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Smart Pollution Detection and Tracking System Embedded With AWS IOT Cloud

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Abstract*: Pollution has a major role in depleting air system. The health risks of air pollution are extremely serious. The Internet of Things (IOT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. The IOT concerns the connection of physical devices (cars, thermostats, smart phones, home lighting, tide sensors, smart meters, etc.) to the Internet. There are more devices connected to the Internet than people on the planet, and the prediction is that there will be 50 billion IOT devices by 2020.In previous papers, to integrate sensors with cloud computing and IOT, other authors have opted for ZigBee hybrid network connected to a WiFi or Ethernet gateway. The main objective of this paper is to implement IOT to measure the pollution of public transports using MQ7 Arduino which is sensitive for Carbon Monoxide. Global Positioning System (GPS) is implemented in these arduino which would find the location of the transport vehicle. The amount of Carbon Monoxide emitted is sensed once in (say 20km) and also the locality of vehicle is used for finding the area which is polluted the most. These are then integrated to the Amazon Cloud IOT which is more securable and many services of AWS can be used along with it. This would enable a Simple Notification Service (SNS) to the mobile phone when the vehicle is causing higher level of pollutants.

Keywords: AWS IOT(Amazon Web Services Internet Of Things),GPS(Global Positioning System), SNS(Simple Notification Service), MQQT(Message Queue Telemetry Transport), IAM(Identity Access Management)

I. INTRODUCTION

Pollution[1] is unwanted, harmful stuff contaminating an environment. The race to develop clean energy is motivated by high levels of pollution that people fear are permanently damaging the earth's environment. Poor air quality increases respiratory ailments like asthma and bronchitis, heightens the risk of life-threatening conditions like cancer, and burdens our health care system with substantial medical costs. Particulate matter is singlehandedly responsible for up to 30,000 premature deaths each year. The immediate alterations that the world is witnessing is Global warming[2]. With increased temperatures worldwide, increase in sea levels and melting of ice from colder regions and icebergs, displacement and loss of habitat have already signaled an impending disaster if actions for preservation and normalization aren't undertaken soon. Having an onsite carbon monoxide gas alarm in your RV, boat, plane or house is essential to mitigate risk. Being able to detect presence of carbon monoxide remotely, from wherever you are, alerts you to a problem as it occurs and wherever you may be. This makes you aware of a situation before you arrive, and enables you to remedy the issue quickly. This paper is mainly interested in reducing pollution mainly from the vehicles using IOT.

The advent of the Internet of Things and cloud computing brings a new approach, enabling to collect, transfer, store and share information on the logistics flow for better cooperation and interoperability among devices. IOT is an evolution in computer technology and communication that aims to connect objects together via the Internet. Objects mean everything that surrounds us and can communicate . AWS(Amazon Web Server) IOT[3] provides secure, bi-directional communication between Internet-connected things (such as sensors, actuators, embedded devices, or smart appliances) and the AWS cloud. This enables you to collect telemetry data from multiple devices and store and analyze the data. We can also create applications that enable the users to control these devices from their phones or tablets. Using this the system pollution is tracked and then AWS cloud takes necessary measures by sending SNS to the mobile phones .

The remainder of this paper is organized as follows Section 2 presents Related Work. Section 3 presents Implementation. Section 4 presents the Conclusions and Future Enhancement.

II. RELATED WORK

In this section, we review related work on using the IOT for vehicular pollution detection, and we review related work on communicating with IOT.

2.1. Vehicular pollution detection:

Due to the huge gaps in ground-based networks of air pollution monitors, there is a necessity to obtain fine-grained air quality data. Various attempts have been made to employ mobile sensors in order to achieve this goal. The School

Bus Monitoring Study [4] conducted at University of California along with NRDC (National Resources Defense Council) highlights the health hazards posed to school children by their exposure to diesel pollutants. It also emphasizes the urgent need for mobile monitoring of air quality because diesel exhaust is known carcinogen and a cause of respiratory illnesses. An interesting study was conducted by EPA [6] to measure air pollutant concentrations inside and outside of a truck cabs. The study however used measurement techniques that involved collecting air samples in the truck and later analyzing them in a lab to derive actual air quality values. Wireless sensor networks for monitoring personal pollutant exposure [7], indoor air quality [5] have also been proposed.

2.2. Communicating with IOT:

To integrate sensors with cloud computing and IOT, other authors have opted for ZigBee[8] hybrid network connected to a WiFi or Ethernet gateway [9], similar to the work presented by Kelly et al.[10].

These reasons are presented as the principal motivation of this work, as well as to implement the pollution detection technique using the simple interaction of users with IOT.

III. IMPLEMENTATION OF SMART POLLUTION DETECTION AND TRACKING SYSTEM EMBEDDED WITH AWS IOT CLOUD

3.1 Architecture

An architecture of Smart Pollution Detection system is shown in **Fig 3.1.** The Pollution from the vehicle is sensed using the MQ7 Arduino 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.

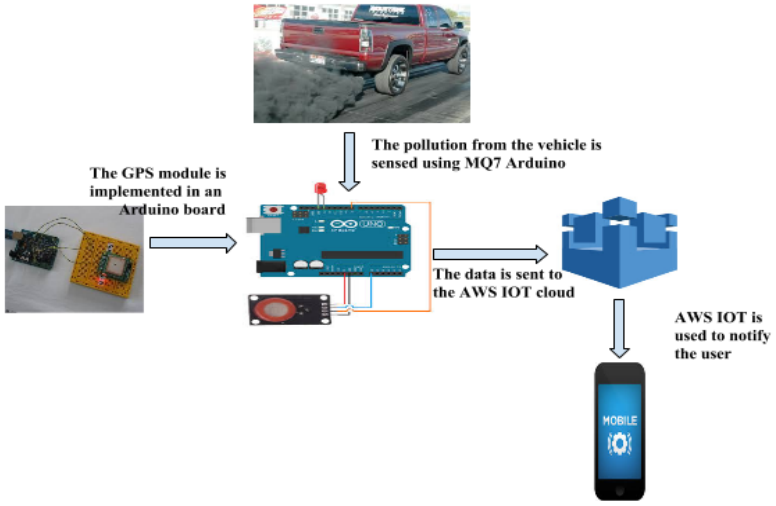

Fig 3.1 An Architecture of Smart Pollution Detection system

The following components are needed for smart pollution detection and tracking system embedded with AWS IOT cloud

- MQ-7 Carbon Monoxide Sensor
- Arduino
- KA278RA05C
- GPS MODULE
- AMAZON AWS IOT

3.1.1 MQ-7 Carbon Monoxide Sensor

This is a simple-to-use **Carbon Monoxide** (CO) sensor, suitable for sensing CO concentrations in the air. The MQ-7 can detect CO-**gas** concentrations anywhere from 20 to 2000 ppm. This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance. The enveloped MQ-7 have 6 pin, 4 of them are used to fetch signals, and other 2 are used for providing heating current. The surface resistance of the sensor Rs is obtained through effected voltage signal output of the load resistance RL which series-wound. The relationship between them is described:

Rs\RL = (Vc-VRL) / VRL

Fig 3.2. MQ7 Carbon Monoxide Sensor

Fig 3.2. Arduino

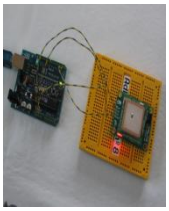

Fig 3.3. GPS Module

3.1.2. 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 onWiring), 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. These will be used to store the value of the analog pin AOUT and digital pin DOUT. The baud rate is set and declares the DOUT pin as input and the output is passed to the AWS IOT. This is because the sensor is an input to the arduino for the arduino to read and process the sensor value. 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 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.

3.1.3. KA278RA05C

The MQ7 requires a heater voltage that cycles between 5v (60s) and 1.4v (90s), drawing approximately 150mA at 5V which exceeds the power capacity of the Uno, so I use the KA278RA05C adjustable voltage regulator to drive this.

3.1.4. GPS Module

The GPS module continuously produces a set of data regarding the position of the earth surface where it is situated which includes the current position with respect to the equator of the earth in terms of Latitude and Longitude. This data can be decoded and printed into the readable format with the help of a microcontroller only. In this paper GPS is enabled to get the location of the place and the MQ7 senses the Carbon Monoxide once in (say)20km. They can communicate using standard communication ports like USART, TWI, SPI etc. which enables them to be connected with various kinds of devices. The Arduino board is designed for easy prototyping and the IDE used for coding is very simple and provides so many libraries for interfacing with common external devices which is shown in Fig.2.3

3.1.5 Amazon AWS IOT:

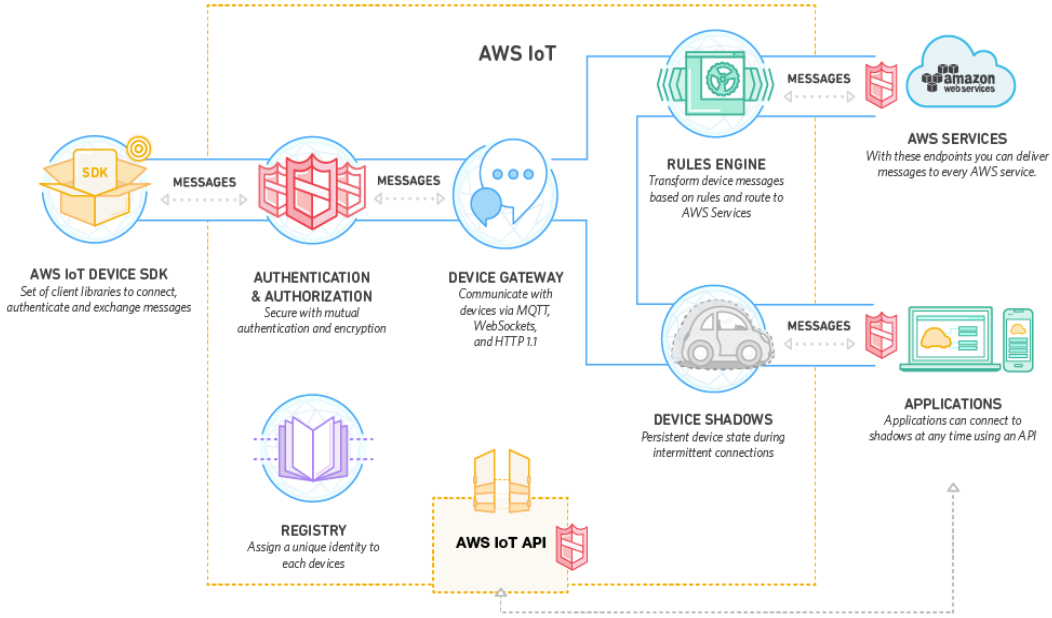

Fig 3.4. AWS IOT

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[3]. 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. With AWS IOT you can use AWS IOT generated certificates, as well as those signed by your preferred Certificate Authority (CA). 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.

IV. CONCLUSION AND FUTURE WORKS:

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[8] 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.

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