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Realtime Multi-Sensor Control Escalation and Alert Aggregator System for Vehicle Pollution Through IoT

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***Abstract*— Wireless sensors are used in most of the in real time applications for collecting physical information. The impossible measurements in typical ways have currently become attainable using the wireless technology. In this technology, the measurement of air quality is one of the difficult areas for the researchers. The main source of atmosphere pollution happens due to vehicles. The high inflow of vehicles in urban areas causing more air pollution and decreasing air quality that leads to severe health diseases. The main objective of the paper is to introduce vehicular pollution monitoring system using Internet of Things (IoT) which is capable of detecting vehicles causing pollution on the city roads and measures various types of pollutants, and its level in air. This paper also reports the status of air quality whenever needed to the environmental agencies. The proposed systems also assures the existence of wireless sensors for vehicle pollution system that specialize in a straight forward accessibility of real time data through internet using IoT. The measured data is also shared to vehicle owner, traffic department and agencies of national environment. This system is a low cost and provides good results in controlling the air pollution especially in the urban areas.**

Keywords-Internet of Things, Radio Frequency Identification, Vehicular pollution monitoring system, wireless technology

I. INTRODUCTION

The main source of pollution in cities is due to vehicles. The increase use of vehicles in cities results in vital increase in the emission load of various toxins into air. As a result increase in environmental problems which will affect the human health in urban places. Air pollutants from taxies, cars and buses result in the damage of ground level ozone and other respiratory problem like asthma attacks. Transportation is main source for generating carbon monoxide that contributes 72% of total pollution in the metropolitan cities like Calcutta, Mumbai, and Delhi.

At present, the Indian pollution control board has made the fitness certificate as compulsory for public and commercial vehicles once in a year to control the pollution. Pollution Under Control (PUC) certificate for every three months is mandatory for all group vehicles from the date of registration. In order to control the air pollution, the amount of air pollution needs to be monitored and vehicles responsible for polluting should be identified. IoT is become helpful in cities for monitoring air pollution from vehicles and also data related to the amount of pollution on different roads of a city can be gathered and analyzed.

Recent approaches in sensing technology, especially in the area of Wireless Sensor Networks (WSNs), it now empower environmental monitoring in real time at special and temporal scales. This paper specially designed to operate the system using sensor network and gather the information about pollutant levels discharged by the vehicles. IoT is a new technology which draws the consideration for both academia and industry. IoT is realized as a network of things, each of which can be label using unique ID and convey based on standard communication protocols. IoT accord objects to communicate with one other, to approach information on the web, to store and collect data, and to collaborate with users, thereby creating smart, ubiquitous and perpetually connected environment. To achieve such intelligence within the environments, big technological innovations methods and developments are needed. The researchers sense that it will be potential to detect a newly built shape to IoT, collect with the crack of pervasive devices in the future. The view of IoT is that of everyday life such as vehicles, roadways in public transport systems, wireless pill-shaped cameras in the system of digestive tracks for healthcare applications, air conditioner, or other household things can be attached with sensors, used to track data regarding these things.

IoT has a unique addressable things and their virtual illustration on an internet like structure. Such things can add to data about them, or can send real-time sensor information about their state or other properties combined with the things. The unique address things are connected to the web, and the data can send using the protocol that communicates computers to the internet. Since the things can sense the environment and communicate and may generally enable automatic reply to challenging scheme without human interference. The more numbers of objects meanwhile produce information from the environment in an automatic way and enable common and ubiquitous computing.

In the design of environmental pollution monitoring system using a wireless sensor network to control quality of air in the city of Nagpur is proposed. This system uses the

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network simulator for measuring pollutant information from sensor nodes. The air quality index is calculated to evaluate health level in a specific area. This is a low power consumption method and gives real time sensor values more accurately.

In a new technique to control the vehicle causing air pollution in the cities has been developed. This proposed system is designed with ARM7 processor that controls the engine of vehicle. Any vehicle exceeds the threshold level of pollution in an area then the engine of the vehicle was automatically switched off by the circuit. The vehicles inbuilt with this system are only controlled but the proposed system is not controlled the pollution generated by other vehicles. This is only the limitation of the system.

IoT is conceived as an integral part of future internet. The research objective key issues are identification, privacy and security. In order to setup fast advancement in technologies similar to IoT, thus, the combination of big data, cloud technologies and future networks like 5G with loT must also be preferred into admiration.

This paper proposed an embedded system using wireless sensor network that provides a framework for collecting the sensor data at anyplace using IoT. Wireless sensor along with active RFID is used in the proposed wireless sensor system to monitor the vehicular pollution based on IoT. The paper is organized into five sections. The design and development of the proposed monitoring system is explained in section II. Section III presents the experimental setup of the proposed system and the experimental results are discussed in section IV. Finally, conclusions are drawn in section V.

II. DESIGN OF THE PRPOSED SYSTEM

The frame work of the proposed system uses IoT to address the vehicular pollution in real-time applications. Two gas sensors CO_2, SO_x are used to monitor the pollutants continuously to maintain the quality of the air. The block diagram of the proposed air pollution monitoring system is shown in Fig 1.

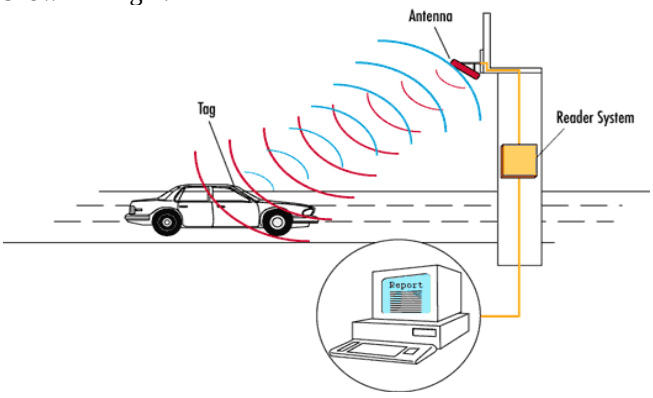

Fig 2.1: Proposed monitoring system using RFIDs

At monitor location, the RFID reader, wireless gas sensors are integrated along with microcontroller. This entire system is placed in either of the road. Whenever the vehicles equipped with RFID tags passed through the sensor node, RFID reader presented in the monitoring system detects the vehicles and the sensors measures quality of the air produced by that vehicle. The sensed continuous data is sent to the microcontroller for verification of the pollution level of the vehicle. The microcontroller verifies the levels of the pollutants of the air produced by the vehicle. If the pollutants levels are beyond the threshold levels, then it sends the warning message to the vehicle owner. The same data is displayed on the Liquid Crystal Display (LCD). The information about the levels of CO_2 and SO_x, vehicular number, RFID of the vehicle and time and date of vehicle are also sent to the server of the authorized agencies. This information is stored in the server database for future analysis.

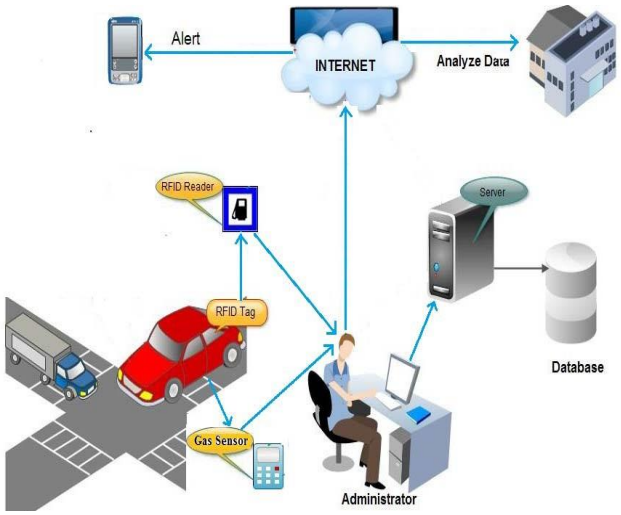

Fig 2.2: Proposed pollution monitoring system using IoT

If any vehicle exceeds the pollution level in an area, then the proposed system send warning message to vehicular owner that contains pollution level of the vehicle and also sends the amount of fine has to paid using IoT application.

III. EXPERIMENTAL SETUP OF THE PROPOSED SYSTEM

The block diagram of the experimental setup of the proposed system for monitoring vehicle air pollution is shown in Fig 3.1. The development of the proposed system is categorized into two parts: (i) hardware implementation and (ii) software implementation.

a. Hardware implementation:

The hardware of the proposed air pollution monitoring system mainly consists of arduino microcontroller development board, ATmega328 microcontroller, MQ Gas

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sensors, EM-18 RFID reader and RFID tag. The developed vehicular pollution monitoring system is shown in Fig 4.

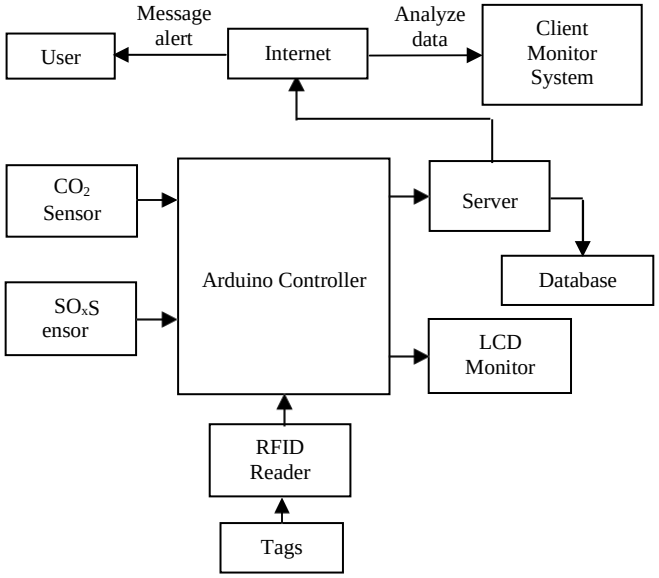

Fig 3.1: Block diagram of vehicular pollution monitoring system

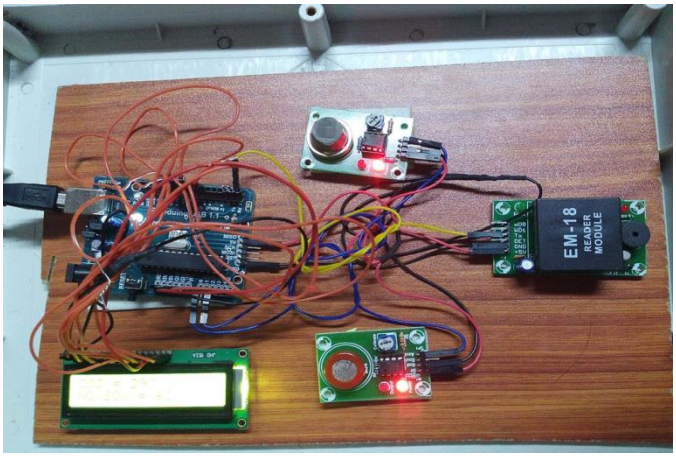

Fig 3.2: Integration of Arduino with RFID and CO_2 gas sensor module

i. *ATmega328 microcontroller:* It is a low power and high performance microcontroller used to read and control the data from sensors and RFID reader. It sends the data to server and LCD display for displaying the pollution level and RFID ID.

ii. *Arduino board:* Arduino is a hardware source platform that can work with different communication technologies and sensor devices. Due to its simplicity and number of hardware extensions more users and developers are used the Arduino.

iii. *Wireless Gas Sensors:* In this research work MQ-7, MQ-2 gas sensor is used to measure the carbon dioxide and sulpher oxides concentration in air. It is simple and low cost gas sensors. There are widely used because of they provide high performance and better accuracy.

iv. *Radio Frequency Identification:* RFID technology is used for detecting, tracking and finding location of vehicles. In this proposed system Em-18 RFID reader and RFID card is used. RFID card is inserted to vehicles, it has 12 byte data. RFID reader detects RFID card and it sends the data to microcontroller.

A prototype was developed for integration of all the devices and the prototype is tested. The information of RFID card sends serially to Arduino board through active RFID reader. The Arduino microcontroller board read the data and also sends the data to terminal and server using IoT.

The server is developed using the java language. It uses Receiver Transmitter Communication (RxTxComm) library. This RxTxComm library is used for serial communication between server and client. The server performs four main functions. These are: (i) receives and displays the data of the wireless sensors through microcontroller, (ii) stores sensors data in the database for future analysis, (iii) sends the sensors data to client to analyze the data, and (iv) sends warning messages to vehicle owners when the pollutants levels exceeds threshold level. The first function of the server is a real time collection of data from sensors on the road when a vehicle passes through the node. The second function is for storing the data of vehicles pollution levels using MySQL. The last two functions are for making the data available to all the users and control agencies through IoT. The client page is implemented in java language. The page uses library of RxTxComm. The main function of client is to receive wireless sensors data from server using IoT. Client page analyses the data that contains pollution levels of vehicles in a specified area.

b. Flowchart

The software implementation of the proposed system is developed using the flowchart as shown in Fig 4.1.

IV. EXPERMINTAL RESULTS

IoT based pollution monitoring system is developed and the performance of the developed system is verified successfully for various vehicles. The registration number of the vehicle inserted with RFID tag and passed through the monitoring system is identified using active RFID receiver and is displayed on the LCD. Fig 4.2 shows the display of the vehicle number that passes through the monitoring system with RFID tag. The monitoring system displays the pollutants levels of the vehicle and is shown in Fig 4.3. The controller sends the details of the vehicle and the pollutant values to server for monitoring the pollution levels of vehicle.

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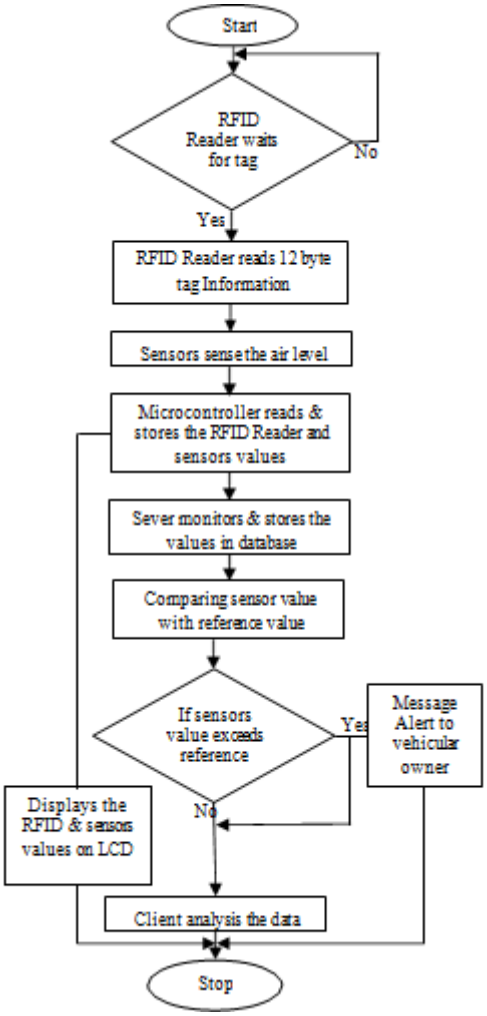

Fig.4.1 Flowchart-Proposed system

Fig 4.2: Identifying RFID of the vehicle

Fig 4.3: Displaying sensor values on LCD

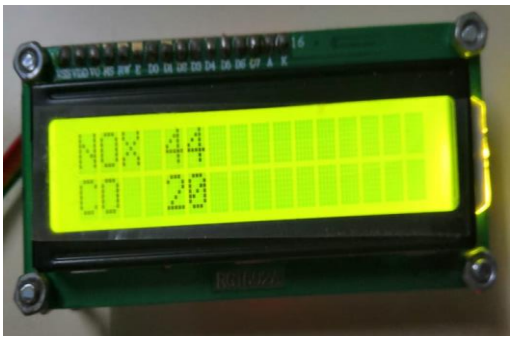

Fig 4.4 Gases in normal room atmosphere

CONCLUSION

At present, the Indian pollution control board has made the fitness certificate as compulsory for public and commercial vehicles once in a year to control the pollution. Pollution Under Control (PUC) certificate for every three months is mandatory for all group vehicles from the date of registration. In order to control the air pollution, the amount of air pollution needs to be monitored and vehicles responsible for polluting should be identified. IoT is become helpful in cities for monitoring air pollution from vehicles and also data related to the amount of pollution on different roads of a city can be gathered and analyzed.

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