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Vehicular Pollution Monitoring and Control based on IoT and Web Service Approach

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Abstract: *One of the essential need of human is clean and fresh air. Air pollution can lead to pulmonary diseases which results in premature death. Sensors do efficient data collection about the air pollutants .The centralized server can analyze the Air Quality Index. In addition to that IoE build on the top of IoT network can alert the owner of the specific vehicle if the emissions level exceeds the threshold level. If three alerts are ignored repeatedly then the system can stop the movement of the vehicle. With the use of IoE, after analyzing AQI information from the vehicles the centralized server can give guidance to the vehicle service center in their surroundings for the better maintenance of vehicle.*

Keywords: *Air Quality Index, Threshold Level, Centralized Server, IoT network, IoE*

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Computing AQI:

Under Swachh Bharat Abhiyan, the Minister of Environment Forests & Climate Change launched the National Air Quality Index (AQI) in New Delhi. It has six levels of air pollution each with one dedicated color to find the air quality within the surrounding area. There are eight pollutants such as Ozone(O_3),Suspended Particulates (PM_{10}),Suspended Particulates (PM_{25}),Carbon Monoxide(CO),Sulphur Dioxide(SO_2),Nitrogen Dioxide(NO_2),Hydrogen Nitride(NH_3),Lead(Pb).

Table1: AQI and its Health Impacts

AQI	Associated Health Impacts
Good (0–50)	Minimal Impact
Satisfactory (51–100)	May cause minor breathing problems
Moderately polluted (101–200)	May cause breathing discomfort to people with lung
Poor (201–300)	May cause breathing discomfort to people on prolonged exposure,
Very Poor (301–400)	May cause respiratory illness to the people
Severe (401-500)	May cause respiratory impact even on healthy people

Table2: Breakpoint table

O_3 (ppb)	O_3 (ppb)	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	CO (ppm)	SO_2 (ppb)	NO_2 (ppb)	AQI	AQI
C_{low} - C_{high} (avg)	C_{low} - C_{high} (avg)	C_{low}- C_{high} (avg)	C_{low} - C_{high} (avg)	C_{low} - C_{high} (avg)	C_{low} - C_{high} (avg)	C_{low} - C_{high} (avg)	I_{low} - I_{high}	Category
0-54 (8-hr)	-	0.0-12.0 (24-hr)	0-54 (24-hr)	0.0-4.4 (8-hr)	0-35 (1-hr)	0-53 (1-hr)	0-50	Good
55-70 (8-hr)	-	12.1-35.4 (24-hr)	55-154 (24-hr)	4.5-9.4 (8-hr)	36-75 (1-hr)	54-100 (1-hr)	51-100	Moderate
71-85 (8-hr)	125-164 (1-hr)	35.5-55.4 (24-hr)	155-254 (24-hr)	9.5-12.4 (8-hr)	76-185 (1-hr)	101-360 (1-hr)	101-150	Unhealthy for Sensitive Groups
86-105 (8-hr)	165-204 (1-hr)	55.5-150.4 (24-hr)	255-354 (24-hr)	12.5-15.4 (8-hr)	186-304 (1-hr)	361-649 (1-hr)	151-200	Unhealthy
106-200 (8-hr)	205-404 (1-hr)	150.5-250.4 (24-hr)	355-424 (24-hr)	15.5-30.4 (8-hr)	305-604 (24-hr)	650-1249 (1-hr)	201-300	Very Unhealthy
-	405-504 (1-hr)	250.5-350.4 (24-hr)	425-504 (24-hr)	30.5-40.4 (8-hr)	605-804 (24-hr)	1250-1649 (1-hr)	301-400	Hazardous

The air quality index is a piecewise linear function of the pollutant concentration. At the boundary between AQI categories, there is a discontinuous jump of one AQI unit. To convert from concentration to AQI this equation is used:

$$I = \frac{I_{high}-I_{low}}{C_{high}-C_{low}} (C-C_{low})+I_{low}$$

Where,
I= Air Quality Index
C= the pollutant concentration
C_{low}=the breakpoint concentration that is less than or equal to c
C_{hign}=the breakpoint concentration that is greater than or equal to c
I_{low}=the index value corresponding to C_{low}
I_{hign}=the index value corresponding to C_{high}

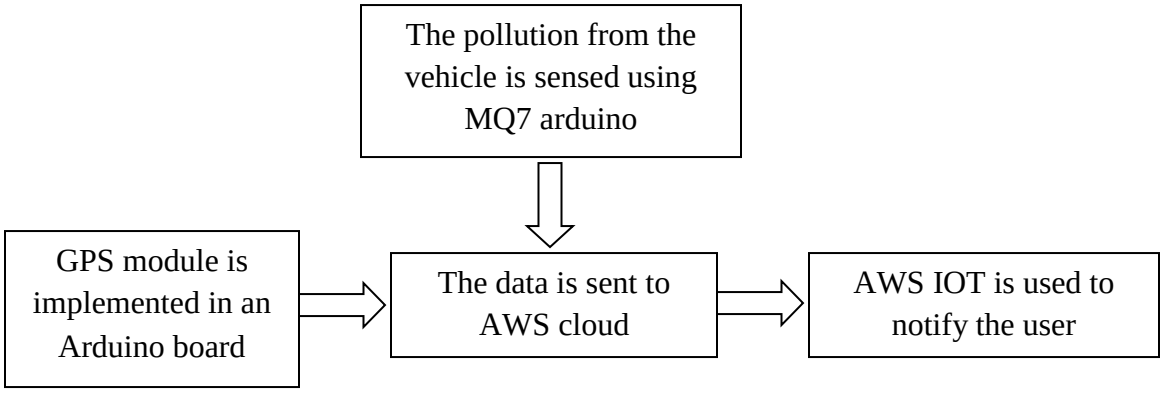

Fig 1. System Architecture

Architecture of Smart Pollution Detection system is shown in Fig 1**.** The Pollution from the vehicle is sensed using the MQ7 CO sensor which is connected with the Arduino board which in turn is connected with the GPS module. The Arduino board is remotely connected to the Amazon AWS IOT using MQTT connection. This enables a secure connection with the Arduino .The data that is received is checked for the threshold value. If it is greater than the threshold value then it is notified to the users mobile phone using thing shadow.

MQ-7 CO sensor

Arduino:

Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. To give a set of instructions to the microcontroller on the board use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing. The processing code defines all the pin connections of the sensor and the LED. Since the AOUT pin connects to analog pin A0, it is initialized to 0. Since the DOUT pin connects to digital pin D8, it is initialized to 8, limit value, are also declared. Analog and digital outputs are stored respectively in A_{out} and D_{out} pins. The baud rate is set and declares the DOUT pin as input and the output is passed to the AWS IOT and the IOT will send a Push Notification Service.

The arduino reads sensor pin AOUT and stores the value in the integer *value*. It also reads the sensor pin DOUT and stores the value in the integer *limit*. We then print the Carbon Monoxide value, which will be a numeric value ranging from either 0 (no gas detected) to 35ppm (maximum level of carbon monoxide that can be read). We will also display the limit which will either be HIGH or LOW. If the CO detected is under the threshold level, the value of limit returned will be low. If the CO and smoke (gas) is detected is above the threshold, the value of limit returned will be HIGH. If the value is HIGH, it will call the Thing Shadow of AWS IOT and you will receive a message using SNS.

Amazon AWS IOT:

AWS IOT connects an arduino using the Arduino Yún SDK.. It provides mutual authentication and encryption at all points of connection, so that data is never exchanged between devices and AWS IOT without proven identity. AWS IOT supports the AWS method of authentication (called „SigV4") as well as X.509 certificate based authentication. Connection using MQTT(Message Queue Telemetry Transport) use certificate based authentication. Authoritative AWS certificates can be generated. You can create, deploy and manage certificates and policies for the devices

from the console or using the API.AWS IOT also supports AWS IAM which allows you to instantly revoke access for an individual device if you choose to do so. AWS IOT supports connection from users‟ mobile apps using Amazon Cognito, Thing Shadow which takes care of all the steps necessary to create a unique identifier for your app‟s users and retrieve temporary, limited-privilege AWS credentials. AWS IOT Arduino Yún SDK The AWS-IOT-Arduino-Yún-SDK allows developers to connect their Arduino Yún compatible Board to AWS IOT. By connecting the device to the AWS IOT, users can securely work with the message broker, rules and the Thing Shadow provided by AWS IOT and with other AWS services like AWS Lambda, Amazon Kinesis, Amazon S3, etc.

MQTT(Message Queue Telemetry Transport)Connection

The AWS-IOT-Arduino-Yún-SDK provides APIs to let users publish messages to AWS IOT and subscribe to MQTT topics to receive messages transmitted by other devices or coming from the broker. This allows to receive the data from the Arduino and also to interact with the standard MQTT PubSub functionality of AWS IOT.

Thing/Device shadow

The AWS-IOT-Arduino-Yún-SDK also provides APIs to provide access to thing shadows in AWS IOT. Using this SDK, users will be able to sync the data/status of their devices as JSON files to the cloud and respond to change of status requested by other applications.

Conclusion and Future work:

Thus this paper mainly aims in Detecting and tracking the pollution from vehicles using MQ7 Arduino along with GPS module embedded into Amazon AWS IOT Cloud.MQ7Gas sensor is preferred to be the cheapest and it can be coded with an Arduino board which enables easy implementation. AWS IOT utilizes an end-to-end approach to secure which is more securable than Zigbee communication and harden our infrastructure, including physical, operational, and software measures. It enables an easy interaction with the Arduino using Arduino SDK and enabling a Push Notification Service. The GPS enabled will get us the position and interacting it with AWS IOT Cloud would enable encrypted data from the Arduino and a Push Notification Service if the limit exceeds the threshold value. This paper mainly focus on Pollution Detection and Tracking which lacks in controlling the pollution.MQ7 is preferred to be the cheapest but many other sensors can be used for both detecting and controlling the pollutants.

REFERENCES

[1] V.R.Patil ,Environmental Challenges,2016 Publications,ISBN:978-1329-92548-9.
[2] International Conference on Pollution Control & Sustainable Environment, April 25-26, 2016 Dubai, UAE. http://www.omicsonline.org/conferences-list/effects-of-pollution.

[3] AWS IOT,docs.aws.amazon.com/iot/latest/developerguide/what-is-aws-iot.html,© 2016, Amazon Web Services

[4] Gina M. Solomon, Todd R. Campbell, Gail Ruderman Feuer, Julie Masters, Artineh Samkian, Kavita Ann Paul. 2001. NO BREATHING IN THE AISLES, Diesel Exhaust Inside School Buses. Report prepared by the Natural Resources Defense Council and Coalition for Clean Air.

[5] Wan-Young Chung, Sung-Ju Oh, Remote monitoring system with wireless sensors module for room environment, Sensors and Actuators B: Chemical, Volume 113, Issue 1, 17 January2006, Pages 64-70, ISSN 0925-4005, 10.1016/j.snb.2005.02.023.

[6] Prakash Doraiswamy, Wayne T. Davis, Terry L. Miller, Joshua S. Fu and Yun-Fat Lam. 2005. Measuring Air Pollution Inside And Outside of Diesel Truck Cabs. Report prepared for US EPA by University of Tennessee, Knoxville TN.

[7] Tsow, F.; Forzani, E.; Rai, A.; Rui Wang; Tsui, R.; Mastroianni, S.; Knobbe, C.; Gandolfi, A.J.; Tao, N.J., "A Wearable and Wireless Sensor System for Real-Time Monitoring of Toxic Environmental Volatile Organic Compounds," Sensors Journal, IEEE , vol.9, no.12, pp.1734,1740, Dec. 2009. DOI= 10.1109/JSEN.2009.2030747.

[8] C. A. Trasviña-Moreno, R. Blasco, R.Casas, and A. Marcus.Autonomous WiFi Sensor for Heating Systems in the Internet of Things

[9] E. Nugroho and A. Sahroni, "ZigBee and wif network interface on Wireless Sensor Networks," in Proceedings of the Makassar International Conference on Electrical Engineering and Informatics (MICEEI "14), pp. 54– 58, Makassar, Indonesia, November2014.

[10] S. D. T. Kelly, N. K. Suryadevara, and S. C. Mukhopadhyay,"Towards the implementation of IoT for environmental condition monitoring in homes," IEEE Sensors Journal, vol. 13, no. 10,pp. 3846–3853, 2013.

[11] Automated Control System for Air Pollution Detection in Vehicles,Siva Shankar Chandrasekaran ; Dept. of Electron. & Commun. Eng., Sri Venkateswara Coll. Of Eng., Sriperumbudhur, India ; Sudharshan Muthukumar ;Sabeshkumar Rajendran.