Air Pollution Detection Using Arduino

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Abstract— **The term "Air Pollution" generally refers to the outdoor air pollution, mainly caused by combustion of fossil fuels by industrial plants, smog, and emissions from cars and trucks. But the air indoors can also be polluted. Indoor air pollution refers to the contamination of indoor air. It may cause harmful health issues. The main sources of indoor air pollution are pesticides, chimneys which contain pollutants such as particulate matter, biomass smoke, fireplaces, moulds, and environmental tobacco smoke. The pollutants are nitrogen dioxide (NO2), Ammonia, sulphur dioxide (SO2), radon, carbon monoxide (CO), carbon dioxide (CO2) and benzene. In this Internet of Things (IoT) project, wireless air pollution monitoring system is built, to measure the concentration of pollutants. The microcontroller used is the Arduino Uno. The sensor used is MQ135, air quality sensor, which along with microcontroller can be used to monitor the pollution indoors.**

Keywords— **Air pollution, Arduino Uno, IoT, MQ123 sensor.**

1. INTRODUCTION

Air pollution is a concern in indoor spaces such as home jobs or schools. The air at these places must be properly monitored, as it is inhaled by human beings in large amounts during respiration. Indoor air pollution refers to the degradation of air at indoors [1], [1], [2]. The main sources of indoor air pollution are biomass smoke, fireplaces, stoves, biological contaminants like pollen, household products, moulds, chimneys which contain pollutants such as particulate matter, nitrogen dioxide (NO2), sulphur dioxide (SO2) and carbon monoxide (CO), pesticides, materials used in the buildings such as asbestos, formaldehyde and lead [1], [3]. In reality, 15% of the indoor air pollution is caused by humans and 85% from non-human sources [3]. Some other pollutants are radon, environmental tobacco smoke, Ammonia, carbon dioxide, and benzene.

It has adverse effects on health, i.e., exposure to high concentrations of certain pollutants may cause immediate death. According to WHO, nearly 2 million people die every year, prematurely, due to diseases caused because of usage of solid fuel [4]. Almost 50% of pneumonia deaths in children are due to particulate matter inhaled from the indoor air [4]. A lot of people die from chronic obstructive respiratory disease (COPD) that develop due to exposure to indoor smoke [4]. Indoor air pollution may cause several diseases like lung cancer, flu, respiratory irritations, loss of coordination, asthma, and allergic reactions [1]. Due to the serious effects caused by Indoor Air Pollution, there is a need for it to be monitored and controlled. According to the National Institute for Occupational Safety and Health (NIOSH), the indoor air concentrations of carbon dioxide that exceed 1,000 ppm indicate inadequate ventilation [7].

The main goal of our project is to identify the level of air pollution. We want to implement a system that will check the level of purity of air particles and gas floating in the air. When the level of all these elements in the air increases, the light will blink and the buzzer will active. In this way the cause of pollution can be avoided by identifying the pollution.

2. LITERATURE REVIEW

Air Pollution has become the biggest problem in recent days, due to a variety of factors like increase in population, building houses by cutting down the trees (thus reducing the amount of oxygen in air), burning the biomass, usage of leaky stoves, reduced ventilation and so on. For Indoor pollution, effect on the health is more [2]. Some research papers related to the above problem are studied. In those designed systems, the air in the atmosphere is sensed by using one of the wide variety of sensors available to measure various gases. The sensitive material used is Tin Oxide (SnO2), whose conductivity is low when the air is pure and clean [6]. As the pollutants start accumulating in the air, which is sensed by the sensor, the conductivity of the oxide increases. Corresponding calculations are made to find the number of pollutants in the air.

The CO2 level in air exhaled by humans is about 38,000 to 48,000 parts per million(ppm). Since predictable levels of carbon dioxide is exhaled by people in the indoors, its amount in the indoor air can be used as a significant indication of the quality of air. The adequacy of the supply of fresh air is often assessed by the level of CO2 in a room. An indoor CO2 concentration of less than 1000 ppm indicates the fresh air supply [5]. The main sources of CO2 are human metabolic activities and combustion sources [3]. Some other sources are kerosene, gas space heaters, and tobacco smoke. This IoT project uses Air quality sensor MQ135 to monitor the air pollution in its surroundings. According to the datasheet of MQ135, the sensor is sensitive for CO2, Alcohol, Benzene, NOx, and NH3 [6]. But CO2 is the fourth most abundant gas in the earth's atmosphere with a concentration of about 350 ppm. This concentration is much higher than all the other gases the sensor detects. So, with the proper calibration of the sensor, the sensor can detect CO2 in the normal atmosphere.

Table 1
Carbon dioxide levels and health problems

Concentration	Effect
250-350 ppm	Normal concentration in outdoor ambient air
350-1000 ppm	Concentrations of occupied indoor spaces with good air exchange
1000-2000 ppm	Poor air and causes drowsiness
2000-5000 ppm	Stagnant and stuffy air. Headaches, sleepiness, increased heart rate and slight nausea may also be present
5000 ppm	Workplace exposure limit
>40,000 ppm	Exposure may lead to serious oxygen deprivation resulting in permanent brain damage, coma, even death

3. METHODOLOGY

3.1 Introduction

This project is based on Arduino Uno and MQ135 gas sensor. Arduino is an open-source prototyping platform. MQ-135 gas sensor provides the system with data which is calculated to find the concentration of gases like CO, CO2, NH4, Acetone, Toluene and Ethanol.

3.2 Working principal of the proposed project

The MQ135 sensor receives air as input to measure the concentration of different gases like CO, CO2, SO2 etc. The sensor is connected to Arduino Uno with a display port. The display port shows the output from the sensor. The power is supplied by the USB port using a USB cable. If the concentration is higher than usual, the connected buzzer with be turned on to notify the unusual air pollution rate.

3.3 Components

To implement this project, we will need some basic equipment-

- MQ135 Air Quality Sensor

- Arduino Uno

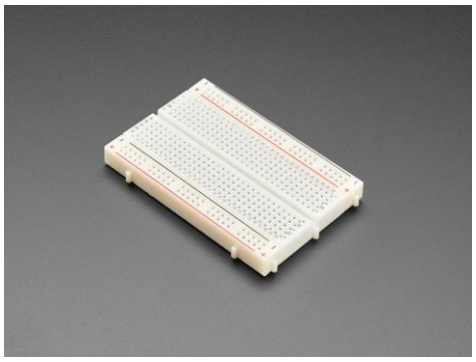
- 16*2 LCD Module display

- Buzzer

- LED

- Jumper cables

- Breadboard



3.4 Implementation

We use Arduino mega to implement this project. Four motors are connected with the L298 driver. Motors in the same side are shorted two controls smoothly. L298 driver is connected with the Arduino with the pin numbers 2 to 5. The Sonar sensor is connected with pin number 6 and 7. And the buzzer is connected with pin 12. The ground is also connected with the ground pin correctly.

Simulation

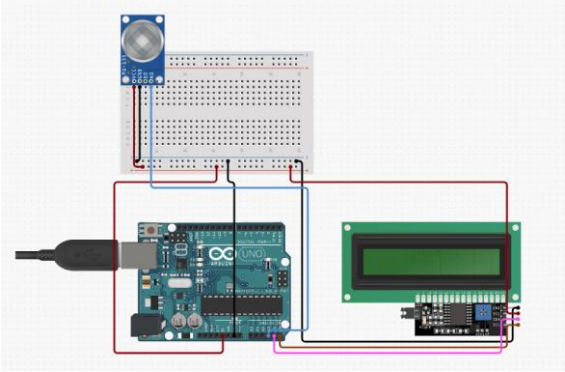


Fig 1: Simulation setup

Hardware Setup

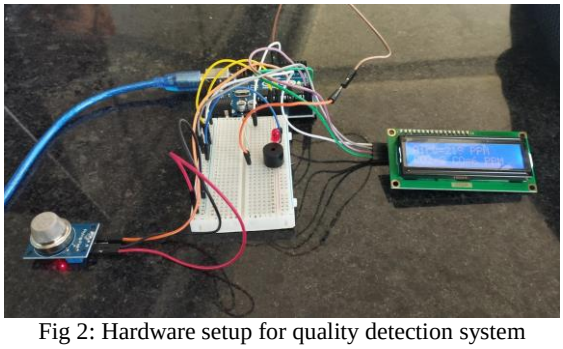


Fig 2: Hardware setup for quality detection system

4. Cost Analysis

Component Name	Price (Taka)
Arduino Uno	1350
MQ135 Gas Sensor	200
16*2 LCD Display	400
Buzzer	50
Jumper cable and LED	50
Breadboard	100
Total	2150

5. Result and Discussion

Code Analysis:

```
#include <LiquidCrystal_I2C.h>

int senval;
LiquidCrystal_I2C lcd(0x27,20,4);  // set the LCD address to 0x27 for a 16 chars and 2 line display

void setup()
{
  lcd.init();                    // initialize the lcd
  // Print a message to the LCD.
  lcd.backlight();
  lcd.setCursor(3,0);
  pinMode(7,OUTPUT);
  pinMode(8,OUTPUT);
}


void loop()
{
  senval = analogRead(0);        // read analog input pin 0
  Serial.print("AirQua=");
  Serial.print(senval, DEC);               // prints the value read
  Serial.println(" PPM");
  lcd.setCursor(0,0);
  lcd.print("AirQ=");
  lcd.print(senval,DEC);
  lcd.print(" PPM");
  int co2 = senval * 0.04;
  int co = senval * 0.03;
```

```
Serial.println(co2);
lcd.setCursor(0,1);
lcd.print("CO2=");
lcd.print(co2,DEC);
lcd.print(" CO=");
lcd.print(co,DEC);
lcd.print(" PPM");
if(senval>=400){
digitalWrite(8,HIGH);
digitalWrite(7,HIGH);}

  if(senval<=300){
    digitalWrite(8,LOW);
    digitalWrite(7,LOW);
}
delay(100);
}
```

Output:

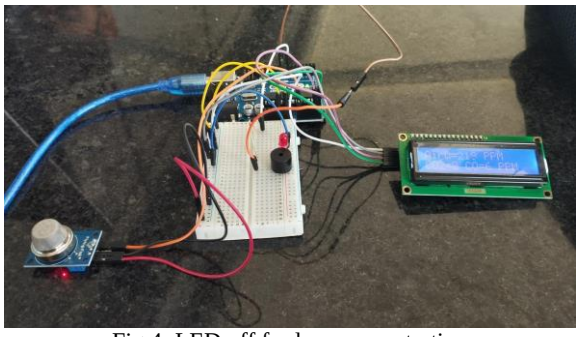


Fig 4: LED off for low concentration

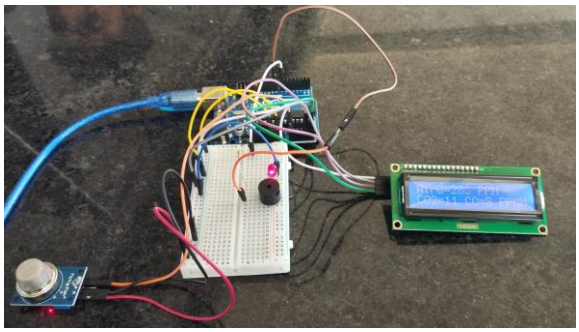
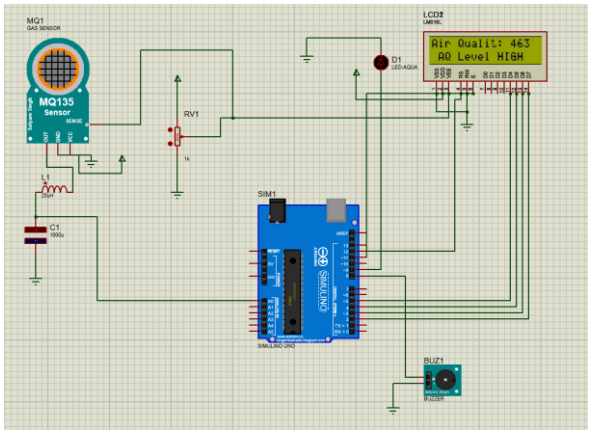
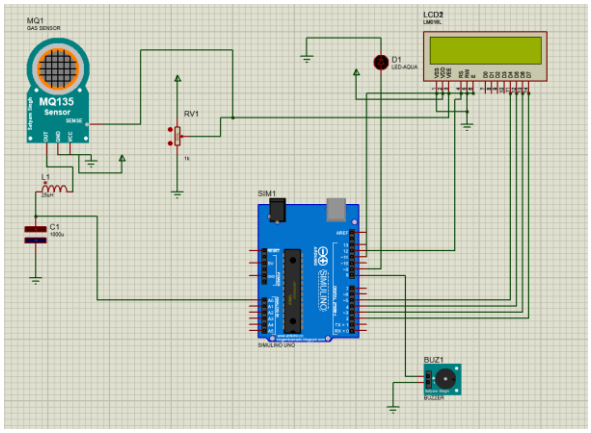


Fig 5: Red LED on for higher CO2 concentration

SIMULATION:





DISCUSSION:

The MQ135 gas sensor can measure the concentration of flammable gases from the air such as CO, CO2 etc. The sensor then sends the output to the Arduino microcontroller. As per the hardware setup, the concentration is displayed and if the concentration is more than 250 the red led will be turned on and the buzzer will be triggered. The led and the buzzer will stay high till the concentration is below the threshold level.

6. CONCLUSION

The project depends on data from gas sensor. MQ-135 gas sensor provides the system with data which is calculated to find the concentration of gases like CO, CO2, NH4, Acetone, Toluene and Ethanol. Accounts are completed using Arduino program. The final output is displayed on the LED & Buzzer alarm in case there is pollutant in the

indoor environment. The designed system is cost effective compared to the conventional air pollution monitoring systems available in the market.

7. REFERENCES

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[7] Wikipedia, Indoor air quality, Dec 2018. [Online]. Available: https://en.wikipedia.org/wiki/Indoor air quality Carbon dioxide