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IOT BASED AUTOMATED CONTROL SYSTEM FOR MONITORING THE EMISSION LEVELS OF THE INDIVIDUAL VEHICLES

Meenu Krishna, Deepak Singh Rawat, Abrar Ahmed, Prof. D.A. Itole.

Abstract

Internet of Things (IoT) is a worldwide system to connect "smart devices" with surrounding. One of the major problems in our era is Global Air Pollution. Harmful pollutant emitted by vehicles exhaust system is one of the major factor of air pollution. Every vehicle has emission but the problem arises when the vehicle's emission exceeds standard limit. This mainly occurs due to incomplete combustion of fuel inside vehicles combustion system and its major concern is improper maintenance of vehicles.

To overcome the existing problem, a system is proposed which individually monitors the pollutant emission of all the vehicles. An IoT kit is designed which contains gas sensors, Arduino integrated development environment (IDE), a microcontroller and a Wi-Fi module. The kit can be physically placed in every vehicles exhaust system. Data about every vehicles pollutant emission is collected by the various sensors and it is forwarded to the microcontroller and Arduino IDE. The Arduino IDE transmits data to the cloud via the Wi-Fi module. A Web Server is designed which keeps the information about the vehicles pollutant emission which the RTO authority can access. The controller continuously monitors the vehicles emission and if its emission exceeds the standard set threshold value notification is generated. Hence by the use of this pollution controlling circuit air pollution can be controlled to a greater extent.

Keywords— *Arduino IDE, Cloud, Global Air Pollution, Microcontroller, Sensors, Threshold value, Wi-Fi Module.*

I. INTRODUCTION

Air pollution in the recent years has become India's most prominent issue and the number one health concern. While the Government across the country is trying to mitigate the poor air quality, with Metro cities deploying maximum measures in past 10 years, people are still gasping for good quality air.

According to Centre for Science and Environment (CSE), the four major sources of pollution that have remained constant through the past decade are transport trucks, diesel vehicle large number of two tyre vehicles and cars causing maximum amount of pollution followed by industries, construction dust suspended in air and other sources like stubble burning, garbage burning, and bio-fuel burning for cooking areas and urban slums.

Hence, an idea is suggested in this paper which would be very useful in reducing the amount of pollution from vehicles.

II. LITERATURE SURVEY

In large urban areas, air pollution has a drastic effect on humans as well as the environment. Issues relating to environment are growing quickly in India. Air contamination is mainly caused by vehicles and industries which cause various respiratory dieses such as asthma and sinusitis. Kolkata, Delhi and Mumbai are few cities where the air quality inferior.

An extensive number of projects have been described in the literature that utilizes low cost air pollution sensing devices. In a study Zheng et al [9] presented a cloud based system that uses knowledge based discovery to find real

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time air quality data. The data are collected by monitoring the stations that are placed in various geo-locations. This system uses mobile clients for monitoring purposes.

Rizwan Patan, and Mahmoud Daneshmand [1], presented and android application termed as IOT Mob-Air where users have access to relevant air quality data from the cloud. Also the pollution level of the entire route is predicted and a warning is displayed if the level crosses the limit.

Reshiet et al. [10] designed a WSN platform, known as VehNode that assist automobiles with the capacity to monitor pollutant level in smoke that are released by vehicles.

Over the years the Government has made several regulations to control the emission from vehicles, most of them being unsuccessful at the same time. The Central Pollution Control Board under the Ministry of Environment & Forests sets the standard and timeline for implementation. The Government of India instituted Bharat Stage emission standard to regulate the output of air pollutants from internal combustion engines. The first emission norms for petrol and diesel were introduced in 1991 and 1992 respectively. Since October 2010 Bharat Stage III norms have been enforced across the country. Bharat Stage IV emission norms have been in place since April 2010 in 13 major cities followed by making the catalytic converter mandatory for petrol vehicles and the introduction of unleaded petrol in the market. With accessibility to better technology, like Bharat Stage VI which is set to be effective from April 2020 - there is a need to revamp in the existing PUC certification system. The PUC certification is issued by the RTO to measure pollutant emitted by vehicles. The current PUC system don't screen for several major harmful pollutants. At present, it only measures the percentage of CO and Hydrocarbons (in ppm) and has no checks for other key pollutants like Particulate Matter (PM), Nitrogen Dioxide (NOx), volatile organic compounds (VOC) and Sulphur Dioxide (SO2). The experts are claiming that the current monitoring system is archaic; hence a need for an advance on road pollution detection monitoring system is required.

A.WSN

A wireless technology where sensor nodes are organized for gathering data. WSN's have limited memory and computation power. At remote location, they are used to monitor low frequency data. In a given location the sensor network layout is intended to recognize all the gases associated with pollution. In this paper CO2, CO and CH4 gases are considered as parameters for air quality. Expenses of WSN would be minimal, unlike the general wired framework. The network can be scaled without complex modification by including more devices. They can also be powerfully adjust to evolving situation.

B. IoT

The Internet of Things is a system where interrelated computing devices, mechanical and digital machines, objects or people are provided with unique identifiers and allows data transfer over a network. In this paper we have used five kinds of things:

1. Arduino UNO (microcontroller) 2.ESP8266-01S (Wi-Fi module) 3.Cloud Service (ThingSpeaks) 4.Gas sensors

The fundamental IoT model is composed of three –layered design i.e. the application, network and sensor layers .The data is attained from the real world in the sensor layer .The sensor layer sends the data to the network layer. The last layer is the application layer which provides services to Incorporate or investigate the data that has been received from the previous two layers.

C. ThingSpeaks-cloud service

In this paper, ThingSpeaks is used as a cloud service to capture and process sensor data. Two items are needed, to publish sensor data on the internet: 1.A place which can be used to access and store data. 2. A way to communicate with it .Generally, these consists of a web application (place) and an API (way of communicating).To exchange sensor data from Arduino to the web application ThingSpeaks API was used.

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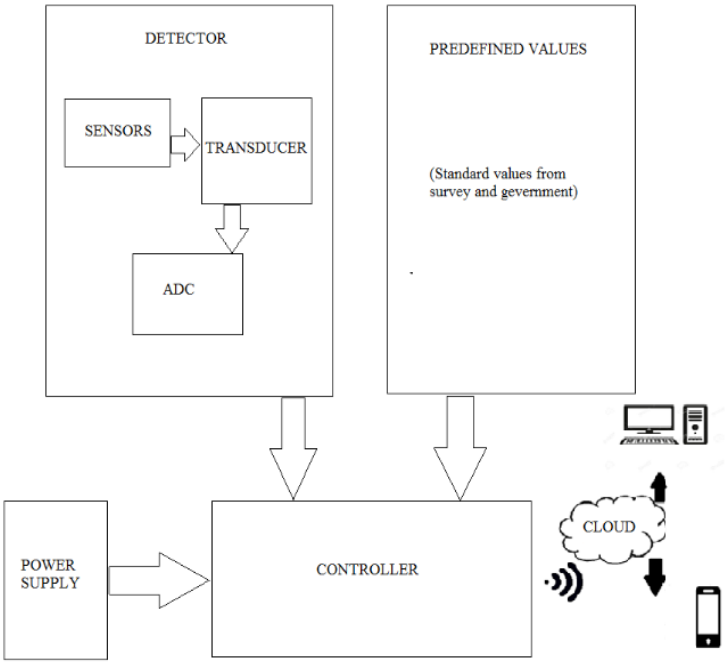
D. Wi-Fi

Wi-Fi stands for wireless fidelity. It belongs to family of wireless networking technologies. It is used to create local area network (LAN) for internet access. It has high data transfer speed of about 1 GB p/s. Its network connection range is about 150 meters. It is based on IEEE 802.11 communication protocol standard. There are many versions of Wi-Fi as per IEEE 802.11 protocol standards, having different radio technologies.
In this paper we are using ESP 8266-01S for creating LAN Wi-Fi for sending the data from controller to the cloud for data interpretation.

III. PROPOSED APPROACH



BLOCK DIAGRAM

IOT- Kit designed is used to monitor the air pollutant emission of individual vehicles. The system design of the air pollution monitoring system involves three main phases:

Phase 1- To detect the concentration of major air pollutants of vehicle emission via sensors.

Detector: The smoke sensor, transducer and ADC are the three sub-blocks in the detector block. The smoke sensors are the main component of the detector block which is embedded on to the exhaust of the vehicle. The ADC converts the digital signal into analog electrical signal. In this paper smoke sensor MQ-2 which can measure CO, CO2, SO2, NOx, PMs and lead concentration is considered. Gas sensor MQ4 which measure Hydrocarbon and Natural gas is also used. For measuring NH3, Benzene, Alcohol, CO2, NOx sensor MQ135 is used. The PM2.5 levels when go above about 35 ugm for every cubic meter of air, it can turn into noteworthy medical issues. The PM

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stands for Particulate Matter and the 2.5 stands for 2.5 um in breadth – generally we measure a solitary bacterium, for this particulate matter sensor SPS30 is used.

PHASE 2:- Storing the data on cloud with help of internet gateway.

The following approach is used to store and process data in ThingSpeak cloud service platform.

1. Create a new account and login on the site "ThingSpeak.com".
2. To publish the sensor data that will provide the API, Setup the data source 'air pollution'.
3. Add a variable to a data source that will hold the value collected and published by ESP8266-01S.
4. Copy the variable id value so that it can be latter substituted in Arduino code.
5. Generate an authentication token that is a security token which prevents former user from posting data to the users' variable.

Phase 3:- Notification generation by RTO authority.

The data collected on cloud of individual vehicles is converted into graph form and is continuously monitored by RTO authority. If the vehicle emission exceeds the standard threshold level notification is generated. Thus, the RTO continuously monitors the vehicle emission level.

IV. IMPLEMENTATION AND RESULT

An IOT kit is designed which contains number of gas sensors that are MQ-2, MQ-4, MQ-135 and SPS30 PM Sensor and a controller ESP 8266-01S.

The IOT kit is designed by following steps:

1. All the gas sensors are interfaced with the controller and the kit is placed in exhaust system of all the vehicles to measure the pollution level of gases emitted by the vehicle. The idea is to place the kit inside the exhaust system of the vehicle at the time of vehicle manufacture.
2. To measure value of pollutant gases emitted by the exhaust system of the vehicle is recorded by the controller.
3. Value recorded by the controller is then uploaded to the cloud using HTTP protocol.
4. The value is recorded on the cloud and the recorded value is then converted into graph and threshold value is set. If the pollutant emitted by the vehicle exhaust is above the set threshold the then the graph crosses the threshold limit and indicates that vehicle emission has exceeded the standard threshold level.

V. CONCLUSION:-

Global air pollution in earlier era was considered to be negligible. Currently air pollution has become a major concern. Air pollution is mainly caused by the industries and vehicles used in transportation. Hence it is need to be reduced to protect the environment from harmful effects of air pollution. Hence an IoT-Kit has will be designed which helps to detect, monitor and test air pollutant emitted by individual vehicles. The IoT-Kit is integrated with exhaust system of all vehicles.

The kit is integrated with various gas sensors which detect harmful pollutant emitted by vehicles. Data generated about vehicles pollutant emission is stored on the cloud. Graph plotting of vehicle emission is also done using the collected data and if the vehicles emission crosses the standard threshold set value a notification is generated.

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This system is helpful for the transportation authority i.e. RTO to detect and take legal action against the defaulter vehicle. Hence helps in reducing the air pollution by controlling the harmful air pollutant emission emitted by the vehicles.

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