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A System for Monitoring Air Quality Smartphones

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Abstract— Worldwide, people are dealing with the health and environmental problems caused by air pollution. Current tracking methods are insensitive, don't take into account the area, and need testing in a lab. Presenting a three-part air pollution monitoring system that uses the internet of things (IoT) and the cloud to make services quicker and more real-time in order to overcome the shortcomings of current systems. The design for the gadget that would monitor air pollution and raise public awareness is what the proposal is all about. An Internet of Things (IoT) kit includes sensors, an Arduino IDE, and an esp32 Wi-Fi module. This device may be strategically placed in various cities to monitor air pollution. The airborne recorders transmit their findings to the Arduino IDE. The data collected is sent to the cloud via the Arduino IDE using the Wi-Fi module. Creating an intuitive and portable android app called IoT-Mobair allows users to track the pollution level between their starting point and their final destination. Levels of air quality index are used to identify particularly polluted regions. Between the two points, the viewer may see the contaminated region. Like Google Visitors or Google Maps' navigation feature, the suggested software would help users find their way about.

Keywords— Air pollution monitoring system; Android; sensors; GPS; Cloud; Air quality index

INTRODUCTION

The air we inhale now was once clean and unadulterated. With so many people crammed into India's urban centers, fresh air has become an impossibility. The fast industrialization is causing the concentration of harmful gases in the air to rise steadily. Any kind of environmental contamination may be traced back to human activity. An issue that we often deal with is the release of toxic gases into the atmosphere as a result of the combustion of any substance, whether it be household goods or chemicals used in the workplace. Both the greenhouse effect and global warming are harmful to the atmosphere. Modern air may be severely polluted by these released particles. A thick coating of these pollutants may develop over the planet's surface, triggering a cascade of exciting events. When plastic is burned, it produces a number of toxic chemicals that may affect both people's lungs and the environment. The emission of sulfur dioxide, huge quantities of ash, and carbon compounds from thermal power facilities significantly increases pollution. Worst traffic conditions in the world are a direct result of India's population boom, which has pushed urban areas beyond capacity. Due to the reckless combustion of fossil oil and other fossil fuels, vehicles on the road release harmful gasses and pollutants. The use of freezers and coolers releases hydrofluorocarbons into the air, while driving on roads creates an excessive amount of muck.There is no aspect of human existence that mobile applications do not impact. It transformed the unthinkable into reality in a matter of seconds. By using these programs in various places, one can ascertain the air quality. Accessing the current air quality, temperature, and humidity levels is a breeze using web server applications.

Internet of things is increasingly growing topic in the business intelligence fields. It integrates data from the hardware devices and can be uploaded in cloud. The internet helps to transmit data without requirement of humans and ensures notification. It provides deeper automation, accuracy and analytical data. Internet of things makes things virtually ‘smart’ over the surroundings. IoT has become an emerging technology for active content, product, or service manageable activities. These applications take information or input from multiple devices and makes sufficient actions to convert into human readable form. They analyze data supported numerous settings and styles so as to perform automation-related tasks or give the information needed by business.

India is home to a fifth of the globe population and each year, nearly 2.5 million deaths are occurred due to pollution. The contamination of air pollutants has destroyed the natural balance of the atmosphere, impairing human, and dependent on life forms. Air quality is measured by the air quality index levels. The National air quality of India was introduced in September 17, 2014. The main pollutants of the air include CO, NO2, SO2, methane and smoke. The combination of these gases in the air exceeds the criteria set by the World Health Organization (WHO). The Central Pollution Control Board along with State Pollution Board

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determines the air quality for each and every year. The color code range can be drawn based on pollution levels. The polluted area can be reported on a daily basis.

I. LITERATURE REVIEW

Air pollutants in massive urban regions have a drastic effect on human beings and the environment. Ecological problems in India are developing quickly. Air infection is particularly induced by automobiles and industries which cause various respiration

The first-rate of air is inferior in metropolitan towns like Kolkata, Delhi, and Mumbai due to a huge amount of carbon dioxide and other dangerous gases emitted from motors and industries [1]. An huge number of projects have been described within the literature that utilize low-cost air pollution sensing gadgets that can be carried by individuals or by using versatile automobiles [6]. In studies, [2] [3], the authors tested an environmental sensing approach that reinvigorate interest and sympathy of citizens towards pollution. Exposure Sense [7] is a transportable participatory sensing framework that is used to display screen one's normal activities.

In another study [4], the authors present a cloud-based system that uses knowledge-based discovery to find real-time air quality data. The records are gathered by monitoring stations that are positioned in various geo-locations. This system uses mobile customers for tracking purposes.

De Nazelle et al. [5], the authors validated environmental sensing tactics that reinvigorated the attention and sympathy of individuals towards pollution.

II. PROPOSED APPROACH

The proposed approach detects the concentration of air pollutants in the area of interest via sensors. Fig. 1 represents the architecture diagram of IoT based air pollution monitoring system. The sensed data is collected in Arduino and transmitted through Wi-Fi module which is stored in cloud - Ubidots. The uploaded data is retrieved by user-friendly android application - MOBAIR helps the user to know the pollution level in the region. The routes are drawn from source to destination and pollution level is estimated in real time computation. The quality of the air is predicted and analyzed using analytical module based on air quality index levels.

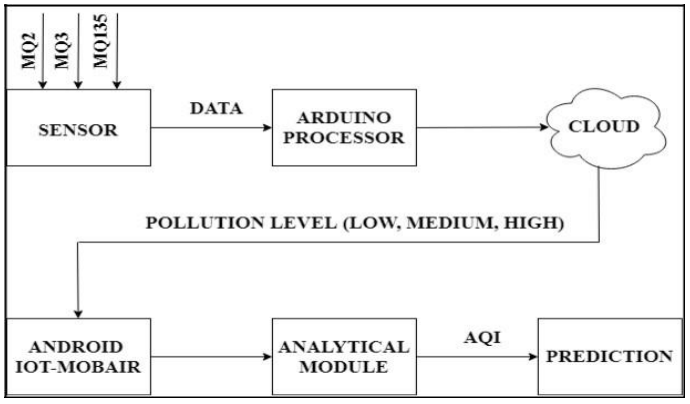

Fig.1 Architecture Design of IoT Based Air pollution Monitoring System.

A. Internet of things

The Internet of Things (IoT) is a system of connecting hardware devices along with software applications. IoT provides a communication between applications and components and that are supplied with distinctive identifiers. It facilitates to transfer knowledge over a network while not requiring human-to-human or human-to-computer interaction.

Air pollution detection kit is developed using IoT [MQ2, MQ3, MQ135, esp32]. The sensors sense the real time air pollution level in particular region. The gas sensor detects dangerous gases like LPG, i-butane, paraffin, propane, methane gases which are paired up in the atmosphere.

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B. Ubidots-Cloud Service

Ubidots is an Internet of Things (IoT) information analytics and visualization companion. It is a platform to turn sensor facts into information that matters for business-decisions, device-to- device interactions. The sensor readings from Arduino IDE are uploaded to cloud service framework - Ubidots. It provides user- friendly protocols to store and access the data.

C. Android Platform

Recently, improvements in smart phone technology have changed the importance of cellular telephones. A phone is not just used for communicating but has also become a crucial part of everyone's daily life. Presently the electronic market is acquired by Android technology.

Over time, smart phones and the Android system are become more prevalent. In this work, we used Java language, the Android Studio platform, Android ADT, and the Android SDK to develop the IoT-Mobair android application. The IoT-Mobair application uses user location data (via GPS system), the Internet of Things (IoT), sensors, and standard websites to give air quality data. If the user travels from source to destination, the entire route pollution rate is monitored and alerts a notification message. If the pollution rate is huge, the user can re-route their journey.

The real time air quality percentage and levels are continuously updated in the Ubidots portal. The uploaded data can be visualized as per user perception in the form of ranges and charts. It also generates the color code based on authorized levels and determines AQI.

III. IMPLEMENTATION AND RESULTS

The comprehensive implementation details can be Visualized as following:

A. Detection of air pollutants levels

The data is generated from the gas sensors (Fig.2 Gas sensors, esp32).These concentration is obtained from the air. Table 1 shows the standard air quality levels. Air contamination can be characterized as the outflow of harmful substances to the air. The main components of pollutants are:

- nitrogen oxides(NOx),
- sulphur dioxide,
- ozone(O3),
- particulate matters,
- carbon monoxide(CO)
- volatile organic compounds(VOCs).

TABLE 1 SENSORDETAILS

Values	Color	Description
0 - 50		Good
50 - 100		Moderate
100 - 150		Unhealthy for sensitive groups
150 - 200		Unhealthy
200 - 250		Very unhealthy
300 - 500		Hazardous

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Fig. 2 IoT Kit

B. Connecting Arduino to Cloud

IoT Kit is constructed in which the data generated by sensors is sent to the cloud, where it is processed and displayed to the user in the appropriate form. Fig. 3 gives the details of JSON data uploaded to Ubidots cloud service framework.

Fig.3 Ubidots Platform

C. Connecting Ubidots to Android

Step 1: Draw route from source to destination

The routes are drawn from source to destination and pollution level is estimated in real time computation. The quality of the air is predicted and analyzed in mobile application based on air quality index levels.

Notification message will be appeared to the user by the comparison of pollution rate in the intermediate waypoints.

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Step 2: Prediction and analysis

Historical data can be used to predict pollution levels for subsequent days. The data collected from the sensors and other trusted websites is made as are placed in a large database.

When the user enters his destination of travel, the *IoT-Mobair* android application first converts the address into corresponding latitude/longitude form. The latitude and longitude are searched in the cloud-based database. Intermediate places between the starting and finishing location are also displayed

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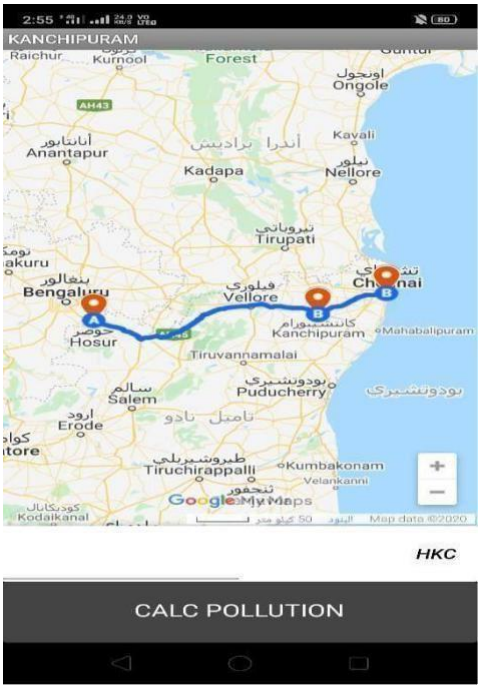

Fig.4 Route from Hosur – Chennai via Vellore

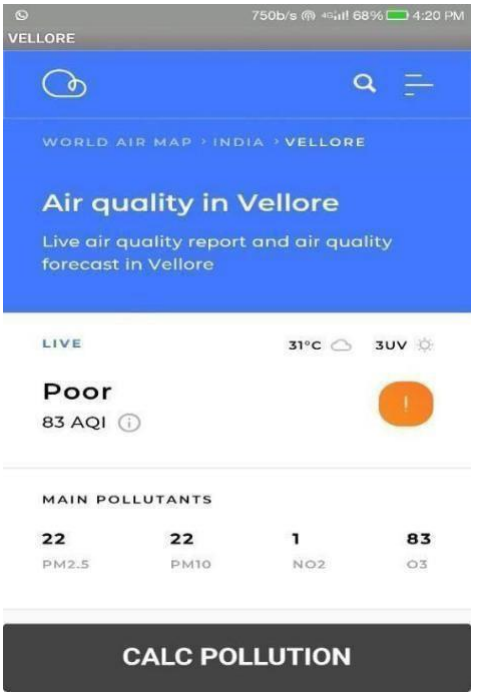

Fig.5 Air Quality in Vellore

CONCLUSION:

There was hardly any pollution back then. Air pollution has reached an all-time dangerous level as a result of fast industrialization and sophisticated technologies. Physically placing the air pollution monitoring kit in various areas allows for the determination of pollution levels, which in turn protects persons from respiratory ailments and safeguards natural resources. Users are able to get the pollution rate in real time via the usage of the IoT-Mobair android app, which is connected to the IoT kit. In addition, AQI values may be predicted by data tracking. In particular, IoT-Mobair generates air quality maps and provides location-based data on air quality measurements. Dealing with massive sensor data is a unique computational challenge for the suggested system. Fog computing, as an alternative to cloud computing, might be a viable option for improving system performance while decreasing calculation complexity. In addition, we can handle such a complicated system by implementing zero tolerance rapid large data real-time stream analytical tools

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