AIR POLLUTION MONITORING SYSTEM USING INTERNET OF VEHICLES AND POLLUTION SENSORS

FIELD OF THE INVENTION

The present disclosure relates to an air pollution monitoring system using internet of vehicles and pollution.

BACKGROUND OF THE INVENTION

There are different causes of air contamination in the environment but contamination due to vehicles is the main cause that contributes significantly to air contamination. Nowadays, air contamination has become a major issue in metro cities and vast urban regions all through the globe, and transportation is perceived as a significant source of air contamination in numerous urban areas, particularly in developing nations. The quick development in vehicle populace is being seen since the start of the twentieth century. The vehicle populace in 1950 was around seventy million which expanded to around seven hundred million in 1996. USA and Europe jointly have two-third of the vehicle populace of the world. After 1980 the yearly development rate of vehicle populace is seen to be 3% and for the creating nations, the rate is considerably higher. In 2020 the vehicle populace is evaluated to be about more than one billion with creating nations comprising 44% of the complete populace.

According to the report given by the Department of Natural Resource and Environment and Natural Pollution Control, the year 2016-19 found that air contamination occurring in Bangkok city and people suffered because of exposure to 03(ozone) and PM10 (dust). The Real time in-vehicle air excellence monitoring through mobile sensing has developed to control air pollution using mobile phones. The mobile phone is used to measure the indoor pollution level; the level of Vehicle Indoor Air Quality (VIAQ) is displayed on the mobile. It has no provision to measure the emission of exhaustive gas and its pollutant contents.

The various chemical air pollutants are discussed as follows:

Ammonia which is chemically represented as NH3, a non-color gas having a different odor consists of hydrogen and nitrogen atoms. NH 3 is a natural representative in human beings, water, air, and soil. To perform metabolic actions ammonium and ammonia plays a major role in the health of human.

Sulfide having negative compounds is known as inorganic sulfides. S2_; these compounds may be regarded as salts of the very weak acid hydrogen sulfide.

Benzene commonly used chemicals in industry. Gasoline and crude oil are the major components of benzene. It helps in creating resins, plastics, rubber lubricants, synthetic fibers, detergents, dyes, and pesticides. Forest fires and volcanoes are the source factors of benzene.

Bio-diesel to save the atmosphere from the vehicular pollution, now various countries are looking for using biodiesel blends. Generally, these fuels are a combination of a variety of vegetable oils that have properties analogous to that of diesel. These fuels are considered as a substitute for diesel and petrol.

Ozone is a high reactance of oxygen. Ozone is represented with three atoms of oxygen and unbalanced 02. Gases of nitrogen base and hydrocarbons together make a chain in the layer of the troposphere of a specific amount to produce ozone.

Alternate fuels most of the vehicles are running on Petrol and Diesel which are quite costly and majorly responsible for pollution in the urban areas. So there is a need for some alternative fuels to reduce pollution in the environment.

Air Contamination Observation System displays the air excellence through the internet to a web-server to activate a warning alarm whenever the quality of air decreases to a level of consideration, it is nothing but gases that are harmful like smoke, C0 2 , NH3,

LPG, alcohol, NOx, and benzene are identified then the Parts Per Million (PPM) present in LCD will be displayed in the webpage to monitor the humidity and temperature in the provided system.

The alarm-based observing device rings the bell on exceeding the threshold limit of the pollutant contents from the smoke outlet. It has also stopped the vehicles after defined time duration, to protect the movement of the vehicles. It has no communication with the third party who can interfere to control the pollution. This device could not achieve the scope of reducing air pollution by road vehicles.

The smart vehicles monitoring system for air pollution monitoring aimed to record the levels of Humidity, Temperature, NO2, CO level of vehicles. The smartphone is used as a network node. The coverage network is set up by using the smartphone as nodes. The data are processed as received by the centralized server in the cloud. It requires a high-cost fo setup. The reliability of the setup is low as the smartphones are connected to the network.

The smart sensor network for measuring and observing the quality of air is determined on behalf of interior and exterior air eminence intensive. It is also applied for tin dioxide sensor arrays for measuring the levels of the pollutants. The temperature and humidity sensors are used to identify false alarming situations. The nodes are connected to the central monitoring unit. Neural networks are employed to decide the threshold alarm on the pollutant levels.

A customized IoT Kit was designed by comprising the Arduino IDE, gas sensors. The designed kit was placed at the appropriate places in the city, the gas sensors gathered the data about the pollutants and transmit the same it to the cloud through Wi-Fi. The android application was also developed for users' accessibility. The air pollution detection and monitoring system has been designed by comprising the GSM module, cloud server and mobile applications. The measured data has been sent to the cloud using GSM; the designed alert generated the alert based on the threshold values.

In one prior art solution the invention relates to an atmospheric pollution monitoring system based on a wireless sensor network, which comprises wireless sensor network nodes, wireless sensor network sink nodes, local monitoring sub centers, a remote control terminal and a mobile phone terminal. Besides the atmospheric pollution monitoring system based on the wireless sensor network, the invention also customizes a wireless sensor network multi-level heterogeneous clustering routing protocol at the stage of network self-organization. when being applied on a large scale, the system can balance the energy consumption of the wireless sensor network nodes, accurately and timely reflect the situation of atmospheric pollution and give the alarm, the wireless sensor network nodes within monitored areas can be conveniently self networked, and are highly scalable, a large-scale monitoring system can be constructed, and the system is suitable for popularization and application.

In another prior art solution a utility model relates to a cloud-computing-based vehicle mounted air quality monitoring system, which solves the problems that no air monitoring system is arranged in a vehicle or the cost of a whole set of air monitoring system installed in the vehicle is high. The system comprises a vehicle-mounted air conditioner control device and a vehicle window control device, and further comprises a vehicle-mounted air detection device and a cloud computing platform, wherein a vehicle-mounted terminal comprises a first sensor, a second sensor, an air purifier and a vehicle-mounted control unit, the vehicle-mounted control unit is connected with the first sensor, the second sensor, the air purifier, the air conditioner control device and the vehicle window control device respectively, and the cloud computing platform comprises a processing unit which is connected with the vehicle-mounted control unit through a wireless network. The cloud-computing-based vehicle-mounted air quality monitoring system has the advantages that the vehicle can monitor the air quality through the unified platform to optimize resources to the maximum extent, the whole set of air quality monitoring system does not

need to be installed on the vehicle, the functions of the vehicle are improved and the cost is saved at the same time.

However, the different contaminations from the emission contaminate the air as they blend with air and have unsafe impacts on individuals and the atmosphere. The vehicular contamination is hard to evade as the emission from the vehicles occurs at a very low height because people live and breathe in these level of environment. Therefore to avoid the aforementioned drawbacks there is a need for an air pollution monitoring system using internet of vehicles and pollution sensors.

SUMMARY OF THE INVENTION

The present disclosure relates to an air pollution monitoring system using internet of vehicles and pollution sensors. The present disclosure proposes an intelligence system consists of a sensors module, a Wireless Communication module with Cloud, and Processing Module with Database. The objective of the present disclosure is to monitor the air pollutants in the air and generates the advanced alerts by forecasting the pollution level in the city. It is designed with the various gases that emerge from automobile pollution affecting urban areas. The proposed system has been experimented in a defined environment and it yielded the better performance as 99.23% accuracy to generate the alert for True-True case. The accuracy is measured on-trend prediction against pre-defined threshold values

The present disclosure seeks to provide an air pollution monitoring system using internet of vehicles and pollution sensors. The system comprises: a perception layer inclusive of a plurality of gas sensors in a vehicle for collecting surrounding data to detect situations and events through a RFID (Radio Frequency Identification) that appears in a road which have a vehicular ID or Global ID terminal at a core of internet of vehicle (IOV); a network layer engaged with a communication module for assuring connectivity between all networks; and an application layer accountable for analyzing, storing, processing, and making a decision regarding any risk situations while air pollution monitoring, wherein learning approach plays a major role to predict alerts generation on air pollution.

The present disclosure also seeks to provide an air pollution monitoring method using internet of vehicles and pollution sensors. The method comprises: measuring level of gas Carbon monoxide (CO), Nitrogen oxides (NOx), Hydrocarbon (HC) using MQ-9, MQ-135, MQ-131 gas sensors; recording measured data and thereby comparing with a threshold values, wherein if trend of measured data is likely to fall into said threshold value of a geo graphical locations, an alert is generated and sends to an owner of vehicles; and wherein if measured data is exceeding threshold value, an alert is generated and sends to owner of vehicles and concern authorities.

An objective of the present disclosure is to provide a system and a method for an air pollution monitoring system using internet of vehicles and pollution sensors.

Another object of the present disclosure is to monitor the air pollutants in the air and generates the advanced alerts by forecasting the pollution level in the city.

Another object of the present disclosure is to measuring level of gas Carbon monoxide (CO), Nitrogen oxides (NOx), Hydrocarbon (HC) using MQ-9, MQ-135, MQ-131 gas sensors.

Another objective of the present disclosure is to measure the recorded data and compare it with a threshold value.

Another object of the present disclosure is to generate an alert and sends to owner of vehicles and concern authorities.

Yet, another object of the present disclosure is to experiment the system in defined environment and yield better performance as accuracy to generate the alert.

To further clarify advantages and features of the present disclosure, a more particular description of the invention will be rendered by reference to specific embodiments thereof, which is illustrated in the appended drawings. It is appreciated that these drawings

depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail with the accompanying drawings.

BRIEF DESCRIPTION OF FIGURES

These and other features, aspects, and advantages of the present disclosure will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

Figure 1 illustrates a block diagram of an air pollution monitoring system using internet of vehicles and pollution sensors in accordance with an embodiment of the present disclosure;

Figure 2 illustrates a flow chart of an air pollution monitoring method using internet of vehicles and pollution sensors in accordance with an embodiment of the present disclosure;

Figure 3 illustrates the Proposed Pollution Monitoring Architecture in accordance with an embodiment of the present disclosure;

Figure 4 illustrates the accuracy of Alert generation on Trend Prediction Exceed the Threshold Values in accordance with an embodiment of the present disclosure;

Further, skilled artisans will appreciate that elements in the drawings are illustrated for simplicity and may not have been necessarily been drawn to scale. For example, the flow charts illustrate the method in terms of the most prominent steps involved to help to improve understanding of aspects of the present disclosure. Furthermore, in terms of the construction of the device, one or more components of the device may have been represented in the drawings by conventional symbols, and the drawings may show only those specific details that are pertinent to understanding the embodiments of the present disclosure so as not to obscure the drawings with details that will be readily apparent to those of ordinary skill in the art having benefit of the description herein.

DETAILED DESCRIPTION

For the purpose of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated system, and such further applications of the principles of the invention as illustrated therein being contemplated as would normally occur to one skilled in the art to which the invention relates.

It will be understood by those skilled in the art that the foregoing general description and the following detailed description are exemplary and explanatory of the invention and are not intended to be restrictive thereof.

Reference throughout this specification to "an aspect", "another aspect" or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present disclosure. Thus, appearances of the phrase "in an embodiment", "in another embodiment" and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

The terms "comprises", "comprising", or any other variations thereof, are intended to cover a non-exclusive inclusion, such that a process or method that comprises a list of steps does not include only those steps but may include other steps not expressly listed or inherent to such process or method. Similarly, one or more devices or sub-systems or elements or structures or components proceeded by "comprises...a" does not, without more constraints, preclude the existence of other devices or other sub-systems or other elements or other structures or other components or additional devices or additional sub-systems or additional elements or additional structures or additional components.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. The system, methods, and examples provided herein are illustrative only and not intended to be limiting.

Embodiments of the present disclosure will be described below in detail with reference to the accompanying drawings.

Figure 1 illustrates a block diagram of an air pollution monitoring system using internet of vehicles and pollution sensors in accordance with an embodiment of the present disclosure. The system 100 includes a perception layer 102 inclusive of a plurality of gas sensors in a vehicle for collecting surrounding data to detect situations and events through a RFID (Radio Frequency Identification) that appears in a road which has a vehicular ID or Global ID terminal at a core of internet of vehicle (IOV).

In an embodiment a network layer unit 104 which is engaged with a communication module for assuring connectivity between all networks. Network layer is a communication layer having one of the communication modules from a group of Bluetooth, 5G, WLAN, and Wi-Fi.

In an embodiment an application layer 106 which is accountable for analyzing, storing, processing, and making a decision regarding any risk situations while air pollution monitoring, wherein learning approach plays a major role to predict alerts generation on air pollution.

Figure 2 illustrates a flow chart of an air pollution monitoring method using internet of vehicles and pollution sensors in accordance with an embodiment of the present disclosure. At step 202 the method 200 includes measuring level of gas Carbon monoxide (CO), Nitrogen oxides (NOx), Hydrocarbon (HC) using MQ-9, MQ-135, MQ-131 gas sensors.

At step 204 the method 200 includes recording measured data and thereby comparing with a threshold value, wherein if trend of measured data is likely to fall into said threshold value of a geo graphical location, an alert is generated and sends to an owner of vehicles.

At step 206 the method 200 includes wherein if measured data is exceeding threshold value, an alert is generated and sends to owner of vehicles and concern authorities.

Figure 3 illustrates the Proposed Pollution Monitoring Architecture in accordance with an embodiment of the present disclosure. To create a social network with participants as various smart objects, IoV utilizes all kinds of interconnection. This existed in the form of SIoV (Social Internet ofVehicle) acted as an instance to vehicles for the social IoT.

To guide real-time data of vehicle sensors are installed in vehicles, platforms, and even in smart terminals to gather information and to communicate securely. Apart from this to detect faults in the products and optimize from manufacturers point IoV provides the connection.

IoV Architecture consists of three layers; Perception layer, Network layer and Application layer as shown in this figure.

The perception layer is Inclusive of all the sensors in the vehicle. This layer helps to collect surrounding data to detect situations and events through RFID (Radio Frequency Identification) that appears in the road which have a vehicular ID or Global ID terminal at the core of the IoV. All problems are identified by RFID, like lacking in speed or coverage with a certain limit. The significance is that Global ID provided to the vehicles is digital IDs that are important for automotive security. The sensors used are: MQ-9 gas sensor uses gas-sensitive resources with low conduction in air tin oxide (SnO2); MQ-135 sensor is highly sensitive to Sulfide, Benze steam, and Ammonia, it is also sensitive to harmful gases even smoke; and MQ 131 sensor senses 03 Sn02, with minimum conduction in the fresh air.

The Network layer acts as the communication layer to assure that the connectivity between all the networks (Bluetooth, 5G, WLAN, and Wi-Fi)

The Application layer is accountable for analyzing, storing, processing, and making a decision regarding any risk situations. It signifies safety, efficiency, and infotainment. The learning algorithm plays a major role to predict the alerts generation on air pollution.

The designed system has been experimented in the defined environment as in smart city environment. The results were recorded and analyzed under four cases True-True: the input environment is polluted and the alert is generated, True-False: the input environment is polluted and the alert is not generated, False-True: the input environment is not polluted but the alert is generated, False-False: the input environment is not polluted and the alert is not generated.

Figure 4 illustrates the accuracy of Alert generation on Trend Prediction Exceed the Threshold Values in accordance with an embodiment of the present disclosure. The proposed system has experimented with the simulated smart city. The accuracy is measured on-trend prediction against pre-defined threshold values. The proposed system is performed as 99.23%, 96.54%, 94.67%, and 92.26% for the True-True, True-False, False-True, False-False Scenarios. It is proved that the proposed system has given better performance as 99.23 which was more than the existing system [15] performance as 98.75%.

The drawings and the forgoing description give examples of embodiments. Those skilled in the art will appreciate that one or more of the described elements may well be combined into a single functional element. Alternatively, certain elements may be split into multiple functional elements. Elements from one embodiment may be added to another embodiment. For example, orders of processes described herein may be changed and are not limited to the manner described herein. Moreover, the actions of any flow diagram need not be implemented in the order shown; nor do all of the acts necessarily need to be performed. Also, those acts that are not dependent on other acts may be performed in parallel with the other acts. The scope of embodiments is by no means limited by these specific examples. Numerous variations, whether explicitly given in the specification or not, such as differences in structure, dimension, and use of material, are possible. The scope of embodiments is at least as broad as given by the following claims.

Benefits, other advantages, and solutions to problems have been described above with regard to specific embodiments. However, the benefits, advantages, solutions to problems, and any component(s) that may cause any benefit, advantage, or solution to occur or become more pronounced are not to be construed as a critical, required, or essential feature or component of any or all the claims.