IoT-Based Air Pollution Monitoring System

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ABSTRACT

The Internet of Things, or "IoT," might be a global network of "smart devices" that can detect, connect, and communicate with their environment as well as with other systems and people. One of the main issues of our day is global air pollution. Numerous factors, including population growth, increasing vehicle usage, industrialization, and urbanization, have contributed to the rise in pollution levels throughout time, which has a negative impact on public health and well-being. When there are sufficient levels of dangerous gases in the atmosphere, such as carbon dioxide, smoking, alcohol, benzene, NH3, and NO2, the quality of the air decreases.

We are creating an IOT-based pollution monitoring system to track air quality via an internet server in order to do analysis. Current monitoring techniques need laboratory analysis, have limited sensitivity, and poor accuracy. Better monitoring mechanisms are thus required. We suggest a three-phase pollution monitoring method to address the shortcomings of the current setup. To make it easy for us to monitor, the air quality in PPM will be shown on the LCD and on the internet. With this Internet of Things project, you may use a computer or mobile device to remotely monitor the pollution level. The MQ2 and MQ7 sensors are used by the system to check the air quality. It detects hazardous gasses and precisely measures their quantity.

Key Words:*IoT, Smart Device, Pollution, Monitoring.*

INTRODUCTION

This file serves as a template. We kindly request that contributors adhere to a few basic rules. To put it simply, we want you to create your paper. The Internet is having an unbelievable impact on human existence and has become widely used and popular around the world. Thus, the "Internet of Things (IoT)" age is upon us. Along with more and more gadgets that have lately gained internet connectivity, it comprises standard computing devices like laptops, tablets, and smartphones. Home appliances, cars, wearable technology, security cameras, and many more items are examples.

A gadget has to be able to connect with other devices in order to be included in the Internet of Things. It therefore needs wired or wireless built-in connectivity. While Wi-Fi is supported by the majority of IoT devices, Bluetooth is also often used to send data to other adjacent devices. Because they can connect with other objects, Internet of objects gadgets are sometimes referred to as "smart devices." Many IoT devices include a variety of sensors that may gather important data in addition to speaking. The Internet of Things has exciting prospects even though it is still in its early stages of development. Over time, the Internet of Things will become less about an abstract concept and more about how life is.

LITERATURE REVIEW

In August 2019, a system for monitoring air pollution was suggested by Monika Singh et al. The Arduino microcontroller in this system is linked to the MQ135 and MQ6 gas sensors, which detect the various gases that are present in the surrounding air. After that, it was linked to the Wi-Fi module, which made a connection to the internet. An LCD was used to show the user the output, and a buzzer was used to notify when the ppm exceeded a certain threshold. They were used for monitoring industrial perimeters, interior air quality, choosing locations for reference monitoring stations, and providing users with access to data.

In November 2018, Yamunathangam et al. utilized the Internet of Things to measure the concentration of gas using a variety of sensors that were seen using an Arduino serial monitor. This information is gathered in Thing Speak channels using an Ethernet shield that is accessible in real time for further processing. These studied data were presented graphically using thing speak. After that, an Android app was used to examine the time-controlled findings and Matlab analysis was used to determine the average pollution level. Using the Android app, the air quality index value was further determined depending on the location. In order to keep users informed about pollution levels, the app also included a display of the health implications.

An air quality monitoring system including an air quality monitoring station, communication connections, a sink node module, and a data server was presented by K. S. E. Phala et al. in November 2014. They created a sink node based on GSM modules and a PC data server. The real-time data were recorded in text format on a micro SD card and stored on a PC data server. They choose MySQL as the DBMS for the database. CO, CO2, SO2, and NO2 concentrations were measured using infrared and electrochemical sensors. For wireless communication between the base station and the distant sensor node, GSM modules have been used. Cellular networks are utilized by the GSM modules to interact, and an MCU was used to manage every operation on the sensor node. Using an internal ADC, the MCU samples the sensor outputs, computes the gas concentrations, and uses the GSM to send the calculated data in packets. In order to assess the sensor node's performance, a test incubator was created. In order to test the sensor node, it was placed inside the incubator, gas was pumped into it, and the sensor node's readings were monitored. A sink node that is serially linked to a computer that runs the GUI software makes up the base station. The data sent by the distant sensor node is intercepted by the sink or receiving node, which then sends it serially to the computer. After that, the data was saved in text files and plotted on the GUI.

A system made up of Beagle bones was suggested by NitinSadashiv Desai et al. in 2017. interfaced with sensors that detect air pollution, including noise and carbon dioxide (CO2) and carbon monoxide (CO). The Beagle Bone Black's analog pin, which takes input signals in the range of 0 to 1.8 volts, was used to read the analog output from the sensor. Python SQL was used to upload sensor data to Azure Cloud. A reserved database was formed in the shape of the actual Beagle bone.CSV data set. The same data is available in the at the conclusion of each day.An uploaded CSV file is made to the cloud database. An automated shell script has been used to remove historical data from the Beagle Bone. Several sensors' worth of data were kept in the Azure database. This database's contents have been retrieved to provide input for the machine learning service. Training the module using historical data was accomplished via the use of a machine learning service. Power BI has been used to visualize sensor data that Beagle Bone Black has retrieved.

An IOT-based air pollution monitoring system, developed by Harsh Gupta et al. in 2019, is comprised of sensors that measure the temperature, humidity, carbon monoxide, smoke, LPG, PM2.5, and PM10 levels in the environment continuously. Through their efforts, an Android application and the open-source cloud platform Thing Speak have established a one-way communication channel. The Raspberry Pi has been used as a hardware system interface gateway. Firebase capabilities like Analytics, Authentication, Storage, Messaging, Hosting, Crash reporting, Real-time Database, etc. were utilized after the Firebase API was integrated into an Android or iOS app. The graphs were created in Thing Speak using the received sensor data, and an Android app displayed the same data in a tabular style.

In 2017, RajatSankhe and colleagues used a carbon sensor to measure the amount of airborne pollutants and carbon particles. The sensor produced an analog signal as its output. The analog output of the sensor was converted into digital form using an ADC and sent as input to the microcontroller, which requires digital input. The LCD keeps showing these readings all the time. The crucial value was entered using a switch pad. The buzzer will sound and the micro controller will use the GPRS module to send a notice to the mobile phone's browser if the amount of air pollutants above the predetermined threshold. This is a dynamic page with constant updates that is accessible from anywhere in the world. On the website, a notice is also issued when the pollution level above the crucial threshold. The modem sends a signal to the mobile phone, which then forwards it to a server and the internet. The data obtained from the smartphone is analyzed by the server. It completes the output based on the incoming data and transmits it over the internet.

In October 2017, Poonam Pal and colleagues created a device that uses an Arduino microcontroller to monitor the air.

They utilized an Arduino to manage the whole operation and a MQ135 gas sensor to detect the many types of harmful gases. The output from the MQ135 gas sensor is voltage levels, which must be converted to PPM. The whole procedure was connected to the internet via a Wi-Fi module, and the visual output was shown on an LCD. The LCD and website will show "Fresh Air" when the value is less than 1000 PPM and "Poor Air, Open Windows" when the PPM exceeds the limit, accompanied by a blaring siren. Should the value surpass 2000, the buzzer will cease to sound and the website and LCD will show "Danger! Get some fresh air.

METHODOLOGY

WORK FLOW

PHASE - 1: Detection of Air Pollutant Level
It denotes the project's first stage. An IoT-based tool for detecting air pollution is created. It deals with gathering data from gas sensors that are linked to Raspberry Pis, sending the data to a cloud platform for storage.

PHASE - 2: Creating the interface
Clarifying the different elements for optional performance is the focus of this step. The MCP3008 is a 10-bit converter with on-board sample and hold circuitry that is calibrated to convert analog data to digital. The mobile application is used to store, analyze, and monitor the acquired data. Using the program, users may examine the data that has been saved.

PHASE - 3: Execution and Testing
Different circuit designs are used to build the project deliverables and link the various components. The purpose of testing, debugging, and troubleshooting the design is to see how well it works in different scenarios. A fresh circuit design should be finished, put into practice, and tested if the original design fails the tests.

HARDWARE COMPONENTS:

1) Raspberry pi 3
2) MQ2 sensor
3) MQ7 sensor
4) Power supply
5) MCP3008
6) 16GB memory

SOFTWARE SPECIFICATIONS:

1) Raspberry pi3 - Raspian OS
2) Python
3) Front end: Php
4) Back end: MySql

BLOCK DIAGRAM

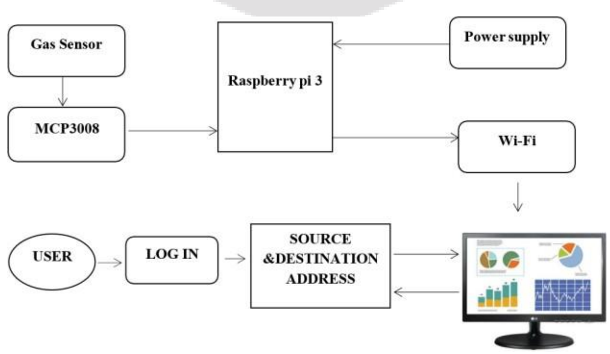

Fig-1Process flow

Hardware Implementation

For the hardware implementation, a Raspberry Pi is needed. Any microcontroller may access your Wi-Fi network with the help of the self-contained System On Chip (SOC) called the ESP8266 Wi-Fi Module. The 10-bit Analog-to-Digital Converter (ADC) MCP3008 is perfect for embedded control applications because it packs a lot of power and performance into a little size. Gases such as methane, CO, hydrogen, alcohol, propane, and LPG may all be measured with the MQ-2 Gas Sensor. The MQ-7 Gas Sensor measures CO concentrations in the air between 20 and 2000 parts per million. It also uses a cycle of high and low temperature to detect CO when the temperature is low (heated by 1.5V). The conductivity of these sensors is increasing as the concentration of gas rises.

STEP 1: Install Raspbian OS in Windows operating system.

Fig-2 Creating a new Raspberry Sketch

STEP 2: Open IDLE and create a new sketch by clicking programming. Programming > Python 3(IDLE).

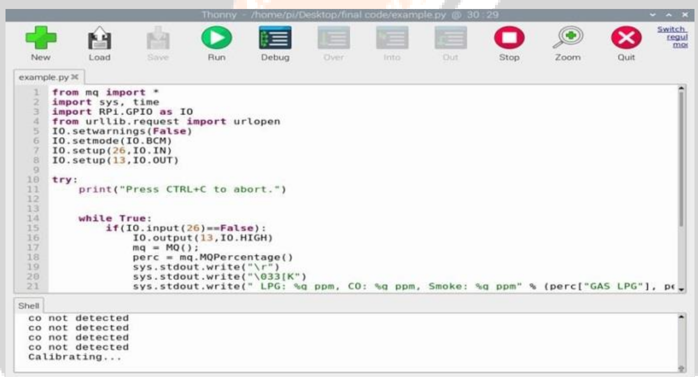

Fig-3 uploading program

STEP 3: Write a program. File > New File.

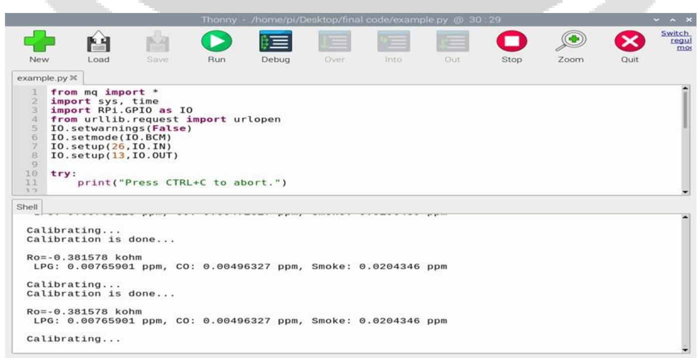

Fig-4 sensing the air pollutants

SOFTWARE IMPLEMENTATION

The software implementation provides the creation of API.

- User needs to sign-in into the application by providing the specified details.

Fig-5 Sing-in page

- For accessing, user must login into the application by providing the credentials

Fig-6 Log-in page

- When the user feeds the source and destination details and clicks "NEXT" the application displays the level of pollutants he is exposed to.

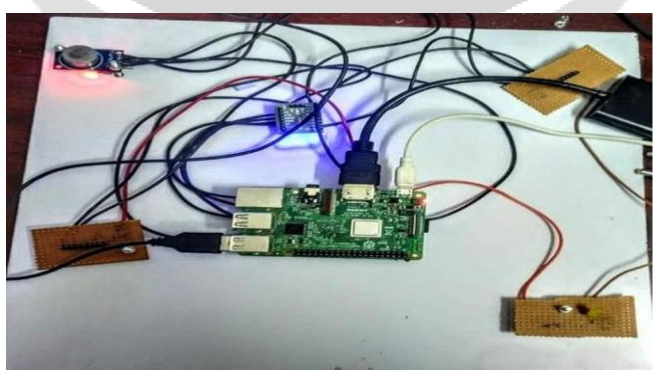

Fig-7 overall assembly

RESULT AND CONCLUSION

Consequently, the goal of our study is to assess the quality of the air pollution exposure level. The source and destination addresses are obtained from the user in order to create the mobile application. In this application, the pollutant level is tracked in this manner. Additionally, it records the person's daily exposure to air contaminants.

The goal of our research was to assist someone in identifying, tracking, and evaluating air pollution in a specific location. The user may now forecast the pollution level throughout their whole journey using the kit's integration with a mobile application. People may determine their amount of exposure to air pollutants by using the integrated mobile application and the suggested air pollution monitoring kit. The app had the following features: real-time calculation of air quality indices; daily updates on air quality depending on users' travel distances; and location-specific reports for air quality measurements.

The main thing hurting our environment is air pollution. impacting not only the environment but also people's health. The smartphone application tracks the amount of exposure an individual has received during the course of a day. The carbon monoxide, smoke, propane, and leakage gas were all detected by the gas sensors. After sensing the gases, the sensor converts analog data to digital data, which is then shown in the application. PPM (Parts per Million) is the unit used to determine the exposure level.

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