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A Survey on Air Pollution Monitoring System using IOT and Data Analytics

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ABSTRACT

As part of an IoT-based air pollution monitoring system, a NodeMCU equipped with an ESP8266 WLAN adaptor interacts with a MQ Series sensor to communicate sensor readings to the ubidots IOT platform. A forecasting model, which is essentially a subset of forecasting, and a suitable IOT platform model to determine the level of air pollution are included in the additional scope of this work. We'll be using our IoT prototype to collect the data. The study's main goals are to monitor, visualize, and project pollution statistics. The best forecasting model for calculating the air quality index (AQI) of five different gases—alcohol, hydrogen sulphide (HS2), carbon monoxide (CO), and carbon monoxide—was determined using this model (CO). Thus, the model can be inferred from this study.

INTRODUCTION

Environmental monitoring is a methodical way of observing and analysing the state of the environment. Humans need clean air to breathe to stay healthy, but as the transportation system grows, pure air is becoming more and more polluted. The way we travel affects the environment in which we live. As the number of vehicles increases, so do the emissions of pollutants associated with traffic. Thus, it is essential to monitor the pollution levels in urban and suburban regions in order to determine how this pollution affects the environment and people's health. Air pollution is causing a lot of health-related problems. Road traffic emissions are a significant cause of air pollution, emitting 97% CO and 75% NO. Monitoring of air quality is therefore necessary in order to provide helpful information about the pollution and, when necessary, take the necessary action to lessen its effects. Monitoring the air quality has two goals: first, it gathers data, but second, it gives scientists, planners, and policymakers the knowledge they need to decide how to manage and improve the environment. The basic purpose of an air quality monitoring network is to keep track of pollution levels and other relevant parameters, then transmit this information or data to the public in order to alert them to potential hazards.

LITERATURE REVIEW

1. Air Pollution Monitoring System based on IoT: Forecasting and Predictive Modeling using Machine Learning

An IoT-based air pollution monitoring system uses a NodeMCU with an ESP8266 WLAN adaptor and a MQ Series sensor. reading to a Thingspeak cloud. The work's further scope includes a forecasting model, which is simply a subset of predictive modelling, and a suitable machine learning model to estimate the degree of air pollution. We used an authorised open-source dataset provided by the US government to extend our model. To gather the data, we will use our IoT prototype device. The study's main goals are to monitor, visualize, and project pollution statistics. In particular, three machine learning (ML) techniques were applied to identify the most efficient forecasts.

IoT is a technology that uses the benefits of an OSI-layered architecture to link intelligent things to the internet. In order to assess the amount of air pollutants in the atmosphere, this paper suggests using a cluster of air quality monitoring motes. The MQ-2 Gas Sensor is used to gather data on gas concentrations, and the NodeMCU is an open-source development board containing ESP8266-12E chips. Small embedded devices can have their processing overheads reduced by using machine learning models. The implementation of the suggested air quality monitoring device The technique of creating prediction models from large collections of data and resolving pressing issues is known as machine learning. This study sought to precisely forecast O3, SO2, NO2, and CO values.

2. IOT BASED AIR POLLUTION NOTIFICATION AND MONITORING SYSTEM

This study proposes an IOT-based air pollution monitoring system that will track air quality online and sound an alarm when there are enough dangerous substances in the atmosphere. The sensor in use, model MQ135, has a wide range of dangerous gas detection and precise measurement capabilities. The system is installable anywhere and can activate a device when the level of pollution exceeds a certain threshold. Objects can be recognised or controlled thanks to the Internet of Things (IoT). Control and live monitoring of pollution-related factors will be made easier by the development of pollution

observation systems. An IOT-based air quality monitoring system will use the internet to monitor the air and will sound an alarm if there are any changes in the quality of the air.

Air pollution happens when unfavorable substances like biological molecules and particles are added to the Earth's atmosphere. IOT technology is anticipated to enhance air quality by offering temperature and humidity sensors, a tiny controller, and sensors for dangerous gases. This initiative aims to prevent, control, and decrease stream, well, land, and air pollution in order to safeguard the environment.

3. Air Pollution Monitoring system

Environmental monitoring is a systematic approach for observing and studying the condition of the environment. It is necessary to track the level of pollution in urban and sub urban areas in order to provide useful information about the pollution and take appropriate measures to mitigate the negative impact. The main mission of air quality monitoring is to record the concentration of pollution and other parameter related to the pollution and deliver these information or data to the population to warn against the any danger. Polluted air causes many health problems and damages, so it is important to monitor the air quality to make a right decision at the right time. The main gases which directly affect the human health are carbon monoxide (CO), hydrogen sulphide, sulphur dioxide (SO2), and nitrogen dioxide (NO2).

Using computer tomography, which creates a two-dimensional map of pollutant concentration, air pollution is monitored. This method emphasizes lower transmitted laser energy, extending the range and enabling monitoring of the area with several polluting sources. The online GPRS sensors array, which comprises of a mobile data acquisition unit, a database server, and a pollution server, is another method of keeping tabs on air pollution. To provide a real-time pollution level and position in significant metropolitan regions, the pollution server is connected to a Google map.

4. ENVIRONMENT AIR POLLUTION MONITORING SYSTEM USING ROOF COMPUTING

In this research, a ROOF-based industrial air pollution monitoring system is proposed. It offers decision- and automation-making capabilities that function autonomously in relation to the local environment. It lessens the negative impacts of industrial air pollution on human health, keeps an eye on the condition of industrial components and possible environmental harm, and provides and shares real-time monitoring news. The way air quality is monitored and managed is changing as a result of technological improvements. Reducing air pollution is crucial for sustaining the health and environment of employees as well as the public at large. Indoor air quality (IAQ) is a significant element in determining public health. In the industry, wireless sensor networks are used to automatically detect the values of parameters like CO, temperature, and pH.

Markets for indoor (fixed and portable), outdoor (fixed, portable, dust and particulate monitors as well as AQM stations), and wearable monitors are the three main categories in the market for air quality monitoring systems. Due to rising adoption of smart home and green building technologies as well as consumer preference for pollution-free indoor environments, the indoor monitors segment dominated the AQMS market in 2017. Gas chromatographs, mass spectrometers, Fourier transform infrared (FTIR), and other devices are currently used to measure air pollution. The majority of the current monitoring system utilises STIMs, or smart transducer interface modules, which pair semiconductor gas sensors with 1451.2-compliant gas sensors. Nevertheless, these systems lack comprehensive solutions, have fewer functionality, or require constant communication with cloud services to carry out tasks necessary for.

5. IoT Based Air Pollution Monitoring System

The Internet of Things (IoT) is a global network of "smart gadgets" that can detect their environment, connect to it, and communicate with people and other systems. One of the main issues of our time is global air pollution, and an IOT-based pollution monitoring system is being developed to track the air quality online. The MQ2 and MQ7 sensors are used by the system to detect and measure hazardous gases. The air quality in PPM will be displayed on the LCD as well as online. An air pollution monitoring system employing an Arduino microcontroller coupled with MQ135 and MQ6 gas sensors was proposed by Monika Singh et al. in August 2019. In November 2018, Yamunathangam et al. used IoT to measure the gas concentration using a variety of sensors. An air quality monitoring system comprised of an air quality monitoring station, communication lines, a sink node module, and a data server PC was presented by E. Phala et al. The levels of CO, CO2, SO2, and NO2 were measured using electrochemical and infrared sensors. Wireless communication between the base station and the remote sensor node was accomplished using GSM modules. All the operations on the sensor node were under the control of an MCU. A system made of Beagle bones was proposed by Nitin SadashivDesai and colleagues.

Any microcontroller may connect to the Wi-Fi network thanks to the ESP8266 Wi-Fi Module, a self-contained System On Chip (SOC), and the MCP3008 ADC combines great performance and low power consumption.

6. An IoT Based Low Cost Air Pollution Monitoring System

For the purpose of tracking the concentrations of the main air pollutant gases, a prototype for an environmental air pollution monitoring system has been created. It measures the concentrations of gases including CO, CO2, SO2, and NO2 using low-cost air-quality monitoring nodes with Wi-Fi modules. The sensors collect information about different environmental factors and transmit it to the raspberry pi, which serves as a base station. Data is displayed on websites using a MEAN stack. By establishing limits on the concentration of different air pollutants, the WHO has produced guidelines for decreasing the negative impacts of air pollution on public health. In order to address shortcomings of conventional monitoring systems and lower test costs, this paper suggests a way combining IoT technology with environment monitoring.

7. A SMART AIR POLLUTION MONITORING SYSTEM

The ecosystem and standard of living on the planet are both at risk from air pollution. The air pollution monitoring system proposed in this project was created using an Arduino microcontroller. The system was created to track and assess air quality in real-time while logging data to a distant server and updating the data online. Based on the PPM metrics, air quality measurements were made, and Microsoft Excel was used for analysis. The outcome was shown on the hardware's interface and was accessible via the cloud on any sophisticated mobile device. Public health is impacted by air quality.

7 million people die from air pollution-related causes each year in the world, and 570,000 children under the age of five pass away from respiratory infections brought on by indoor and outdoor pollution and secondhand smoke. The design and implementation of a smart air pollution monitoring system that can track, analyze, log, and update air quality data to a remote server are the main topics of this study. The use of sensors is revolutionizing air pollution monitoring, enabling the development of intelligent ecosystems where objects communicate and work together. There have been advancements made to the current air pollution monitoring systems, including a system for home air quality monitoring and a UAV-based system to monitor air pollution.

8. AIR POLLUTION MONITORING SYSTEM USING IOT AND DATA ANALYTICS

An IoT-based air pollution monitoring system interfaces a MQ Series sensor with a NodeMCU and ESP8266 WLAN adaptor to communicate sensor values to a ThingSpeak cloud. A forecasting model and three machine learning (ML) algorithms were used to predict the air pollution level and the air quality index (AQI) of four distinct gases. The best result was achieved by Random Forest, which is practical to use in high-pollution areas. This study tracks, displays, and projects air pollution levels using an IoT device and a licensed open-source dataset. The best forecasting and predicting models for determining the AQI of four distinct gases were found using three machine learning (ML) methods. The best performance was achieved by Random Forest, which can be used in real-world applications.

In this study, we intend to build a forecasting model, which is a subset of predictive modelling, and an appropriate machine learning model to predict the air pollution level. The best forecasting and prediction models for estimating the AQI of four different gases—Carbon Monoxide (CO), Nitrogen Dioxide (NO2), Sulphur Dioxide (SO2), and Ozone—were discovered using three machine learning methods (O3). Root Mean Square Error (RMSE) and Mean Absolute Error were used as performance measurements (MAE). The best performance was achieved by Random Forest, and high-pollution locations can use the model in practice.

9. Air Pollution Monitoring In Urban Area

This suggested design intends to monitor and detect the amount of carbon dioxide in the air in real-time and to promptly deliver alerts about the overall air quality. It suggests integrating data from air quality sensors, temperature sensors, and CO2 sensors to test for pollutant levels in the air in real time and identify areas with polluted air. An alarm is activated, and alert messages are sent through GSM to the department in charge of traffic and pollution control when the air quality exceeds the threshold level. The gadget has the ability to gauge the quality of the air around it, raising awareness among the population.

The Internet of Things (IOT) is a technology that links all objects to the Internet to build intelligent spaces. Air pollution monitoring systems use wireless communication to exchange data and send alerts to one another. This paper proposes a novel approach to combining an air pollution monitoring system with IOT in order to build a smart city. The three essential components of the system as proposed are the sensors, GSM, and IOT modules. The GSM module is used to monitor the areas impacted by pollution and build web servers, while the sensors are used to send SMS alerts to the department in charge of traffic and pollution management.

10. Air Pollution Monitoring System using IoT

The authors measured the amount of air pollution produced by automobiles on city highways using IoT. The sensors utilized were the UVI-01 for ultraviolet light, the BMPO85 for pressure and temperature, the LDR (light dependent), the TGS 2600 (general air quality), the MICS-2710 (nitrate) and the MICS-5525 (carbon monoxide). The suggested system keeps track of every result and uploads data to the cloud, where decisions are made in accordance with the created report. In order to verify accuracy and provide a more organized monitoring system, low cost sensors such the MQ135, MQ4, MQ9, and MQ7 were used. The authors provide data to the relevant authority after using sensors to identify air contaminants. They also create sophisticated sensors that can detect certain materials, carbon dioxide, ozone, and noise levels. They also employ IoT-based air pollution monitoring.

People will be more aware of pollution levels and know when to take action as a result of the IoT's ability to collect and communicate data in an approachable format.

CONCLUSION

Air quality is a serious problem that directly affects people's wellbeing. Remote monitoring devices equipped with a variety of vaporous sensors and meteorological ones are used to gather information about air quality. These data are examined and used in the process of anticipating fixation estimations of contaminations using clever machine-to-machine stage We can draw the conclusion that we need a highly capable and reliable system that can deliver precise readings of real-time data (pollutant levels) so we can act right away to control the pollution levels. An IoT-based system, such as the one described earlier, can achieve this. The information in the database is automatically kept and can be used by the authorities to take quick action. Also, it enables regular people to control pollution in their neighbourhood by being aware of its magnitude. Because of the rising pollution threat in industries, this is a sturdy system that is highly helpful.

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