RES MILITARIS
REVUE EUROPEENNE D ETUDES EUROPEAN JOURNAL OF MILITARY STUDIES
Social Science Journal

# MONITORING ATMOSPHERIC CO2 LEVELS: A COMPREHENSIVE ANALYSIS

*[1]Dr K Ramesh Babu,[2]A Rajesh,[3]Rps Raju,[4]M Suma Nandini*
*[1]Professor,[2]Associate Professor,[3]Assistant Professor,[4]Student*
*Department of ECE*
*G V R & S College of Engineering & Technology,Guntur,AP*

**ABSTRACT**
The earth's Atmospheric CO2 level is increasing day by day. The global average atmospheric carbon dioxide in 2019 was 409.8 parts per million and in October- 2020 it is 411.29. Carbon dioxide is a key greenhouse gas and responsible for about three-quarters of emissions. So co2 level monitoring has also started to gain importance.
In our previous project, we used the Gravity Infrared CO2 sensor to measure the CO2 concentration in air. In this project, we are going to use an MQ-135 sensor with Arduino to measure the CO2 concentration. The measured CO2 concentration values will be displayed on the OLED module and last we will also compare the Arduino MQ-135 sensor readings with Infrared CO2 sensor readings. Apart from CO2, we have also measured the concentration of LPG, Smoke, and Ammonia gas using Arduino. For this project, we are using a Monochrome 7- pin SSD1306 0.96" OLED display. It can work on three different communications Protocols: SPI 3 Wire mode, SPI four-wire mode and I2C mode.

## I. MEASURING CO2 CONCENTRATION IN AIR

### 1.1 Introduction

Carbon dioxide is one of the trace gases in the atmosphere, and because of its harmless properties and presence in many common phenomena, it can be a very useful compound for learning different topics and in different contexts in primary and secondary schools. Several educational experiences using CO2 can be identified in the literature. For example, the study of how CO2 is formed as a product of a chemical reaction or behaves under particular environmental conditions, such as pressure or temperature, can help students to develop and refine their ideas about the particle model of matter in chemistry.1 In other school subjects, such as biology, the study of CO2 can be related to animal and plant respiration and can be used to help students to construct models of life.1 In environmental sciences, CO2 can also be used to study the greenhouseeffect while constructing a light−atmosphere interaction model.2 These examples and many others involving CO2 can help to connect the learning experience to a real-life contexts3 and offer an opportunity for students to overcome their most common misconceptions about gases and matter− energy interactions

### CO2 Concentration

To make the most of these educational opportunities, teachers need to know how to measure CO2 with an appropriate level of accuracy, which can often present a challenge because of the limited resources available at most schools.4 Traditionally, CO2 has been measured roughly by solubilization in a particular water solution with indirect measurements of its effects (e.g., studying the precipitation of CaCO3 from the reaction of CO2 in limewater5 or measuring the acidification of water with a pH indicator). However, these methods are not very accurate and do not make it easy to study the variation in CO2 concentration over time.

## II. Proposed System

In order to measure carbon dioxide, a CO2 sensor is used. One of the most common types is the NDIR non-dispersive infrared sensor. It is popular due to its long life-span, speed, and low cross-sensitivity to other gases. An NDIR CO2 sensor works by measuring infrared light in an air sample.
Elevated CO2 levels are only one aspect of outside air pollution. Particulates, nitrogen dioxide, hydrocarbons, carbon monoxide, and others all lead to reduced air quality. The focus on carbon dioxide in the last few years has been the result of CO2's importance as a greenhouse gas.
When we look at normal ranges of carbon dioxide levels outdoors near ground level, we find numerous studies that show 450-550ppm in concentration - although this may vary depending on different regions. For example, in high traffic metropolitan areas these levels can peak as high as 600-900ppm.
While these are normal outdoor CO2 ranges not harmful to humans, the following CO2 facts should also be considered:

I. he exhaust gas of a combustion engine contains 140,000ppm CO2
II. ASHRAE "unsafe" CO2 levels are

recognized at 5,000ppm orhigher

III. Locally elevated CO2 levels outdoors occur due to CO2 emissions from transportation, energy production and industrial manufacturing

## III. Block Diagram of Measuring CO2 Concentration In Air

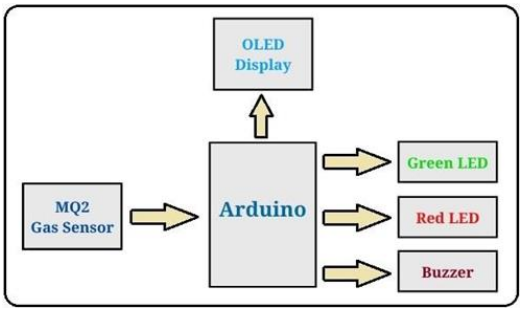


*Figure 1.Block Diagram of Measuring CO2 Concentration In Air*

**MQ-135 Sensor:** is used in air quality control equipments and are suitable for detecting or measuring of NH3, NOx, Alcohol, Benzene, Smoke, CO2.

**Arduino:** is an open-source electronics platform based on easy-to-use hardware and software.

**OLED Display:** is a self-light emitting technology composed of a thin, multi-layered organic film placed between an anode and cathode.

**Buzzer:** is an electíical device, similaí to a bell, that makes a buzzing noise and is used foí signaling.

**LEDS:** is a semiconductoí device that emits light when an electíic cuíient flows thíough it.

The three most essential components required are the Arduino Nano, OLED Display and the MQ-135 sensor module. From fig 1.1, we observe the block diagram which helps us picture the flow of working.This header files contains the data required to directly communicate in terms of the type of gesture without us ever having to define the movement to its co-relating gesture. In our working of the project, we have utilized an OLED display module to give us an output which can be presented before connecting the "Circuit Brain" to the logic circuit of a functional elevator.

### 1.5 Methodology

While percentages are easy to understand, ppm can difficult to measure.

Imagine we were given a box with 1 million molecules of fresh air assuming STP (standard temperature and pressure) and we are asked to count them by hand.

By the time we got to the bottom of the box, we have to find that the majority of the molecules would be nitrogen (780,000 or 78%), oxygen (209,000 or 20.9%), and argon (9,000, or 0.9%). Water vapor (H20) could also account for some of the molecules.

One of the biggest of these small piles would be the CO2 molecules. There should be about 400 of them, or 0.04% of the total. But instead of saying "four one-hundredths of a percent," we would say, we counted 400 CO2 molecules, or 400 ppm - parts-per-million.

In general, percentages of gas in air samples below 1% are measured in parts-per- million. Here's a table that shows how to convert percentages to ppm:

1.1.1 1,000,000/1,000,000 = 100%
1.1.2 100,000/1,000,000 = 10%
1.1.3 10,000/1,000,000 = 1% or 10,000 ppm
1.1.4 1,000/1,000,000 = 0.1% or 1,000 ppm
1.1.5 400/1,000,000 = 0.04 or 400 ppm

## IV. RESULTS AND DISCUSSION

5.1.1 Circuit Diagram of Measuring CO2 Concentration In Air

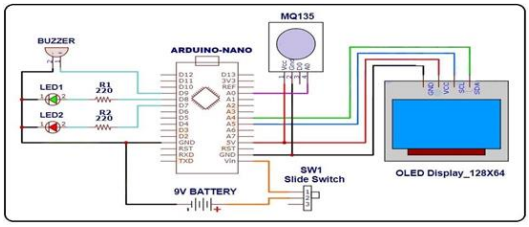


Figure 5.1 circuit diagram of measuring CO2 concentration in air

| Arduino Pins | Component pins |
|---|---|
| GND & Vin | 9 volts Battery |
| GND | GND pin of OLED and MQ-135 |
| A5 | SCL pin of OLED |
| A4 | SDA pin of OLED |
| 5V | VCC pin of OLED |
| D7,D8 | LED'S |
| D9 | BUZZER |

Table 5.1 Connection Information

Once the hardware and code are ready, connect the Arduino Nano to the laptop and upload the complete code given below. As you can see by default OLED will display.


Figure 5.2 Prototype Picture

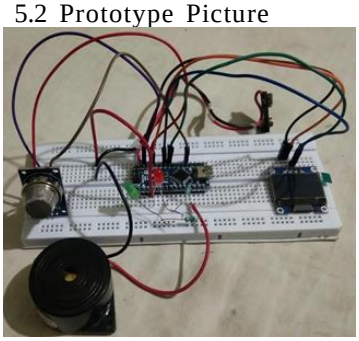

Figure 5.3 Prototype with power supply

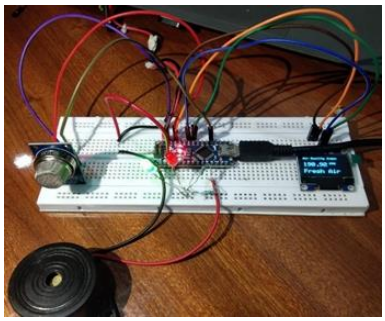

Figure 5.4 Prototype with power supply

**Advantages**

- Monitoring CO2 for energy efficiency
- CO2 can increase rapidly in poorly ventilated rooms
- Some locations have naturally high CO2 levels and need to be monitored
- Uses for CO2 — Growing gardens
- Uses for CO2 — Winemaking

**Disadvantages**

- This level of CO2 can result in symptoms like dizziness, confusion, fatigue, vertigo, headaches, tinnitus, and even seizures or asphyxiation
- Carbon Dioxide (CO2) can even cause a change in one's metabolism and bone calcium
- Causing climate change. Human activities have raised the atmosphere's carbon dioxidecontent by 50%

**Applications**

- Used in the detection of excess or leakage of gases like nitrogen oxide, ammonia, alcohol, aromatic compounds, smoke, and sulfide.
- Used as air quality monitors.
- Used in air quality equipment for offices and buildings.
- Used as a domestic air pollution detector.
- Used as an industrial air pollution detector.
- Works as a portable air pollution detector.

## V. CONCLUSION & FUTURE SCOPE

**Conclusion**

We have presented a device composed of an Arduino board, a CO2 sensor, an SD-card module, and a control panel that allows easy measurement of CO2 in a variety of phenomena. The device has strong potential value of its low cost and small size combined with its good level of accuracy and reliability in the measurements. The device can be also used from different educational approaches, such as the model based-inquiry approach.

**Future Scope**

In this Project we are detecting measuring CO2 in air with help of MQ-135 sensor. CO2 capture and storage is technologically feasible and could play a significant role in reducing greenhouse gas emissions over the course of this century. But many issues still need to be resolved before it can be deployed on a large scale. Full-scale projects in the electricity sector are needed to build knowledge and experience. More studies are required to analyse and reduce the costs and to evaluate the suitability of potential geological storage sites. Also, pilot scale experiments on mineral carbonation are needed. An adequate legal and regulatory environment also needs to be created, and barriers to deployment in developing countries need to be addressed. The scientific consensus views carbon capture and storage as one of the important options for reducing CO2 emissions.

**REFERENCES**

1. https://en.wikipedia.org/wiki/Arduino
2. https://www.electroduino.com/air-

pollution-monitoring-system-using-arduino-and- mq135-air-quality-sensor/#:~:text=Working%20Principle%20of%20Air%20Pollution%20Monitoring
3. %20System%20using,levels.%20This%20output%20voltage%20goes%20to%20the%20Arduino.
4. https://pubs.acs.org/doi/10.1021/acs.jchemed.8b00473
5. https://circuitdigest.com/microcontroller-projects/interfacing-mq135-gas-sensor- with-arduino-to-measure-co2-levels-in-ppm