IoT Based Wireless Sensor Network for Air Pollution

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Abstract— A system that uses sensors, wireless communication technology, and cloud-based services to gather, analyse, and publish real-time air quality data is known as an IoT-based wireless sensor network (WSN) for air pollution monitoring. The system is made to monitor several air pollutants, such as carbon monoxide, sulphur dioxide and particle matter, as well as to tell end users about the quality of the air. The system is made up of several nodes that are dispersed around the region of interest and connect to one another wirelessly. In order to analyse and analyse the data, the nodes transfer it to a central server after gathering it from their immediate area. The data is subsequently made available to end users via a variety of channels, including web interfaces and mobile applications. The system has a number of benefits, including scalability, cheap cost, and real-time data monitoring. By giving decision-makers accurate and timely information, it can also assist to lessen the adverse effects of air pollution on human health and the environment.

Keywords—IoT, Traffic light, Fog eliminator.

I. INTRODUCTION

The term "air pollution" refers to the transient elements that disrupt regular operations and have a negative impact on health. In another method, pollution might irritate a person's wellness and also affect their typical periodicity. Given how prevalent modernization and automation are, Also, pollution is becoming more evident everywhere. The presence of fleeting elements that disrupt regular processes and have a negative impact on health is referred to as air pollution. In another method, pollution might irritate a person's wellness and also affect their typical periodicity. Given how prevalent modernization and automation are, Also, pollution is becoming more evident everywhere. Human welfare has been seen to be greatly impacted by air pollution in mechanically creating or formed countries when there is no system in place to screen for or monitor it. Recent studies have shown a strong link between diseases like asthma and lung-related illnesses and batten's climatic pollutants. Worldwide, air pollution is presently a major concern, and the WHO has developed precise guidelines to limit the cutoff values of certain gases including O3, NO2, and SO2. The majority of the time, accurate and exact AQM stations are used to estimate the Air Quality Index and monitor pollution. They exhibit perfect consistency and are effective in measuring a variety of air pollutants. But even with all of these stations, there is a significant decline in three regions

- Infrastructure, which is necessary for establishment because to the enormous size.
- The requirements of operations are simply mind-boggling.
- The typical expenditures associated with alignment, support, and setup.

When we consider the detrimental effects of pollution on humans, we find that in 2012, 7 million unexpected deaths globally—or one out of every eight total worldwide passings—were caused by air pollution. These fatalities were caused by a variety of illnesses, including severe lower respiratory anomalies in children, lung cancer, chronic obstructive pulmonary disease, stroke, and ischemic heart disease. The mix of indoor and outdoor air pollution is the common cause of each sickness. When it comes to water pollution nowadays, drinking contaminated water may really cause serious health problems for individuals. Risky waterborne illnesses including amoebiasis, hepatitis An, E coli, and loose stools can be brought on by protozoa, viruses, and microscopic organisms.

A WHO (world health organisation)estimates that these diseases affect around 3.6% of the global population daily. Each year, it causes roughly 1.5 million human deaths due to a variety of illnesses.

Moreover, noise pollution may cause hearing loss, hypertension, ischemic heart disease, irritability, and sleep disruptions, making it equally as deadly as the other two categories of pollution. In light of the aforementioned issues, this study looks at the idea of an IOT-based air pollution monitoring and control system.

The project deals with the development of air pollution monitoring and control using IOT. The Proposed system can help us monitor the levels of examine the levels of pollution at various points across the city and assist in selecting the controls to stop the pollution if it exceeds a certain threshold. Several types of pollutant gases are tracked by sensor nodes attached to IOT hardware, and they are then transmitted to the server via IOT protocols. The created web application can assist the pollution control board in viewing the details of the pollution in real time at various locations throughout the city and taking the necessary corrective actions, as well as projecting the pollution levels on a map using GPS coordinates to provide an overview of the pollution levels throughout the city..

A. Background

It's crucial to get an understanding of some of the services and keywords before we dive into the project's execution.

Fig. MCU Ecosystem

A microcontroller (MCU) is a little chip with a straightforward operation that is used in several products, such as sensors, home appliances, health monitors, cars, and industrial automation. Several of these gadgets might gain from device access to the cloud. For instance, in order to record use, smart energy meters will need to connect to the cloud, and building security systems will need to interact locally in order to release doors when a badge is scanned [11]. The computation and memory resources of the MCU are constrained to enable the completion of straightforward functional activities [10]. IoT applications are made more difficult by the fact that microcontrollers often run operating systems without built-in capability to connect to the cloud or local networks. Free on Amazon. This issue is resolved by RTOS, which offers both the core operating system and software libraries (to operate the edge device). This makes it simple to connect securely to the cloud (or other edge devices) so that data can be gathered from them for IoT applications to take action.

B. Related Work

Before starting with the project a brief study was made on the currently existing systems in this domain. The work carried out by notable research scholars is studied in depth and its excerpt is documented here in study of the literature.

and his team [1] The IOT cloud processes and analyses all air quality data. The whole air quality monitoring system, including the software and hardware, has been created and effectively used in metropolitan settings.

Marinov, Marin B. et al. [2] assess environmental factors utilising gas and aerometric sensors and the PIC18F87K22 microcontroller (infrared).To continually monitor the environment, sensor nodes have been placed throughout many different locations. The city map displays the findings.

Xing Liu [3] compared many intelligent sensors, items, devices, and things from the Internet of Things. The authors have also provided a full explanation of the terminology and concepts of the Internet of Things. The distinctions and parallels between smart objects and IOT objects are shown in tabular form.

[4] has explored the indoor environments in dwellings. The author suggests a monitoring architecture for temperature, humidity, and light intensity that consists of widely dispersed sensing devices, data aggregation, reasoning, and context-aware information systems. The sensor data's dependability is encouraging. Several monitoring techniques have lately been developed to detect environmental contamination. Despite the fact that special monitoring equipment for CO2 is available.

[5] creates a monitoring system that shows the carbon dioxide content in a remote site. The device also keeps track of the exterior monitoring area's temperature, humidity, and light levels.

Changhai Peng[6] The major goal of this study is to design an internode data reception control architecture and low-power ZigBee sensor network for the real-time data collection and transmission of VOC air pollution levels.

Using the IBM Watson IoT platform, the results of a system described by Mitar Simic, Goran M., et al. [7] for the measurement and gathering of data on water and air quality parameters are displayed. The system recharges its batteries using a solar-powered charger.

In [8], a WSN-based system for monitoring the quality of the air indoors and outside is shown. Each node has a variety of sensors that are hardwired or wirelessly linked to the central monitoring device.

[9]Offers a technique for real-time indoor air quality monitoring. The system has seven sensors that monitor seven different gases.

Chiwewe and all collected data on the air quality in numerous South African cities [10]. Following data analysis using machine learning methods, models for forecasting ground level ozone were created.

II. METHODOLOGY

The system for managing air pollution will be built using IOT, according to the proposal. The hardware component and the IOT control panel are the two main divisions of the project or system. The hardware component is put in several cities areas and interfaces with various sensors to form one sensor node. The sensor nodes may be deployed in various cities areas in various numbers. The Sensor uses lightweight IOT Protocols to continually monitor the amounts of the

various gases and update the server. The Software part is a web application hosted on internet. The admin can login into the system and view real-time data of the pollution. The GPS based mapping system is developed which maps the pollution levels at different location using the different markers making it easier to identify the high pollution zones. The another part is traffic scheduling system. The traffic scheduling system consists of Automatic traffic scheduling in pollution areas to reduce the levels of the pollution. The Fog eliminator device developed in this project can detect the level of fog and smog and if it obstructs visibility it will automatically activate the same which will reduce the pollution due to smog to some level by eliminating the same.

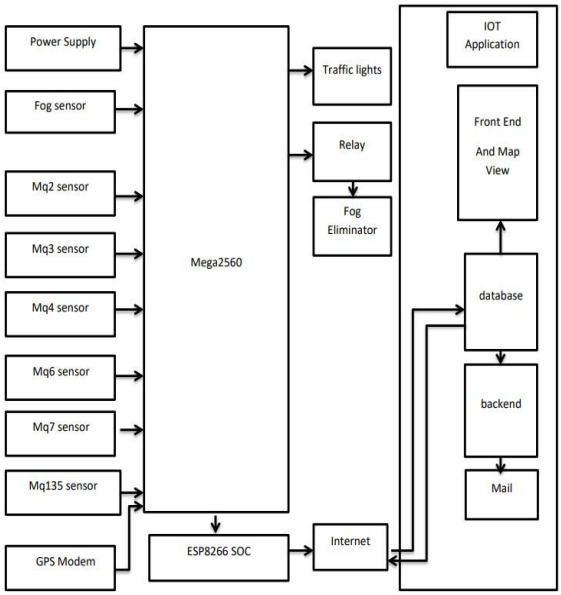

Fig . Block diagram of the project

The project's technique is broken down into a variety of distinct parts. The project will be carried out in phases, starting with the creation of the following system. The developed IOT-based air pollution control system is the suggested system. The system is set up to track rising air pollution levels and combat them with appropriate measures. The system comprises of internet-connected sensor nodes that may be positioned all across cities in different places. A sensor node is made up of several sensors that work together to continually monitor pollution data from various sensors and send it via lightweight IOT protocols to a cloud server. In order to show the pollution levels to the pollution control board, the web application was created to analyse the data from the sensor node. The system broadly consists of development:

Internet connected sensor node:

A MCU is linked to several sensors on the internet-connected sensor node to read the levels of various air contaminants. The sensor data is kept in a database on the server and transferred to the Internet using low weight IOT protocols. According to the architectural diagram below, the designed sensor node comprises of the following sensors coupled to the MCU. Smoke, carbon monoxide, benzene, hydrogen, Nox, butane, and LPG.

The application For Air pollution Management and Visualization:

The program, which is housed on a cloud server, was created for the administration of air visualization. The user of the programmed may see the data obtained from the sensor nodes. The Database is used to store the pollution data received on the server. The PHP backend is developed which will connect to the pollution visualization application and the same can be projected onto the map with a visualization regarding the pollution content in that zone.

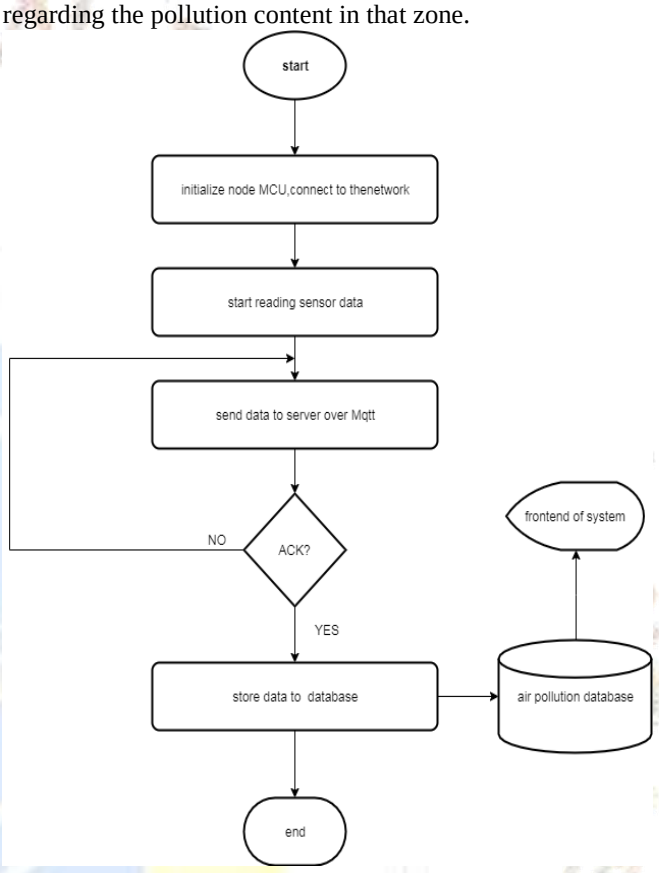

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Fig . Flow Chart of the project

The Traffic automated scheduling system:

When pollution levels in places like traffic signals surpass a certain threshold, the traffic lights are automatically scheduled to reduce pollution. This aids in the immediate management of pollutants. The system for detecting and eliminating fog: The proportion of fog and smog will be detected by a fog sensor interfaced to the MCU.
If it reaches a certain level, the fog eliminator circuit will be turned on and the pollution management panel will get a notification through IOT. This will somewhat automatically remove the fog.

The notion of creating an intelligent, IOT-based pollution control system is the focus of the proposed project. The suggested solution consists of a pollution control system that offers a single window from which users may read all the pollution levels in the various city neighborhoods using information gathered from hardware sensor nodes. We may infer from the completed project that the suggested system contributes to delivering a new method for leveraging the internet of things for pollution monitoring and control. By

monitoring and controlling pollutants under one roof, the one window helps to maintain the safety of our environment. By automatically attempting to clear traffic, traffic scheduling lowers pollution levels. The system also helps in elimination of fog smog caused due to pollution. Thus the proposed project provides a complete solution for pollution control.

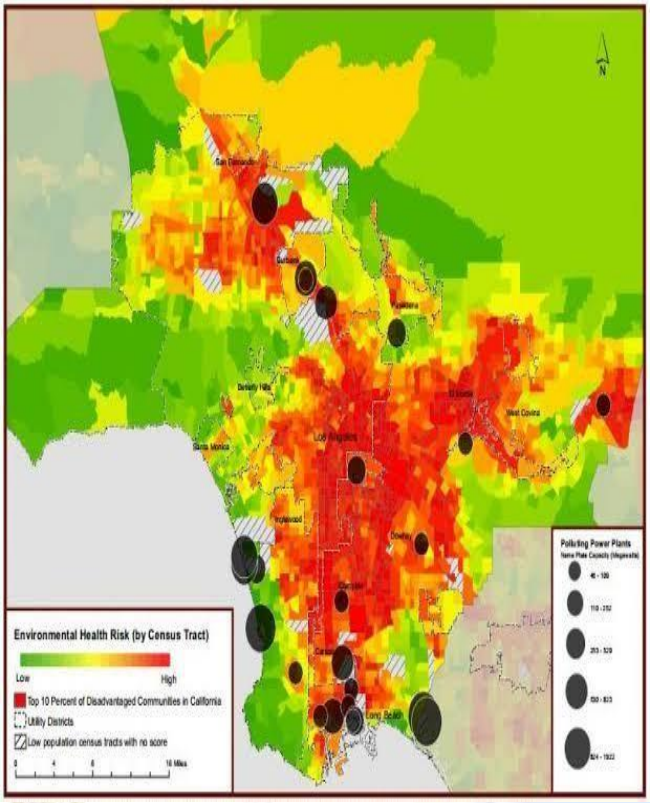

Fig . Simulation of android application showing real time data

III. CONCLUSION

This report has covered all the essential details on the problem's existence and the steps taken to address it. The system has also been tested, and the findings seem to have come out as planned. From the data gathered, it is evident that a broader region, in addition to the community for which it is intended, needs the planned Air quality monitoring system. This is primarily because of its significance in assisting in the collection of accurate data for studies aimed at regulating air quality.

IV. FUTURE SCOPE

The architecture proposed in the system will help in analyzing the air quality for the particular surrounding in the real time and it will help the authorities to get the accurate data for the action. We can add many more sensor for detecting different gas components. We can control vehicular pollution monitoring in Tunnels and Parking Lots.

ACKNOWLEDGMENT

We would like to express our sincere gratitude to all those who have contributed to the completion of this research. We are grateful for the guidance and support provided by our professors and mentors throughout the course of this research.

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