

# Smart Pollution Monitoring System using Raspberry Pi

Snehal Bokarde<sup>1</sup>, Pooja Netke<sup>2</sup>, Vaishnavi Wangaskar<sup>3</sup>, Mohini Ghyar<sup>4</sup>, Krutika Badhiye<sup>5</sup>

Dr.R.D.Raut<sup>6</sup>(Guide)

1, 2, 3, 4 & 5 are students of Government college of Engineering , Nagpur.

6 is Prof. of Government college of Engineering , Nagpur.

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**Abstract** -Air pollution is increasing hastily day by day due to growth in population,use of vehicles,industries, urbanization which can adversely affect human health.The presence of harmful gases like CO<sub>2</sub>,smoke if exceeds certain limit it may lead to severe accidents.This can be avoided by implementing an effective pollution monitoring system.

In this paper, the IOT based Smart Pollution Monitoring System using Raspberry Pi is introduced to monitor various parameters of air pollution. Carbon dioxide ,Methane, Butane, LPG, Smoke, Temperature, Humidity are these parameters. Sensors can be located at various locations which can sense or collect the data.The collected data from such gas sensors can be uploaded on web server using internet. Air quality can be displayed on webpage as well as on LCD screen which makes monitoring easy.Our system also contains an mobile application named as 'AQI',sothat one can monitor the pollution level from anywhere using either a computer or mobile.

**Keywords:**IOT, Web Server, Raspberry Pi, Gas Sensors.

## 1.INTRODUCTION

Air pollution is a rising issue these days. It is compulsory to monitor air quality and keep it under control for a healthier future and healthy living for all. It is because , After smoking, high blood pressure and poor diet, air pollution is the fourth-highest cause of death worldwide with most deaths occurring in developing countries. India and China are the two countries with the most pollution deaths per year with 2,326,711 and 1,865,566 respectively. Fig1 shows a survey analysis on deaths per year.

With the growth of population the atmospheric conditions are considerably deteriorating day by day. Risky effects of pollution include several allergic reactions causing irritation of the eyes, nose and infections of the throat.It can also lead inflammation inside lungs paving way to problems like bronchitis, heart diseases, pneumonia, lung and aggravated asthma.To overcome these pollution related issues we have introduce an efficient monitoring system.



Fig. 1: Pollution related deaths per year

Our system works on the procedure of continuous online monitoring that uses sensors to monitor the parameters and then send to control center by n/w.

The way of data transfer includes both wired and wireless system, but we are using wireless mode. This system measures concentration of gases such as CO, NO<sub>2</sub>, Smoke, Temperature, Humidity using electro chemical sensors. All these air pollutants levels pack into the frame with GPS physical location, time and date. The frame is uploaded to the IOT modem and transmitted to the central server via IOT. System is interfaced to Google maps to display exact location of hardware unit.

## 2.METHODOLOGY

The IOT based smart pollution monitoring system using Raspberry Pi consists of sensors, controller, output device and Wi-Fi communication system. The system contains six different sensors.

The CO<sub>2</sub> sensor measures the carbon levels in the air. The methane sensor measures the level of methane gas . The DHT11 calculates humidity by measuring the electrical resistance between two electrodes. The MQ 6 gas sensor can detect and measure gases like LPG gas and butane gas. The MQ 135 is air quality sensor which detect a wide range of gases including NH<sub>3</sub> ,NO<sub>x</sub> ,alcohol ,benzene and smoke.

The output of all these sensors is given to the ADC (MCP3008). It is a 10 bit 8-channel analog to digital converter (ADC). The MCP3008 talks to the Raspberry Pi over the SPI (Serial Peripheral Interface). The hardware SPI requires certain pins on the Raspberry Pi to be connected to certain pins on the MCP3008.

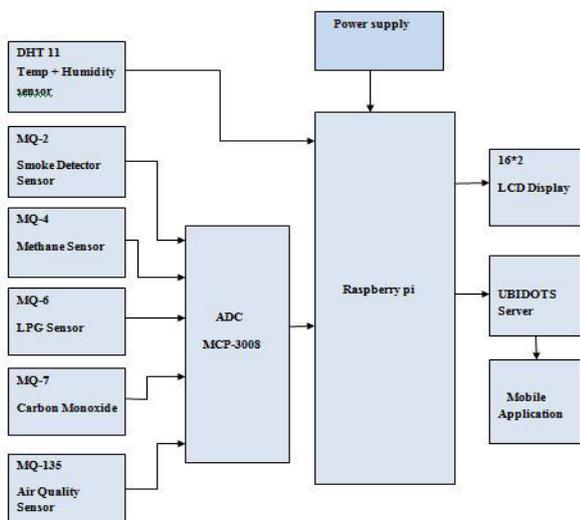


Fig. 2: Block Diagram

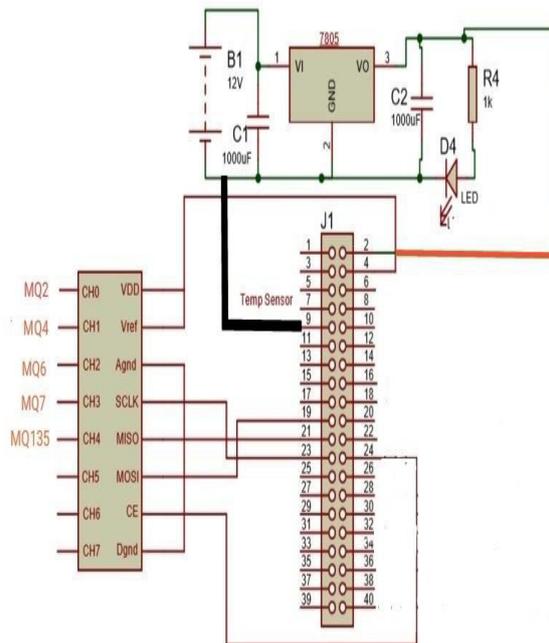


Fig. 3: Circuit Diagram

All the data collected from these sensors is continuously fed to a controller which is a Raspberry Pi board in our project. The Raspberry Pi converts this sensor's data into a convenient form and transmits to a UBIDOTS web server by making use of IOT – internet of things communication protocols. Apart from that, the sensor data is also displayed on monitor screen in real time by the Raspberry Pi. This system can be installed in areas of which pollution has to be monitor, we are going to used it in college campus. On the IOT web server , an optional graphical user interface can be created, which visualizes and displays the sensor data in a convenient way. By virtue of this IOT based pollution monitoring system project, air and pollution levels can be constantly monitored from a remote location, it can be anywhere in the world and steps can be taken in order to reduce the air pollution levels. Here we had also developed a software called “AQI” by using Appsgeyser platform which also displays the result of all the sensor. For that each individual must have the valid userID and Password for login.

### 3. HARDWARE AND SOFTWARE DETAILS

#### 1.Details of hardware components used-

- a. Raspberry Pi: The raspberry Pi(RPi) is a low cost device for performing various code base experiments. It is a credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse so to use as whole computer. The Raspberry Pi 3 Model B+ is the latest product in the Raspberry Pi 3 range,it has a 64-bit quad core processor operating at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth, faster Ethernet and much more.



Fig. 4: Raspberry Pi

- b. MCP3008 ADC IC: The MCP3008 ADC (Analog to Digital Converter) is an Integrated Circuit which measures the voltage level of a signal, an analog signal, and provides a digital numeric value that provides a digital representation of the analog signal. The actual digital value will depend on the operating mode of the MCP3008, Single Ended mode or Pseudo-Differential mode.

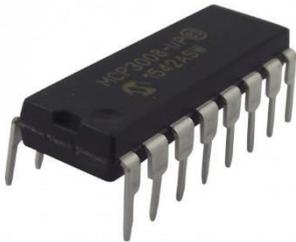


Fig. 5: MCP3008 ADC IC

- c. MQ2 Sensor: The MQ2 has an electrochemical sensor, which varies its resistance for different concentrations of different gasses. The sensor is connected in series with a variable resistor to make a voltage divider circuit, and the variable resistor is used to vary sensitivity. When one of the combustible gas comes in contact with the sensor after heating, the sensor's resistance change.



Fig. 6: MQ2 Sensor

- d. MQ-4 sensor: MQ-4 gas sensor modules are used in gas leakage detecting equipments in houses and industries. They are suitable for detection of CH<sub>4</sub>, Natural gas, LNG, avoid the noise of alcohol and cooking fumes and cigarette smoke. The concentration sensing range of 300 ppm to 10,000 ppm is suitable for gas leak detection.



Fig. 7 : MQ4 Sensor

- e. MQ-6 sensor: MQ-6 gas sensor modules are used in gas leakage detecting equipments in family and industry, are suitable for detecting of LPG, iso-butane, propane, LNG, avoid the noise of alcohol and cooking fumes and cigarette smoke. This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance.



Fig. 8: MQ-6 sensor

- f. MQ-7 sensor: The MQ-7 sensor can detect Carbon Monoxide (CO). The Concentration range of MQ-7 is 10 to 10000 ppm. The Operating temperature of this sensor is 10° to 50° C.



Fig. 9: MQ-7 sensor

- g. DHT11 Sensor: The DHT11 is a cheap digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure and detect the nearby air quality, and give out a digital signal on the data pin (no analog input pins needed). It is fairly simple to use, but requires careful timing to get data.

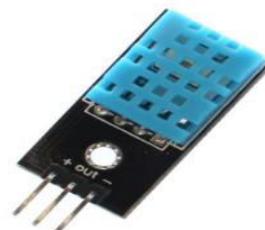


Fig. 10: DHT11 Sensor

- h. MQ-135 sensor: The MQ-135 Gas sensors are used in air quality control equipments and are suitable for detecting or measuring of NH<sub>3</sub>, NO<sub>x</sub>, Alcohol, Benzene, Smoke, CO<sub>2</sub>.The sensor convert the gases which come in its contact.It also makes changes in the resistance of the sensing material.



Fig. 11 : MQ135 Sensor



Fig. 13: AppsGeyser

**2. Software details:**

- a. Ubidots: Ubidots is an IoT Platform which powers innovators and industries to create prototype and scale IoT projects to production. We can use the Ubidots platform to send data to the cloud from any Internet-enabled device. You can then set up actions and alerts based on your real-time data and unlock the value of your data through visual tools. Ubidots offers a REST API that allows you to read and write data to the available resources.

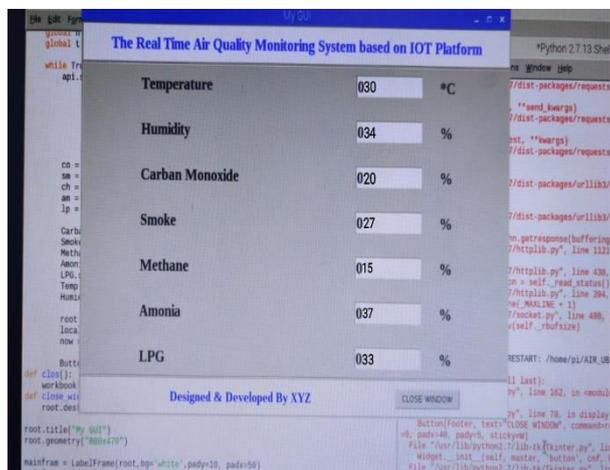


Fig. 12: Ubidots

- b. AppsGeyser: AppsGeyser is the online Android app maker platform.Android is the fastest growing mobile device segment in the marketplace with over a million apps in GooglePlay alone..AppsGeyser is the most efficient and effective online app maker tool platform. It provides the app creator with over 50 free templates to create an Android app.

**4.RESULT**

In this proposed system,we can monitor the leakage of toxic gases and the level of pollution using Raspberry-Pi.By the use of MQ135/2/4/6/7/DHT11 gas sensors the harmful gases can be sensed and alert can be given to save the life of people.The table 1 shows ranges of various sensors and table 2 shows how we can converted ppm(parts per million)into percent.

Sensors	Range
MQ-2	300-10000ppm
MQ-4	300-10000ppm
MQ-6	100-10000 ppm
MQ-7	10 to 10000 ppm
MQ-135	10-300ppm NH <sub>3</sub> & Alcohol, 10-1000ppm Benzene

Table No .1: Range of sensors

**Conversion Factors-**

- 1 ppm = 1.145 mg/m<sup>3</sup>
- 1 mg/m<sup>3</sup>= 0.873 ppm
- 1% = 1/100
- 1ppm= 1/1000000
- 1ppm=0.0001%

PPM	Percent(%)
0 ppm	0%
5 ppm	0.0005%
50 ppm	0.005%
500 ppm	0.05%
1000 ppm	0.1%

Table No.2: Conversion from ppm to %

## 5.CONCLUSIONS

This project is useful for everyone,as in today's world people need to know the extent to which their activities affect the air quality which in turn affects day to day activities and quality of life,it poses threat to the ecosystem.So the "Smart Pollution Monitoring System using Raspberry Pi" is a solution for this threat which is purely based on digital platforms like IOT,Ubidots.This proposed system has a feature that the result can be seen in website as well as in android application using either a computer or mobile.The system measures the levels of almost all the pollutants with good accuracy and hence we can interface more number of sensors to know detail content about all gases present in environment.We can also use digital storage devices like SD card to store the data.The system is made with affordable cost.

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