International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 03 | Mar 2021 www.irjet.net p-ISSN: 2395-0072

IoT Based Air Pollution Monitoring System

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Abstract - Internet of Things (IoT) may be a worldwide system of "smart devices" which will sense and connect with their surroundings and interact with users and other systems. Global air pollution is one of the major concerns of our era. The level of pollution has increased with times by lot of things like the increase in population, increased vehicle use, industrialization and urbanization which ends up in harmful effects on human wellbeing by directly affecting health of population exposed to it. Air quality goes down when enough amount of harmful gases present in the air like carbon dioxide, smoke, alcohol, benzene, NH3, and NO2.

In order to analyses we are developing an IOT Based pollution Monitoring System which we'll monitor the Air Quality over an internet server. Existing monitoring systems have inferior precision, low sensitivity, and need laboratory analysis. Therefore, improved monitoring systems are needed. To overcome the issues of existing systems, we propose a three-phase pollution monitoring system. It will show the air quality in PPM on the LCD and also as on webpage in order that we will monitor it very easily. In this IOT project, you can monitor the pollution level from anywhere using your computer or mobile device. The system uses MQ2 and MQ7 sensor for monitoring Air Quality. It measures their amount exactly and finds out harmful gases.

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

1. INTRODUCTION

This document is template. We ask that authors follow some simple guidelines. In essence, we ask you to make your paper The Internet has become ubiquitous and popular in almost every corner of the globe and is affecting human life in an unimaginable way. So we are now entering an era of "Internet of Things (IoT)". It includes traditional computing devices like laptops, tablets and smartphones, but also includes a growing list of other devices that have recently become internet enabled. Examples include home appliances, automobiles, wearable electronics, security cameras and lots of other things.
In order for a device to be part of the Internet of Things, it must be able to communicate with other devices. Therefore, it requires some sort of built-in wired or wireless communication. Most IoT devices are Wi-Fi enabled, but Bluetooth also can be wont to transfer data to nearby devices. IoT devices are commonly called "smart devices", since they're ready to communicate with other things. Along with the capacity to speak, many IoT devices also include an array of sensors that provide useful information. While the Internet of Things is still in its infancy, it provides promising opportunities for the future. In time, the web of Things will subsided of an abstract idea and more of how of life.

2. Literature Review

Monika Singh Et al. in August 2019 proposed an Air Pollution Monitoring System. This system uses an Arduino microcontroller connected with MQ135 and MQ6 gas sensor which senses the different types of gases present in the environment. It was then connected to the Wi-Fi module which connects to the internet and LCD is used to display the output to the user and buzzer alerts when the ppm crosses certain limit. Their applications were industrial perimeter monitoring, indoor air quality monitoring, site selection for reference monitoring stations, making data available to users.

Yamunathangam Et al. in November 2018 used IoT by measuring the concentration of gas using various sensors which were observed through serial monitor of arduino. This data is collected in Thing speak channels by means of Ethernet shield which is available in live for further processing. These analyzed results were viewed through thing speak in a graphical format. Then the average pollution level was calculated using matlab analysis and the time controlled results were viewed through an android app. Further based on the location, the air quality index value was obtained through the android app. Along with this, the health effects were also displayed in this app, so that the users can stay aware of the pollution levels.

K. S. E. Phala Et al. in November 2014 presented an air quality monitoring system that consists of air quality monitoring station, communication links, a sink node module and a data server. They developed the GSM module based sink node with data server PC. The real-time data were saved in a micro SD card in text format and also saved in the data server (PC). For the data base they chose MySQL as the DBMS. Electrochemical and infrared sensors were used to measure the concentrations of CO, CO2, SO2 and NO2. GSM modules have been used for the wireless communication between the base station and remote sensor node. The GSM modules communicate over cellular networks and a MCU was used to control all the processes on the sensor node. The MCU samples the sensor outputs using an internal ADC, it then calculates the gas concentrations and transmits the computed data as packets using the GSM. A test incubator

was designed and constructed to evaluate the performance of the sensor node. The sensor node was tested by placing it inside the incubator; pumping gas into the incubator and observing the measurements taken by the sensor node. The base station comprises a sink node serially connected to a computer which runs the GUI software. The sink or receiving node captures the data transmitted by the remote sensor node and serially forwards it to the computer. The data was then plotted on the GUI and stored in text files.

Nitin Sadashiv Desai Et al. in 2017 proposed a system that consists of Beagle bone Interfaced with air pollution measure sensors such as carbon dioxide [CO2], carbon monoxide [CO] and noise sensor. Analog output from sensor was read from Analog pin of Beagle bone black which reads the input signal in the range 0 v to 1.8v. Data from sensor was uploaded on Azure Cloud with the help of python SQL. Reserved data base was created in the beagle bone itself in the form of .CSV file. At the end of each day, same data present in the .CSV file is uploaded in the cloud data base. Old data in the beagle bone have been deleted with the help of automated shell script. Data from different sensor was stored in the Azure data base. This data from database has been fetched as input for machine learning service. Machine learning service was used to train the module with the help of previous data. Power BI have been used to represent sensor data fetched by beagle bone black.

Harsh Gupta Et al.in 2019 presented an IOT based Air Pollution Monitoring System which consists of sensors that were to constantly monitor the Temperature, Humidity, Carbon Monoxide, Smoke, LPG, PM2.5 and PM10 levels in the atmosphere. In their work, a one-way communication between Thing Speak, an open source cloud platform, and an Android Application has been developed. Raspberry Pi has been used as a gateway to interface the hardware system. Once the firebase API was included in Android or iOS App, firebase features like Analytics, Authentication, Storage, Messaging, Hosting, Crash reporting, Real-time Database etc. were used. The Graphs were plotted in Thing Speak according to the sensors data received and the same were visualized in an Android App in a tabular format.

Rajat Sankhe Et al. in 2017 used carbon sensor for sensing the pollutants or the carbon particles in the air and it also detects the level of pollutants in air and gives the output in form of analog signal. The microcontroller takes input in digital form so ADC was used to convert the analog output of the sensor into digital form andgives it as input to the micro controller. These values are continuously displayed on the LCD. A switch pad was used for entering the critical value. If the value of pollutants in air exceeds the critical value entered then the buzzer beeps and also a notification will be sent to the webpage on the mobile phone by the micro controller through the GPRS module. This information is continuously being updated on the webpage which can be accessed globally. A notification was also received on the webpage when the level of pollutants rises above critical value. Mobile phone receives the signal from modem which it forward to server to the internet. Server analysis the data received from the smartphone. It concludes the output from the data received and sends the output over the internet.

Poonam Pal Et al. in October 2017 developed a system to monitor the air using Arduino microcontroller. They used MQ135 gas sensor to sense the different type of dangerous gas and arduino to control the entire process. MQ135 gas sensor gives the output in form of voltage levels and needs to be converted into PPM. Wi-Fi module was used to connect the whole process to internet and LCD was used for the visual output. When the value is less than 1000 PPM, the LCD and webpage will display “Fresh Air” and when the PPM exceeds the limit then the buzzer starts beeping and the LCD and webpage will display “Poor Air, Open Windows”. If it will increase 2000 then the buzzer will keep beeping and the LCD and webpage will display “Danger! Move to fresh Air”.

3. METHODOLOGY

3.1 WORK FLOW

PHASE - 1: Detection of Air Pollutant Level

It indicates the early phase of the project. An IoT based air pollution detection kit is developed. It deals with the collection of data from gas sensors connected to Raspberry Pi and the information is sent to the cloud platform that stores it.

PHASE - 2: Creating the interface

This stage involves the clarification of the various components for optional performance. MCP3008 is a 10 bit converter which is calibrated to convert analog data to digital with on-board sample and hold circuitry. The data collected is stored, processed and can be monitored using the Mobile Application. Users can review the stored data through the application.

PHASE - 3: Execution and Testing

The various components are interfaced together and the project deliverables are built with the help of different circuit designs. The testing, debugging and troubleshooting of the design is performed to test the performance of the design under various conditions. If a circuit design fails to pass the tests, then a newer circuit design should be completed, implemented and tested.

4. HARDWARE COMPONENTS:

1) Raspberry pi 3 2) MQ2 sensor

3) MQ7 sensor 4) Power supply

5) MCP3008 6) 16GB memory

5. SOFTWARE SPECIFICATIONS:

1) Raspberry pi3 - Raspian OS 2) Python

3) Front end: Php 4) Back end: MySql

6. BLOCK DIAGRAM

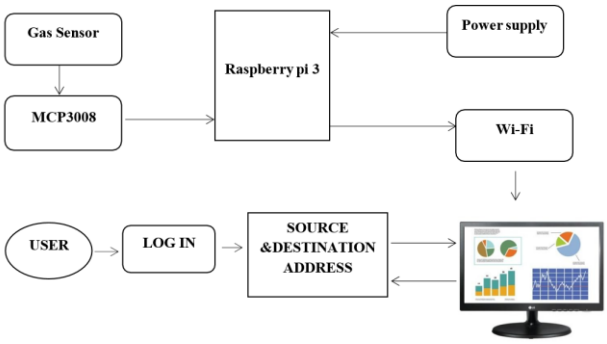

Fig-1Process flow

7. Hardware Implementation

The hardware implementation requires a Raspberry Pi. The ESP8266 Wi-Fi Module is a self-contained System On Chip (SOC) that can give any microcontroller access to your Wi-Fi network. MCP3008 is a 10-bit Analog-to- Digital Converter (ADC) combines high performance and low power consumption in a small package, making it ideal for embedded control applications. MQ-2 Gas Sensor can measure gases like LPG, Alcohol, Propane, Hydrogen, CO and even Methane. MQ-7 Gas Sensor detects CO concentrations in the air anywhere from 20 to 2000ppm and it also makes detection by method of cycle high and low temperature, and detect CO when low temperature (heated by 1.5V). These sensors conductivity is more high along with gas concentration rising.

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).

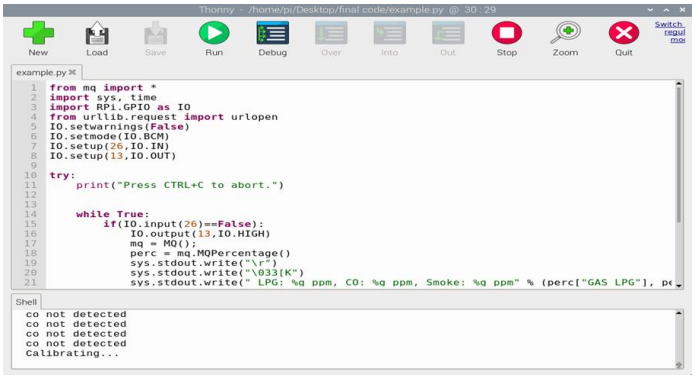

Fig-3 uploading program

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

Fig-4 sensing the air pollutants

8. 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.

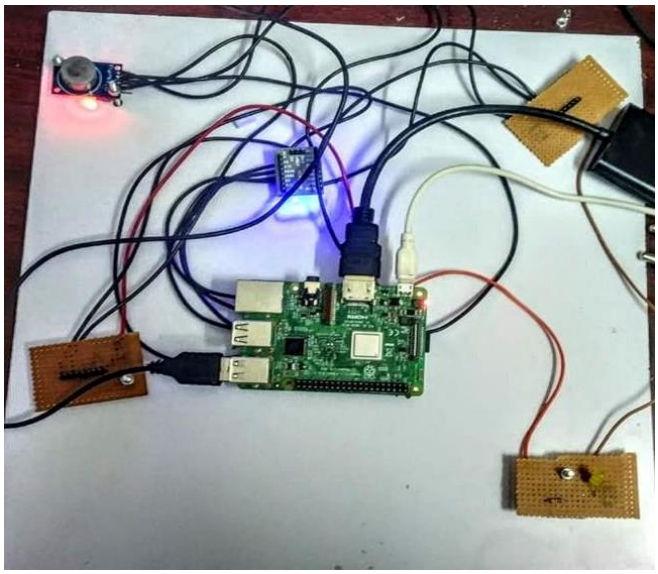

Fig-7 overall assembly

9. RESULT AND CONCLUSION

As a result, our project is to check the quality of the exposed level in the air pollution. The mobile application is developed by getting the source and destination address from the user. In this application it monitors the pollutant level through that way. It is also tracks the individual's exposure level of air pollutants for a single day.

Our project was designed to help a person to detect, monitor, and test air pollution in a given area. The kit has been integrated with a mobile application that helps the user in predicting the pollution level of their entire route. This proposed air pollution monitoring kit along with the integrated mobile application can be helpful to people to identify their exposure level to air pollutants. The app had following features, indices of air quality using real-time computation, air quality daily reports based on users travel distance, specific reports for air quality measures based on locations.

Air Pollution is the major affecting factor to our environment. Not only affecting the environment and alsoaffects the human health. The mobile application is developed to monitoring system it tracking the how much the human has exposed in a day. The gas sensors was used for identifying the Leakage Gas, Carbon Monoxide, Smoke, and Propene. The sensor senses the gases and convert from analog to digital and displays in the application. The exposed level is calculated in PPM (Parts per Million).

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