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Air Quality Monitoring Sytem Design and Analysis Using IoT

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***Abstract*—A change in air quality that may be identified by measurements of the chemical, biological, or physical pollutants in the air is known as air pollution. Air pollution thus refers to the presence of contaminants or the abnormal increase in the concentration of particular atmospheric elements. It can be divided into two categories: invisible and visible air pollution.Air quality monitoring is a big task in urban areas., Especially in the developing countries like India people suffers from various health hazards like asthama,lung cancer and some of the respiratory problems like emphysema.Additionally, long-term exposure to air pollution can harm a person's nerves, brain, kidneys, liver, and other organs. Some scientists think that birth abnormalities are caused by air pollution.This paper presents an Internet of Things (IOT) enabled air quality monitoring system in nature and analyses real-time ambient data measuring levels of PM, methane, butane, alcohol, LPG gas, carbon monoxide, smoke, and nitric oxide. The system can monitor contamination of air quality in the local area and alerts the people around the contamination area with the buzzer sound that is installed in the device built into the system. The system technology is so user-friendly and simple to operate that it can be implemented in homes, businesses, and even entire cities.**

***Keywords*—PM, AQI, Node MCU, Thing speak ,Air quality monitoring**

I . INTRODUCTION

One of the most crucial natural resources for the continuation and survival of all species on this planet is air. However, an improved way of living has led to more air pollution in cities. Due to the grave risks to the population's health, there is a considerable increase in public concern about air pollution. Air pollution plays a significant role in heart disease, chronic obstructive pulmonary disease (COPD), stroke, and lung cancer.

People who breathe in poor-quality air may experience asthma, wheezing, coughing, and difficulty breathing. Air pollution has a significant impact on not just human health but on the global ecology and economy. It is commonly established that air pollution contributes to acid rain, smog, and global climate change. The effects of air pollution are observed to be worse among the elderly and young children.

A web server and the Internet are utilised to monitor the air quality using an IOT-based air pollution monitoring system. According to the project's overview, it offers a procedure for combining the detection of various gas concentrations in the air with the detection of released LPG gas, which allows for the detection of air quality. The values and levels of the gases detected by the MQ-135 sensor are shown on an LCD display screen, which also continually displays the MQ135 gas sensor's real-time output value.The system can be installed anywhere, but is most frequently seen in homes and businesses where gases are more common. It sends out an alert message when the amount of gases in the immediate area exceeds a predetermined threshold. environment conditions. In the proposed system, in section II literature survey is documented, system Methodology is presented in section IV, section V is presented with future scope and conclusion.

II. MOTIVATION AND RELATED WORK

ThingSpeak Cloud platform is used by the proposed Real-time Air Quality monitoring systems. Here, Qt5 and GUI design are used to implement the system. The goal of this project is to have a fully automated remote monitoring system for the air quality of the interior environment. It integrates connectionless sensor networks with the Internet of Things based on the ThingSpeak cloud. Here, the lightweight MQTT protocol is implemented for connecting IoT-based systems. Advantages include lower power and data consumption, transmission of temperature and humidity values via the IEEE 802.11 ac wireless module, and the ability to measure interior and outdoor air quality.Exact measure of contaminated harmful gases are not detected in ppm[1].

In order to reduce transmit power and increase distance, this study describes an IOT-based real-time air quality monitoring and data-analysis system that sends data on PM and gas concentrations using LoRa. The sensor module, data processing, and display software are two components of the system. One microprocessor, a unit of gas and PM sensors (NO2, SO2, O3, CO,

PM1, PM10, and PM2.5), and an LPWAN node that are all connected via wireless technology make up the sensing module. Software for data processing and display are all data on the GUI, information. End users can acquire the historical evolution of the air quality in the monitored locations[2].

In this study, a CO sensor is used to measure the CO level in the air. The sensed CO level, along with the location of the location determined by GPS, are transferred to the Arduino controller as packet frames, and the details can then be sent to a pollution server via GSM (the global system for mobile communications). Any client can access this server to learn the pollution levels in the city at any location. A CO threshold level is established, and whenever CO gas reaches that level, an Arduino-attached LED blinks and an alarm transmits a message of warning to the server. It may display the CO level at precise places on the website by gathering information from the server[3].

This study presents an Arduino-based system for tracking air pollution. A connection between the cloud platform and the air quality sensors is built using IoT concepts. It is done to compare two IoT connection protocols and two Cloud computing service models. On the basis of the Cloud-based analysis, a practical method for managing the power consumption of IoT devices is finally suggested[4].

III. PROPOSED SYSTEM ARCHITECTURE

The block diagram that is depicted above in Figure 3.1 serves as the foundation for the proposed air pollution monitoring system. The MQ-135 gas sensor, MQ-6 LPG gas sensor, MQ-4 methane gas sensor, and MQ-3 alcohol sensor all detect air concentration. The MQ-135 sensor can detect CO2, alcohol, smoke, NH3, NOx, and NOx. LPG and LNG can be detected with the MQ-6 sensor. Methane, butane, and CNG gas are detectable by the MQ-4 sensor. MQ3 sensor can detect smoke, alcohol, and ethanol. For the system that monitors air pollution, these sensors serve as dynamic gas sensors.When sensors are coupled with an Arduino, it detects all gases and provides the pollution level in parts per million (PPM) (parts per million)

The output will be provided in the form of voltage levels by the MQ-135 gas sensor, MQ-6 LPG gas sensor, MQ-4 methane gas sensor, and MQ-3 alcohol sensor. It is necessary to convert voltage levels into PPM. MQ-135 gas sensor, MQ-6 LPG gas sensor, MQ-4 methane gas sensor, and MQ-3 alcohol sensor libraries are used to convert the output into PPM. The safe limit for air quality, determined by sensor reading, is 150 PPM, and it shouldn't go over 300 PPM.The LCD will show "Fresh Air" when the reading is less than 50 PPM. When the value increases from 51 PPM to 100 PPM, the LCD will display "Satisfactory Air," when the value increases from 101 PPM to 200 PPM, the LCD will display "Moderate Air," when the value increases from 201 PPM to 300 PPM, the LCD will display "Poor Air," and when the value increases from 301 PPM to 400 PPM, the LCD will display "Very Poor Air," and the system will also send an email alert via a pyth The buzzer will begin to beep when the value rises from 401 PPM to 500 PPM, and the LCD will show "Danger Air" as well as send an email notice through a Python SMTP server.

This section consists of software and hardware units needed for the experimental setup of the proposed research paper.

- Arduino Uno
- ESP8266 Wi-Fi module
- I2C serial interface adapter module
- MQ-135 Air quality Gas sensor
- MQ-6 LPG gas sensor
- MQ-4 Methane gas sensor
- MQ-3 Alcohol gas sensor
- 16x2 LCD Panel
- 1k ohm resistor
- Buzzer
- Capacitors (0.01 mF, 470 mF)
- LCD
- Jumper Wires
- Cable

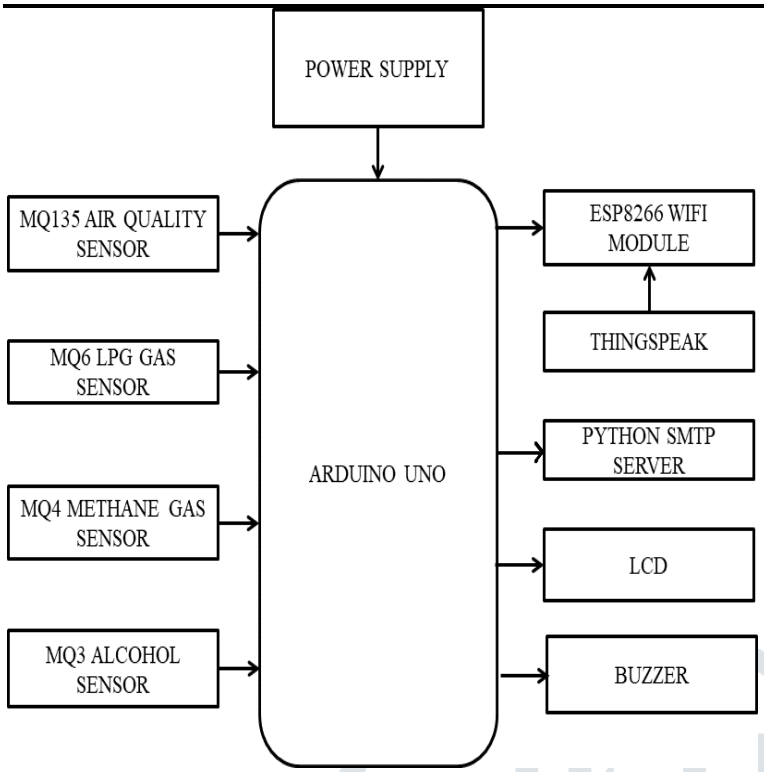

Fig. 1: Proposed System block diagram

A. WORKING PRINCIPLE

With the help of an Arduino, sensors, LCD display, jumper wires, and buzzer, connections are established as indicated in the below The ESP8266 Wi-Fi module is used to measure the values from various sensors. Using the ESP8266 Wi-Fi module, these values are then uploaded to the ThingSpeak database. In the ThingSpeak, the data is kept as key-value pairs.These values are retrieved, and the LCD and monitor display the necessary messages in accordance with the data. In times of emergency, a buzzer and an email notice are sent..In the Air Quality Monitoring System, the LCD is interfaced via I2C. The SCL pin of I2C is linked to the Arduino Uno's A5 pin, the SDD pin to the A4 pin, the VCC pin to the Arduino Uno's 5V, and the GND pin to the Arduino Uno's GND pin. And all four of the sensors' GND pins are linked to the Arduino Uno's GND pin, their VCC pins to the Uno's VCC, and their analogue pins to the Uno's analogue pins.respectively, one. A resistor is wired between the buzzer's positive pin and the Arduino Uno's digital pin, and the buzzer's GND pin is linked to the Arduino Uno's GND.The ESP8266 W-Fi module's data is fetched, and ThingSpeak stores it all. The key-value pairs are where the data is kept. The Python SMTP server retrieves these values.

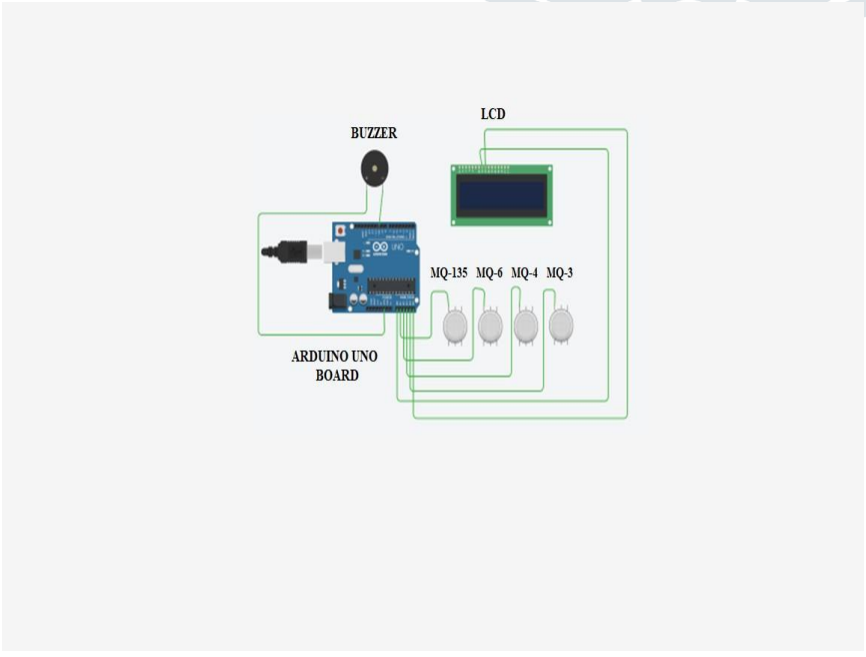

Fig 2: Circuit Diagram containing Arduino Uno and sensors

B. Flowchart

The flow chart for the Air Quality Monitoring System is shown in Figure.3. Four MQ-135, MQ-6, MQ-4, and MQ-3 sensors, an ESP8266 Wi-Fi module, an Arduino Uno, an LCD, an I2C serial interface adaptor module, and a buzzer make up the system.

Initialization, IP configuration, and network connection are performed on the ESP8266 Wi-Fi module. To read the sensor data, start the analogue pin read command. Open a TCP connection to the ThingSpeak server and load the sensor's libraries. Setup a Python SMTP server to send alarm messages when the air quality reaches a certain threshold and to display all sensor readings on the screen throughout the day.

If MQ-135 sensor value is between 0-50 PPM Display Fresh Air on the LCD screen,Otherwise, if the MQ-135 sensor value is between 51 and 100 PPM, it displays satisfactory air on the LCD screen, between 101 and 200 PPM, it displays moderate air on the LCD screen, between 201 and 300 PPM, it displays poor air on the LCD screen, between 301 and 400 PPM, it displays very poor air on the LCD screen, and it sends an email alert, if the MQ-135 sensor value is greater than 401 PPM, it displays dangerous air on the LCD screen.

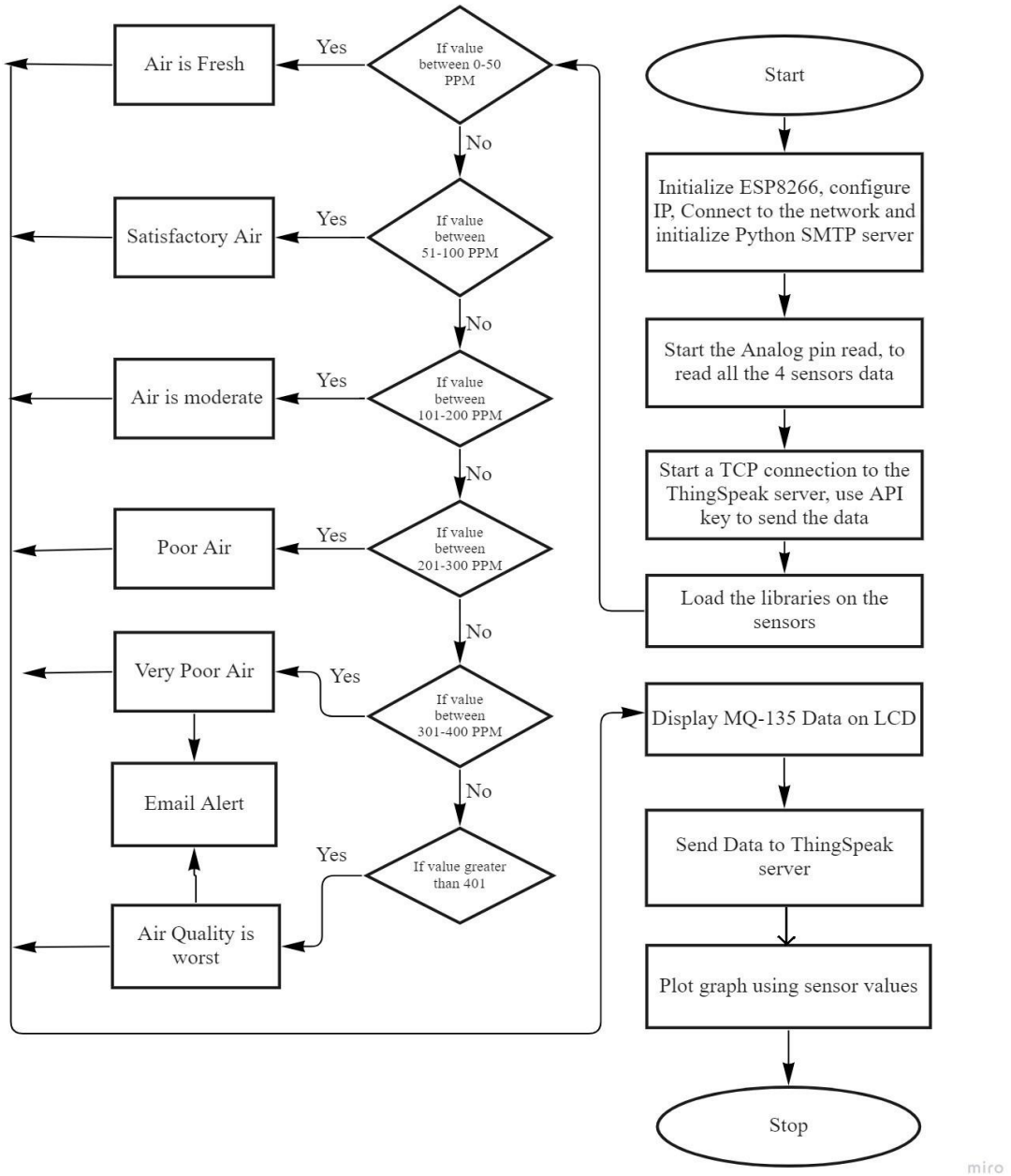

Fig 3: Flowchart of Air Quality monitoring system

This model is capable to measure some of the harmful gases in the atmosphere. The concentration of gases are displayed on the monitor. All the conditions are checked for MQ-135 sensor and when the concentration of gases goes beyond threshold limit buzzer starts beeping and sends email alert.

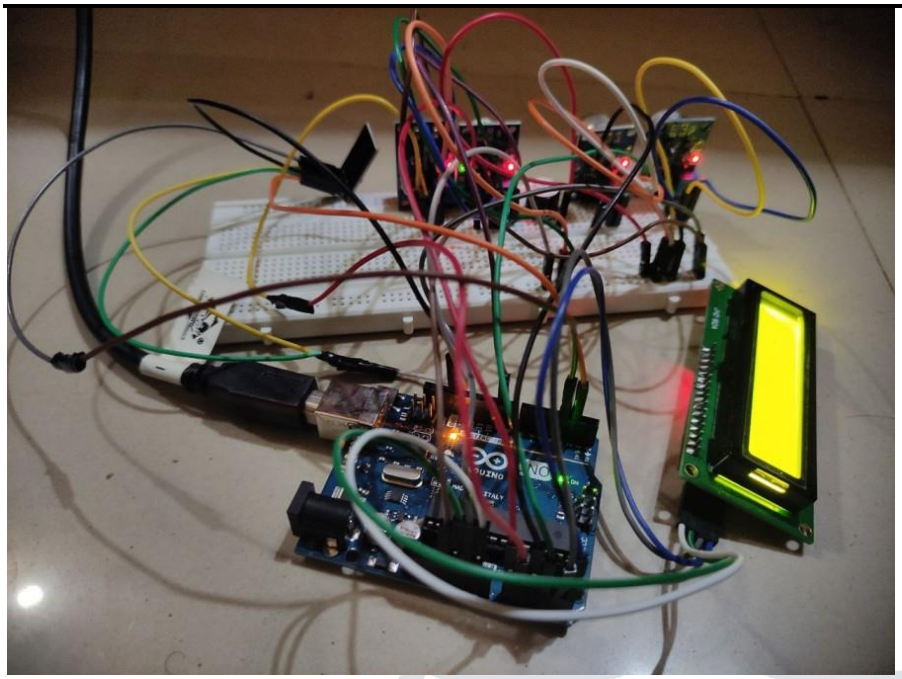

Fig 4:Air quality model connections

IV. Result Analysis

With the help of IOT, the fundamental objective of this suggested model is to offer automatic air quality monitoring, which has been accomplished as demonstrated below results are obtained from the sensors.

Fig 5:MQ-135 sensor reading on LCD when air quality is Satisfactory

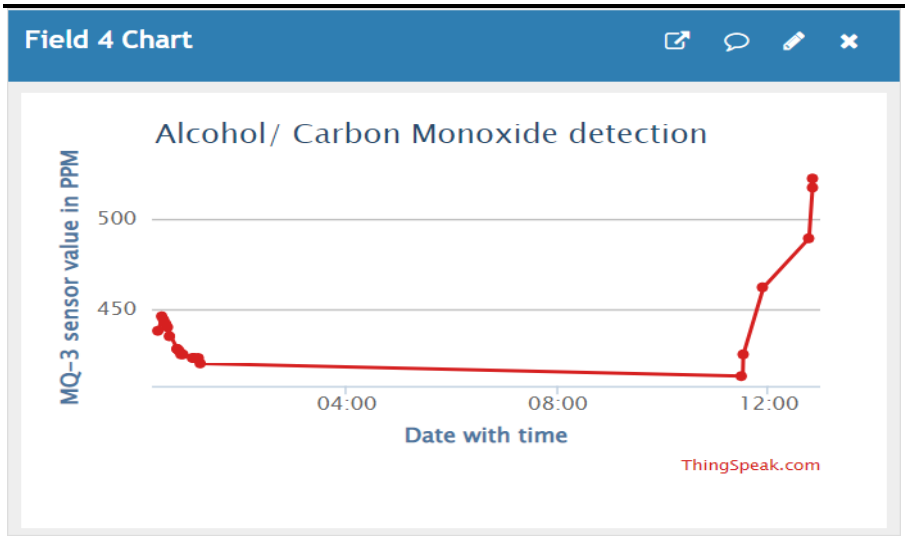

Fig 6: Graph representing the amount of carbon monoxide in air

The Fig 6 graph represents the level of accumulation of carbon monoxide in the air along with date and time,Thingspeak platform will automatically reads the level of certain gas in the atmosphere and represents in the form of graph.

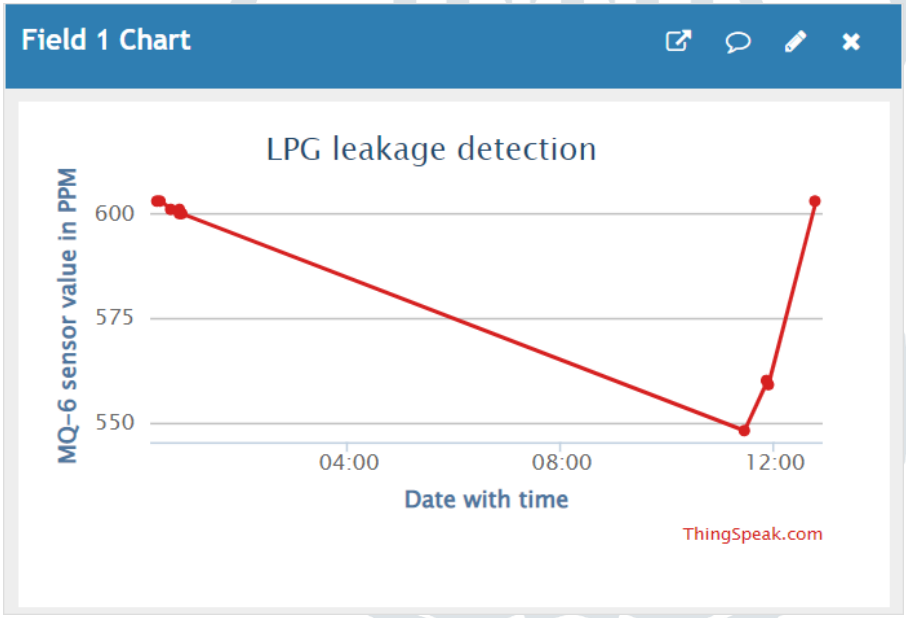

Fig 7: Graph representing the Leakage of LPG gas in the air

The Fig 7 graph represents the level of accumulation of LPG gas in the air along with date and time,Thingspeak platform will automatically reads the level of certain gas in the atmosphere and represents in the form of graph.

V. CONCLUSION & FUTURE WORK

A. Conclusion

In the present system, an inexpensive air quality monitoring system senses the real-time data of nearby parameters such as methane, butane, alcohol, LPG gas, smoke, carbon monoxide, nitric oxide, sulphur dioxide, and PM level and alerts the public by activating the buzzer and by sending an email alert when the quantity of these elements exceeds a threshold level and displays the data in a graphical format easily understandable format..

The main benefits of this system are that it is lightweight, compact, and affordable. The suggested system supports cutting-edge technologies like Node, Ruby, etc. and leverages "ThingSpeak," which enables data to be shown in a graphical way. Additionally, Python SMTP has been added to the system to warn users by email when a serious situation arises. The implementation of a low-cost Internet of Things (IoT) based air quality monitoring system is suggested in this paper. In addition to being low cost and power-hungry, it also takes up less space, can be installed anywhere, and offers operational efficiency and flexibility over conventional wired methods.

B.Future work

The method proposed in this paper can be improvised further to identify the pollutants produced in large-scale locations such as cities, traffic, industry, etc.Further an android application can be developed which sends the alert message to the people who are exposed to the high level of pollution in certain areas. So, that the person who are in the heavy air polluted area can avoid those places in-order to avoid the future health effects.

In future few more gas sensors are added to sense the hazardous gas and the values collected from these sensors can be given to machine learning algorithms to predict the level of pollution intelligently and take appropriate decision based on the pollution levels.

REFERENCES

[1] S. Faiazuddin, M. V. Lakshmaiah, K. T. Alam and M. Ravikiran, "IoT based Indoor Air Quality Monitoring system using Raspberry Pi4," 2020 4th International Conference on Electronics, Communication and Aerospace Technology (ICECA), 2020, pp. 714-719, doi: 10.1109/ICECA49313.2020.9297442.

[2] Sujuan Liu, Chuyu Xia and Zhenzhen Zhao, "A low-power real-time air quality monitoring system using LPWAN based on LoRa," 2016 13th IEEE International Conference on Solid-State and Integrated Circuit Technology (ICSICT), 2016, pp. 379-381, doi: 10.1109/ICSICT.2016.7998927.

[3] Ratnaprabha Kasde, Karan Siyal. (2016) "Embedded System Based Air Pollution Monitoring System."

[4] G. B. Fioccola, R. Sommese, I. Tufano, R. Canonico and G. Ventre, "Polluino: An efficient cloud-based management of IoT devices for air quality monitoring," 2016 IEEE 2nd International Forum on Research and Technologies for Society and Industry Leveraging a better tomorrow (RTSI), 2016, pp. 1-6, doi: 10.1109/RTSI.2016.7740617.

[5] Vijayakumar Sajjan,Pramod Sharma.(2019)"Research on an Iot Based Air Pollution Monitoring System."

[6] D. Wang, C. Jiang and Y. Dan, "Design of air quality monitoring system based on Internet of Things," 2016 10th International Conference on Software, Knowledge, Information Management & Applications (SKIMA), 2016, pp. 418-423, doi: 10.1109/SKIMA.2016.7916258.

[7] K. Zheng, S. Zhao, Z. Yang, X. Xiong and W. Xiang, "Design and Implementation of LPWA-Based Air QualityMonitoringSystem," in IEEE Access, vol. 4, pp. 3238-3245, 2016, doi: 10.1109/ACCESS.2016.2582153.

[8] Ravichandiran, Sindhu & Dhillippan, Dr & Dr.N.Vijayalakshmi,. (2021). Internet of Thing Based Monitoring Systems and Their Applications.

[9] S. Kumar and A. Jasuja, "Air quality monitoring system based on IoT using Raspberry Pi," 2017 International Conference on Computing, Communication and Automation (ICCCA), 2017, pp. 1341-1346, doi: 10.1109/CCAA.2017.8230005.