INDOOR AIR QUALITY MONITORING SYSTEM

Project Exhibition –1

Submitted in partial fulfillment for the award of the degree of

Bachelor of Technology

In

Electronics And Communication Engineering

(Specialization in Ai and Cybernetics)

Submitted to

VIT BHOPAL UNIVERSITY (M.P.)

Submitted by

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Under the Supervision of

Dr. Thiyagu Priyadharsan

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

VIT BHOPAL UNIVERSITY

BHOPAL (M.P.)-466114

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SCHOOL OF ELECTRICAL & ELECTRONICS ENGG.

CANDIDATE'S DECLARATION

I hereby declare that the Dissertation entitled "INDOOR AIR QUALITY MONITORING SYSTEM" is my own work conducted under the supervision of thanks **Dr. Thiyagu priyadharsan** , assistant professor , SEEE at VIT University, Bhopal.

I further declare that to the best of my knowledge this report does not contain any part of work that has been submitted for the award of any degree either in this university or in other university / Deemed University without proper citation.

Laxmi Parmar (21BAC1003)

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Date: 3/09/2022

Dr. Thiyagu Priyadharsan

Assistant professor (SEEE)

Digital Signature of Guide

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CERTIFICATE

This is to certify that the work embodied in this Project Exhibition -1 report entitled **"Indoor air quality monitoring system"** has been satisfactorily completed by **Ms./Mr.Laxmi Parmar, Aashish Barpete, Manish Meena**.Registration No. **21BAC10033, 21BAC10037, 21BAC10038** respestively in the School of Electrical & Electronics Engineering at VIT University, Bhopal. This work is a bonafide piece of work, carried out under my/our guidance in the School of Electrical & Electronics Engineering for the partial fulfilment of the degree of Bachelor of Technology.

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Assistant Professor SEEE

Forwarded by

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DR DEBASHIS ADHIKARI

Professor & Dean

Acknowledgement

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Executive Summary

Indoor Air Quality Monitoring or Testing (IAQ) is an essential process to determine the level of contaminants present in indoor air which can affect productivity & well-being of occupants. This project provides a combination of process of sensing several gas levels in the air and also the ambient temperature and humidity, thus sensing the quality of the air. The levels of the gases and the temperature is displayed in a LCD display panel , which continuously shows the real time output values of the gas sensors , temperature and humidity sensor, to measure and display temperature and humidity level of the environment. To combine advanced detection technologies to produce an air quality sensing system with advanced capabilities to provide low cost comprehensive monitoring. To display the sensed data in user friendly format in LCD display panel.

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INTRODUCTION

Indoor Air Quality Monitoring or Testing (IAQ) is an essential process to determine the level of contaminants present in indoor air which can affect productivity & well-being of occupants. Good and healthy Air Quality at the workplace can increase worker's comfort, productivity and well-being. The main objective of this project is to devise a simple low cost arduino based air pollution monitoring system using wireless technology which finds presence of various gases like CO2 , CO , NH3 and it can also detect the presence of alcohol, smog , lpg gas etc and parameters like humidity, temperature etc. We can also use these project as lpg detector , alcohol detector , smog detector etc. We can use this project in our homes, universities , community kitchens , offices and villages. To create a tool which will monitor the quality of air of our environment, content of different gases present in air or area around us and display the data on LCD.

LITERATURE RIVIEW

1.Title- Electronic System for Real-Time Indoor Air Quality Monitoring

Published in – The 8th IEEE International Conference on E-Health and Bioengineering – EHB 2020 Grigore T. Popa University of Medicine and Pharmacy, Web Conference, Romania, October 29-30, 2020 .

The system involves 8 detectors: RD200M, SPS30, SVM30, DGS-CO 968-034, DGS-H2S 968-036, DGS-O3 968- 0424, DGS-NO2 968-043, and the DGS-SO2 968-038. The detectors were chosen to be able to provide sufficiently accurate data for the system to fulfill its role, and to a certain extent, it can even be stated that the performance-cost ratio associated with these components is significantly high. The data generated by the sensors is received by the processing module of the system, which is represented by the microcontroller of the Arduino Mega 2560 REV3 development board.

2.Title-A real-time ambient air quality monitoring wireless sensor network for schools in smart cities.

Published in: Smart Cities Conference (ISC2), 2015 IEEE First International.

Authors:H**.** Ali, J. K. Soe, Steven. R. Wel.

(School of Electrical Engineering & Computer Science, The University of Newcastle, Callaghan, NSW 2308, Australia)

In this paper, a low-cost solar-powered air quality monitoring system based on ZigBee wireless network system technology is presented. The solar powered network sensor nodes can be deployed by schools to collect and report real-time data on carbon monoxide (CO), nitrogen dioxide (NO2), dust particles, temperature, and relative humidity. The proposed system allows schools to monitor air quality conditions on a desktop/laptop computer through an application designed using LabVIEW and provides an alert if the air quality characteristics exceed acceptable levels. They tested the sensor network successfully at the Singapore campus of the University of Newcastle, Australia. The experimental results obtained by them demonstrated that the sensor network can provide high-quality air quality measurements over a wide range of CO, NO2 and dust concentrations.

3.Title-Design of Indoor Air Quality Monitoring Systems

Published in -2020 4th International Conference on Electrical, Telecommunication and Computer Engineering (ELTICOM)

Authors-Tigor Hamonangan Nasution department of Electrical Engineering Universitas Sumatera Utara Medan, Indonesia tigor.nasution@usu.ac.id

The development of sensor technology that is part of the automated monitoring technology has also developed. Monitoring systems are used by various fields such as health, agriculture, disaster management, and so on. The type of device or system used for remote monitoring varies depending on the object being monitored and the monitoring area. Therefore, in this study, we designed a system that can monitor indoor air quality. This research was conducted based on several previous studies on indoor monitoring. This research is also a continuation of our previous study. We previously designed a system for monitoring outdoor air quality. We have also developed a system to monitor the temperature and humidity in the server room. Unlike previous studies, this time, we designed a system that can monitor indoor air quality by using ESP32 as a controller. The parameters we watch in our research are temperature, humidity, H2S, NH3, CO, NO2, and SO2.

PROBLEM FORMULATION AND PROPOSED METHODOLOGY

PROBLEM FORMULATION

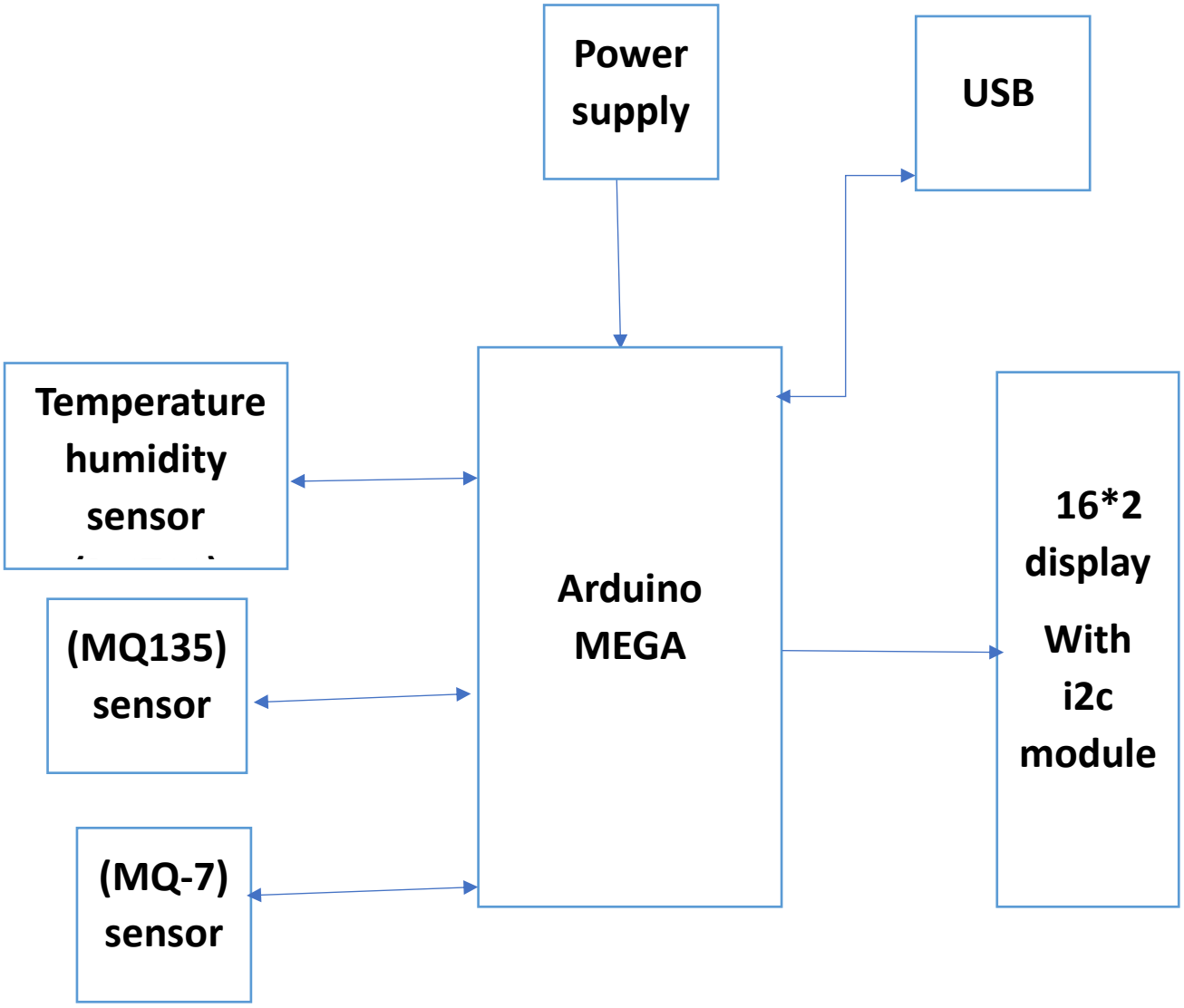
Air pollution is one of environmental issues that cannot be ignored. Inhaling pollutants for a long time causes damages in human health.Traditional air quality monitoring methods such as- building air quality monitoring stations , are typically expensive. This project is suitable for air quality monitoring in real time.

PROPOSED METHODLOGY

The working of the project can be clearly explain by considering the indoor air quality monitoring system.Project's basic principle of working is the sensing of data from the sensor.Basically we are using three sensors that are MQ7 (CO sensor),DHT11 (temperature and humidity sensor), MQ135 (gas sensor).Convert the analog (Voltage) data into digital form.Process the digital data and display it on LCD.

BLOCK DIAGRAM

Fig2.1.1 Block Diagram



CIRCUIT DIAGRAM

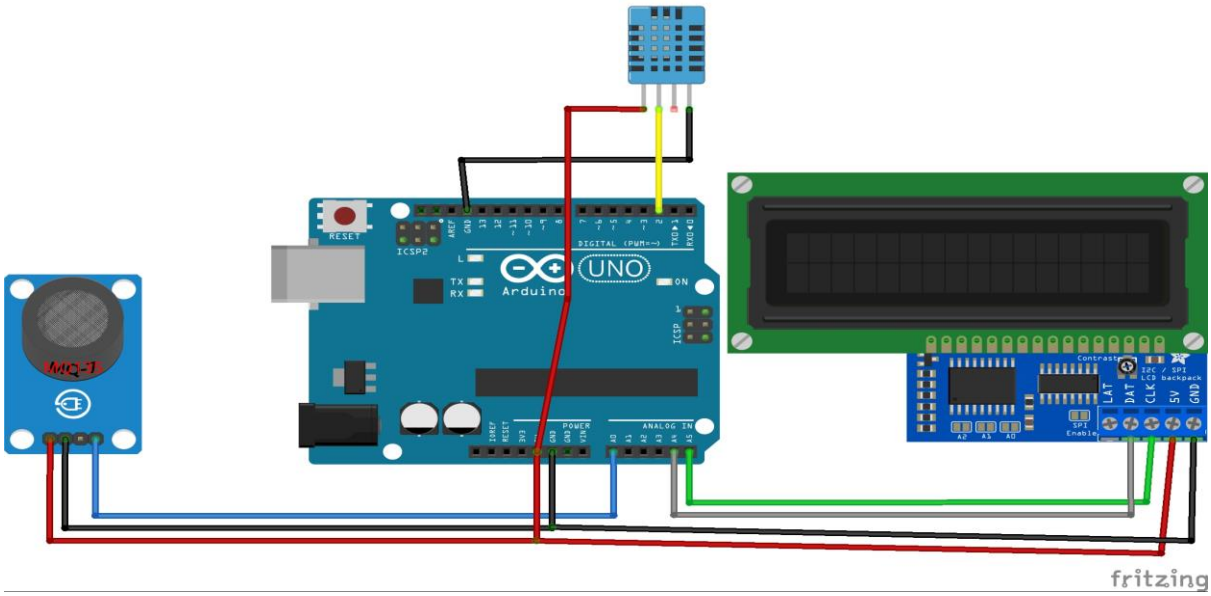


Fig.2.1.3 Circuit Diagram

COMPONENTS DISCRIPTION

ARDUINO MEGA 2560-

The Arduino MEGA 2560 is designed for projects that require more I/O lines, more sketch memory and more RAM. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects. This gives your projects plenty of room and opportunities maintaining the simplicity and effectiveness of the Arduino platform. This document explains how to connect your Mega2560 board to the computer and upload your first sketch. The Arduino Mega 2560 is programmed using the Arduino Software (IDE), our Integrated Development Environment common to all our boards and running both online and offline.

Fig.3.2.1.1 Arduino mega

USB-

The USB connection with the PC is necessary to program the board and not just to power it up. The Mega2560 automatically draw power from either the USB or an external power supply. Connect the board to your computer using the USB cable. The green power LED (labelled **PWR**) should go on.

Temperature and humidity sensor (DHT11):-

Product Description:

DHT11 digital temperature and humidity sensor is a composite Sensor contains a calibrated digital signal output of the temperature and humidity. Application of a dedicated digital modules collection technology and the temperature and humidity sensing technology, to ensure that the product has high reliability and excellent long-term stability. The sensor includes a resistive sense of wet components and an NTC temperature measurement devices, and connected with a high-performance 8-bit microcontroller.

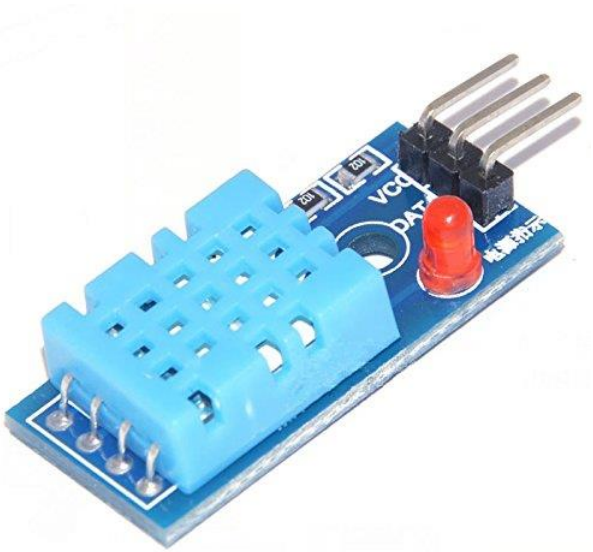


Fig. 3.2.1.2 DHT11 Sensor

Pin Description:

- 1, the VCC power supply 3.5～5.5V DC
- 2 DATA serial data, a single bus
- 3, NC, empty pin
- 4, GND, used to connect the module to system ground

MQ 7 sensor-

This Carbon Monoxide (CO) gas sensor detects the concentrations of CO in the air and outputs its reading as an analog voltage. The sensor can measure concentrations of 10 to 10,000 ppm. The sensor can operate at temperatures from -10 to 50°C and consumes less than 150 mA at 5 V. To use the Sensor Module, you have power the device with 5V supply and the Power LED will start to glow. To power it, you can use external supply or connect +5V and GND pin of Arduino. You should give it some preheating time before start reading the output. While measuring the gas present, the Output LED will glow in a specific concentration of the gas. You can change it by using the potentiometer.

Fig. 3.2.1.3 MQ7 sensor

SENSITVITY ADJUSTMENT

Resistance value of MQ-7 is difference to various kinds and various concentration gases. So, When using this components, sensitivity adjustment is very necessary. we recommend that you calibrate the detector for 200ppm CO in air and use value of Load resistance that(RL) about 10 KΩ(5KΩ to 47 KΩ).

When accurately measuring, the proper alarm point for the gas detector should be determined after considering the temperature and humidity influence. The sensitivity adjusting program:

a. Connect the sensor to the application circuit.

b. Turn on the power, keep preheating through electricity over 48 hours.

Air Quality Sensor (MQ135):-

Product Description:

Air quality click is suitable for detecting ammonia (NH3), nitrogen oxides (NOx) benzene, smoke, CO2 and other harmful or poisonous gases that impact air quality. The MQ-135 sensor unit has a sensor layer made of tin dioxide (SnO2), an inorganic compound which has lower conductivity in clean air than when polluting gases are present. To calibrate Air quality, use the on-board potentiometer to adjust the load resistance on the sensor circuit.

Fig3.2.1.4 MQ135 sensor

Pin Description:

- 1, the VDD power supply 5V DC.
- 2,GND , used to connect the module to system ground.
- 3, DIGITAL OUT, you can also use this sensor to get digital output from this pin, by setting a threshold value using the potentiometer.
- 4, ANALOG OUT, this pin outputs 0-5V analog voltage based on the intensity of the gas.

Specifications of MQ-135 gas sensor-

- Wide detecting scope • Fast response and High sensitivity
- Stable and long-life Simple drive circuit
- Used in air quality control equipment for buildings/offices, is suitable for detecting of NH3, NOx, alcohol, Benzene, smoke, CO2, etc.
- Size: 35mm x 22mm x 23mm (length x width x height)
- Working voltage: DC 5 V • Signal output instruction.
- Dual signal output (analog output, and high/low digital output)
- 0 ~ 4.2V analog output voltage, the higher the concentration the higher the voltage.

Applications:

- Domestic air pollution detector
- Industrial air pollution detector
- Portable air pollution detector

16X2 LCD Panel:-

Product Description:

A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. [1] LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and seven-segment displays.

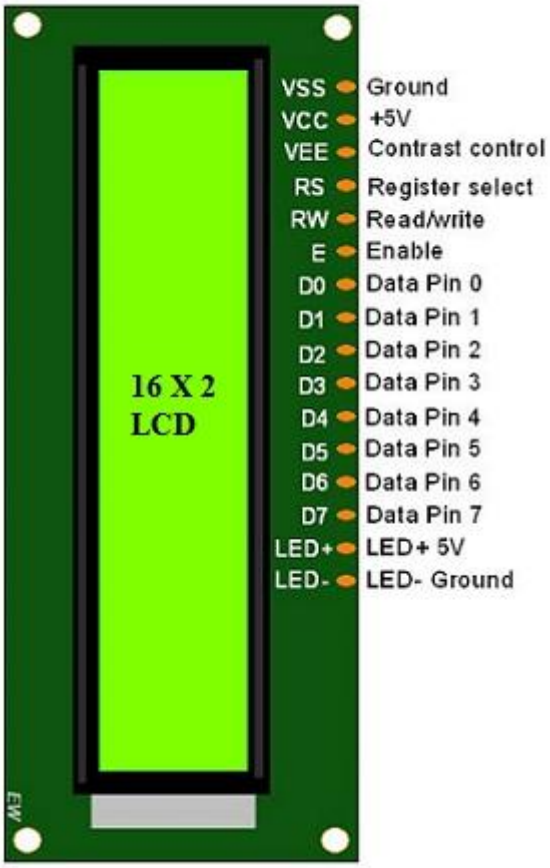


Fig. 3.2.1.5 LCD

Features of LCD16x2

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers
- Is display can work on two modes like 4-bit & 8-bit
- These are obtainable in Blue & Green Backlight
- It displays a few custom generated characters

Jumper wires

Generally, jumpers are tiny metal connectors used to close or open a circuit part. They have two or more connection points, which regulate an electrical circuit board.Their function is to configure the settings for computer peripherals, like the motherboard. Suppose your motherboard supported intrusion detection. A jumper can be set to enable or disable it.Jumper wires are electrical wires with connector pins at each end. They are used to connect two points in a circuit without soldering.You can use jumper wires to modify a circuit or diagnose problems in a circuit. Further, they are best used to bypass a part of the circuit that does not contain a resistor and is suspected to be bad.This includes a stretch of wire or a switch. Suppose all the fuses are good and the component is not receiving power; find the circuit switch. Then, bypass the switch with the jumper wire.

Types of Jumper Wires:

- Male-to-male jumper
- Male-to-female jumper
- Female-to-female jumper

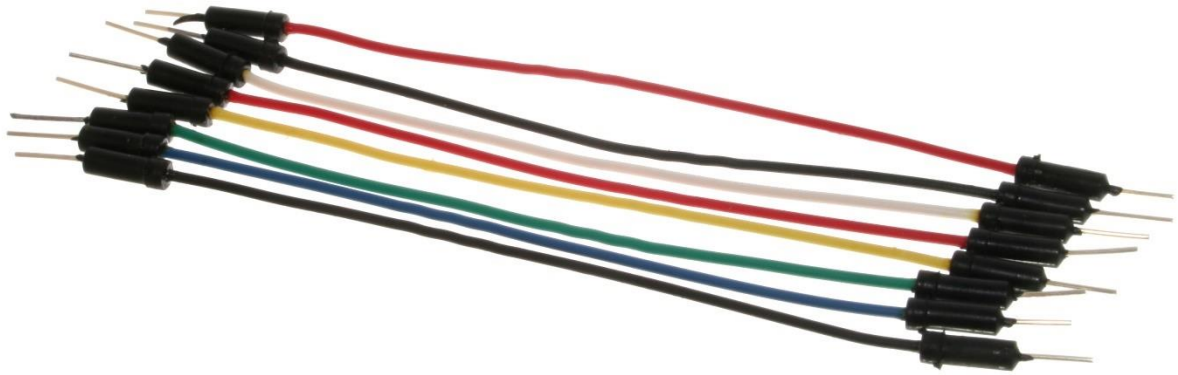
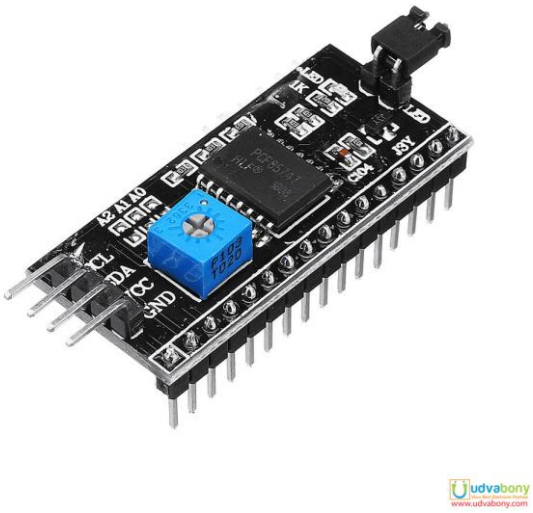


Fig.3.2.1.6 Jumper wires

I2C module for lcd

This is a RoHS compliant I2C Serial LCD Daughter board that can be connected to a standard 16×2 or 20×4 Character Display Module that supports 4-bit mode. All Character Modules sold on our site support 4-bit mode, and nearly all commercially available 16×2 and 20×4 line character modules support it too.

This board has a PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display. There are many examples on the internet for using this board with Arduino. Do a search for "Arduino LCD PCF8574". The I2C address is 0x3F by default, but this can be changed via 3 solder jumpers provided on the board. This allows up to 3 LCD displays to be controlled via a single I2C bus (giving each one it's own address)



Fig,3.2.1.7 I2c module

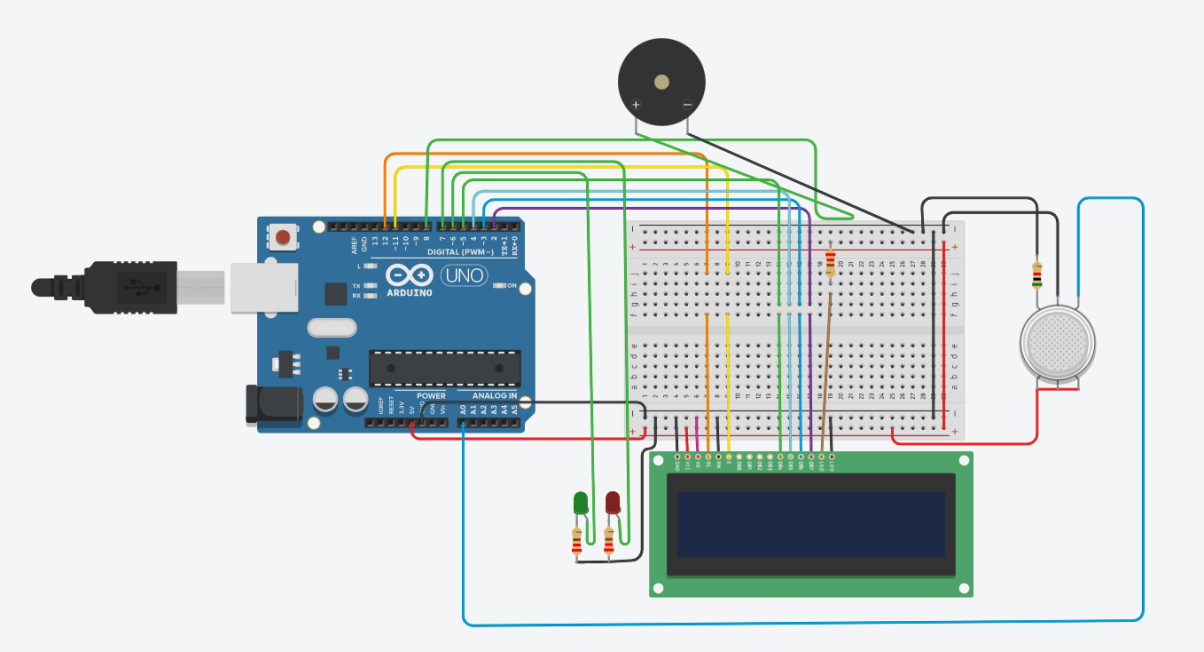
This section mentions some of the features and specifications of the I2C Serial Interface Adapter Module.

1. Operating Voltage: 5V DC
2. I2C control using PCF8574
3. Can have 8 modules on a single I2C bus
4. I2C Address: 0X20~0X27 (the original address is 0X20, you can change it yourself via the onboard jumper pins)

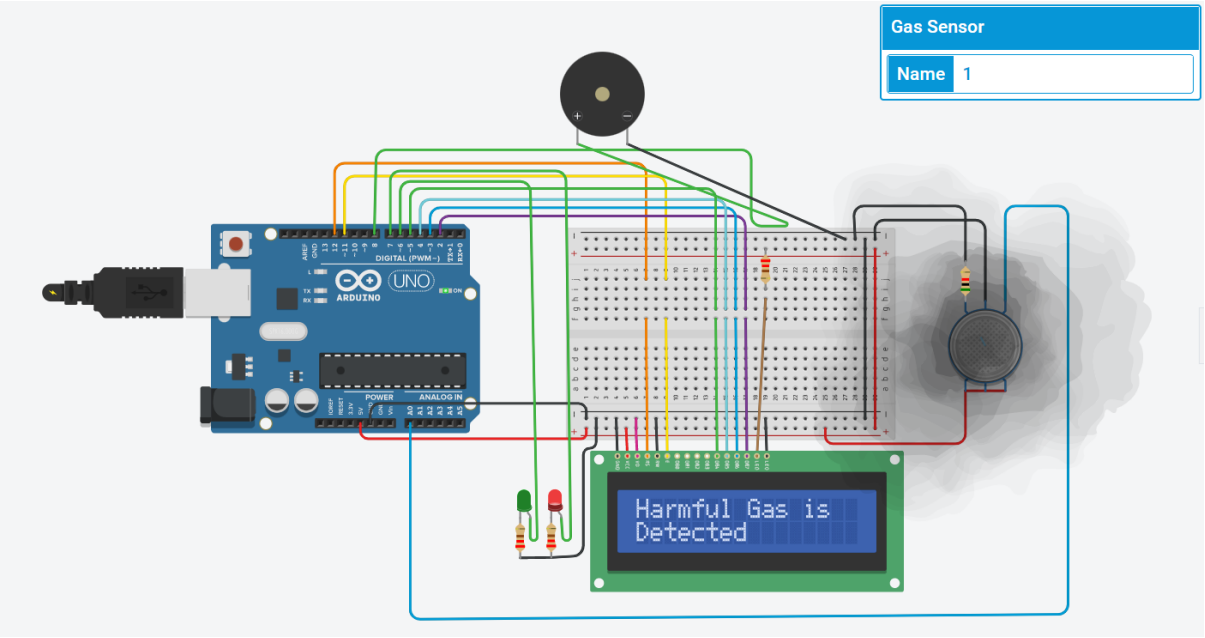
SIMULATION

Fig.2.1.2 Simulation

Plugged out(a)



Plugged in (b)



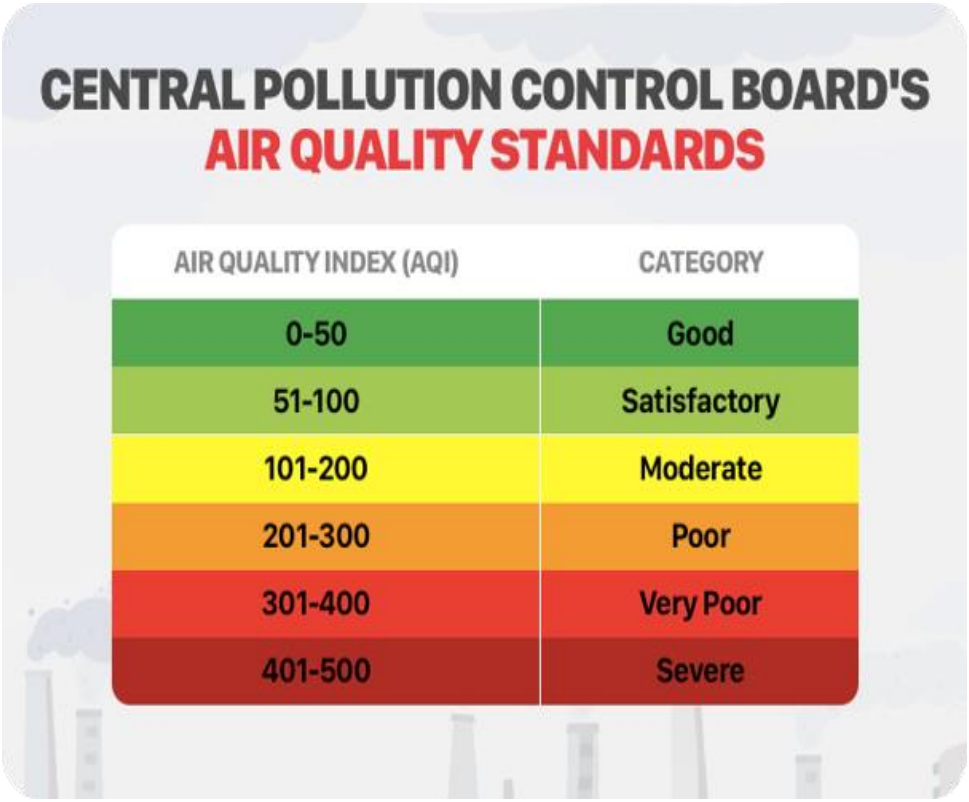
RESULTS AND DISCUSSION

RESULTS

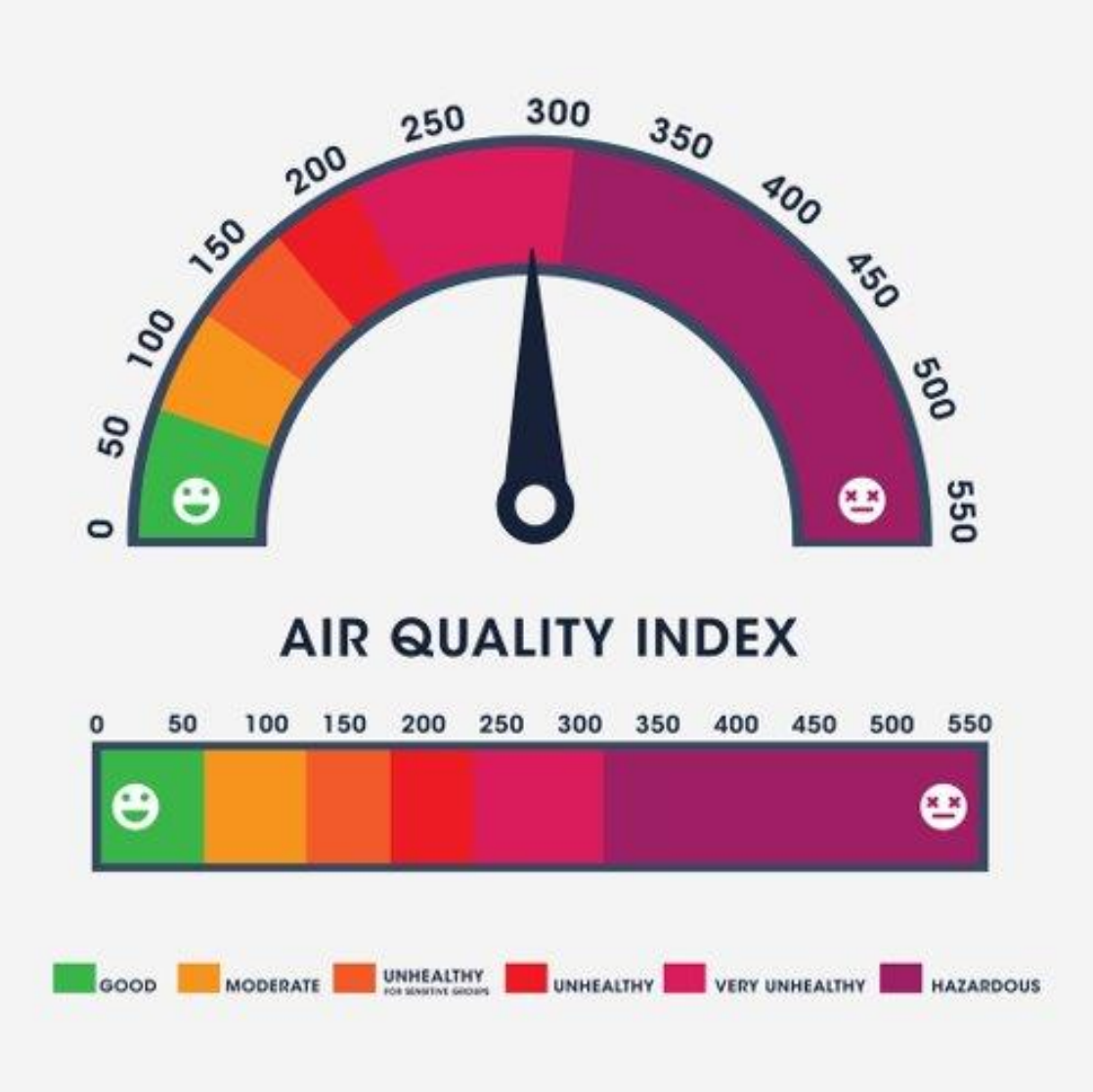
Reading

According to the Indian Government (CPCB), Indian AQI range is from 0-500, from 0 being good and 500 being severe. There are eight major pollutants to be taken into account for AQI calculation, viz. particulate matter (PM 10 and PM 2.5), carbon monoxide (CO), ozone (O3), nitrogen dioxide (NO2), sulfur dioxide (SO2), ammonia (NH3), and lead (Pb). To calculate AQI, data for a minimum of three pollutants must be present, of which one should be either PM10 or PM2.5, AQI ranging from 0-500 has different concentrations for each pollutant and has health effects accordingly.

AQI



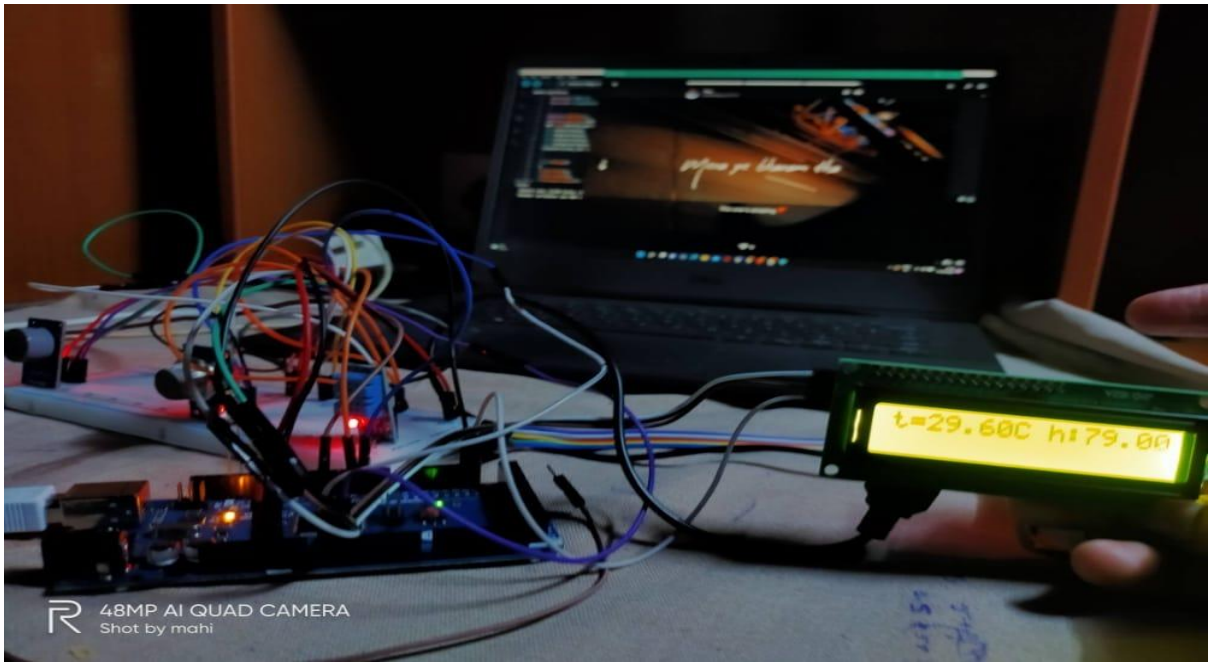
AIR QUALITY INDEX GRAPH

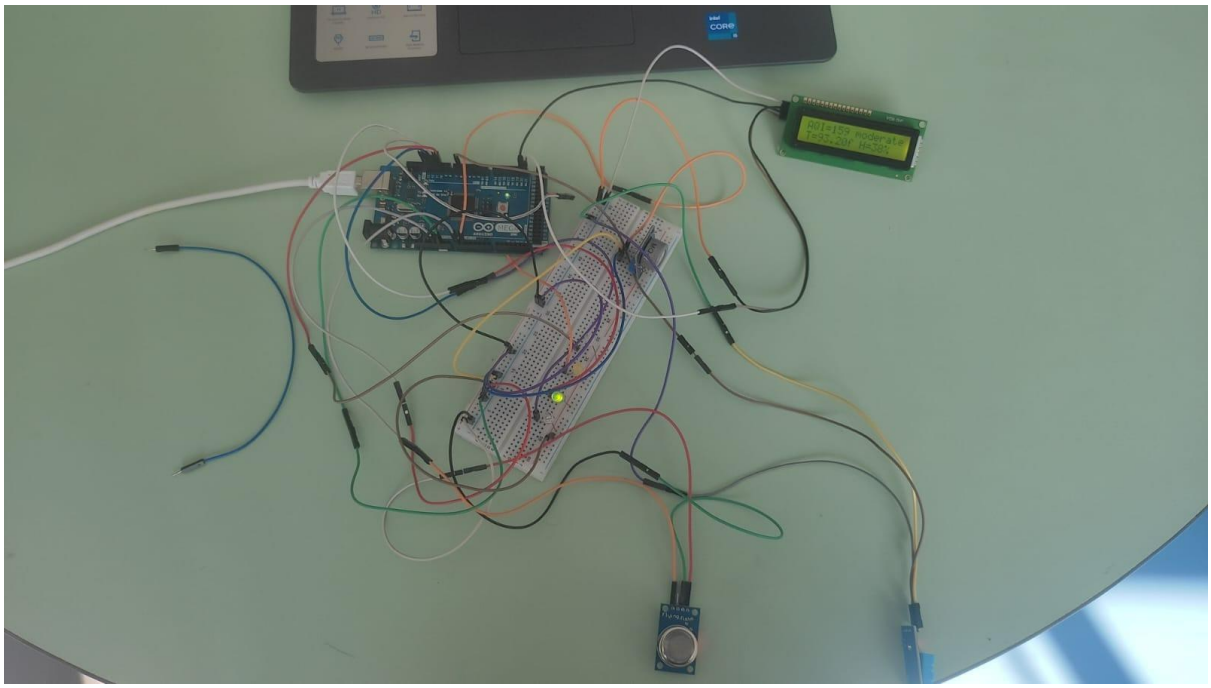


Conversion of Sensor Values into AQI

```
  mq135sensorValue = analogRead(0);
  mq7sensorValue = analogRead(1);
  Serial.print("co=");
  Serial.print(mq7sensorValue,DEC);
  Serial.print(" ppm ");
  Serial.print("AirQua=");
Serial.print(mq135sensorValue, DEC);               // prints the value read
Serial.println(" PPM");
int AQI = map(mq135sensorValue,100,1000,0,500);
Serial.println(AQI);
int CO = map(mq7sensorValue,10,500,0,500);
Serial.println(CO);
```

IMPLEMENTATION





CONCLUSION & FUTURE SCOPE

CONLUSION

Quality of air monitoring is a planned application space which is of specific incentive to the society. For monitoring the quality of air from numerous sources by utilizing the demonstrative ability of the system is extremely useful. This project is very helpful as the Quality of the air can be monitored over the Android base mobile system and it also alarms an produces warning whenever the IAQ decreased beyond the permissible limit. This system is very useful in the arrangement like universities, hospitals, warehouses where circulation of outdoor air is provided in constrained manner and even a small degradation in the quality of air may severely affect the performance of the individual residing in the area in terms of breathing troubles. The system was tested with one sensor node, it may easily adapt to include more sensing nodes.

FUTURE SCOPE

In the near future ,this system can be modified to add a lot more features by increasing highly sensitive, selective sensors. Also, measured sensor data can be stored in a database, and cloud server.

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