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A Review on Smart Air Monitoring System Using IoT

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***Abstract*— This abstract presents an -innovative method to create a Smart Air monitoring System that would be based on IoT. As we know air pollution is one of the major issues in today's world. According to the World Health Organization (WHO), more than 5.5 million people worldwide die each year as a result of air pollution. As the world's population is becoming increasingly urban the number of vehicles also increasing rapidly. The emission level has been increasing rapidly in the past few years. In recent years, the air quality of the cities has become one of the major causes of concern around the world.**

In this paper, 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. The user will enter the source to destination location on their system map(webpage) and the system will provide route suggestions for traveling from source to destination location by avoiding the most polluted route or also a traveler can take a proper precaution by analyzing the map for traveling, which will help them to travel pollution-free.

Keywords **— Air monitoring, IoT, Map, Location, pollution.**

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 death 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 as well as heavy traffic areas. This system would help to reduce the air pollution from vehicles. IoT has emerged as a solution for the pollution challenges imposed by the increasing population. The main goal is to prevent -pollution as well from heavy traffic-related problems which are common in urban cities This aim at enhancing urban's pollution and traffic-related issues which will directly help to improve citizens health, energy efficiency, and transport system, it will also help to reduce travel time. The main aim of this paper is to provide an overview of IoT-based air monitoring systems.

The purpose is to improve the traveling system with the help of existing IoT technology, making the road traffic-free and avoiding the more polluted route while traveling. These all aspects will help to reduce travel costs, saving of time, fuel efficiency, and pollution-related health issues which are the major issues in the current era. It also features a user-friendly interface, quick access. We believe that this survey helps to know about the techniques used for the smart air monitoring system. The remaining paper is organized as follows. The literature studied about the techniques involved such as IoT technology, transmitting data to the web server via LTE in real-time, GSM, GPS, Cloud, Pollution detection sensors, and LTE modem is discussed in section 2. Section 3 consists of the discussion regarding the survey and the conclusion are given in section 4.

II. LITERATURE REVIEW

In [1] Ajitesh Kumar, Mona Kumari, Harsh Gupta In this research, have developed a cost-efficient air quality

monitoring system that senses the real-time data of surrounding various parameters like smoke, carbon monoxide, and PM level and alerts the people when the quantity of these elements goes beyond a certain limit and shows the data in an easily understandable format. For monitoring the air quality, LPG, carbon monoxide(CO), humidity, smoke, temperature, and other perilous particulate matters such as PM2.5 and PM10 particles in the atmosphere they have used different gas sensors. Thing Speak has been used in this system, which is an open-source cloud platform for easily storing and retrieval of data through HyperText Transfer Protocol i.e HTTP over the internet. It is used as a platform for plotting charts, graphs, creating plug-ins and apps of real-time sensing data
MQ2 sensors used in this system produce analog output and for that purpose, ADC (analog to digital converter) has to be used. Raspberry pie 3b used in the system has built-in Wi-Fi modules, for large data that is transferred over the internet. several input-output pins of Raspberry pie had been wasted. Monitoring the air quality over the internet using ESP8266 with Arduino senses the harmful gases and triggers the buzzer when air quality exceeds a certain limit. In this Node MCU has been used as a processing unit and sends detected data to the internet. Thinkspeak, an open cloud source platform is used to store data and retrieve it through hypertext transfer protocol (HTTP) over the Internet. With the help of the Thing Speak platform, the sensed data can be plotted in graphical form and can be seen on the OLED monitor.

In [2], Vishal Choudhary has developed an IOT Based Air Pollution Monitoring System using Arduino Uno to monitor Air Quality over a web server using the internet and will trigger an alarm when the air quality goes down beyond a certain level. The system will show the air quality in PPM on the LCD and as well as on the webpage so that it can be monitored very easily. Temperature and Humidity are detected and monitored in the system. LPG gas is detected using an MQ6 sensor and the MQ135 sensor is used for monitoring Air Quality as it detects most harmful gases. The system will send the SMS alert using the GSM system to the user when air quality goes beyond the permissible level. Users will also be notified by buzzer for poor-quality air.
In [3], In this system represents a functional design of real time-based air pollutant monitoring system which integrates IOT, ESP8266, and sensors. Real-time monitoring means that data received from sensors is delivered immediately after collection. The data gathered from the device has a difference of about 15 seconds in this model. The system deploys multiple sensors for efficient monitoring of Carbon monoxide (CO), air quality (Carbon dioxide), and dust particles in conjunction with the location of coordinates. The sensing entity consists of MQ2, MQ 135, a dust sensor, and GPS (Global Positing System) module. The sensed data is allowed to pass to ESP8266 which uploads value to the thingspeak cloud. The proposed system will allow users to scan the pollution level from remote through their android phone. The pollutants value can be spotted in Google Maps with geographical location. The page has been designed using HTML and JavaScript which uses certain APIs to establish a connection between thingspeak cloud and google maps.
In [4], G Spandana, Mr. Shanmughasundram R proposed a model that predicts the air pollution level easily using the Internet of things. In this proposed model sensing unit is present which has field sensor MQ135 which senses ammonia, carbon dioxide, and smoke, and dust sensor DSM501A which senses dust is connected to Arduino ESP 8266. The Gas sensors and dust sensors are placed in the E-rickshaw of the city. After sensing the quality of air sensors transmit data to the Arduino ESP 8266. After analysis of data, data is stored in the cloud and if the pollution level crossed its limit then the response goes to the alarming station in the city, and the alarm rings to raise awareness about pollution level. Information about pollution levels is also checked by the android application. A notification goes to the alarming station for alarming if the pollution increased in the city. If the If the pollution level increases a notification goes to the pollution-related android application of people. With the help of the android app on mobile people can know about the pollution level of the crowded area by which they can change their route. Alarming units also rings and then measures can be taken to control air pollution level. With this model, we can easily detect and predict air pollution.
In [5], In this paper, they have developed a smart wireless sensor network for monitoring air pollution. To achieve that, they connected gas sensor nodes in the areas where air pollution concentration data in the environment is to be collected. Also, they connected the sensors to a microcontroller, which is connected to a wireless communication gateway device such as the XBee module (IEEE 802.15.4 Zigbee protocol). After converting the sensor's captured data from analog to digital via the analog-to-digital converter (ADC), the data is sent to the gateway using the IEEE 802.15.4 Zigbee protocol. This data is saved in the local database of the gateway, and then it is also sent using a Wi-Fi connection to an external database. They have used a wireless gateway (Meshlium) to receives data from the Waspmote, and store this data on the local database it hosts. The Meshlium gateway is designed to communicate with four different radio frequency communications, namely Wi-Fi 2.4 GHz (Access Point), cellular mobile system 4G/3G/GPRS/GSM, and XBee/RF radios. Moreover, the Meshlium gateway integrates a GPS module for mobile and vehicular applications. It is worth mentioning that the gateway is designed to endure a harsh atmosphere.
In [6], In this paper, they have developed a system using Arduino Uno (Microcontroller), ESP8266 (Wi-Fi Module), Cloud service (Ubidots), gas sensors, and Android. This Google Maps Navigation was utilized as a part of this research.

Google Maps Navigation is a versatile application that has been incorporated into the Google Maps mobile application. Google Maps Navigation utilizes an internet connection to access the GPS navigation system to find the user's location. The user can enter a destination into the application, which will plot a path from source to destination. The application shows the user's advancement along the route and it issues directions. they also have developed an android application based on java which will use user location data via GPS, Internet of Things (IoT), sensors, and standard websites to give air quality data. If a user is set out to a destination, the pollution level of the entire route is predicted, and a warning is displayed if the pollution level is too high so that the user can re-route his journey.

In [7], In this paper, They have used Arduino Uno, gas sensors such as MQ135, GP2Y1010AU0F dust sensor, MQ7. These data are converted into digital form by the ADC of the Arduino Uno. These data received are first converted into ppm of the gases and then using this ppm of gases Air Quality Index is calculated. These data after calculations are sent to the transmit pin of Arduino which is connected to the receive pin of the Wi-Fi module ESP8266 [8]. With the help of this Wi-Fi module, real-time data is sent to the online server of thingspeak.com, where this data could be analyzed. Using API keys, this data can be accessed in a mobile phone application that uses past air quality data of places to calculate the condition of air in that area at that time and constitute an alert mechanism. The mobile application displays the condition of air into categories such as Good, bad, Severe, etc. based on the AQI.

In [8], In the proposed system, the device consists of a microcontroller, calibrated gas sensors, and GPS. The data obtained by the sensor mote is transmitted to the cloud. Data transmission between the cloud and the server is based on the MQTT protocol. A Computer with a dedicated program (server) is responsible for storing and processing the data obtained from the cloud. The processed data is then illustrated in various graphical representations on a monitoring device

In [9], In this, A two-level architecture System based on a microcontroller has been proposed which has the first level consisting of D-A-Q (Data acquisition unit) and second level of Pollution server. The DAQ can be installed on any moving vehicle or it can be connected to a mobile device so that it can acquire the data while moving. The paper proposes a technique which is known as gas mobile architecture. In this architecture, a mobile device is connected to the ozone sensor through a USB translator and after running mobile in USB host mode with the external power source for the sensor, that result can be seen on the app.

In [10], In This paper, they have used the google cloud platform which supports R libraries is used for big data analysis. Moreover, analyzed data is visualized in real-time using an open-source geospatial data visualization framework such as Leaflet. In this system, they have used a huge amount of sensors data collection and efficient data processing. Android application has been made for displaying the real-time Air quality index(AQI) result.

Table 1. Existing Techniques Comparison

Author and Year	Technique Used
Ajitesh Kumar, Mona Kumari, Harsh Gupta [1] 2020	IoT,Sensors,Thinkspeak,Cloud
Vishal Choudhary [2] 2020	IoT, Sensors, GSM
Harsh N. Shah, Zishan Khan, Abbas Ali Merchant, Moin Moghal, Aamir Shaikh, Priti Rane [3] 2018	IoT, Thinkspeak, Google map navigation
G Spandana, Mr Shanmughasundram R [4] 2018	IoT, Cloud
Sarita Jiyal, Rakesh Kumar Saini [5] 2020	IoT, GSM, XBee/RF, GPS
Anwar Alshamsi, Younas Anwar, Maryam Almulla, Mouza Aldohoori, Nasser Hamad, Mohammed Awad [6] 2017	Cloud, Sensors, Google map navigation, GPS
Swati Dhingra, Rajasekhara Babu Madda, Amir H. Gandomi [7] 2019	Sensors, Thinkspeak
Rohan Kumar Jha [8] 2020	Sensors, GPS, Cloud
Nilay Mishra, Neetu Gupta, Ajay Rana [9] 2020	DAS, USB

Sumanth Reddy Enigella, Hamid Shahnasser [10] 2020	Cloud, Big data analytic,Leaflet

III. DISCUSSION

Due to urbanization, the number of vehicles the is increasing rapidly which lead to congestion and heavy traffic-related problems in cities
.Traffic and congestion are one of the major contributors to air pollution in cities. Because of this commuters face pollution-related health issues, waste of time in heavy traffic, fuel efficiency, and much more. To overcome all those problems, we have developed our system which would help the commuters to find a better route for traveling from source to destination by avoiding heavy traffic and more polluted routes in the cities.

First, Commuters will have to enter their source and destination location in the system before starting the journey. After entering data, System will analyze the pollution level and traffic data of each route and will provide a better route option with less polluted and less crowded routes for traveling which would rather help to improve the transport system for the cities.

IV. CONCLUSION

In this paper, we reviewed different IoT technology and various method for air monitoring. We classified those techniques based on Sensors, Cloud, Navigation, GPS, and GPRS. Different types of technologies were discussed in this paper. Limitations and future directions for air monitoring systems were also discussed. We believe that this survey work will help researchers to understand the scope of IoT technology, current trends, challenges, and future application of smart air monitoring systems.

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