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IOT Based Air Quality Monitoring System

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Abstract: Exposure to air pollutants in ambient air can be harmful to humans. As a result, each country establishes health-based standards and objectives for a variety of air pollutants. The detection and measurement of atmospheric contents is becoming increasingly important. Measurements must be carefully planned. The location of monitoring stations is a major factor that influences the representativeness of data collected. The planning and establishment of a monitoring station is complicated and expensive. To monitor the pollution levels of various pollutants in Coimbatore, an IoT-based real-time air pollution monitoring system is proposed. The geographical area is divided into three zones: industrial, residential, and traffic. This article proposes an Internet of Things (IoT) system that could be deployed anywhere and store the measured value in a cloud database, perform pollution analysis, and display the pollution level at any given location.

Keywords: Air Quality, Air Pollution, Cloud, Cloud Database, Coimbatore, IoT, Nimbus, Sensors, Air Quality Monitoring System.

I. INTRODUCTION

CO2 Air pollution is the most serious problem in every country, developed or developing. Health problems are becoming more prevalent, particularly in developing-country cities where industrialization and an increase in the number of vehicles result in the release of a large amount of gaseous pollutants. Pollution causes mild allergic reactions such as throat, eye, and nose irritation, as well as more serious problems such as bronchitis, heart disease, pneumonia, lung, and aggravated asthma. According to a survey, air pollution causes 50,000 to 100,000 premature deaths in the United States alone each year. In the EU, the figure is 300,000, with over 3,000,000 worldwide. The IOT Based Air Pollution Monitoring System monitors the air quality over a web server via the Internet and will trigger an alarm if the air quality falls below a certain threshold level, which means there is a sufficient amount of harmful gases present in the air such as smoke, alcohol, benzene, NH3, LPG, and NOx. It will display the air quality in PPM on the LCD as well as on the webpage so that it can be easily monitored. This system, which is mostly used in homes, includes an LPG sensor. Temperature and humidity will be displayed by the system. The system can be installed anywhere, but it is most commonly found in industries and homes where gases are present, and it sends an alert message when the system exceeds the threshold limit. [1]

Hardware and Software Requirements:

Hardware Requirement:

1) MQ135 Gas sensor
2) Arduino Uno
3) Wi-Fi module ESP8266
4) 16x2 LCD
5) Breadboard
6) 10K potentiometer
7) 1K ohm resistors
8) 220-ohm resistor
9) Buzzer
10) MQ 6 LPG gas sensor
11) Temperature sensor LM35
12) Humidity sensor SY-H5220

Software Requirement: -

1) Arduino 1.6.13 Software
2) Embedded C Language

II. BLOCK DIAGRAM AND WORKING

The proposed Air Pollution Monitoring System is built on the block diagram shown in Figure 1. MQ135 gas sensor and MQ6 LPG gas sensor recognise air data. The MQ135 sensor is capable of detecting NH3, NOx, alcohol, Benzene, smoke, and CO2. As a result, it is dynamically sensored gas for our air pollution monitoring system. When connected to an Arduino, it will detect all gases and report the pollution level in PPM (parts per million). MQ135 gas sensor output will be in the form of voltage levels, which we must convert to PPM. So we used a library for the MQ135 gas sensor and the MQ6 sensor to convert the output to PPM.

When there is no gas nearby, the sensor returns a value of 90, and the air quality safe level is 350 PPM, which should not exceed 1000 PPM. When it exceeds the 1000 PPM limit, it causes headaches, sleepiness, and stagnant, stuffy air. If it exceeds 2000 PPM, it will cause an increase in heart rate as well as a variety of diseases. When the value is less than 1000 PPM, the LCD and webpage will display "Fresh Air". When the value will increase from 1000 PPM, then the buzzer will start beeping and the LCD and webpage will display "Poor Air, Open Windows". When it reaches 2000, the buzzer will continue to beep and send an alert message to the smartphone via GSM. "Danger!" will be displayed on the LCD and on the website. "Get some fresh air". It will include temperature and humidity, so it may display the current temperature and humidity of the air. We used an LM35 sensor for temperature and a SY-HS-220 sensor for humidity.

According to the model, the four sensors serve as input data, transmitting data to determine which gas it is, as well as the temperature and humidity. The output devices are an

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LCD and a buzzer. The LCD displays gas data in ppm (parts per million), and the buzzer sounds when the ppm exceeds a preset limit. [2]

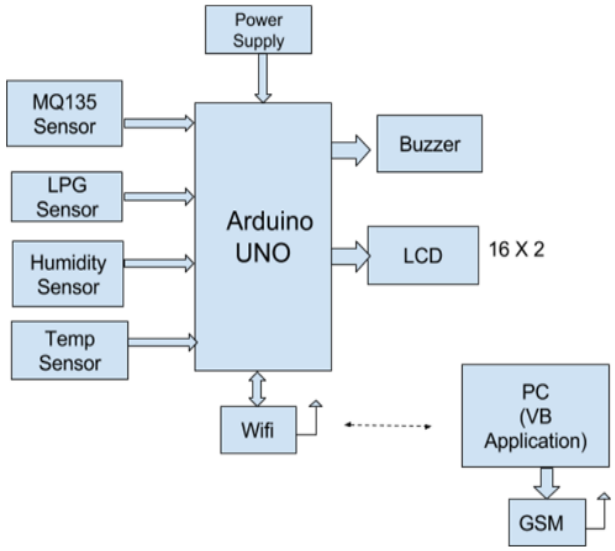

Figure 1: Block Diagram

The primary goal of this paper is to create a low-cost monitoring system that can measure and display ambient air quality from different zones. The project's specific goals are to store the pollutant readings, as well as the meteorological, Geographic Information System (GIS) data, date, and time, in a cloud server, allowing for efficient storage and retrieval for analysis purposes, and to develop an application with access to it for viewing data measured in the various zones. The main improvement of this device is that it can be accessed from any location. In this paper, we present a system for automatically monitoring air pollution and storing the data in a cloud database. As a result, when a user enters a location, he can learn about the pollution levels in that location. Furthermore, the system will store all pollutant levels in specific areas such as residential areas, industrial areas, and traffic areas in the cloud. [3]

System Description:

Geographic Zone Classification

Due to the complexities of the factors influencing environmental quality, large differences can be found between water bodies, industries, residential and industrial areas in different parts of a city or in different hydro and geoclimatic zones. Monitoring has evolved to determine trends in the quality of the aquatic, terrestrial, and atmospheric environments, as well as how they are affected by contaminants released into the environment, other anthropogenic activities, or waste treatment operations. Because pollutants differ depending on location, they are classified as industrial, residential, or traffic zone pollutants, as shown in Figure 2 [4].

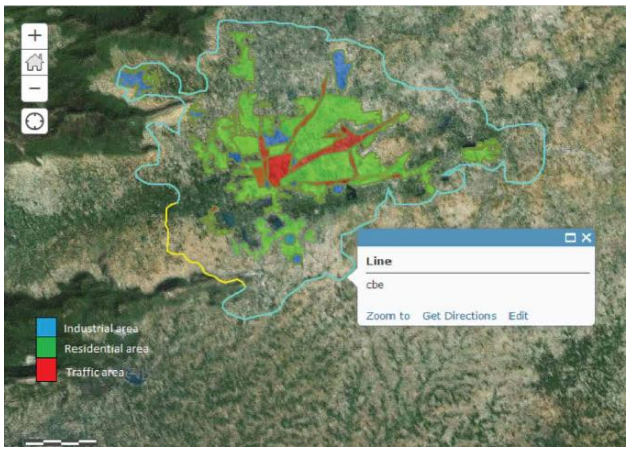

Figure 2: Geographical zones

Residential Zone

Fine particles are the most dangerous air pollutants for humans. They are easily transported from the outside to the inside air. The majority of your exposure to pollutants occurs at home, where you spend the majority of your time.

Traffic Zone

In cities, vehicular traffic has become a major source of air pollution. Exposure to vehicular pollution has a significant impact on the health of city dwellers. The rise in population and economic activity has resulted in an increase in pollution. CO, NOx, and SO2 are the most common gases found in traffic areas.

Data Acquisition:

The Data Acquisition Unit (DAQ) depicted is made up of hardware components and sensors that collectively measure the level of pollutants required to calculate the Air Quality Index (AQI). CO (Carbon Monoxide) and NO x (Mononitrogen oxides) sensors are used to measure the target pollutants. SO2 is not calculated because the major pollutants affecting any area are carbon and nitrogen oxides. As a result, the level of SO 2 will be negligible. In addition, the SO 2 sensors can be linked to the microcontroller unit to improve accuracy if necessary. The temperature sensor measures the current temperature, which is used to calculate the AQI value, which is affected by temperature and weather. When the microcontroller receives a signal from the timer, which is set to take readings on a regular basis, all of the sensors are activated to obtain the various values from the sensor arrays and the temperature sensor. These values are then processed to determine the air quality index, and the corresponding health hazard can be notified to the user based on the classification. [5]

Carbon Monoxide Sensor (CO)

The carbon monoxide sensor is connected to the AT Mega 328 microcontroller's analogy pin A0. For accurate readings, the sensor requires a one-day warm-up period. The power and ground pins are connected to the raspberry pi's power and ground pins. When the power pin is triggered, the Doubt displays the current reading of the carbon monoxide level.

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Nitrogen Oxide Sensor (NO)
High-temperature combustion produces nitrogen dioxide. It is also produced during a thunderous electric discharge. NO x pollution produces PM 2.5 pollutant, a fine particulate matter that causes lung infection. Respiratory problems are common in Coimbatore because the city has many textile mills that emit cotton dust.

Sulphur Dioxide Sensor (SO 2)
Sulphur Dioxide gas (SO2) is a toxic gas with an unpleasant odour. It exists in very low concentrations in the atmosphere and is emitted naturally during volcanic eruptions. It is also a precursor to acid rain and particulates in the atmosphere.

Temperature Sensor
The temperature sensor measures the temperature at a specific location. Temperature is measured in degrees Celsius. Pollution levels in a given area vary with temperature. As a result, the reading must be taken at various times.

Humidity Sensor
The relative humidity in the air is sensed, measured, and reported by a humidity sensor (or hygrometer). As a result, it measures both moisture and air temperature. The ratio of actual moisture in the air to the maximum amount of moisture that can be held at that air temperature is known as relative humidity.

III. OBJECTIVES

1. To study of how Air Pollution is the major affecting factor to our environment.
2. To analysis of different phases of air pollution affect the environment.
3. To study of different zones which is affected due to air pollution.
4. To check the quality of the exposed level in the air pollution

IV. RESEARCH METHODOLOGY

PHASE - 1: Detection of Air Pollutant Level

It denotes the project's initial stages. An air pollution detection kit based on IoT is being developed. It collects data from gas sensors connected to Raspberry Pi, and the information is sent to a cloud platform where it is stored.

PHASE - 2: Creating the interface

This stage entails clarifying the various components for optional performance. The MCP3008 is a 10-bit converter with on-board sample and hold circuitry that is calibrated to convert analogue data to digital.

The collected data is saved, processed, and can be viewed using the Mobile Application. The application allows users to review the stored data.

PHASE - 3: Execution and Testing

The various components are interfaced together, and the project deliverables are constructed using various circuit designs.

The design is tested, debugged, and troubleshooted to ensure that it performs well under a variety of conditions. If a circuit design fails the tests, a newer circuit design should be finished, implemented, and tested.

V. REVIEW OF LITERATURE

The disadvantages of traditional monitoring instruments are their large size, heavy weight, and exorbitant price. This results in a sparse deployment of monitoring stations. Because the air pollution situation in urban areas is highly related to human activities, the locations of the monitoring stations must be carefully chosen in order to be effective.

The IOT Based Air Pollution Monitoring System monitors the air quality over a webserver via the internet and will trigger an alarm when the air quality falls below a certain level, indicating the presence of harmful gases such as CO2, smoke, alcohol, benzene, NH3, NOx, and LPG.

Al-Ali, Zualkernan, and Aloul (2010) proposed a system in which a Mobile Data Acquisition Unit (DAQ) and a centralised server listen for pollution data from the DAQ. Socket Server, Air Pollution Index Function, and Google Mapped Application comprise the software application in the Application Layer. A multithreaded java programme called Socket Server listens to a pre-configured port and stores pollution data in a MySQL database. The Google Mapped Application is a PHP programme that runs on the Apache web server and reads pollution data from a MySQL database and plots it in a Google Map using the Google Maps API. [6]

Khedo, Perseedoss, and Mungur (2010) presented a Wireless Air Pollution Monitoring System (WAMPS) design that uses the Air Quality Index (AQI) to specify pollution levels. The Recursive Converging Quartiles (RCQ) Data Aggregation Algorithm is used in the implementation. Using Duplicate elimination and Data Fusion Techniques, the algorithm merges data to eliminate duplicates, filter out invalid readings, and summarise them into a simple form to reduce the amount of data to be transmitted to the sink. Jung et al. (2008) proposed a system in which sensor nodes are deployed throughout an area and a cluster node collects all data and runs the RCQ before sending it to the gateway and storing it in a database. [7]

According to a recent study, Coimbatore leads other cities in Tamil Nadu in terms of nitrogen dioxide pollution. Nitrogen dioxide is a serious air pollutant because it contributes to the formation of photochemical smog, which can be harmful to one's health and may cause traffic accidents due to poor visibility (Sharma, Maheshwari, & Pandey, 2001). The primary source of NO 2 is the combustion of fossil fuels. In Thadagam alone, there are over 200 brick kilns (Pragatheesh & Jain, 2013).

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Sulphur dioxide, Nitrogen Oxides, and Carbon Monoxide are produced by furnaces in foundries, heat treatment units, and forging units at the SIDCO Industrial Estate in Kurichi. Pollution is also caused by the use of fuel for boilers and vehicle transportation in the cluster and surrounding area, as specified in the Final Action Plan Report (2010). [8-9]

VI. RESULT AND DISCUSSION

As a result, the goal of our project is to assess the quality of the exposed level in air pollution. This application monitors the pollutant level in this manner. It also monitors an individual's exposure to air pollutants over the course of a single day. Air pollution is the most serious threat to our environment. Not only does it have an impact on the environment, but it also has an impact on human health.

Figure 4 from the measured set of values shows that NO concentrations are higher in the industrial region. Pollution was discovered to be coming from foundries and brick kilns. [10]

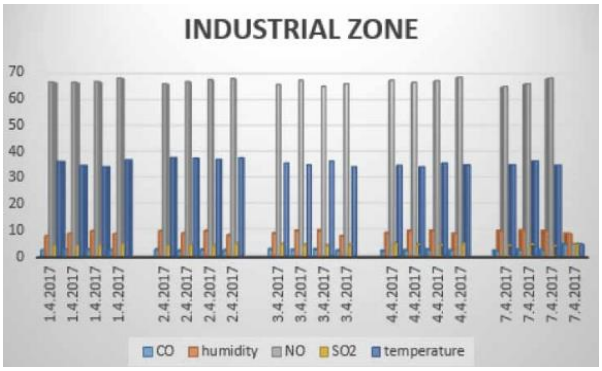

Figure 4: NO concentration at various zones

Figure 5 from the measured set of values shows that SO2 concentrations are higher in the industrial and traffic zones. This pollution was caused by textile mills and foundries. [11]

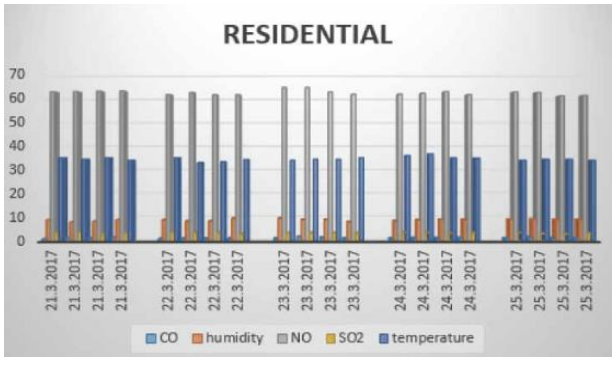

Figure 5: SO2 concentration at various zones

Figure 6 shows that the temperature concentration is higher in the industrial region, and thus the most important point to remember is that temperature concentrations are measured as an average value for one hour in various zones such as traffic, residential, and industrial. Temperature may rise as a result of the emissions of these gases. [12]

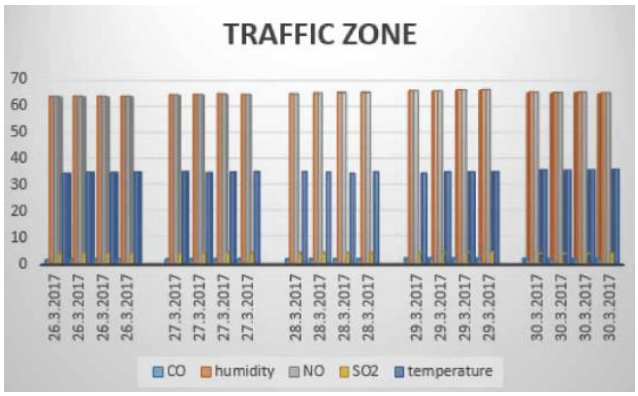

Figure 6: Temperature at various zones

There was a significant level of pollution in residential areas where textile mills were present. This system could be improved to detect more air pollutants. The collected data can be used to predict pollution in similar zones based on the location and proximity of the type of industry in that area. This is expected to lower the cost of pollution monitoring while also allowing people to choose their residential area based on the associated health risk.

VII. CONCLUSION

Air quality is a fundamental issue that has a direct impact on human prosperity. Data on air quality are collected remotely from checking bits outfitted with a variety of vaporous and meteorological sensors. This data is investigated and used as a component of imagining obsession estimations of pollutions using keen machine to machine organisation. Ongoing air contamination remote monitoring framework uses xbee, while zigbee and GPS-based air contamination monitoring framework and wsn-based air contamination monitoring framework use zigbee to send poison data to the computer. A bluetooth system is used in the wireless sensor system-based contamination checking framework, and the investigation is completed using id3 calculation. Arduair's air quality monitoring framework makes use of a USB link for data transfer and continuous chart plotting. All of the frameworks mentioned above have a short range for sending data to the computer. Constant remote air contamination checking framework has used multi jump structure, but it is more expensive due to libelium waps.

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