Smart Pollution Detection System using IoT Sensors Networks

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Abstract: The contamination has a major role in weaken air system. Every vehicle has its own emission of gases, but the problem occurs when the emission is beyond the standardized values. This emission from vehicles cannot be completely avoid, but it definitely can be control. The proposed system concept is based on wireless sensor network and Internet of Things. It includes in two separate parts. One is transmitter/ordinary node and another is master/sink node. The transmitter node is consist of DHT11, CO, Ionization, LPG sensor and nRF24 module with atMega328p microcontroller. The transmitter node will be attach with vehicle, CO sensor placed at outlet of smoke, LPG and DHT11 sensor has placed nearby fuel tank. And the master node has consist of nRF24 module and Raspberry pi board. The master node has placed at the traffic signals and more zones in the city. The transmitter node reads the values of the sensors and transmits nearest it to master node using Radio Frequency. The master node is connected with cloud using Wi-Fi or Ethernet and it create, update and store contamination history in the database as well as user dashboard. When the emission level or Ionization level or gas leakage outreach threshold value then cloud server will send the alert notification for maintenance to vehicle owner via SMS of email. On the basis of city wise contamination history, a strict action can be taken by administration to reduce the contamination from last year of contamination history. The proposed novel system helps reduce and store contamination history.

Index Terms **- IoT, nRF, LoRa, LoRaWAN, Corban monoxide (CO), MQTT, SMTP, OS, Virtual Sensor Network (VSN), Wireless Sensor Network(WSN), Digital Humidity Temperature (DHT), Low Noise amplifier (LNA), Power amplifier (PA).**

I. INTRODUCTION

Contamination has a significant part in draining air framework. Each vehicle has its own emanation of gases, however the issue happens when the outflow is past the normalized values. This emanation from vehicles can't be totally stay away from, however it unquestionably can be control. Because of this, there is a gigantic expansion in the temperature of climate prompting "An unnatural weather change". The ecological contamination or changes has been characterized as presence of substances in the climate that can causes precariousness, jumble, harmer distress to the actual frameworks or living organic entities. The World Health Organization expresses that 2.4 million individuals pass on every year from causes straightforwardly owing to air contamination, with 1.5 million of these passing owing to indoor air contamination. Based the reality previously mentioned, we zeroed in on air contamination observing around metropolitan and modern urban communities in India by utilizing IoT, Zigbee based Wireless Sensor Networks while conveyed on Public Transport vehicles. It is vital to screen and control the air contamination. The best way to deal with control air contamination is to screen surpassed levels of air poisons and need to take appropriate exercises to control it. This paper is mainly interested in reducing and maintaining analysis of pollution from the vehicles using IOT and wireless sensors network.

II. LITRATURE REVIEW:

Benefits of the IoT and wireless sensor network include proficient asset the executives, improved efficiency, and expanded personal satisfaction for human populaces. The IoT is subsequently a principal empowering agent of brilliant conditions, like keen homes, keen wellbeing, savvy urban communities and shrewd production lines, among others. In reality, the pattern towards keen x guarantees an upset for most sorts of human-related exercises.

Raspberry pi has been utilized to peruse sensor information [1]. Sensor information is shipped off the Amazon Web Services Internet of Things (AWSIoT) console. AWS Simple Notification Service (SNS) will convey email warning to the concerned proprietor dependent on the AWS IoT console message dependent on the messages from the AWS IoT console. All the interruption logs are likewise put away in Google accounting page by OAuth2.0 convention to get to related Google Application program interface [1].

The paper [2] proposed IoT based participation framework. Participation framework is planned with the utilization of miniature regulator ESP8266 12e and OLED show. OLED show shows the names of the understudies whose finger impression is filtered. A finger impression module R305 has been utilized to filter and perceive the fingerprints. Different parts utilized are wires, switches, and PCB. The framework has a communicating module to send the unique finger impression coordinated with ID. A worker in participation framework gets finger impression coordinated with ID from the sending module. Subsequent to preparing the information, understudy participation is determined in rate. An understudy can check their participation through the android application given by the framework.

The paper [6] has proposed Smart Pollution Detection and Tracking System Embedded with AWS IOT Cloud. The Pollution from the vehicle is sense utilizing the MQ7 Arduino, which has associated with the Arduino board, which thus has associated with the GPS module. The Arduino board has distantly associated with the Amazon AWS IOT utilizing MQTT association. This empowers a protected association with the Arduino .The information that is get checked for the edge esteem. In the event that it is more noteworthy than the limit esteem, it is advise to the users‟ cell phone utilizing thing shadow. This is an easy to-utilize Carbon Monoxide (CO) sensor, reasonable for detecting CO fixations noticeable all around. The MQ-7 can identify CO-gas focuses somewhere in the range of 20 to 2000 ppm. This sensor has a high affectability and quick reaction time. The sensor's yield is a simple obstruction.

The paper [7] has proposed to remote sensor network arrangement: Approaches and Techniques. In this paper remote sensor organizations (WSNs) arise as a functioning examination region wherein testing subjects include energy utilization, steering calculations, choice of sensors area as indicated by a given reason, heartiness, proficiency, etc. In spite of the open issues in WSNs, there are now a high number of utilizations accessible. In all cases for the plan of any application, one of the primary targets is to keep the WSN alive and practical to the extent that this would be possible. A vital factor in this is the manner in which the organization has framed. This review presents latest development methods and instruments for the WSNs. In this paper, the investigated works are arranged into appropriated and brought together methods. The investigation is cantered around whether a solitary or numerous sinks are utilized, hubs are static or portable, the arrangement is occasion discovery based or not, and network spine is framed or not. We centre around ongoing works and present a conversation of their benefits and disadvantages. At long last, the paper outlines a progression of open issues, which drive, further exploration nearby.

III. METHODOLY OF RESEARCH WORK:

We have to work on the basic electronics for the device-to-device communication. Need a brief knowledge about gas, smoke, temperature and humidity sensor. Pick any piece of hardware before you – odds are it has sensors in it. Furthermore, not just gadgets: presently sensors are even in trees and structures. Also, they are there for an explanation: individuals extricate esteem from their readings. Along these lines, in the event that you feel those sensors on your industrial facilities' gear are additionally conceivably a benefit gainer.

IV. IMPLEMENTATION OF THE PROPOSED SYSTEM:

In the proposed system having two device, one is transmitter node, which is also known as ordinary node. Another device is master node, which is also known as sink node. The ordinary device node consist of the following hardware components:

4.1 Hardware used:

The hardware are used to execute the overall system. This includes the microcontroller atMega328p, Sensors and power supply.

MQ-6 Sensor: The MQ6 sensor is the primary detecting segment, which has utilized in a gas recognition apparatus. The sensor comprise of a detecting material, which ionize the gases, which comes in its contact. Accordingly, the ionization cycle of the gases changes the opposition across the circuit.

MQ-7 Sensor: The CO (Carbon Monoxide) sensor persistently sense poison level of discharge from the vehicle. This sensor comprises of transducer. The sensor distinguishes smoke in the simple structure the transducer changes over it into the electrical sign and Analog to Digital Converter (ADC) in microcontroller changes over the electrical sign into advanced worth, and afterward changes over contamination level to PPM.

Gas Sensor: The LPG (Liquid Petroleum Gas) sensor detects the LPG gas in simple structure on account of gas spillage and transducer converts it into electrical sign and afterward ADC in microcontroller converts it into computerized esteem.

DHT11 Sensor: DHT11 sensor comprises of a capacitive stickiness detecting component and a thermistor for detecting temperature. The stickiness detecting capacitor has two anodes with a dampness holding substrate as a dielectric between them. Change in the capacitance esteem happens with the adjustment of mugginess levels. The IC measure, measure this changed opposition esteems and change them into computerized structure.

AtMega328 Microcontroller: This is an 8-bit RISC based microcontroller, which having 28 pins. The programmable GPIOs pins are 23. It follows the AVR having 1 KB internal RAM and 32 kb programmable flash memory.

Power Supply: An electricity supply is an electrical gadget that provisions electric capacity to an electrical burden. In this circuit is utilizing 5 volt of force supply.

Raspberry Pi Board: The Raspberry pi modest PC that runs Linux, but on the other hand is gives a bunch of GPIO pins, WiFi/Ethernet permitting to control gadgets apparatuses.

Block Diagram:

There are two separate node devices in this system, one is transmitter/ordinary node another is master/sink node.

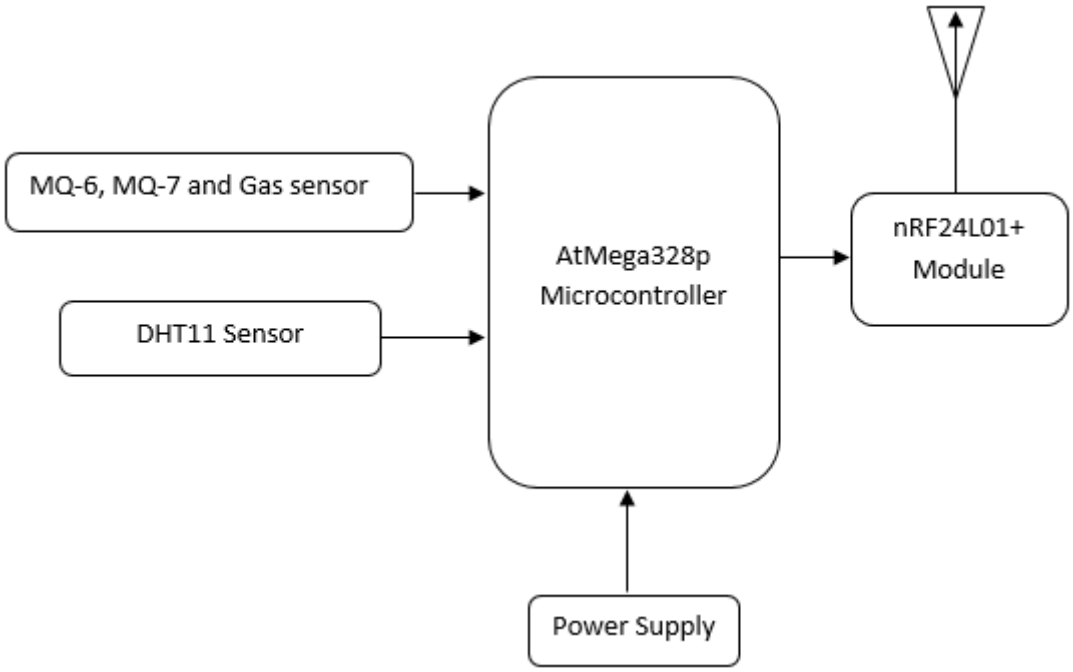

Fig5.1: Block Diagram of Transmitter/ordinary node.

The transmitter node is consist of DHT11, CO, Ionization, LPG sensor and nRF24 module with atMega328p microcontroller. The Fig.3 shows the block diagram of the ordinary device. In the diagram, sensors has connected with AtMega328 microcontroller. The sensors sense environment and give readings to the microcontroller. The microcontroller having the program to execute the readings and transmit reading to master node through nRF24L01+ module.

The addition of Power Amplifier (PA) and Low Noise Amplifier (LNA) antenna concept with nRF24L01+ module increase the range of the communication.

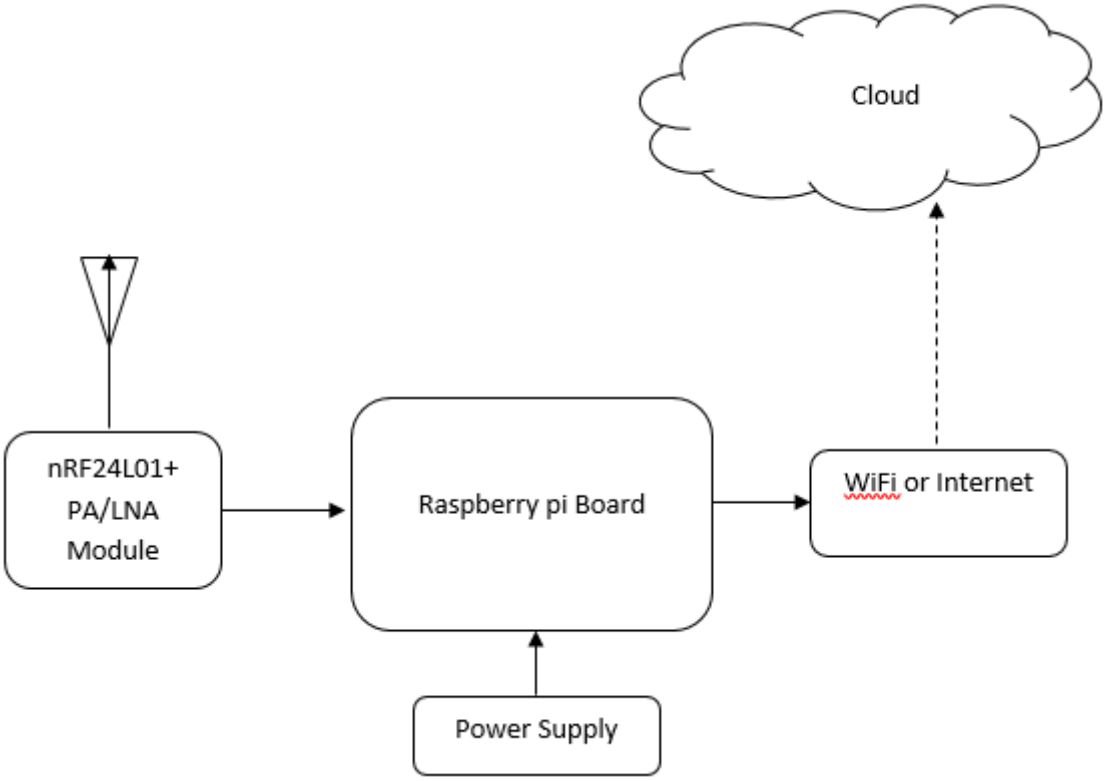

Fig5.2: Block Diagram of Master/Sink node.

The master node is consist of nRF24 module and Raspberry pi board. In the master node the nRF24 module having PLA/NA duplex based antenna. Raspberry pi board enables the Wi-Fi and cloud connectivity for updating and pollution history.

a. Circuit Diagram:

Circuit chart is a visual and graphical portrayal of an electrical circuit. A pictorial circuit graph utilizes straightforward pictures of segments, while a schematic outline shows the segments and interconnections of the circuit utilizing normalized representative. The Fig5.1.6 shows the components connections of the transmitter node or ordinary device. In this the sensors are connected with AtMega328p microcontroller. And the microcontroller is also connected with the nRF24L01+ module for the transmission of the data. This circuit can be powered by battery or any kind of 5V power supply. The nRF24L01+ module and AtMega328p are communicating with each other via SPI protocol for sharing the information. Once the readings comes from sensor then these reading transmits to master node.

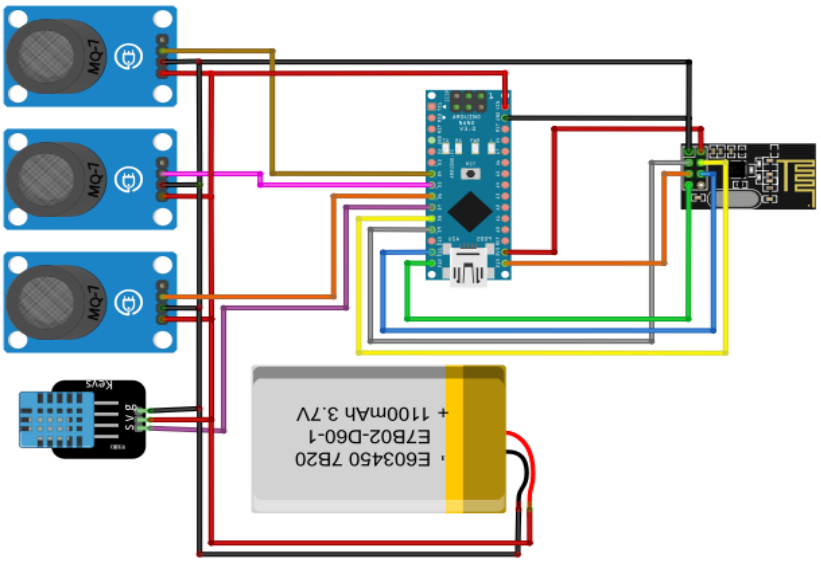

Fig6.1: Circuit Diagram of Transmitter node.

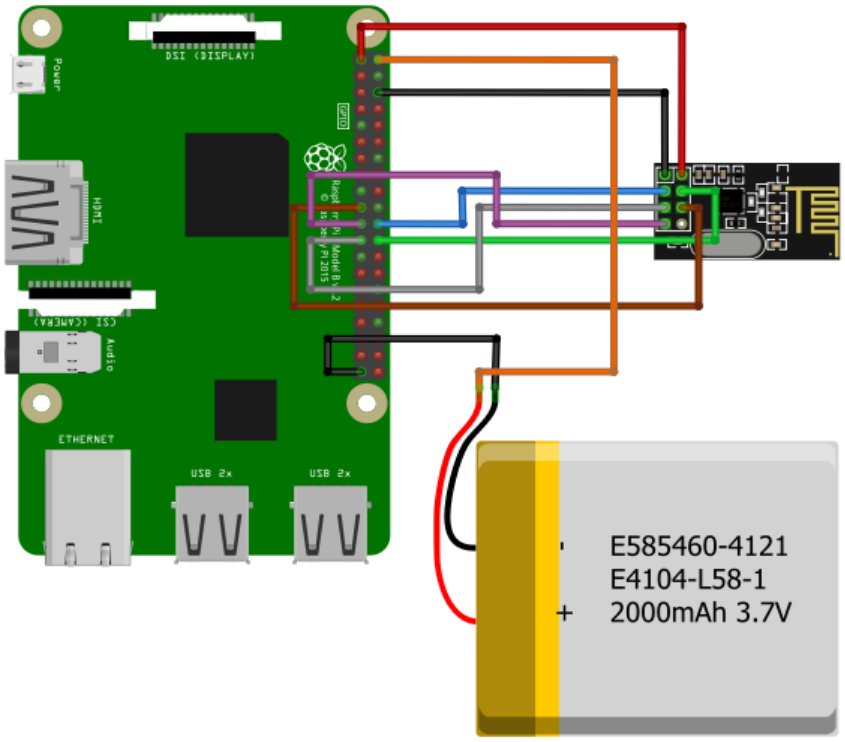

Fig6.2: Circuit Diagram of Master node.

b. Software used:

In the development of proposed system mainly used software are Python, MobaXterm, Node-Red, Win32DiskImager, Adafruit IO platform, VNC server and Linux operating system. For the controlling through the smart phone, MQTT Dashboard android app is used.

c. Flow chart of the proposed system:

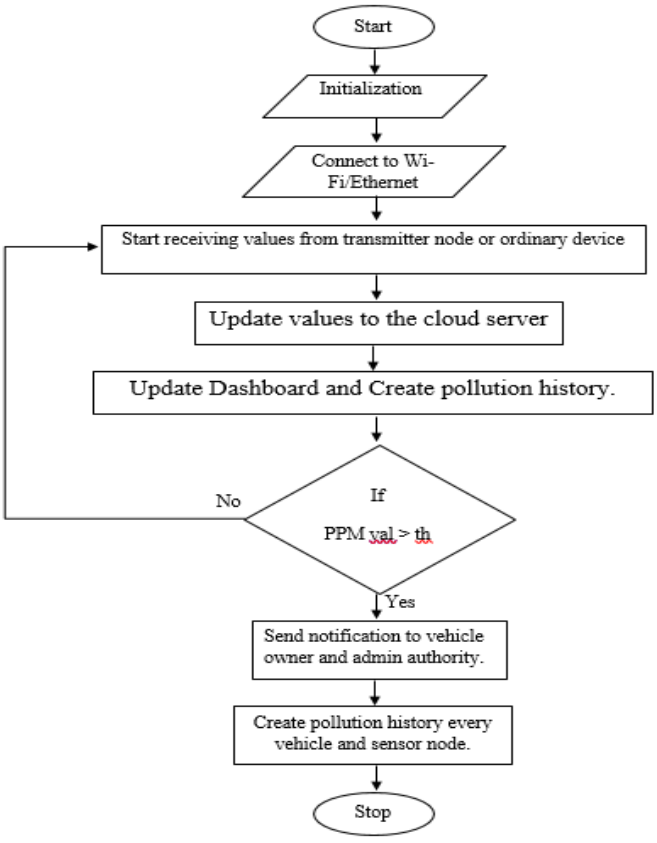

Fig7.1: Flow chart of the proposed system.

V. WORK PRINCIPLE:

The working of the proposed system has based on the Wireless Sensor Networks and Internet of things.

In this project the all transmission nodes forms wireless sensor network and collecting this data by the master node on server, on basis of threshold sending the notification to user is including the concept of the Internet of Things. For the posting and updating the data over the cloud, HTTP, MQTT and SMTP are used. The communication between master and ordinary device, Radio Frequency and channel are used.

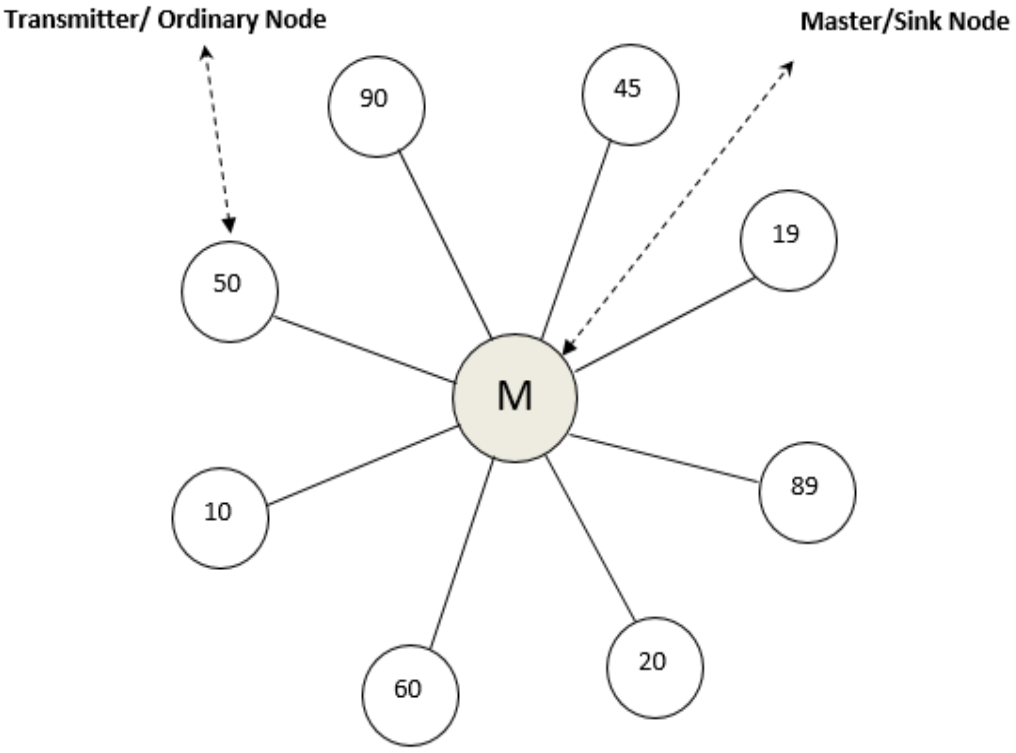

Fig5.1: Connectivity between sink and ordinary node.

The connectivity between the sink node and ordinary node is like wireless sensor network [7] as shown in Fig5.1.

5.1 Working:

The transmitter node/ordinary device, which having CO sensor, LPG Gas sensor, Temperature and Humidity sensor will be attach with silencer of the every vehicle. The microcontroller reads the values of the sensor at every moments and transmit it through the nRF24L01+ module.

The master node/sink device, which having 100m range capability to receive the data from the transmitter node will be install on every traffic lights. The Raspberry pi board will connected with internet. The received readings from the nRF24L01+ module in the raspberry pi board will updated on the server using internet with help of python programming scripts.

The all updated data will be store in the cloud; it will show on the dashboard as well as history of pollution data. The stored data on the cloud can be fetch through the APIs at any moment from anywhere. As indicated by the application, adaptability permits adding more hubs to the organization without changes on the organization execution, which implies that this doesn't influence the remainder of the organization. Organizations depend on the nearby data information, in particular, neighbours. The all transmitter node can be send the data to the nearest master node. In other words if any transmitter node will comes into the range of 100m then the master node will catch the readings.

5.2 Formula:

For the implementation of this system, mainly two formulae are used:

a. RF channel frequency of your selected channel:

Freq(Selected) = 2400 + CH(Selected)

b. To calculate sensors voltage [11]:

VL = Vc * (Rs/Rs + RL)

c. To calculate digital value:

Dv = (VL/VC) * 1024

d. To calculate PPM value:

PPM = (in- inmin)*((outmax-outmin)/(inmax-inmin))+outmin

VI. RESULT AND CONCLUSION:

The mainly goal of this paper is to reduce, detect, track and inform about air pollution status to the vehicle owners and store the pollution history on cloud. In between the designing and development of this system, it has observed that pollution can be tack and reduce in more effective manner. The working prototype has designed as per the proposed system. All the functionalities, sensors and pipelines are working as expected. The component of large scale manufacturing was to a lesser degree a worry. The model could exhibit that with alterations it tends to be empowered for large scale manufacturing. The motivation behind why this is referenced here in light of the fact that a few components in the task probably won't be the specific fit rather it is look at what could be. For instance, utilizing Bluetooth in the mines isn't exceptionally viable due to the reach, yet utilizing a genuine arrangement can be incredibly expensive and complex to plan. Moreover, the Body is produced using plastic, which won't be appropriate in higher temperature.

Fig6.1: Result Dashboard of Adafruit Cloud.

The proposed air contamination identification framework proprietors assists with keeping vehicle in great condition and store air contamination history on the cloud; it advise the client and finds the closest help stations when the emanation of CO/spillage of gas surpasses the limit esteem. It assists with controlling the reason for vehicular air contamination. The future extent of the proposed framework is to get administration answer message from the assistance station and to carry out the proposed work for modern applications.

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