Smart Air Monitoring System Using IOT

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Abstract— **India is facing severe health hazards. In recent reports, more than 10 cities in India are listed on top for poor air quality. In recent years, the air quality of cities has become one of the major cause of concern around the world due to industrialization and increase in number of vehicles. Urban air pollution is a major problem in many cities globally. Air quality monitoring is needed to control air pollution in urban areas. It is necessary to constantly monitor the air quality to get real time pollution level of any place for any city.**

we propose and develop an IoT-based Smart Air Monitoring System, which helps people to find the best route for traveling from their source to destination by avoiding the most polluted route. The real-time data of the air quality is accessed through the system devices which will be installed at different locations of the cities for tracking the real-time pollution level.

Keywords— IoT, MQ2, MQ5, MQ7, MQ135

I. INTRODUCTION

In a recent report about air quality, the World Health Organization (WHO) warns that air pollution has been increasing rapidly over the last few years which represents the greatest environmental risk to human health, more than over 6 million premature deaths caused by exposure to contaminated air sources. Studies have shown that exposure to air pollution can increase the risk of stroke, heart disease, lung cancer, chronic and acute respiratory diseases including asthma as well as the probability of premature death. Pollution problems are big issues in large cities with high population density due to the sources of pollution are more abundant i.e. a greater number of cars and industries burning fossil fuels, which are a major source of pollution, and their population is often constantly exposed to high levels of air pollution.

According to the WHO, levels of ultra-fine particles of less than 2.5 microns are higher in India than in any other country, which has 16 of the world's 30 most polluted cities.

Only technology is the solution to measure and manage air pollution in cities to migrate the problem, and hence, it has been a topic of study for several researchers worldwide, the internet of things (IoT) is one of the most promising technologies to overcome these tasks. IoT refers to the network of all intelligent sensors which exchange information about them and their surroundings. There are many systems based on IoT for the management of environmental problems.

IoT has emerged as a solution for all the pollution-related problems imposed by increasing populations. This system aims to improve health in citizens. It is important to study the different solutions that have been proposed to monitor and mitigate the pollution problems in large cities, hence we have developed a smart air monitoring system which will help to avoid people from pollution-related health issues. The purpose of this system is to create an advanced level pollution monitoring system that will help to provide an alternate route for traveling from their source to destination by avoiding more polluted areas. IoT has emerged as a solution for the pollution challenges imposed by the increasing population.

RELETED STUDIES

There are numerous amount of research has been conducted in order to control the environmental related pollution all across the world and it has been observed that the air pollution is one of the leading factors to contribute towards the overall environmental pollution. Some researchers have use the GIS technology to detect and monitoring the air quality [2]. In paper [3][9] the author provided the real time air monitoring system using the cloud based technique. The framework proposed by the author monitors the air quality based on different parameters like PM of smoke and carbon monoxide. Thingspeak was used to store and retrieve the data over the internet. In paper [4] authors has used the dashboard to show the data of air quality. AirQ device collects the air quality data and uploads it wirelessly to cloud-based backend. The backend is built using the Django framework. The device is configured to upload the air quality data to the backend server at regular intervals (every 30 seconds). The data is stored in MongoDB, which is a NoSQL database. The AirQ backend provides a web-based dashboard that displays the sensor data from each device graphically in real time.several papers have used the different types of sensors to measure different parameters like humidity, temperature, dust sensors etc. [5][7][8].

Swati Dhingra, Rajashekhara Babu, Amir.H.Gandomi [10] published their article on Internet of Things Mobile-Air polluting Monitoring System in IEEE-IOT journal. It focuses on the poor quality of air around the globe, it uses sensors to sense the air quality and these sensor data are sent to online servers to analyze and predict the quality of air.

Paper [11] by R. K. Jha, "Air Quality Sensing and Reporting System Using IoT," created an android application which shows the concentration of various gases and dust in ppm along with the AQI. It also shows the quality of air based on AQI calculated by previous data of pollution in that area.

II GENERAL DESCRIPTON

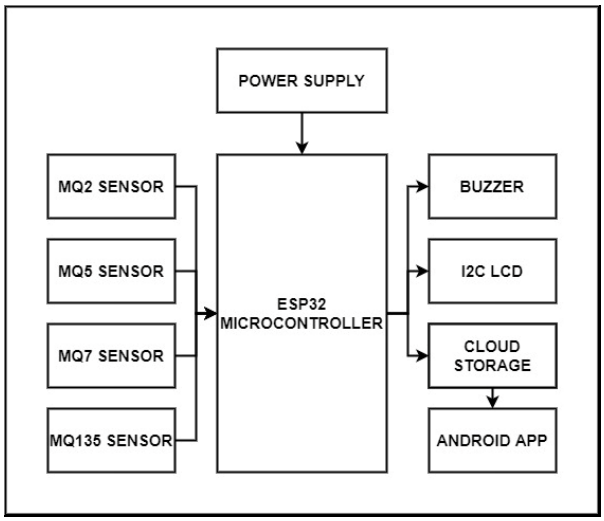

Fig.1 Block diagram

Block Diagram Description:

The proposed Smart Air Pollution Monitoring System is based on the following block diagram as shown in Fig.1.In this model, we are going to use different Gas sensors which will detect the presence of different pollutants. The data of emission level is recognized by different gas sensors. The sensors can sense gas, smoke, carbon monoxide, carbon dioxide, ammonia, nitrogen oxide etc. These all sensors will collect the pollution level of the different gases. It is connected with Node MCU and ESP32 wifi module to track the real time value of every gases and send the real time data to the mobile application.

Table 1 Sensor details

Sensors	Gas	Range
MQ2	Gas and Smoke	0-1000 (Normal) 1000- 15000 (Risky) (15000- 50000 Very High)
MQ5	LPG, Natural gas	0-1000 (Normal) 1000- 15000 (Risky) (15000- 50000 Very High)
MQ7	Carbon Monoxide	0-1000 (Normal)1000-15000 (Risky) (15000- 50000 Very High)
MQ135	Air Quality	0-500 (Normal) 500-1500 (Risky) 1500-2000 (Very high)

a. METHODOLOGY

1. The system uses ESP32 Microcontroller.
2. The reason for using ESP32 Microcontroller is it support Wi-Fi protocol which makes it suitable for IoT Application.
3. MQ2, MQ5, MQ7 & MQ135 Gas Sensors are used to monitor values.
4. This values are sent to ThingSpeak Cloud Storage.
5. This data can be viewed in the Android App designed for this project.
6. The Android App is developed using Kodular Platform.
7. It creates a marker where the device is placed and shows the current pollution status of that area.

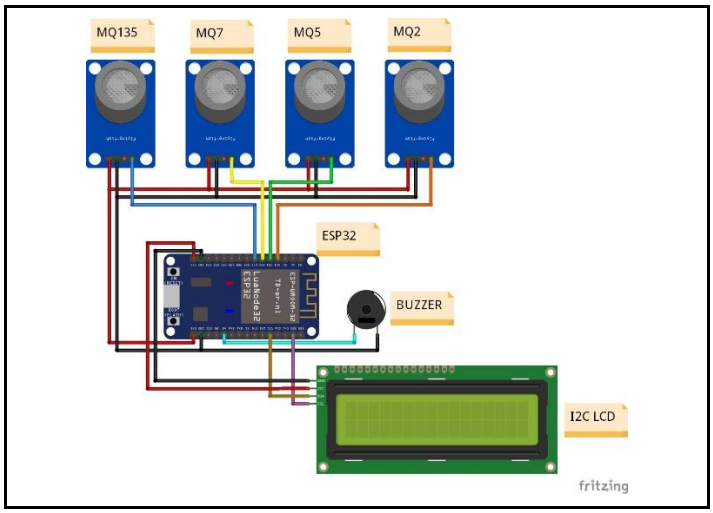

Fig.2 Circuit diagram

b. Circuit Diagram Description

Node MCU: It is a low -cost open source IOT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif system and hardware which support for the ESP32 32-bit. It runs on 3.3V and gives our system access to Wi-Fi or internet.

Gas Sensors: Sensors are the peripheral part as they act as a link between the external world and the digital processors by sending the data collected via its vicinity to the processing unit for further processing.

For this project we have used this gas sensors.

MQ 2- Detects the gas and smoke.

MQ 5- Detects LPG, Natural gas.

MQ 7- Detects Carbon Monoxide.

MG135- Air Quality.

16*2 LCD Display: This is a basic (16x2) display it mean it can display 16 character per line and there are 2 such lines. It will display the value of different gases level present in air.

Buzzer: A buzzer is an audio signalling device which will beep once or two times when the certain limit value is crossed.

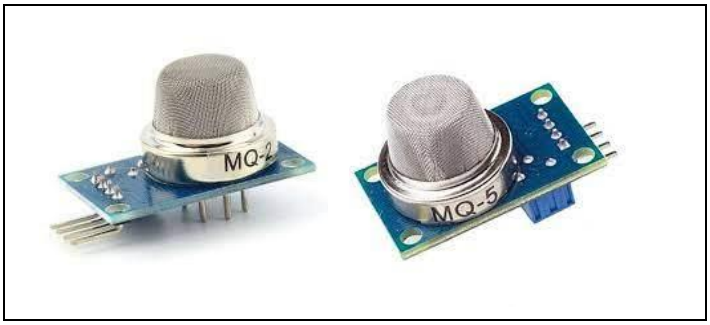

Fig.3 MQ2, MQ5 Gas Sensors

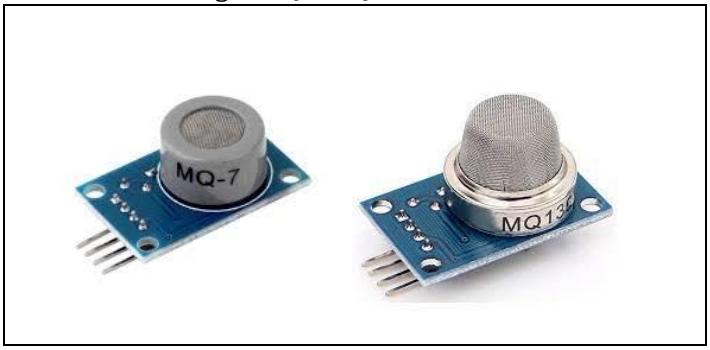

Fig.4 MQ7, MQ135 Gas sensor

c. Hardware Implementation

For hardware part we have used some gas sensors to give value to the Arduino nano. These sensitives sensors are responsible for changing in values if they get high level of particular air particle.

We have used MQ2 gas sensors which helps to detect gas and smoke, MQ5 for detection of LPG and hydrogen gas. These sensors are able to detect different parts per million of that particular air pollutant. Other sensors we have used is MQ7 which is needed to detect the presence of Carbon Monoxide. MQ135 sensors is additionally helpful near industrial areas because it can detect ammonia and nitrogen oxide which emits from automobiles like trucks and in construction sites.

This sensors are highly sensitive, stable and accurate to detect the air pollutant. To detect the analog output from sensors and convert in digital we used the Arduino nano and ESP8255 wifi module. Embedded C is used in Arduino nano to display the value of sensor in LED.

Figure 5 shows the implementation of hardware unit of our project.

d. Software Implementation

Interface and working of software part is done by using the Kodular platform. We have created a Mobile Application by which the value of the gas sensors can be displayed on the mobile screen with the proper information and location. With the given threshold value of the air pollution to the Arduino, it will send the data to our mobile application. In this application it shows the location of the user and above that it will show the current air quality of that particular area whether it is poor, moderate or good. furthermore it will also display the value of each sensors in the bottom bar of the application. We have created this software application user friendly so it can be easily understand and used by the user without any problem. Figure 6 shows the screenshot of Air pollution monitoring system mobile application.

III RESULTS AND OUTPUT

It is being observed that we have successfully obtained the result through different sensors and received the output from hardware unit as well as software application.

We have also used our project in the different environmental conditions to determine the air quality and measurement of accuracy. To detect the proper working of project we have tested our project in different locations where the level of LPG, carbon dioxide, Carbon monoxide, smoke and other gases are being varied and as per the environmental conditions the hardware unit has successfully detected the level of pollutants and showed the data to the LCD. The given data is also sent to the mobile application where the location and the quality of the air (i.e. Poor, Moderate, Good) is shown in geographical map. It also shows the value of each sensors in the bottom bar of the mobile application.

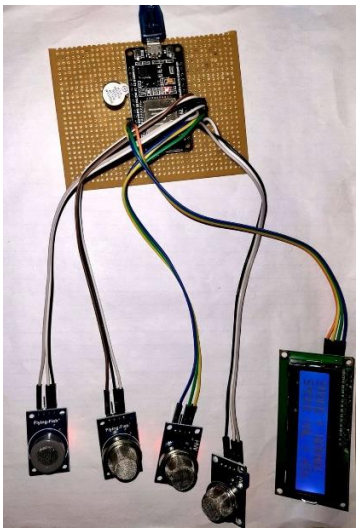

Fig.5 Hardware Implementation

Fig.6 Software Interface

IV ADVANTGES

1) Easy to Install.
2) Accurate Pollution monitoring.
3) Remote location monitoring
4) Fully automated process, no manual interruption.
5) It has features to show result directly on map, So easy to analyze the pollution level any time.
6) By this system users can avoid travelling from the most polluted route.

V FUTURE SCOPE

With the help of this prototype we can design multiple hardware units placed at the different location of the world, so it can show the real time pollution level at any place in the world with help of single mobile application.
All the record of that data can be stored in mobile application. We can add more sensors to find the more accurate level of pollution.

VI CONCLUSION

This system is used to monitor the air quality of environment using different gas sensors, IOT Technology is used to send the data of air quality. The use of IoT technology enhances the process of monitoring various aspects of the environment such as the air quality monitoring through mobile application. Here we are using the MQ-2, MQ-5, MQ-7, MQ-135 gas sensors which indicates the presence of the different types of gases. Wi-Fi module connects the whole process to internet and LCD is used for the visual Output. This project is proposed to reduce the human efforts in daily routine works and makes it simpler than before. Since the system is fully automated it allow user to analyze the real time pollution on map. This will help the user to choose a perfect way to travel from source to destination Which helps to reduce the pollution related health issues.

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