IoT Based Air Quality Prediction System Using SVM And RF

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ABSTRACT

Internet of Things (IoT) may be a worldwide system of "smart devices" which will communicate with users, interact with environment, and detect their surroundings. We live in an era that is plagues by global air pollution. There are several things that have led to an increase in pollution with the passage of time, such as a rise in vehicle use, industrialization and urbanization, which can negatively affect human health.

When elements like Carbon Dioxide, smoke, alcohol, Benzene, NH3 and NO2 are present in enough amount, the quality of the air rapidly goes down. For the purpose of analysing, we are developing an IoT Based Air Quality Prediction System which will help in detecting the quality of the air by making use of internet servers. The system currently exists have inadequate precision, low sensitivity and requires analysis from the laboratory.

Keyword: *Air quality monitoring, Machine learning, Air quality index*.

INTRODUCTION

We live in an environment that encompasses everything around us. Due to human activities and natural disasters, the environment is becoming increasingly polluted, with air pollution being one of the most serious. Due to increased transportation facilities, urbanization is one of the main causes of air pollution, as are industrialization and industrialization's effects on air pollution.

Nitrogen Oxide (NO), Carbon Monoxide (CO), Particulate matter (PM), SO2 etc are the major pollutants. Petroleum, gas, and other propellants produce carbon monoxide when they are not properly oxidized. Nitrogen Oxide is produced due to the ignition of thermal fuel and the Benzene is produced because of smoking. The effects of all these harmful gases are headaches, vomiting, respiratory problems, dizziness, nausea, etc.

Quality of air is measured using the Air Quality Index (AQI). In past, use of classical methods like probability, statistics were made for predicting the air quality, but those methods were not much convenient for making the prediction of the air quality. Now a days, fetching the data about the air quality pollutants using the sensors has become very easy, thanks to the advancement of technology. The evaluation of raw data to identify pollutants requires very careful analysis. Machine learning algorithms, including deep learning techniques such as Convolutional Neural Networks (CNNs) and Recursive Neural Networks (RNNs), can be used to predict future AQI levels. By leveraging these models, appropriate measures can be taken to address potential air quality concerns.

In the proposed work, the use of supervised learning approach, which is a type of machine learning algorithm, has been done. Many algorithms comes under supervised learning, such as linear regression, SVM, Naïve Bayes, Random Forest. Compared to all the algorithms, random forest gives the better results, so we have chosen the random forest for the accurate prediction of air pollution.

LITREATURE SURVEY

Paper 1: The Prediction of Quality of the Air Using Supervised Learning, Chakradhar ReddyK and Nagarjuna Reddy K

The supervised machine learning technique (SMLT) was used to gather several pieces of information from the dataset, including variable recognition, univariate analysis, bi-variate and multivariate analysis, missing value treatment and analysis, data cleaning/preparation and da ta representation. Their results provide a invaluable guidance for the sensitivity analysis of model parameters in terms of success in predicting atmospheric pollution through accuracy measurement. (2021).

Paper 2: Air Pollution Prediction Using Machine Learning Supervised Learning Approach, Madhuri VM, Samyama Gunjal GH

Madhuri VM, Samyama Gunjal GH, their work suggests that machine learning algorithms can be effective for predicting AQI, and that the RF algorithm in particular may be a useful tool for researchers and policymakers interested in monitoring and improving air quality. (2020)

Paper 3: Air Quality and Dust Level Monitoring using IoT, Akshatha S and Jayaram M N

Akshatha S and Jayaram M N, The purpose of the system was to use different sensors and servers to design effective air quality monitoring system without causing any harm to the natural environment and avoid conflict by providing the live updates. (2019).

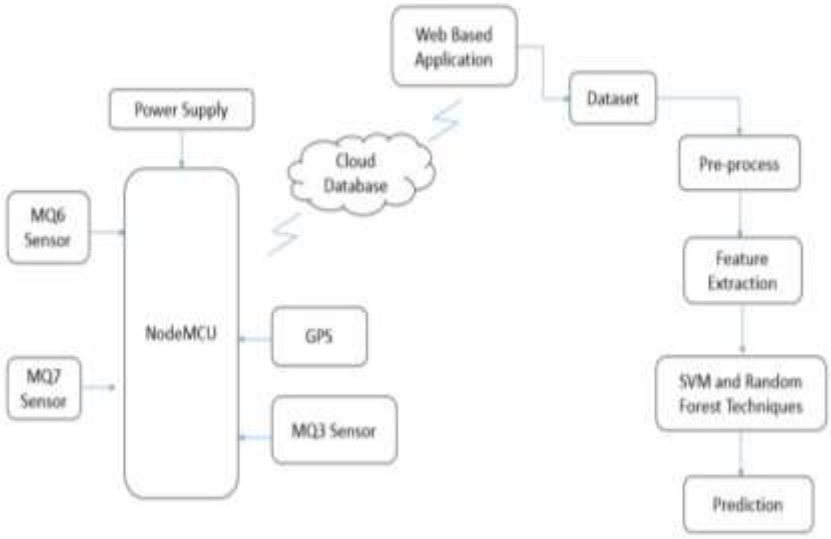
Paper 4: Air Pollution Level Prediction System, Rajeev Tiwari, Shuchi Upadhyay, Parv Singhal

Two different teams worked on developing systems related to air quality prediction and monitoring. The first team, consisting of Rajeev Tiwari, Shuchi Upadhyay, and Parv Singhal, aimed to create an artificial neural network capable of predicting air quality using a limited dataset. They sought to ensure that their network was robust enough to handle noise and errors in the data. To achieve this, they used a dataset that focused on four major pollutants (Nitrogen Dioxide, Sulphur Dioxide, Carbon Monoxide, and Ozone) in the US over the course of a ten-year period (2008-2017).

Paper 5: Air Pollution Monitoring System using the Internet of Things, , Shivam Sharma and Nishu Soni.

The second team, composed of Shivam Sharma and Nishu Soni, focused on developing an air quality monitoring system that utilized the Internet of Things (IoT). Their system aimed to control air pollution and enhance the quality of air by measuring real-time air quality index, temperature, and humidity. The data was displayed on a website through the internet to provide real-time information to users. (2019).

BLOCK DIAGRAM



System Architecture

1. **Node MCU:**

Node MCU is an opensource platform based on ESP8266 which can connect objects and let data transfer using the Wi-Fi protocol. Node MCU is a microcontroller development board with wi-fi capability. It uses an ESP8266 microcontroller chip.

2. **MQ3 Sensor:**

The MQ3 Gas Sensor module is a useful tool for detecting gas leaks in both home and industrial settings. It is designed to detect a range of gases, including Alcohol, Benzine, CH4, Hexane, LPG, and CO. The module is highly sensitive and can provide fast response times, allowing for quick and accurate measurements to be taken.

3. **MQ6 Sensor:**

The MQ6 Sensor, also known as the LPG Gas Sensor, is a straightforward and user-friendly sensor designed specifically for detecting liquefied petroleum gas (LPG). It can be used in a variety of consumer and industrial applications, including gas leakage detection equipment. The MQ6 sensor is capable of detecting a range of gases, including LPG, iso-butane, propane, and LNG, while avoiding the noise of alcohol, cooking fumes, and cigarette smoke. With its high sensitivity and fast response time, the MQ6 Sensor is an ideal tool for ensuring safety and security in gas detection.

4. **MQ7 Sensor:**

The MQ7 Sensor is a straightforward and user-friendly Carbon Monoxide (CO) sensor designed for sensing CO concentrations in the air. The sensor is capable of detecting CO-gas concentrations ranging from 10 to 500ppm. With its high sensitivity and fast response time, the MQ7 Sensor is an ideal tool for detecting potentially harmful levels of CO gas. The sensor's output is an analog resistance signal, which can be easily integrated into a wide range of monitoring and control systems.

5. Cloud Database:

A cloud database is a specialized type of database designed to operate within a public or hybrid cloud environment. Its purpose is to assist organizations in efficiently organizing, storing, and managing their data. Overall, a cloud database can help organizations to streamline their data management processes and improve their overall data-driven decision-making capabilities.

6. Feature Extraction:

Feature extraction is a critical process in data analysis that involves converting raw data into numerical features that can be effectively processed while retaining important information from the original dataset. Techniques such as Artificial Intelligence and Artificial Neural Networks are frequently used to perform feature extraction. By extracting meaningful features from complex datasets, these techniques enable data scientists and analysts to gain deeper insights into the underlying patterns and relationships in the data, leading to more accurate predictions and better decision-making.

7. Support Vector Machine:

Support Vector Machines (SVMs) are a type of supervised machine learning algorithm that can be utilized for both classification and regression tasks. However, SVMs are most commonly used in classification problems. The goal of SVM is to identify a hyperplane that has the maximum possible margin between the hyperplane and any point within the training dataset. By choosing this optimal hyperplane, SVMs can increase the likelihood of correctly classifying new data that has not been previously encountered. This makes SVMs a powerful tool for solving complex classification problems in a variety of domains, including image and speech recognition, natural language processing, and more.

8. Random Forest:

The Random Forest Algorithm is a widely used supervised machine learning technique that is capable of solvin both classification and regression problems in Machine Learning. In classification tasks, the majority vote of the decision trees is used to make the final prediction, while in regression tasks, the average value of the predictions is used. The Random Forest Algorithm is known for its accuracy, robustness, and versatility, making it a popular choice for a wide range of applications, including image recognition, speech recognition, and fraud detection

9. ThingSpeak:

ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud.

ThingSpeak stores all the information you send it in one central location in the cloud, so you can easily access your data for online or offline analysis. Your private data is protected with an API key that you control.

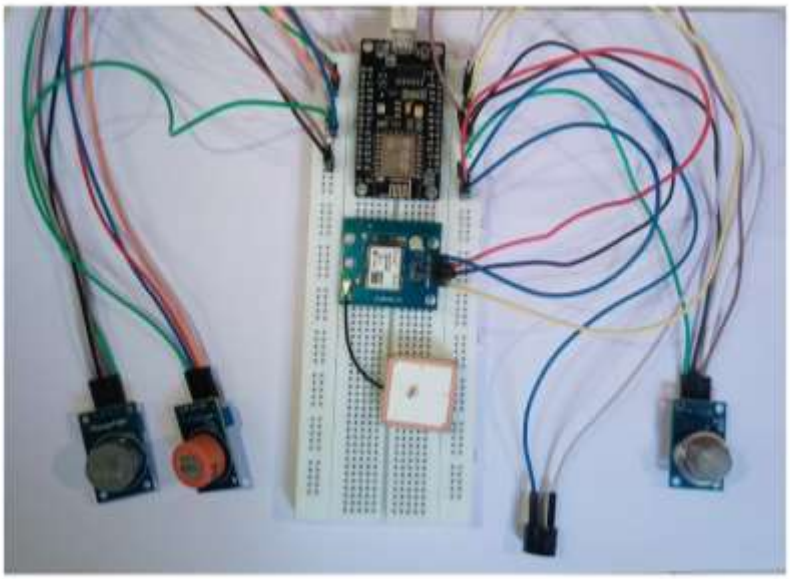
10. Buzzer:

The buzzer is a sounding device that can convert audio signals into sound signals. It is usually powered by DC voltage. It is widely used in alarms, computers, printers and other electronic products as sound devices. The active buzzer is connected to a pin set as a digital output. The passive is also connected to a pin set as digital output and PWM compatible.

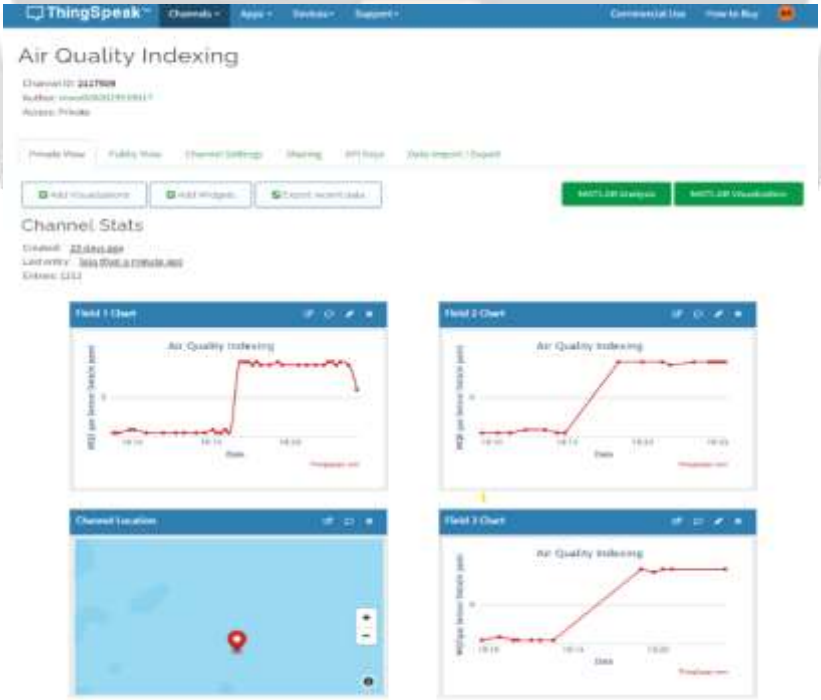
11. GPS Module:

GPS is module that receives a certain location from a satellite. GPS is a good method for finding a location when outdoors. Several GPS satellites can be used in the GPS module

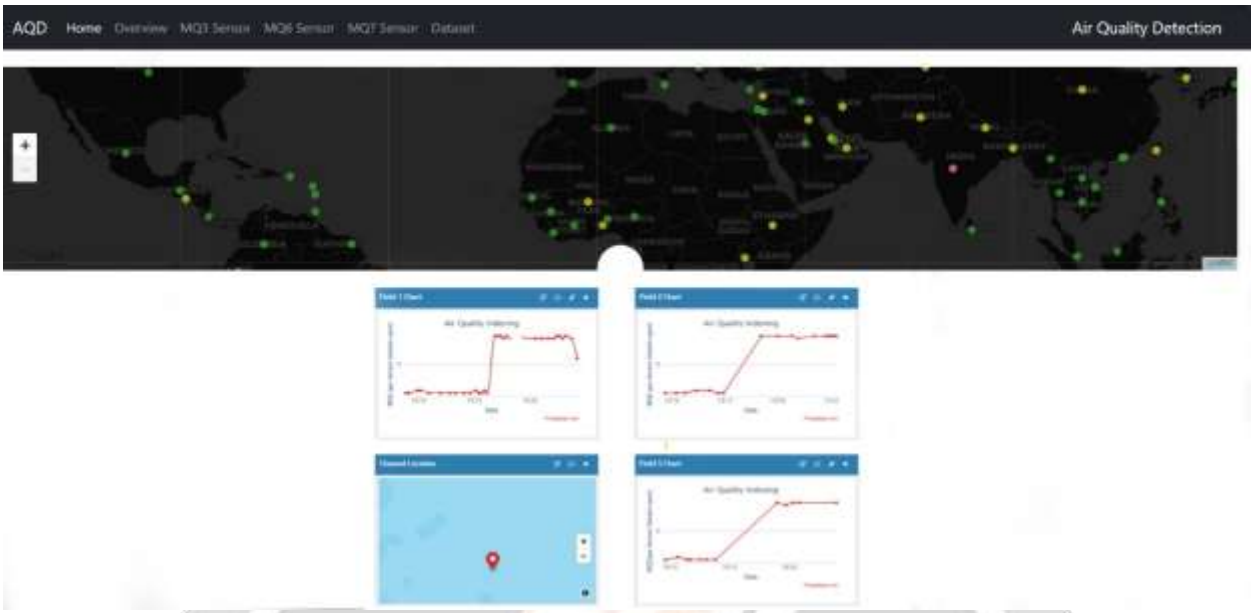
IMPLIMENTATION RESULT



Hardware Connections



ThingSpeak Visualization



User Dashboard

CONCLUSION

As a result, our project is to check the quality of the exposed level in the air pollution. Our project was designed to help a person to detect and predict the air quality in a particular area. Air Pollution is the major affecting factor to our environment. Not only affecting the environment and affects the human health. The web-based application is developed to predict the air quality. The gas sensors were used for identifying the gases and GPS for getting the location of area.

REFERENCE

1. Chakradhar ReddyK and Nagarjuna Reddy K , "The Prediction of Quality of the Air Using Supervised Learning" , IEEE 2021

2. Madhuri VM, Samyama Gunjal GH, Savitha Kamalapurkar , "Air Pollution Prediction Using Machine Learning Supervised Learning Approach ", International Journal Of Scientific & Technology Research Volume 9, Issue 04, April 2020

3. Akshatha S and Jayaram M N , "Air Quality and Dust Level Monitoring using IoT ", International Research Journal of Engineering and Technology 2019

4. Rajeev Tiwari, Shuchi Upadhyay, Parv Singhal , "Air Pollution Level Prediction System", International Journal of Innovative Technology and Exploring Engineering (IJITEE) , 2019

5. Shivam Sharma and Nishu Soni , "Air Pollution Monitoring System using the Internet of Things", International Research Journal of Engineering and Technology 2019

6. Mauro Castelli and Fabiana Martins Clemente, “A Machine Learning Approach to Predict Air Quality in California” , Research Article , 2020

7. Yun-Chia Liang and Yona Maimury , “Machine Learning-Based Prediction of Air Quality ” , Applied Science , 2020