A Project Report on

VEHICULAR POLLUTION MONITORING SYSTEM USING INTERNET OF THINGS

*Submitted as a part of **Micro-Controllers Lab** course*

in

Bachelor of Technology 5th Semester

in

Electronics and Communication Engineering

By

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AIM

Designing an IOT Based Vehicular Pollution Monitoring using NodeMCU(ESP8266) Microcontroller.

ABSTRACT

An increase in automobile vehicle leads to an increase in air pollution since automobiles are the main source of environmental pollution. The smoke emitted from the vehicle consists of gases like nitrogen oxides (NOx), carbon monoxide(CO), and hydrocarbon (HC). approximately one-half of the nitrogen oxide gases, carbon monoxide and one-fourth of hydrocarbon gases in our environment are emitted from automobile vehicles, which leads to global warming. Due to poor vehicle maintenance and ignition defect. the gases emitted from the exhaust may increase. In order to reduce environmental pollution and to increase vehicles life, we can use this system. When the rate of gases emitted from the vehicle exceeds the threshold limit set by the government, our system will notify the user.

INTRODUCTION

Air pollution is a major risk to health and to the environment. Outdoor air pollution is estimated to cause 1.3 million annual deaths worldwide (WHO, 2011). Road transport often appears as the single most important source of urban pollutant emissions in source apportionment studies In the coming decades, road transport is likely to remain a large contributor to air pollution, especially in urban areas. For this reason, major efforts are being made for the reduction of polluting emissions from road transport. These include new powertrains and vehicle technology improvements, fuel refinements, optimization of urban traffic management and the implementation of tighter emission standards Road vehicle emissions depend on many parameters. Emission models are used to perform the calculations of road transport emissions. Road vehicle EFs are functional relations that predict the quantity of a pollutant that is emitted per distance driven, energy consumed, or amount of fuel used. EFs are typically derived for vehicle categories (but they also exist for single vehicles, or even an entire fleet), and they depend on many parameters such as vehicle characteristics and emission control technology, fuel

specifications, and ambient and operating conditions (cold-start, cruising, acceleration, etc.). The quality of the application of any road vehicle emission model largely depends on the representativeness of the EFs it contains. This refers to the accuracy with which the EF can describe the actual emission level of the particular vehicle type and driving condition it is applied to. For example, an EF based on the mean speed of vehicles may be representative for the estimation of emissions at a national level, but its representativeness will decrease when trying to assess the impacts of local traffic measures (e.g. a local traffic intervention with large impacts on the stop-and go pattern of vehicles but not affecting their mean travelling speed).

Pollutant emissions need to be accurately estimated to ensure that air quality plans are designed and implemented appropriately. Emission factors (EFs) are empirical functional relations between pollutant emissions and the activity that causes them.

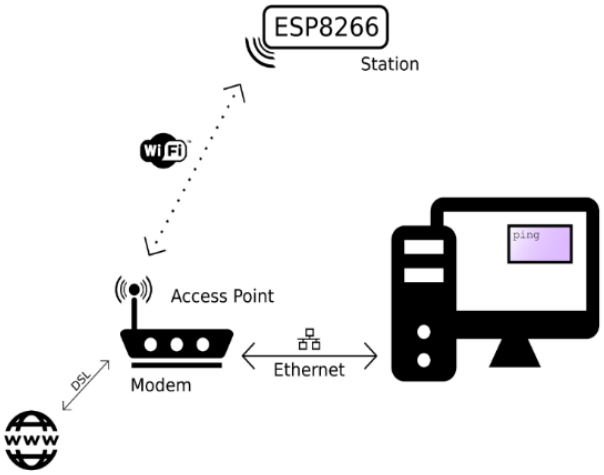
So here we are developing a primitive circuit that calculates the amount of pollution created by automobiles and sends a notification to the user by which the user tries to minimize the use of their automobile to sustain our beautiful environment.

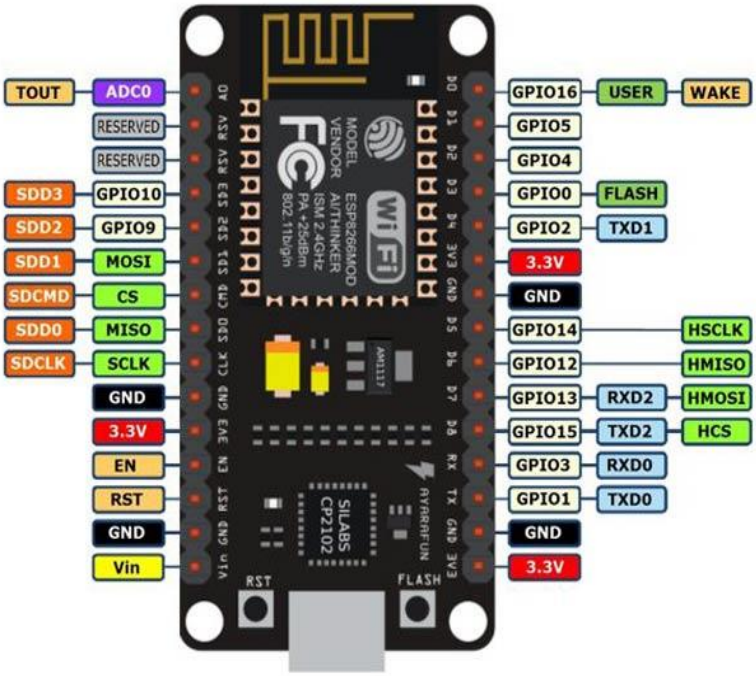
This also helps us to maintain a graphical data of the smoke emitted by the automobile.

HARDWARE COMPONENTS REQUIRED :

1. NODEMCU(ESP8266) -

The ESP8266 module enables microcontrollers to connect to 2.4 GHz Wi-Fi, using IEEE 802.11 bgn. It can be used with ESP-AT firmware to provide Wi-Fi connectivity to external host MCUs, or it can be used as a self-sufficient MCU by running an RTOS-based SDK. The ESP8266 can operate in three different modes: Wi-Fi station, Wi-Fi access point, and both at the same time.





Pinout diagram of NodeMCU(ESP8266)

2. SMOKE SENSOR(MQ2) -

The main component in smoke is Hydrocarbon so here we use this sensor to find the presence of hydrocarbon.MQ-2 sensor detects the presence of hydrocarbon gases (HC) (methane, propane and n-butane) at concentrations from 3000 to 10,000 ppm. measuring hydrocarbon gases is important for pollution monitoring. It has 4 pins (power, ground, digital and analog output). the sensitivity of the sensor can be varied by the onboard trimmer. The sensor can operate at temperatures from -20 to 50-degree Celsius.

Fig. 5 Mq-2 Gas Sensor (Hydrocarbon Sensor)

3. CARBON MONOXIDE SENSOR(MQ7) -

MQ-7 sensor is used to detect Carbon Monoxide(CO) from 20 to 2000ppm. the sensitivity of the sensor can be adjusted by using a potentiometer. It has 4 pins (power, ground, digital and analog output). The output is directly proportional to the density of Carbon monoxide gas. The data from the sensor is in terms of analog output.

Fig. 6 Mq-7 Gas Sensor (Carbon Monoxide Sensor) No_x Sensor

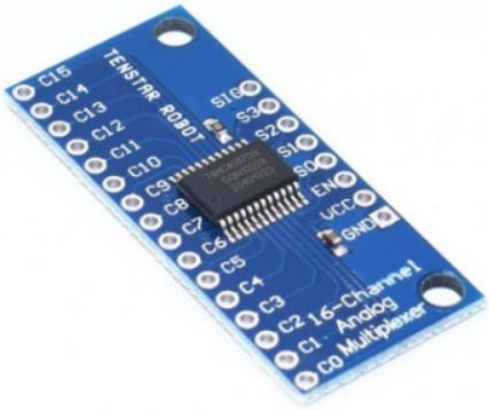
4. AIR QUALITY SENSOR (MQ135) -

SnO2 is a sensitive material used in MQ135 gas sensor. Which has lower conductivity in clear air, when the concentration of gas gets increase it's conductivity also get's increase. It has high sensitivity to Sulphide, Ammonia, Benzene steam and also sensitive to smoke. It is used to detect gases from a concentration of 10 to 10,000 ppm.

Fig. 7 MQ-135 gas sensor (NO_x sensor)

5. 16-channel ANALOG MULTIPLEXER -

In electronics, a multiplexer, also known as a data selector, is a device that selects between several analog or digital input signals and forwards the selected input to a single output line. The selection is directed by a separate set of digital inputs known as select lines. The NodeMCU used by us has only one digital pin so by using this we can have many other digital pins so as to connect many sensors.



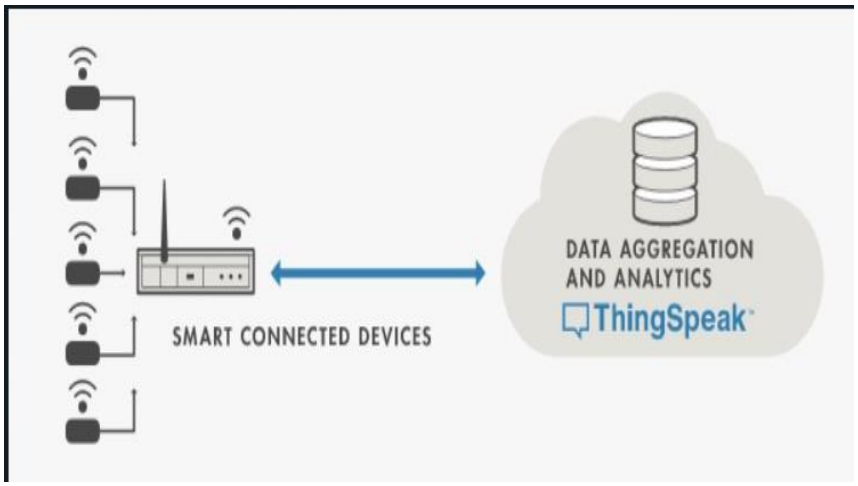
SERVICES & PLATFORMS USED:

1. ARDUINO IDE -

The Arduino Integrated Development Environment is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards. It is a text editor like a notepad with different features. It is used for writing code, compiling the code to check if any errors are there and uploading the code to the Arduino

2. THINGSPEAK -

ThingSpeak is an open-source software written in Ruby which allows users to communicate with internet enabled devices. It facilitates data access, retrieval and logging of data by providing an API to both the devices and social network websites. ThingSpeak provides instant visualizations of data posted by your devices to ThingSpeak. With the ability to execute MATLAB® code in ThingSpeak you can perform online analysis and processing of the data as it comes in. ThingSpeak is often used for prototyping and proof of concept IoT systems that require analytics. Features of ThingSpeak include real-time data collection, data processing, visualizations, apps, React etc. At the heart of ThingSpeak is a ThingSpeak Channel. A channel is where you send your data to be stored. Each channel includes 8 fields for any type of data, 3 location fields, and 1 status field



3. TWILIO -

Twilio is an American cloud communications platform as a service company based in San Francisco, California. Twilio allows software developers

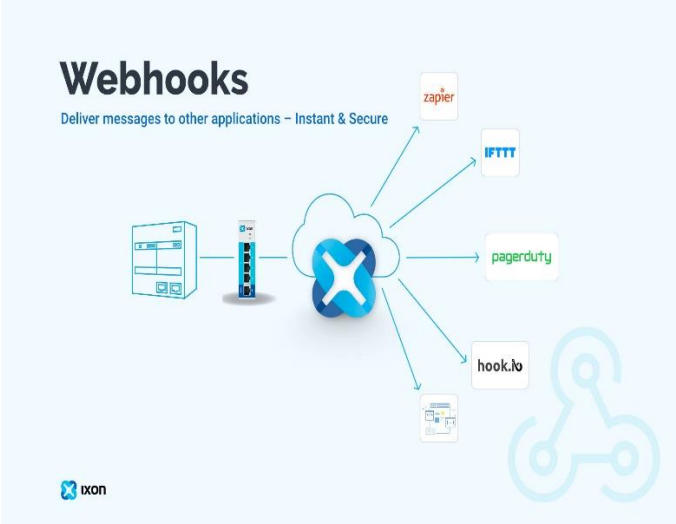
to programmatically make and receive phone calls, send and receive text messages, and perform other communication functions using its web service APIs. It uses intelligent sending features to ensure messages reliably reach end users wherever they are. Twilio has SMS-enabled phone numbers available in more than 180 countries.

4. IFTTT -

IFTTT helps you connect all of your different apps and devices. When you sign up for a free account, you can enable your apps and devices to work together to do specific things they couldn't do otherwise. IFTTT is a low-cost smart home protocol. It lets you connect various devices to create an entire smart home system. IFTTT is accessible on the web and through the IFTTT app. It can work on either an iPhone or Android device.

5. WEBHOOKS -

A webhook is a lightweight API that powers one-way data sharing triggered by events. Together, they enable applications to share data and functionality, and turn the web into something greater than the sum of its parts. APIs and webhooks both allow different software systems to sync up and share information. It allows you to send real-time data from one application to another whenever a given event occurs.

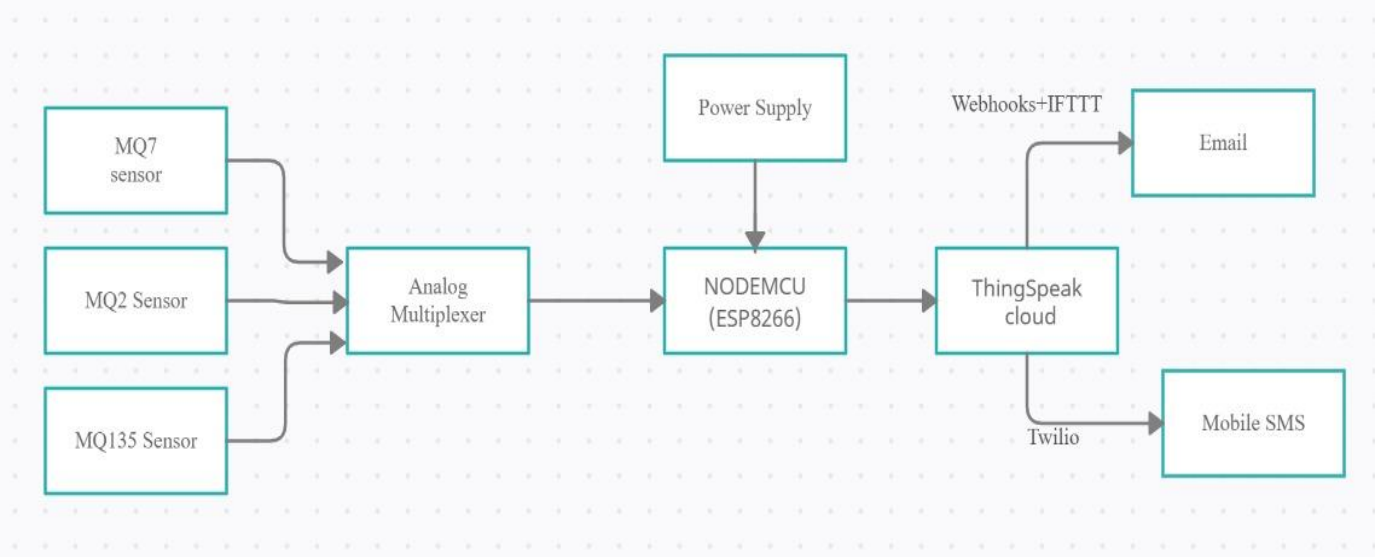


WORK FLOW :-

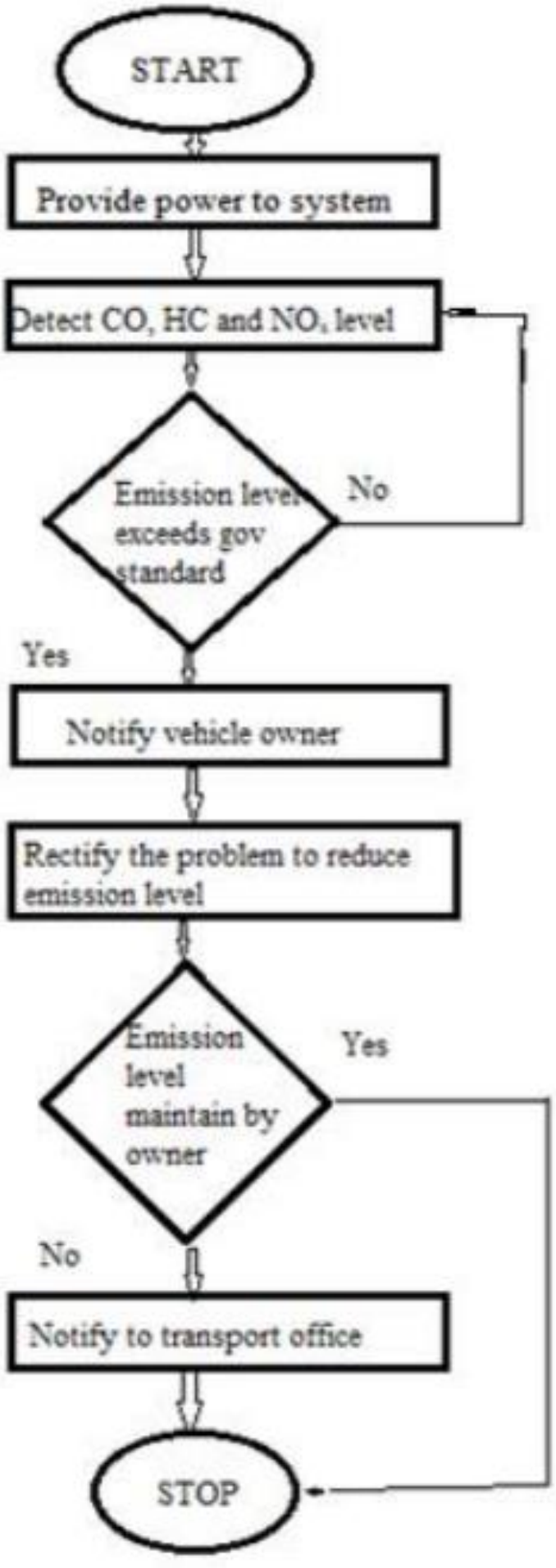
We will be able to calculate the amount of various pollutants(Hydrocarbons, Carbon monoxide, Sulphide, Ammonia, Benzene, NOx) in PPM(parts per million) which helps us to decide the contamination of air. This data collected from various sensors(MQ2, MQ7 & MQ135) will be sent to ThingSpeak Cloud using MQTT(Message Queuing telemetry transport) and will display the values graphically and on reaching a threshold value of a pollutant which will be detected by React Service of ThingSpeak, the cloud will notify the user about the emission and environmental pollution due to his automobile. The notification is sent to the user in the form of Mobile SMS(using ThingHTTP & Twilio) and an Email(using ThingHTTP, Webhooks & IFTTT). On getting the notification user can give his vehicle for maintenance or decrease the use of vehicle in order to make the environment sustainable

This project design gives a solution for identifying pollution causing vehicles. This system is a product in the sense that they are of low cost and the pollution level of any vehicle with a sensor inbuilt at the exhaust can have its pollution status. Since the sensors are placed at the exhaust, there is no chance of any mixing of other pollutions from vehicles or from the environment, changing the actual sensor values or working condition of the system.

BLOCK DIAGRAM OF SYSTEM :

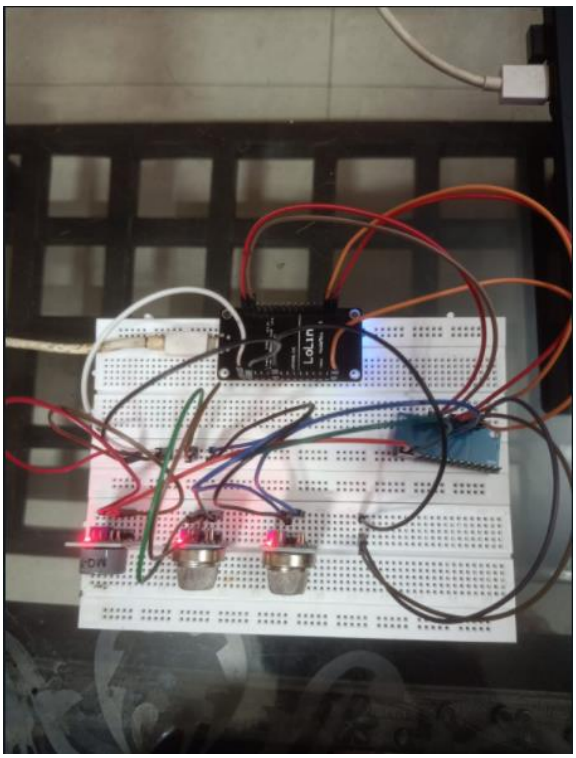


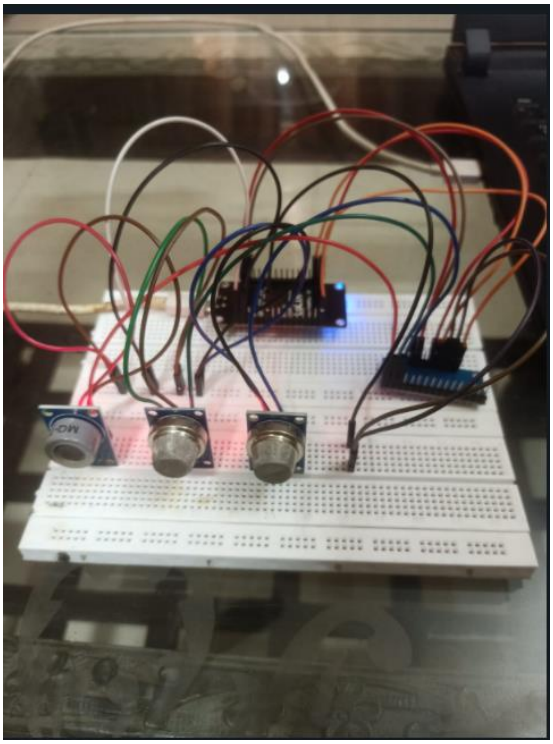
Flow Chart


START
Provide power to system
Detect CO, HC and NO, level
Emission level exceeds gov standard
No
Yes
Notify vehicle owner
Rectify the problem to reduce emission level
Emission level maintain by owner
Yes
No
Notify to transport office
STOP

EXPERIMENTAL SETUP :-

Here is the circuit picture where we have connected all our components to make our primitive setup successful.



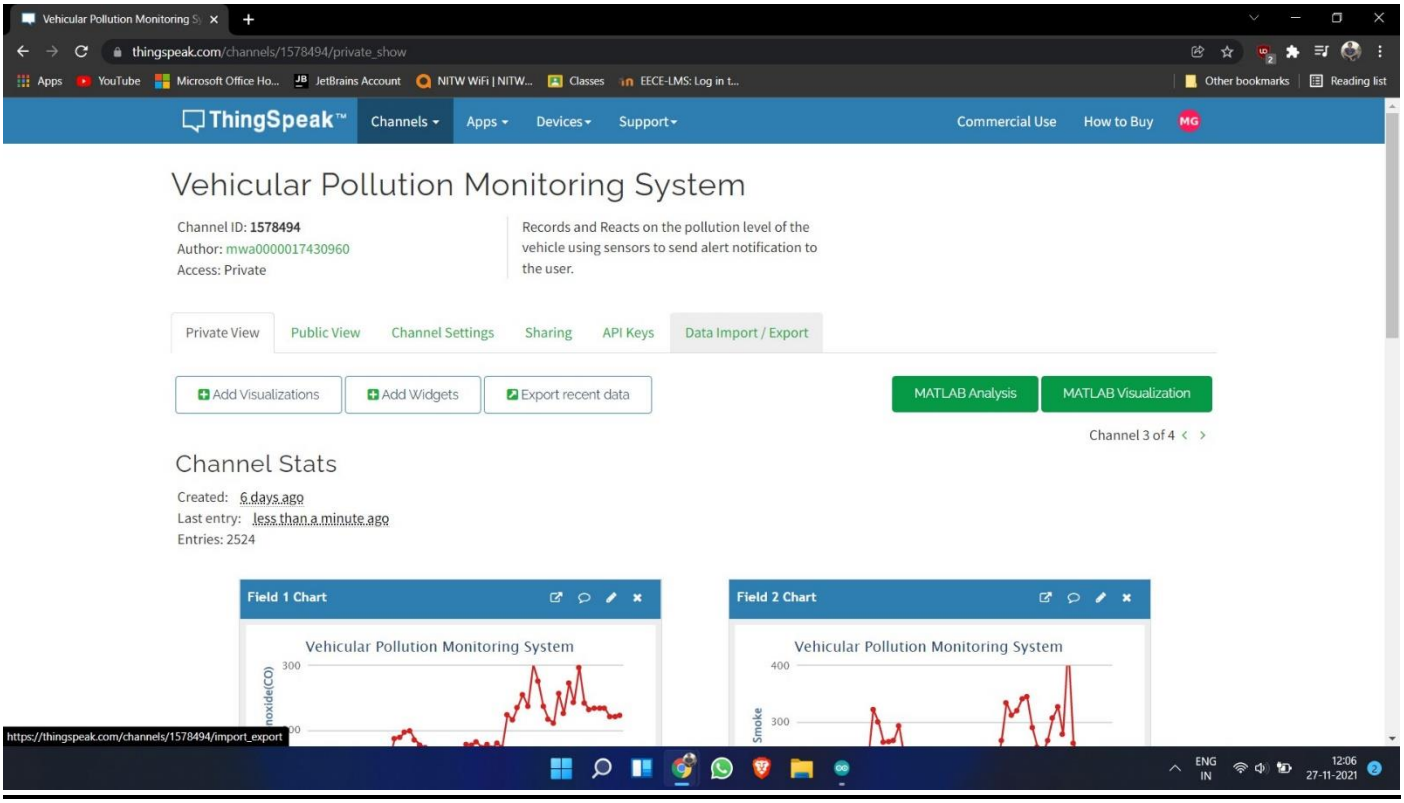


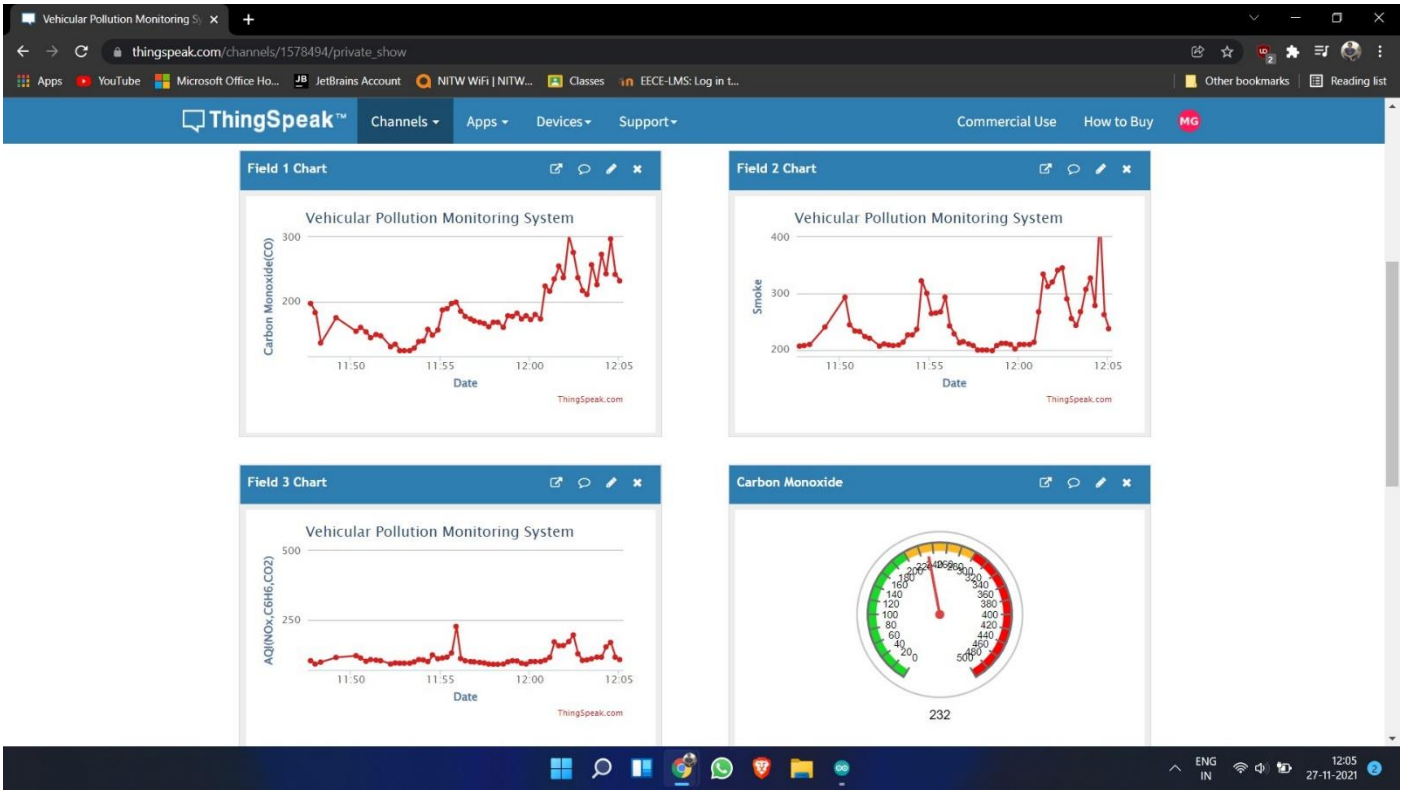
RESULTS:-

Here we successfully connected the circuit with all sensors then later we used the ThingSpeak cloud to upload all the data and represent the data using Graphs and Gauges.

Apart from this , As the concentration of any pollutant crossed a threshold(for eg. At 12:04 PM) then the cloud sent a notification in the form of a SMS and an EMAIL.

Below are all the screenshots of the implementation of our primitive setup that controls the vehicles emission .


Vehicular Pollution Monitoring Sy
thingspeak.com/channels/1578494/private_show
Apps
YouTube
Microsoft Office Ho...
JetBrains Account
NITW WiFi | NITW...
Classes
EECE-LMS: Log in t...
Other bookmarks
Reading list
ThingSpeak™
Channels
Apps
Devices
Support
Commercial Use
How to Buy
MG
Vehicular Pollution Monitoring System
Channel ID: 1578494
Author: mwa0000017430960
Access: Private
Records and Reacts on the pollution level of the vehicle using sensors to send alert notification to the user.
Private View
Public View
Channel Settings
Sharing
API Keys
Data Import / Export
Add Visualizations
Add Widgets
Export recent data
MATLAB Analysis
MATLAB Visualization
Channel 3 of 4
Channel Stats
Created: 6 days ago
Last entry: less than a minute ago
Entries: 2524
Field 1 Chart
Vehicular Pollution Monitoring System
Field 2 Chart
Vehicular Pollution Monitoring System
https://thingspeak.com/channels/1578494/import_export
ENG
IN
12:06
27-11-2021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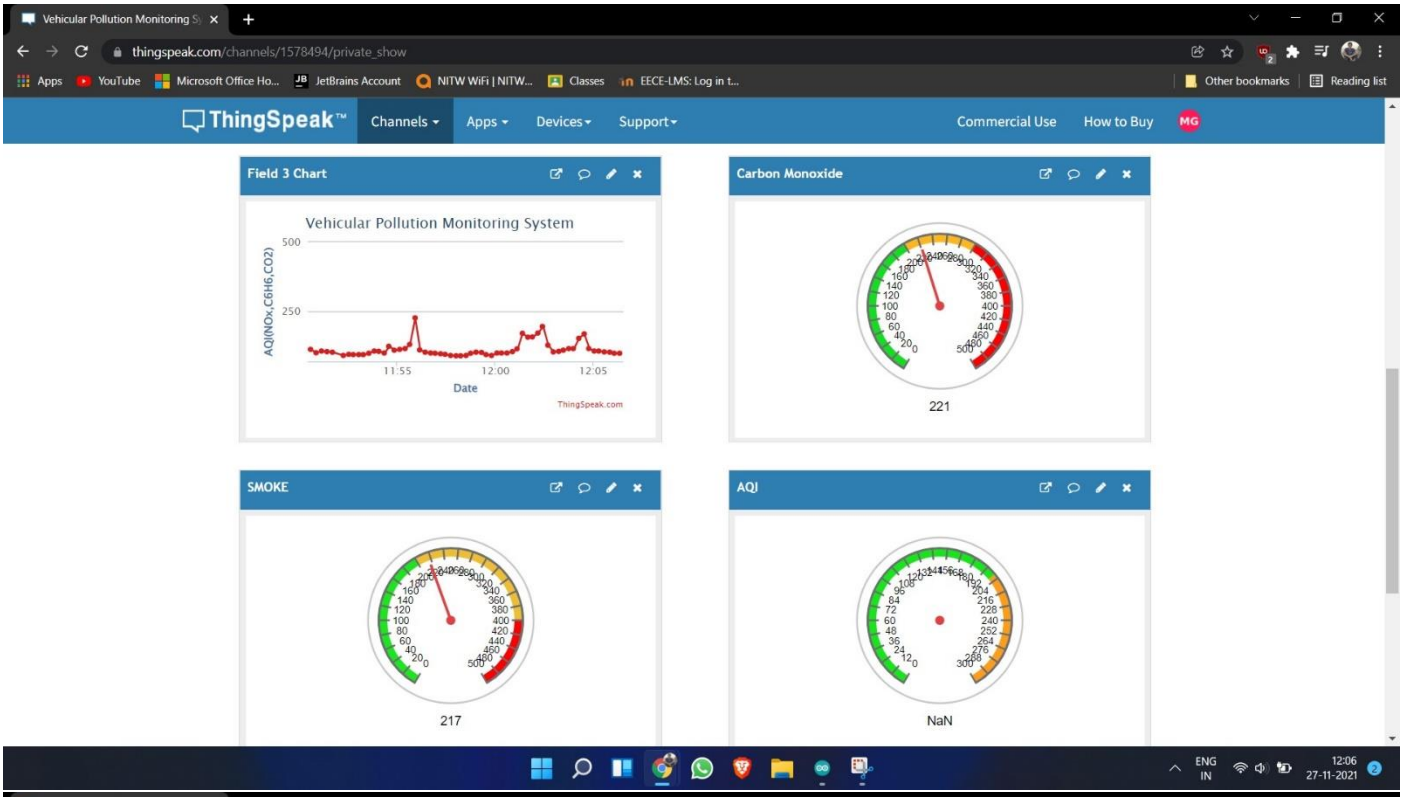
Reading list
ThingSpeak™
Channels
Apps
Devices
Support
Commercial Use
How to Buy
MG
Field 1 Chart
Vehicular Pollution Monitoring System
Carbon Monoxide(CO)
Date
ThingSpeak.com
Field 2 Chart
Vehicular Pollution Monitoring System
Smoke
Date
ThingSpeak.com
Field 3 Chart
Vehicular Pollution Monitoring System
AQI(NOx,C6H6,CO2)
Date
ThingSpeak.com
Carbon Monoxide
232
ENG
IN
12:05
27-11-2021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How to Buy
Field 3 Chart
Vehicular Pollution Monitoring System
AQI(NOx,C6H6,CO2)
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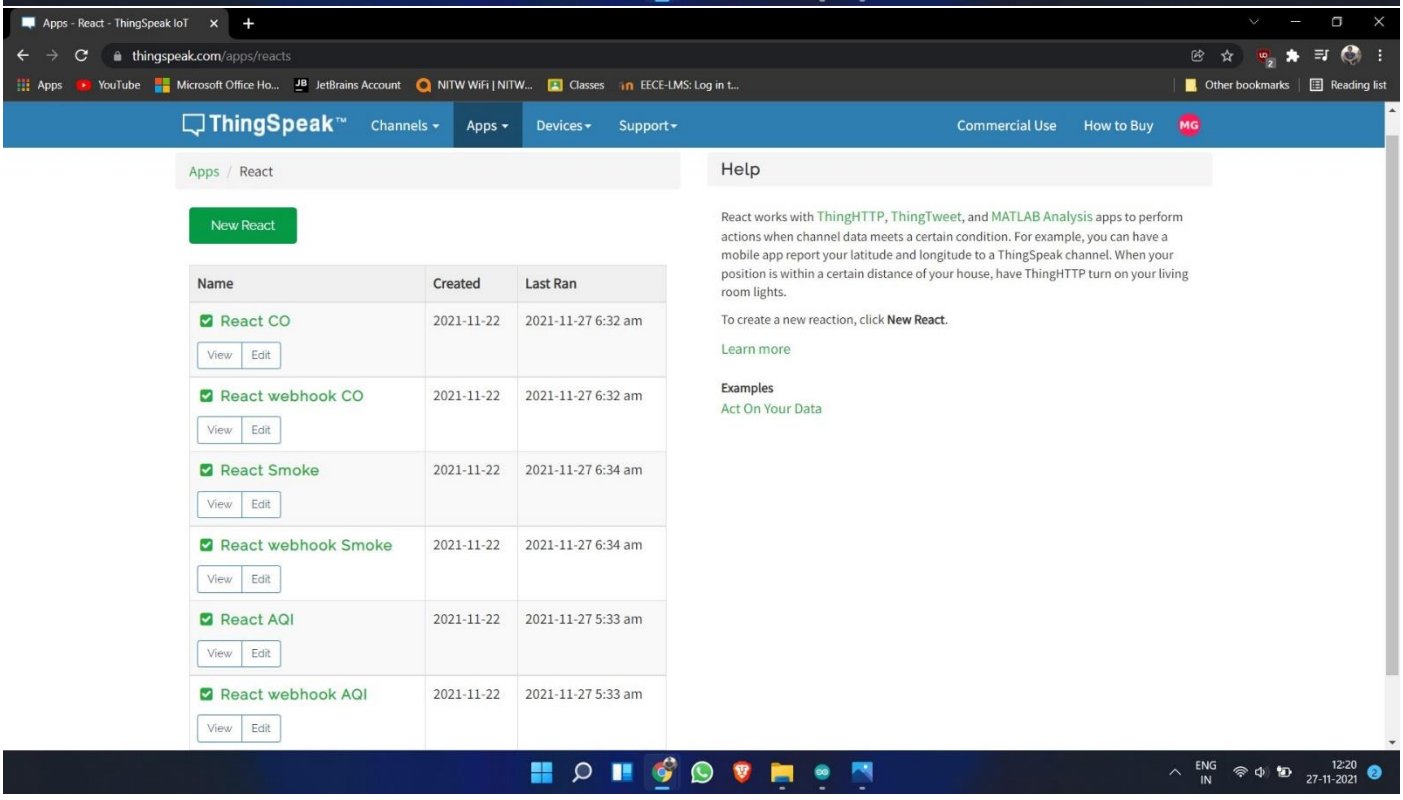
ThingSpeak.com
Carbon Monoxide
221
SMOKE
217
AQI
NaN


Apps - React - ThingSpeak IoT
thingspeak.com/apps/reacts
ThingSpeak™
Channels
Apps
Devices
Support
Commercial Use
How to Buy
Apps / React
New React
Name
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2021-11-27 6:32 am
View
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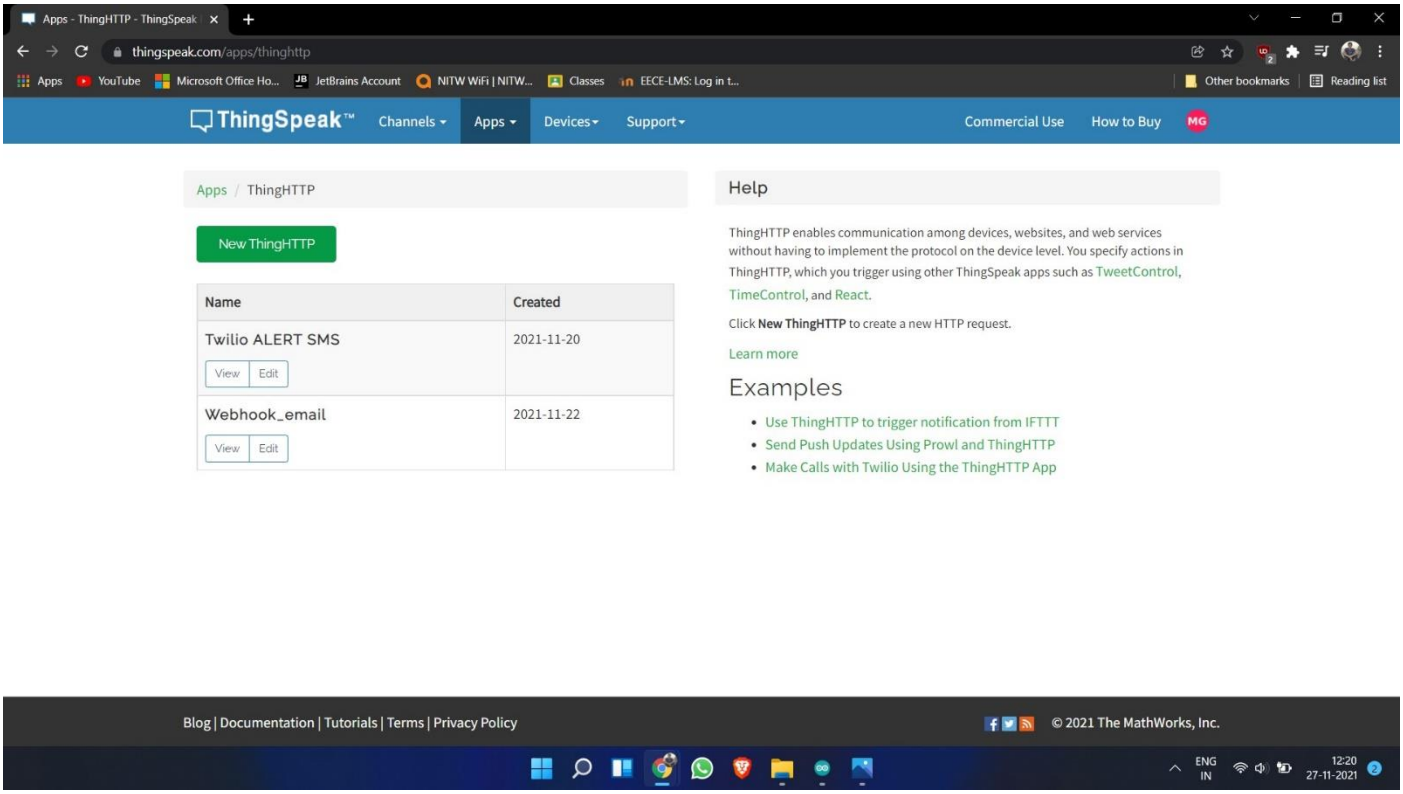
2021-11-27 6:32 am
React Smoke
2021-11-22
2021-11-27 6:34 am
React webhook Smoke
2021-11-22
2021-11-27 6:34 am
React AQI
2021-11-22
2021-11-27 5:33 am
React webhook AQI
2021-11-22
2021-11-27 5:33 am
Help
React works with ThingHTTP, ThingTweet, and MATLAB Analysis apps to perform actions when channel data meets a certain condition. For example, you can have a mobile app report your latitude and longitude to a ThingSpeak channel. When your position is within a certain distance of your house, have ThingHTTP turn on your living room lights.
To create a new reaction, click New React.
Learn more
Examples
Act On Your Data


Apps - ThingHTTP - ThingSpeak
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How to Buy
Apps / ThingHTTP
New ThingHTTP
Name
Created
Twilio ALERT SMS
2021-11-20
View
Edit
Webhook_email
2021-11-22
View
Edit
Help
ThingHTTP enables communication among devices, websites, and web services without having to implement the protocol on the device level. You specify actions in ThingHTTP, which you trigger using other ThingSpeak apps such as TweetControl, TimeControl, and React.
Click New ThingHTTP to create a new HTTP request.
Learn more
Examples
Use ThingHTTP to trigger notification from IFTTT
Send Push Updates Using Prowl and ThingHTTP
Make Calls with Twilio Using the ThingHTTP App
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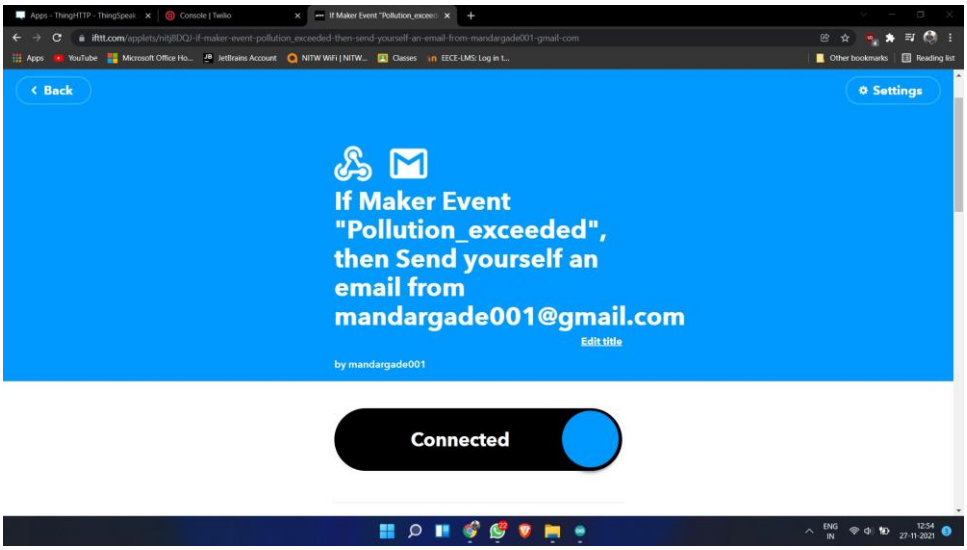
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Settings
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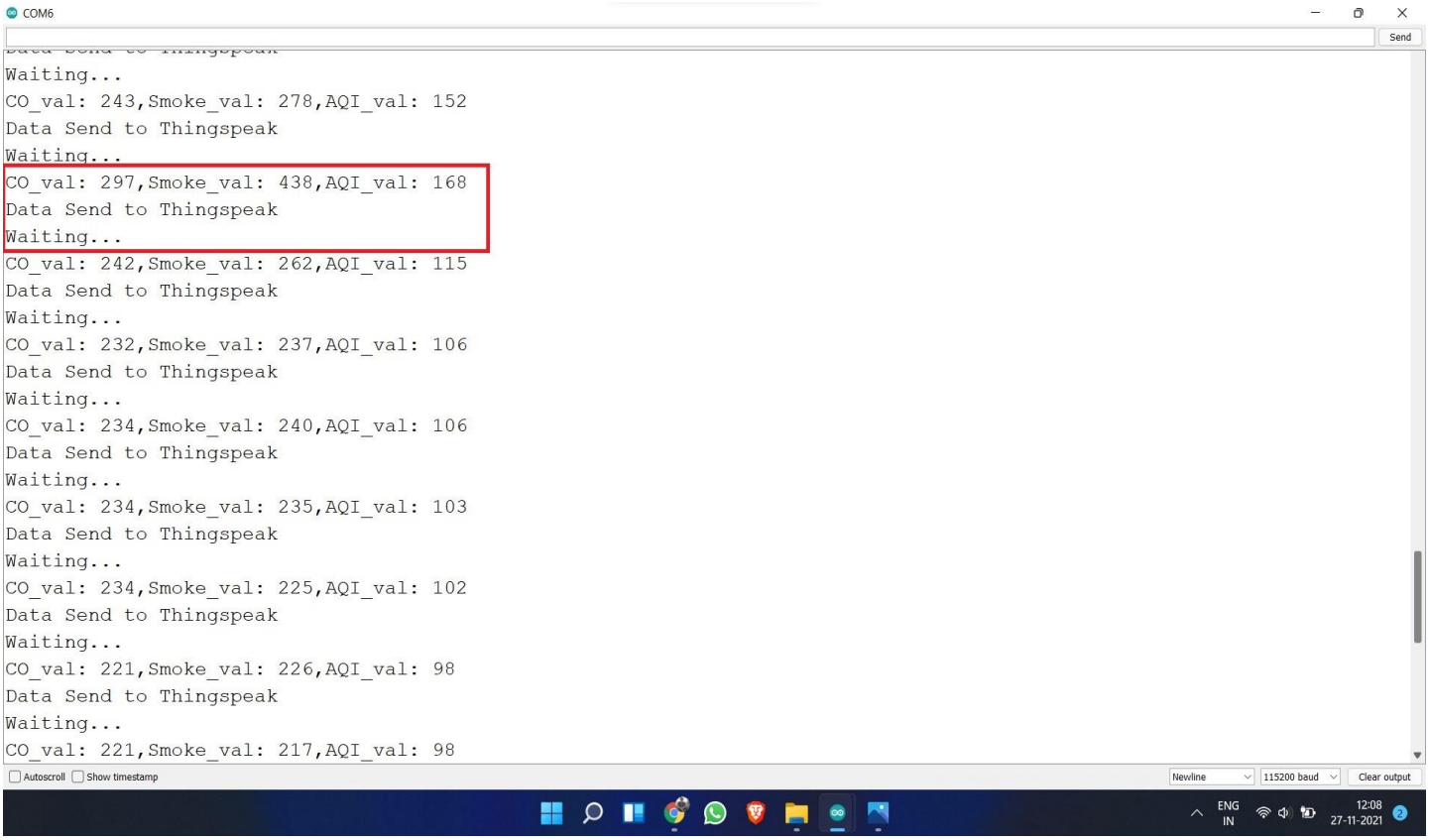
by mandargade001
Connected


COM6
Send
Waiting...
CO_val: 243,Smoke_val: 278,AQI_val: 152
Data Send to Thingspeak
Waiting...
CO_val: 297,Smoke_val: 438,AQI_val: 168
Data Send to Thingspeak
Waiting...
CO_val: 242,Smoke_val: 262,AQI_val: 115
Data Send to Thingspeak
Waiting...
CO_val: 232,Smoke_val: 237,AQI_val: 106
Data Send to Thingspeak
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CO_val: 234,Smoke_val: 240,AQI_val: 106
Data Send to Thingspeak
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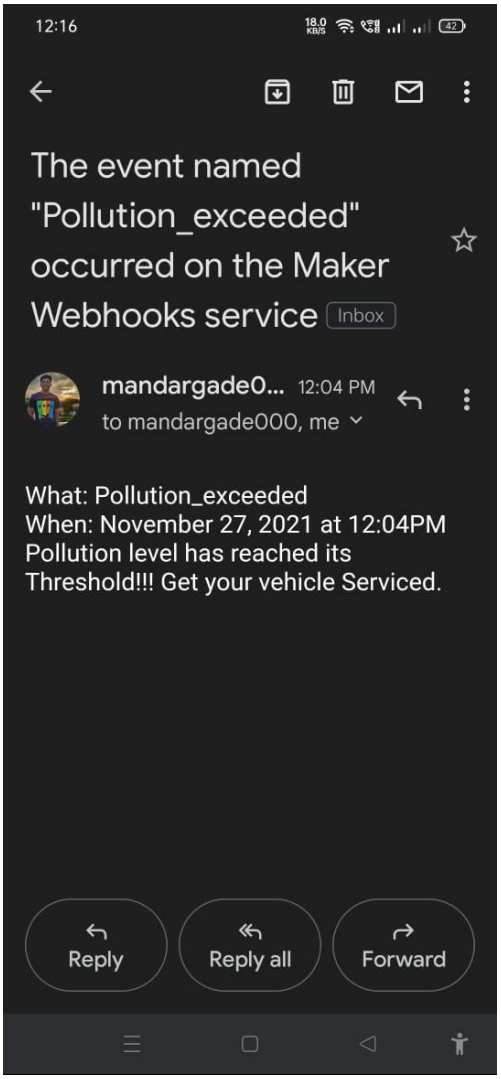
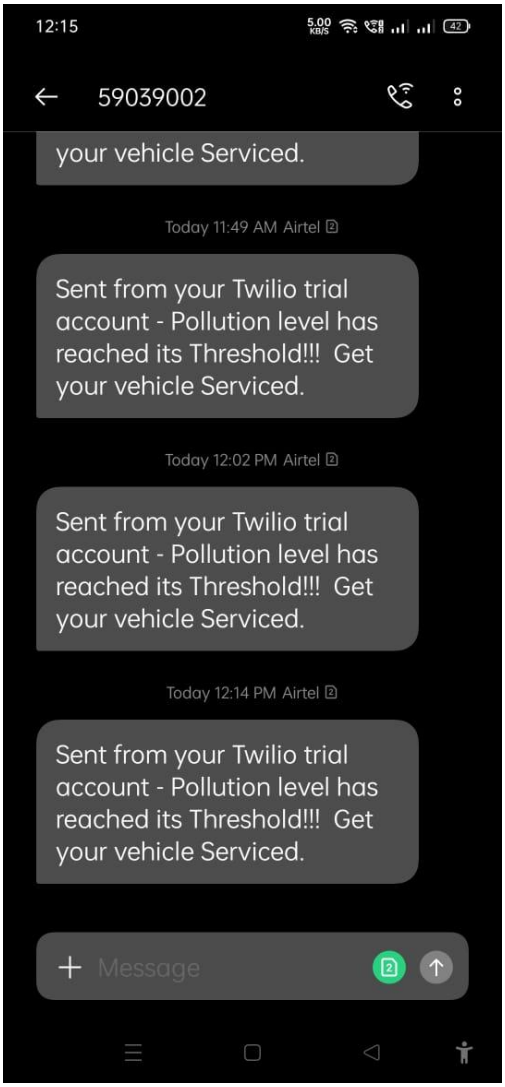
CO_val: 234,Smoke_val: 235,AQI_val: 103
Data Send to Thingspeak
Waiting...
CO_val: 234,Smoke_val: 225,AQI_val: 102
Data Send to Thingspeak
Waiting...
CO_val: 221,Smoke_val: 226,AQI_val: 98
Data Send to Thingspeak
Waiting...
CO_val: 221,Smoke_val: 217,AQI_val: 98
Autoscroll
Show timestamp
Newline
115200 baud
Clear output
ENG
IN
12:08
27-11-2021


12:16
The event named "Pollution_exceeded" occurred on the Maker Webhooks service
Inbox
mandargade0... 12:04 PM
to mandargade000, me
What: Pollution_exceeded
When: November 27, 2021 at 12:04PM
Pollution level has reached its Threshold!!! Get your vehicle Serviced.
Reply
Reply all
Forward


12:15
59039002
your vehicle Serviced.
Today 11:49 AM Airtel
Sent from your Twilio trial account - Pollution level has reached its Threshold!!! Get your vehicle Serviced.
Today 12:02 PM Airtel
Sent from your Twilio trial account - Pollution level has reached its Threshold!!! Get your vehicle Serviced.
Today 12:14 PM Airtel
Sent from your Twilio trial account - Pollution level has reached its Threshold!!! Get your vehicle Serviced.
Message

CONCLUSION:-

Each country follows different emission standards based on their geographical location and availability of resources but most of them try to implement the UNFCCC summit standards in order to reduce the emission and conserve the environment. In the future, it is also important to consider the other gas parameters and to update the system to equip with the new gas emissions regulations standards. In this project we are able to monitor the gases emitted from vehicle and analyse the standards and condition vehicle

The vehicle owner gets an awareness about the emission level without going for a checking process. The main objective is we will be aware of the pollution level from the vehicles. Hence a solution for global warming.

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