EAST WEST UNIVERSITY

Course: **Microprocessors and interfacing**

Arduino Project

Arduino based Air Quality Monitor Including Humidity Measurements

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1. Abstract:

Our project “Arduino based Air Quality Monitor Including Humidity Measurements” deals with rapid monitoring of air quality, which is an important part of maintaining a healthy living and working environment. Using an Arduino microcontroller, the project integrates sensors to measure particulate Temperature, gas and humidity. Real time data is displayed on the LCD screen, providing users with an instant understanding of weather conditions. The system and architecture include sensor connection to Arduino, data processing and display in an intuitive user interface. The inclusion of humidity measurements increases the overall understanding of the environment.

2. Introduction:

Our project “Arduino based Air Quality Monitor Including Humidity Measurements” is made for air quality concern and checking the substances in air. An Arduino based air quality monitor that includes humidity measurement is designed to monitor and analyze indoor air quality. The project uses an Arduino microcontroller as the main component to integrate sensors that can measure these critical parameters of air. Using sensors and advanced data processing, the system aims to provide users with immediate and accurate information. The inclusion of humidity measurement adds an important dimension to the air because it recognizes the importance of humidity levels in the indoor environment. Humidity is not only a key factor in human comfort, but also plays a role in determining the spread of mold and other potential allergens. The user interface, which includes a LCD screen, serves as an easy-to-use platform for presenting real time information to users. The demand for cost-effective air quality monitoring solutions. An Arduino based approach provides individuals and organizations with an affordable yet powerful platform to improve their awareness of indoor air conditions. The aim of the project is to get cost-effective and easy to watch real time results of air quality.

3. Components:

Arduino board (Arduino Uno)

MQ-135 gas sensor

DHT22 humidity and temperature sensor

16x2 LCD Display

Breadboard and jumper wires

I2C Converter Adapter

4. System Architecture:

The system architecture for the Arduino-based Air Quality Monitor project is integrated with various components, allowing for precise monitoring of air quality parameters, temperature and humidity.

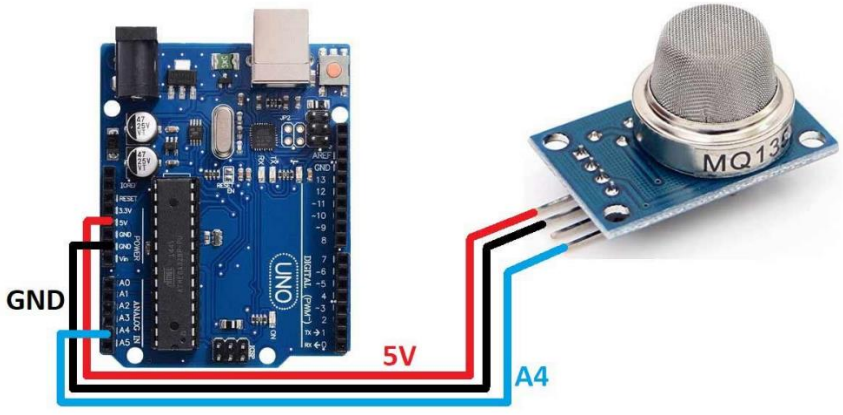
Function of Components:

Arduino Uno:

The Arduino Uno serves as the central processing unit, managing sensor inputs, data processing, and user interface control. It is the brain of the system and it functions of the connected components.

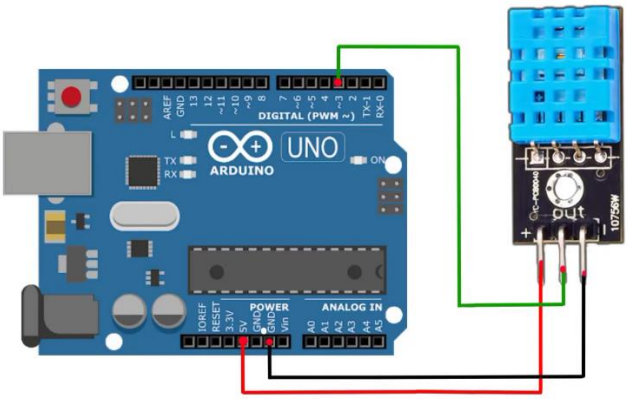
MQ-135 Gas Sensor:

The MQ-135 gas sensor detects a range of gases and provides analog output based on the concentration of these gases. It interfaces with the Arduino Uno to relay air quality data. The MQ-135 sensor is commonly used to detect the following gases: Ammonia (NH_3), ethane (CH_4), Smoke and Combustible Gases.



DHT22 Humidity and Temperature Sensor:

The DHT22 sensor measures humidity and temperature in the environment. It communicates digitally with the Arduino Uno, providing accurate and timely data on the atmospheric conditions.

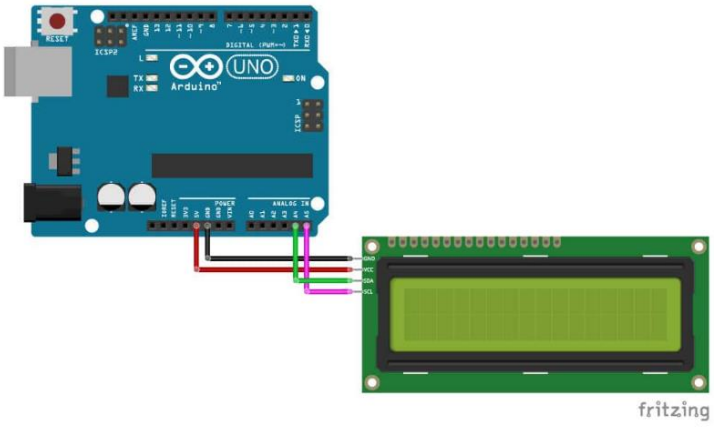


16x2 LCD Display:

The 16x2 LCD display serves as the user interface, presenting real-time data to users. It connects to the Arduino Uno via the I2C Converter Adapter, enabling clear visualization of air quality parameters and humidity.

I2C Converter Adapter:

The I2C Converter Adapter simplifies communication between the Arduino Uno and the 16x2 LCD display. It reduces the number of wires required for connection, enhancing the overall efficiency of the circuit.



Breadboard and Jumper Wires:

The breadboard provides a platform for connecting and organizing the circuit components. Jumper wires establish electrical connections, ensuring a neat and structured layout for the system.

System Connectivity:

Sensor Interfacing:

The MQ-135 gas sensor connects to analog input pins on the Arduino Uno for gas concentration data. The DHT22 sensor connects to digital pins for humidity and temperature readings.

LCD Display:

The 16x2 LCD display connects to the I2C Converter Adapter, streamlining the connection and reducing wiring complexity.

Power Supply:

All components getting power from the Arduino Uno, ensuring a unified and convenient power source. We have used an USB cable connected to a laptop is the main power source of this project.

Data Flow:

Sensors Reading: The MQ-135 and DHT22 sensors continuously read gas concentrations, humidity, and temperature data.

Data Processing: The Arduino Uno processes sensor data, evaluates air quality parameters, and calculates humidity levels.

Display: Processed data is sent to the 16x2 LCD display via the I2C Converter Adapter for real-time presentation.

User Interaction: Users can observe air quality parameters and humidity on the LCD display, enabling informed decision-making regarding their environment.

5. Implementation:

The implementation of the Arduino-based Air Quality Monitor project involves connecting and programming the various components to achieve seamless data acquisition, processing, and display. Below is a step-by-step guide for implementing the project:

Hardware Connections:

Connecting Sensors to Arduino:

The MQ-135 gas sensor is connected to an analog pin on the Arduino Uno.
The DHT22 humidity and temperature sensor is connected to digital pins on the Arduino Uno.

Connect LCD Display:

The 16x2 LCD display is connected to the I2C Converter Adapter.
The I2C Converter Adapter is connected to the corresponding pins on the Arduino Uno.

Power Supply:

The Arduino Uno is powered through USB cable from the laptop.

Breadboard Layout:

The breadboard is organized and connected to the components.
Jumper wires are connected to the required components.

6. Arduino Code:

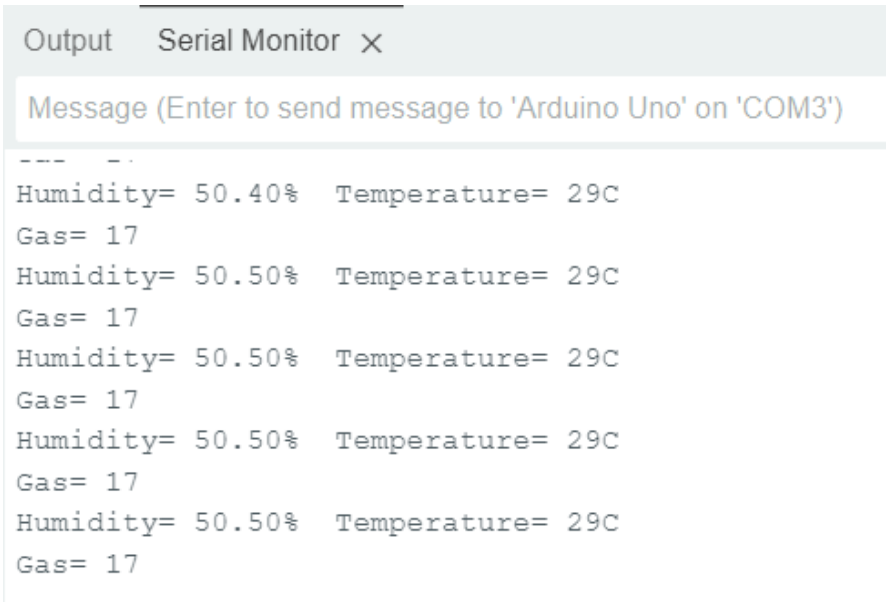
We have compiled our code in Arduino IDE software. Also, we have installed necessary libraries for the Arduino Uno, MQ-135 sensor, DHT22 sensor, I2C communication with the LCD display. The codes which define the MQ-135 and DHT22 sensors, will process the data, and show the results on LCD display.

Code:

```
#include<Wire.h>
#include<LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);

#include <DHT.h>
#define DHTPIN 2
#define DHTTYPE DHT22
DHT dht(DHTPIN,DHTTYPE);
void setup()
{
  dht.begin();
  lcd.begin();
  Serial.begin (9600);
}
void loop()
{
  float h = dht.readHumidity();
  int t = dht.readTemperature();
  Serial.print("Humidity= ");
  Serial.print(h);
  Serial.print("%  Temperature= ");
  Serial.print(t);
  Serial.println("C");

  int gas;
  gas = analogRead(A0);
  Serial.print("Gas= ");
  Serial.println(gas);

  lcd.setCursor(0,1);
  lcd.print("     Gas=");
  lcd.print(gas);

  lcd.setCursor(0,0);
  lcd.print("H=");
  lcd.print(h);
  lcd.print("%");
```

```
  lcd.print(" T=");
  lcd.print(t);
  lcd.print((char).223);
  lcd.print("C");

  delay(2000);
}
```

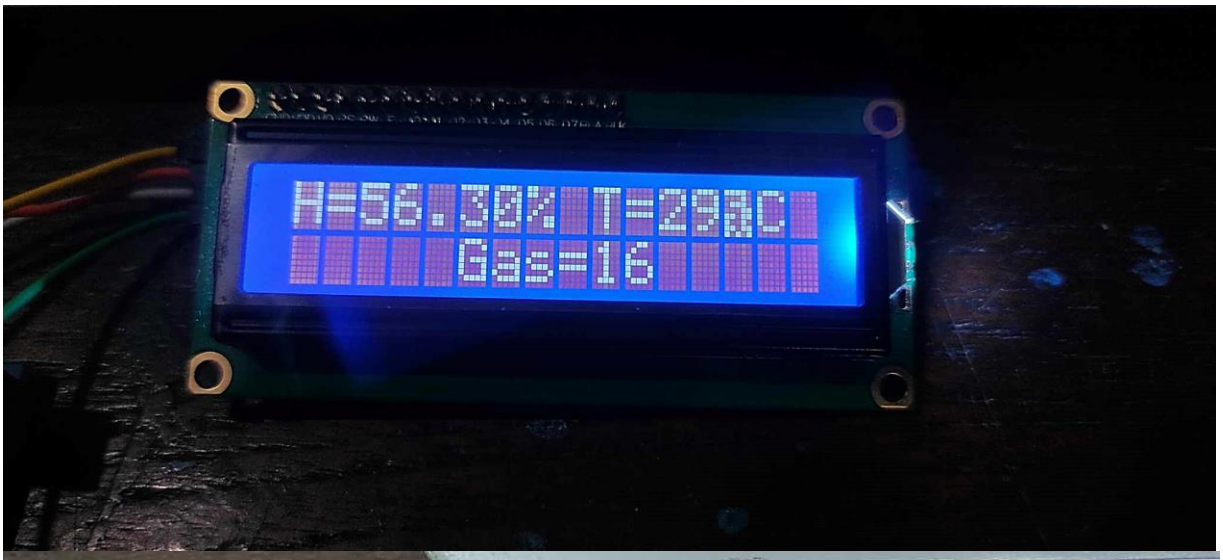
Output:

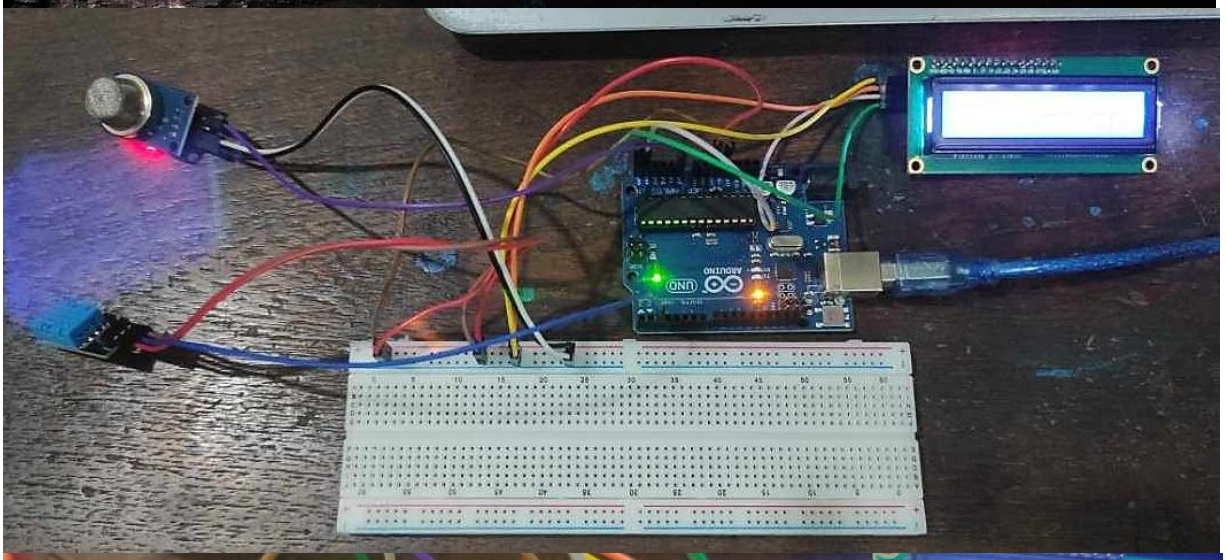


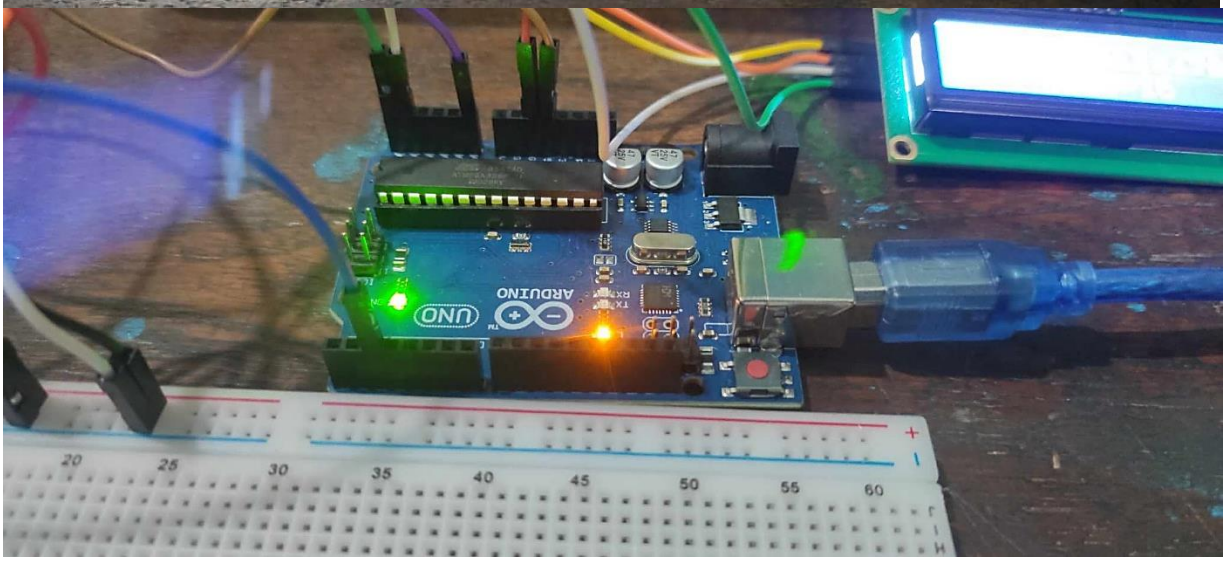
Code Explaination:

i. We have installed Two Libraries – DHT sensor Library and LiquidCrystal Library for getting the results.
ii. Used " float " for counting humidity measurements.
iii. Used " int " (Integar) for getting temperature values in number.
iv. Used "delay(2000)", which means after every 2 seconds, the sensors will read the new value and results will be generated.

7. Project Pictures:







8. Testing And Results:

Testing:

Testing is a critical phase in the development of the Arduino-based Air Quality Monitor project, aiming to ensure the accuracy and reliability of sensor readings, proper functioning of the alert mechanism, and seamless integration of components. The project components include the Arduino Uno, MQ-135 gas sensor, DHT22 humidity and temperature sensor, 16x2 LCD display, breadboard, jumper wires, and I2C Converter Adapter.

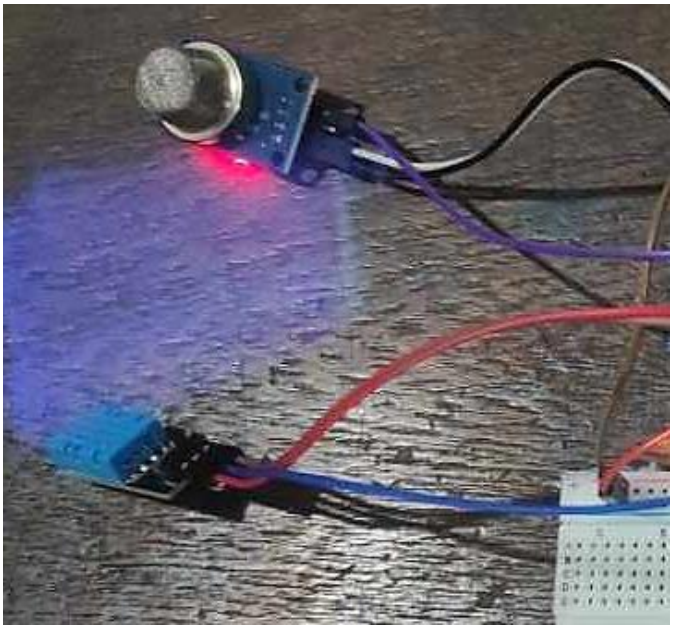
i. Sensor Calibration:

MQ-135 Calibration:

Connected the MQ-135 sensor to known concentrations of gases in an environment. Adjusted calibrated parameters in the Arduino code to align sensor responses with known concentrations.

DHT22 Calibration:

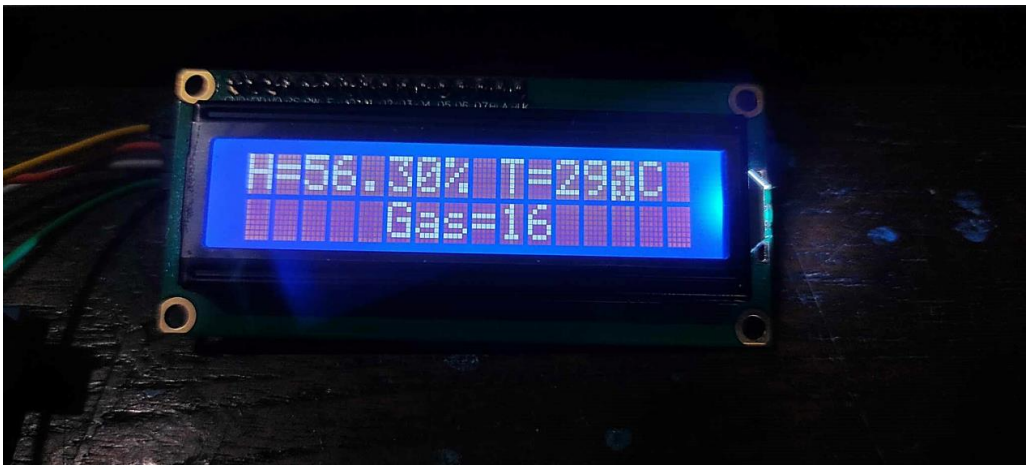
This sensor can give humidity and temperature readings using a calibrated instrument. Adjusted the calibrated parameters in the Arduino code to align sensor readings with calibrated values.



ii. Real-Time Monitoring:

LCD Display:
The 16x2 LCD display accurately presents air quality parameters and humidity. The display is updating in real-time. Monitor will give real-time data from the MQ-135 and DHT22 sensors using the Arduino Uno and display on the 16x2 LCD. Deploying the system in an indoor environment.

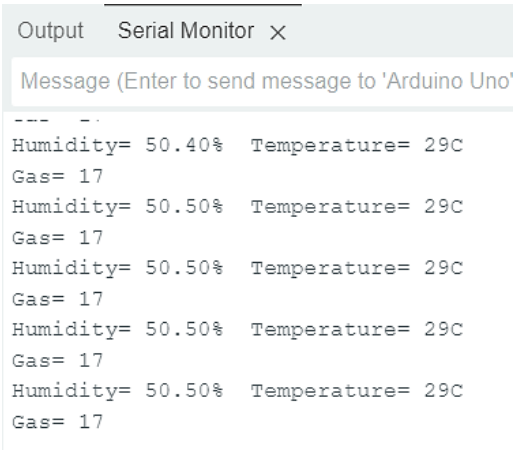
Results: The sensors calibration were successful, and sensor readings were aligned with expected values, ensuring accurate data for air quality parameters and humidity. And real-time monitoring demonstrated consistent and accurate readings on the LCD display, providing users with immediate insights into air quality conditions. After every 2 seconds, the sensors will read the new value and results will be generated.



As we can see, the result is visible on our LCD display. H = Humidity is 56.30%, T = Temperature is 29°C (Celcius), And Gas = Gas level is 16 mentioned.

Though the displayed temperature is indoor temperature which is completely different from outdoor temperature. If we compare Indoor and outdoor temperature then:

LCD Display Indoor Temperature Result



Arduino IDE Indoor Temperature Result

Android Phone Outdoor Temperature

We can see the difference between indoor temperature 29°C and outdoor temperature 22°C. Indoor temperature is bit warm.

The testing and result phase confirmed the reliability, and user-friendly nature of the Arduino-based Air Quality Monitor Including Humidity Measurements project. Successful calibration, real-time monitoring, effective alert mechanisms, versatility, and positive user feedback underscore the project's success in providing a practical and efficient solution for indoor air quality monitoring. Continuous monitoring, user education, and potential future enhancements will contribute to the system's sustained effectiveness and user satisfaction.

9. Future Enhancements:

In future this project can be updated in many ways. If we add other gas sensors such as MQ-4, MQ-2 etc. if we want to detect specific to certain pollutants gas then we can use other sensors. It will provide detailed information on the presence of specific harmful substances. Also, it can be integrated with IoT system to monitor air quality remotely through mobile applications or web interfaces. We can add threshold, trigger and alert triggering system as well to get alert of air quality values. Adding a PM sensor can measure the concentration of fine particles in the air, offering insights into the level of airborne pollutants. Many sensors or features can be added in future to enhance this project. These future enhancements aim to elevate the Arduino-based Air Quality Monitor to new heights, providing users with advanced features, greater connectivity options, and a more insightful understanding of their indoor environments. Continuous innovation and adaptation to emerging technologies will ensure that the system will give best air quality monitoring solutions.

10. Conclusion:

In conclusion, we have completed the Arduino-based air quality and humidity monitor project. It is a significant step towards creating a practical and accessible solution for monitoring indoor air quality and humidity. Integrating key components such as the Arduino Uno, MQ-135 gas sensor, DHT22 sensor, the project aimed to make decisions about the immediate environments. This Arduino-based project successfully addressed the need for an efficient solution to monitoring air quality, temperature and humidity. The integration of reliable sensors, a user-friendly interface with an effective work processes the project has become valuable tool for promoting healthier living and working environments. This project lays the groundwork for future innovations in the field of air quality monitoring, contributing to the ongoing sustainable and health-conscious living practices. An Arduino based approach provides to improve their awareness of indoor air conditions. In future, this type of projects will be demanding for environmental awareness. The aim of the project is to get cost-effectiveness and easy to get real time results of air quality.