters and symbols. 16X2 LCD digital display has been used in the system to show the room temperature and light brightness. Liquid Crystal Display screen is an electronic display module and find a wide range of applications.

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.

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

3.7. Relay SPDT:

Relay is an electro-mechanical switch used to control high power application through low power signal electronic circuits, for an example a simple timer circuit working under 5V DC bias cannot control high voltage light bulb, by introducing Relay component we can easily control light bulb.

In a Relay SPDT, if there is not enough DC supply in coil terminals then Relay represents idle condition that is common terminal connected in N/C terminal. When the coil gets required DC supply then coil gets Magnetically Energized and this magnetic flux force attracts common terminal lever which is made of iron and makes the connection to N/O terminal, now the N/C becomes open.

5. Software Used

1. Arduino IDE
2. SolidWorks
3. TinkedCAD

5.1. Arduino IDE:

- Arduino is an open-source electronic prototyping platform that also sells microcontrollers.
- The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board.

5.2. SolidWorks:

- SolidWorks is a solid modelling computer-aided design and computer-aided engineering application published by Dassault Systèmes.

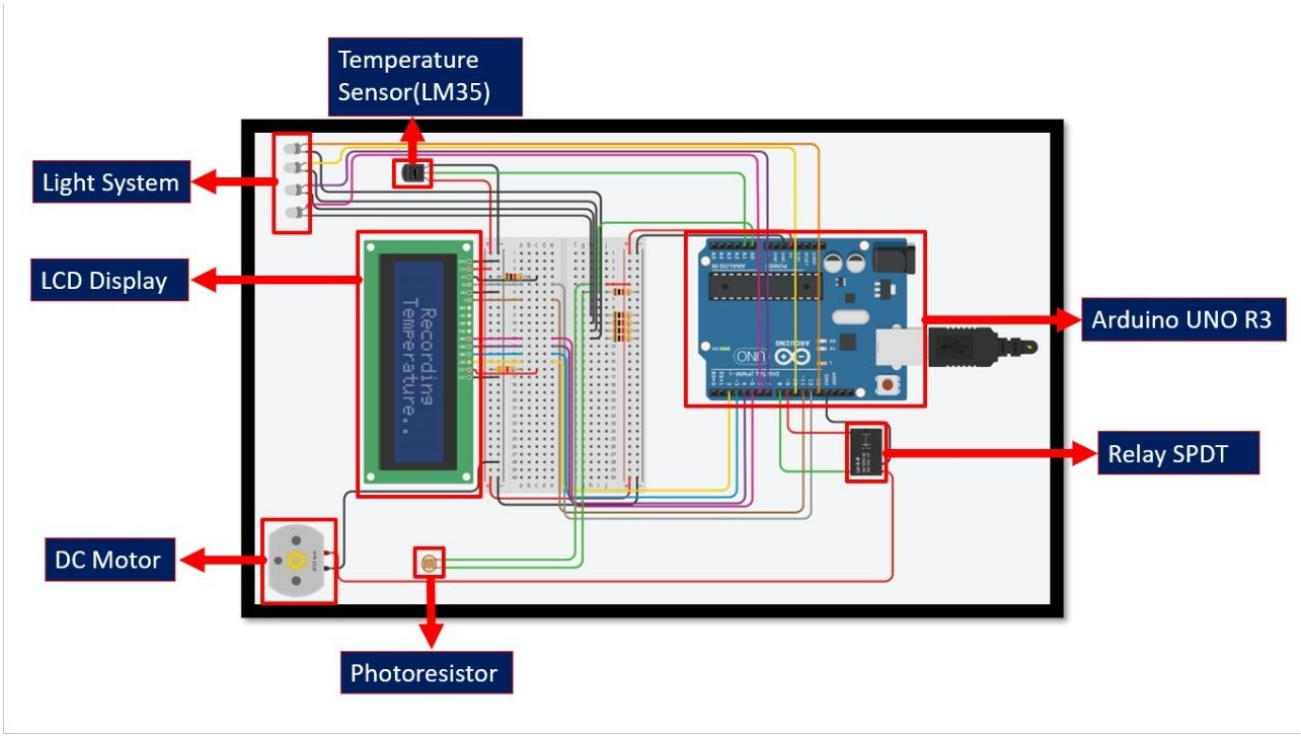
5.3. TinkerCAD:

- TinkerCAD is a free, easy-to-use web app that equips the next generation of designers and engineers with the foundational skills for innovation: 3D design, electronics, and coding!
- TinkerCAD Circuits allows anyone to virtually create and program Arduino projects without the need for physical hardware.

6. Working

The temperature sensor LM35 senses the temperature and converts it into an electrical (analog) signal, which is applied to the Atmega328 microcontroller of the Arduino UNO Board. In this the Arduino UNO board converts the recorded signal from analog to digital signal. So that the recorded values of the temperature and speed of the fan are displayed on the LCD. A low-frequency pulse-width modulation (PWM) signal, whose duty cycle is varied to adjust the fan's speed is used.

The photoresistor changes its resistance according to the intensity of incident light, which results in change of voltage across it. This change is read as an analog signal by microcontroller. And based on the brightness detected, the state of LEDs is controlled.



Schematic of the circuit

Code:

```
#include<LiquidCrystal.h>
LiquidCrystal lcd(12,11,5,4,3,2);

#define LM35 A1

int fan = 9;
int relaypin = 8;
int photopin = A0;
float phx = 30.0;

void poweronrelay()
{
  digitalWrite(relaypin,HIGH);
  lcd.print("FAN ON");
  delay(1000);
  lcd.clear();
}

void poweroffrelay()
{
  digitalWrite(relaypin,LOW);
  analogWrite(fan,0);
  lcd.print("FAN OFF");
  delay(1000);
  lcd.clear();
}

void setup()
{
  pinMode(fan,OUTPUT);
  pinMode(relaypin,OUTPUT);
  pinMode(6,OUTPUT);
  pinMode(7,OUTPUT);
  pinMode(10,OUTPUT);
  pinMode(13,OUTPUT);
```

```
  lcd.begin(16,2);
  lcd.setCursor(1,0);
  lcd.print("DIYfinalProject");
  delay(1000);
  lcd.clear();
  lcd.setCursor(3,0);
  lcd.print("Team 11");
  delay(1000);
  lcd.clear();
  lcd.print("Lets Get Started");
  delay(1000);
  lcd.clear();

  Serial.begin(9600);
  delay(10);
}

void loop()
{
  lcd.setCursor(3,0);
  lcd.print("Recording");
  lcd.setCursor(2,1);
  lcd.print("Temperature..");
  delay(1500);
  lcd.clear();
  lcd.setCursor(0,2);

  int lmvalue=analogRead(LM35);
  float voltage=lmvalue*(5.0/1023.0);
  float tempc=voltage*100;

  lcd.setCursor(0,0);
  lcd.print("Temperature=");
  lcd.setCursor(0,1);
  lcd.print(tempc);
```

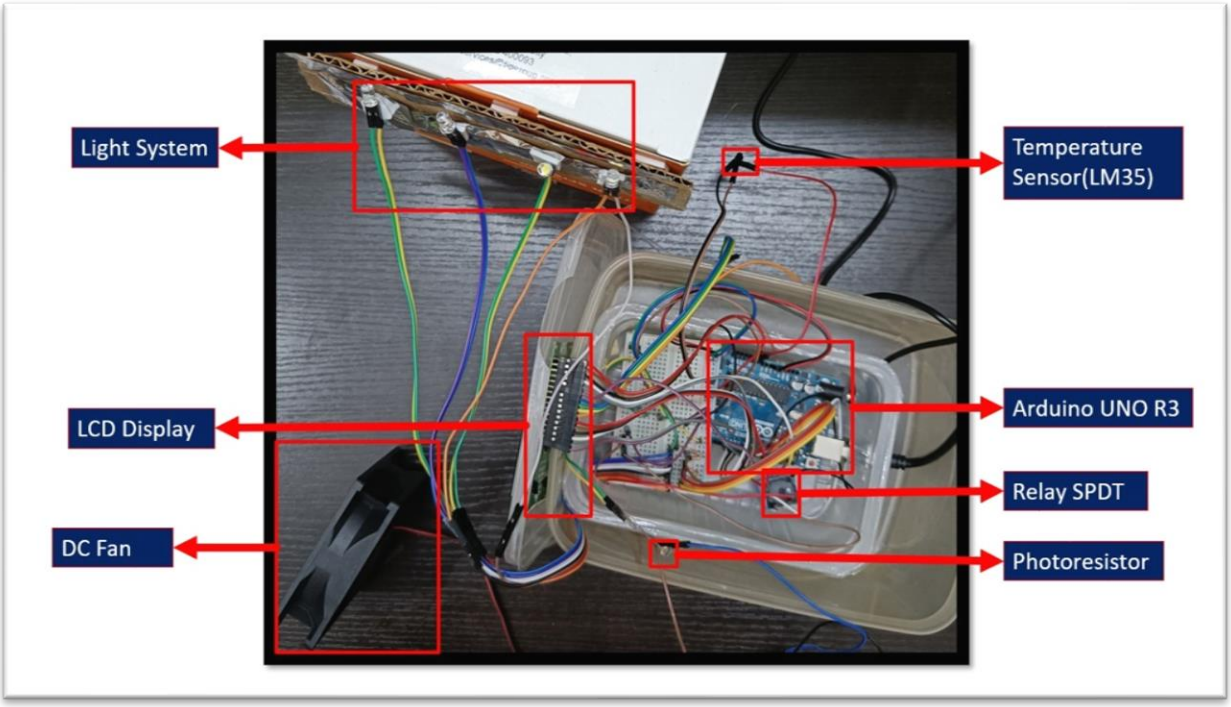
```
lcd.setCursor(14,1);
lcd.print(" C");
delay(1000);
lcd.clear();

Serial.print("temp ");
Serial.println(tempc);
delay(10);

if(tempc>=25)
{
  poweronrelay();

  int fansp=map(tempc,0,35,0,255);
  analogWrite(fan,fansp);
  float fanspper=(fansp*100)/255;
  lcd.print("Fan Speed:");
  lcd.print(fanspper);
  lcd.print("%");
  delay(1000);
  lcd.clear();
}
else
{
  poweroffrelay();
}

int ph=0;
ph = analogRead(photopin);
float phpercent = (ph/phx)*100.0;

lcd.setCursor(0,0);
lcd.print("brightness=");
lcd.setCursor(2,1);
lcd.print(phpercent);
lcd.print("%");
```

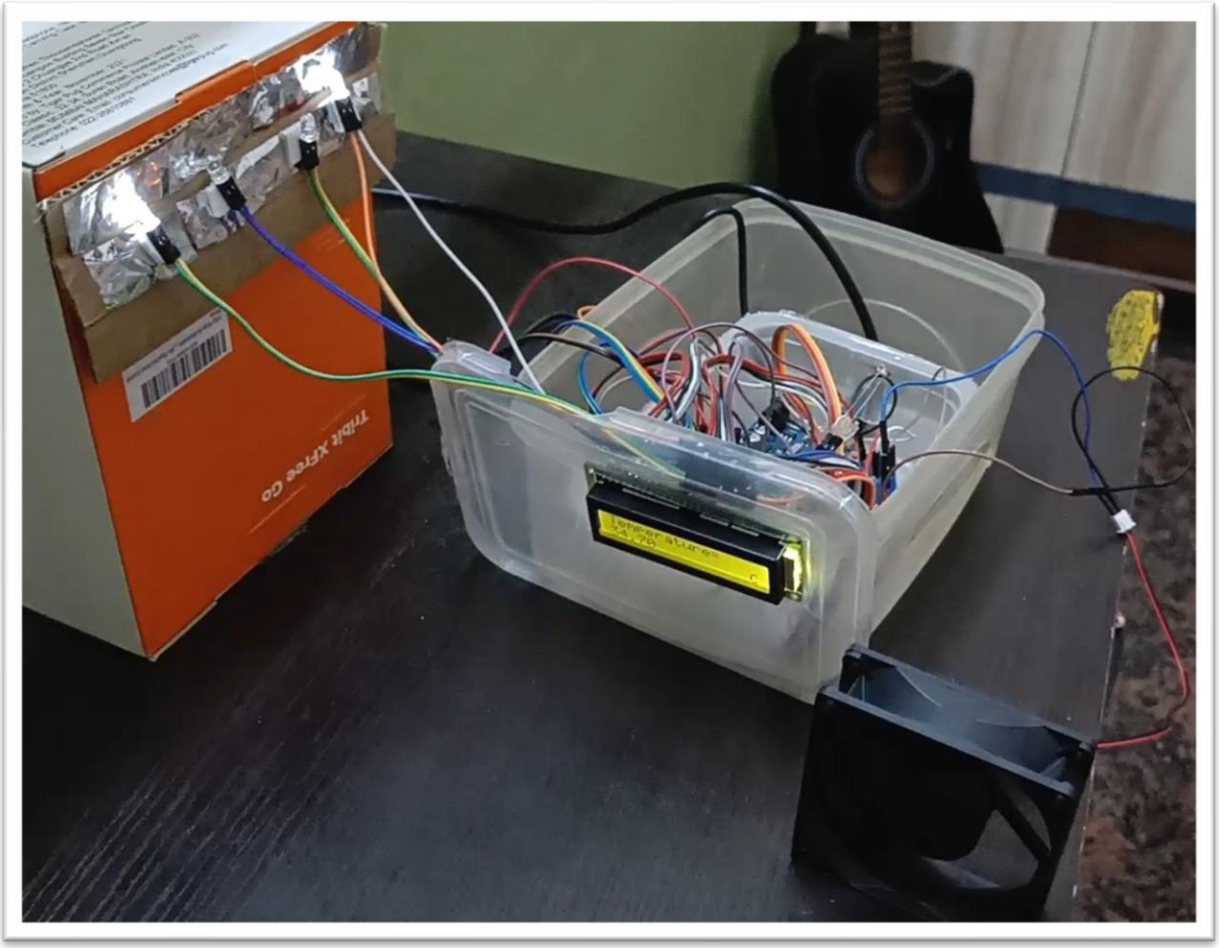
```
delay(1500);
lcd.clear();

Serial.print("bright ");
Serial.println(ph);
Serial.println("");
delay(10);

if(ph<=24)
{
  lcd.print("Lights ON");
  delay(1000);
  lcd.clear();

  if(ph>20 && ph<=24)
  {
    digitalWrite(13,HIGH);
    digitalWrite(10,LOW);
    digitalWrite(7,LOW);
    digitalWrite(6,LOW);
  }
  if(ph>13 && ph<=20)
  {
    digitalWrite(13,HIGH);
    digitalWrite(10,HIGH);
    digitalWrite(7,LOW);
    digitalWrite(6,LOW);
  }
  if(ph>6 && ph<=13)
  {
    digitalWrite(13,HIGH);
    digitalWrite(10,HIGH);
    digitalWrite(7,HIGH);
    digitalWrite(6,LOW);
  }
  if(ph>=0 && ph<=6)
```

```
    {
      digitalWrite(13,HIGH);
      digitalWrite(10,HIGH);
      digitalWrite(7,HIGH);
      digitalWrite(6,HIGH);
    }
  }
  else
  {
    lcd.print("Lights OFF");
    delay(1000);
    lcd.clear();
    digitalWrite(13,LOW);
    digitalWrite(10,LOW);
    digitalWrite(7,LOW);
    digitalWrite(6,LOW);
  }
}
```

LM35 temperature sensor voltage to temperature conversion, now one of the most difficult things is how to convert the voltage generated/output by the lm35 sensor at output in Celsius or Fahrenheit scales. This conversion is shown above in the code.

7. Result


Light System
Temperature Sensor(LM35)
LCD Display
Arduino UNO R3
Relay SPDT
DC Fan
Photoresistor



8. Challenges faced

1. *LM35 Temperature Sensor:*

Problem:

The LM35 temperature sensor which we've ordered online turned out to be defective. This sensor is a very important component of our project and hence the project is delayed a bit.

Solution:

We've ordered new LM35 temperature sensors.

2. *LCD Soldering:*

Problem:

We did not find any header pins. So, we directly soldered the LCD pins to jumper wires.

Solution:

We've directly soldered the LCD to jumper wires.

9. Project Potential

- We normally control the fan speed with the regulator. In our project, as the temperature changes, the fan speed changes accordingly.
- The fan designed in this project, has more scope to use in the Middle East countries. It's better suited for hot climates.
- Optimal brightness is automatically ensured at all times by the Light system, preventing eye strain.
- To watch the environments that is not comfortable, or possible, for humans to monitor, especially for extended periods of time.
- Prevents waste of energy when it’s not hot enough for a fan to be needed.
- To assist people who are disabled to adjust the fan speed automatically.

10. Further Improvements

- In the future, we would be able to monitor even more variables, such as humidity and temperature, and control them at the same time, sending the data to distant locations via mobile or internet.
- Using this technology, we can able to draw graphs of variations in these parameters using computer. And the temperature exceeds the limit; a call will be dialled to the respective given number by an automatic Dialler system.
- We could use a lamp, CFL bulb, or a tube light instead of the LEDs.
- Instead of using raw sensors, we could use modules of the sensors which enhance accuracy and cancels noise.
- We could use push buttons in the circuit so that the user can calibrate the sensors as per the requirements.

11. Conclusion

This project can be used in both the home and Industry. It helps in saving the energy and electricity. The budget of this project was 1400 INR. Most of the microcontroller systems are limited to windows. The Arduino in our project can access all kinds of platforms like Windows, macOS and Linux, giving our project a cross-platform advantage. Our project is very flexible and so can be used for many applications.

12. Work Distribution

Roll Number	Name	Work done
21CS10073	Sai Varshith Valugula	Documentation, Reporting, PPT designing
21EC10085	Vankadara Jayadithya Sreekar	Components purchase, Hardware Assembly, Testing and video shooting
21ME10094	Victor John Clement Beera	Video Editing and Project Management
21ME30028	Gollapalli Dheeraj	Box Designing, Circuit designing on TinkerCAD, Code building, testing and debugging

13. Links

- Link to TinkerCAD model and code →

https://www.tinkercad.com/things/kkND0MrOad2?sharecode=7IM9m5Va9erzHWQ-ExTStEmXWnqCF1-E9As0fYhJpFQ

- Link to YouTube video →

https://youtu.be/BlvERDlxnyQ