Mini Project Report on

"*Vehicle Pollution Detector and Analyzer*"

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CERTIFICATE

This is to certify that Mini Project report entitled

Vehicle Pollution Detector and Analyzer

by

Mangesh Deshmukh(18CE1062)

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AmitKumar Jaiswar (18CE1036)

is successfully completed for Third Year Computer Engineering as prescribed by University of Mumbai.

Supervisor	Project Co-ordinator
(Mrs Rajashree Shedge)	(Dr. Bharti Joshi)
Head of Department	Principal
(Dr. Leena Ragha)	(Dr. Mukesh D. Patil)

Mini Project Report Approval

This is to certify that the Mini Project entitled "Vehicle Pollution Detector and Analyzer" is a bonafide work done by Mr. Mangesh Deshmukh, Mr. Omkar Joshi, Mr. AmitKumar Jaiswar under the supervision of Mrs. Rajashree Shedge This Mini Project has been approved for Third Year Computer Engineering.

Internal Examiner :

1. .....

2. .....

External Examiners :

1. .....

2. .....

Date : .../.../.....

Place : .....

DECLARATION

I declare that this written submission represents my ideas and does not invovle plagiarism. I have adequatelycited and referenced the original sources wherever others' ideas or words have been included. I also declarethat I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action against me by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Date: _____

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Contents

Abstract

The pollution due to the vehicles has sky-rocketed several risks not only for the organisms but has also disturbed the balance of the environment. In the past decade, the number of vehicles has increased enormously due to which vehicular pollution has only increased. In most of the cases, the driver does not have the information related to the emission of the vehicle thus making it difficult for the driver to take the particular actions to get the vehicle repaired. So, in order to control the vehicular pollution, the '**Vehicle Pollution Detector and Analyzer**' model can be used. The model will help in detecting the vehicles which emit the pollution greater than the standard limit. Moreover, the data will help in analyzing what sort of vehicle type are the major contributor of the pollution and thus making proper strategies to tackle such vehicle problems.

List of Figures

Chapter 1

Introduction

1.1 Overview

Vehicular pollution is becoming the major concern for the present generation. Due to the exponential growth in the number of the vehicles in the past few years' vehicular pollution rate is sky rocketed. The air pollution caused by the vehicles disturbs the entire ecological balance prevailing in the nature as this pollution is not only harmful for the humans but also for the entire surroundings. Vehicular pollution is the resultant of tremendous urbanization and enormous increase in the population in the last decade. For the developing countries like India, automobile industry is becoming the backbone of the economic development but the pollution caused by the automobiles is also a hazardous problem.

Presently, person has to drive the vehicle to the authority in order to get the vehicles pollution limit checked. However, in this busy world, it becomes quite difficult for the people to take such necessary steps. As a result, some vehicles that emits fumes larger than the standard limit causes air pollution. Moreover, there is no uniform or regular check for the emission of the vehicles which also act as a key aspect of increasing of air pollution. Therefore, the proposed model can be used in order to maintain the proper and the regular check of the emission of vehicles.

The sensors are arranged in the form of network i.e. the topology like Star or Bus topology. Then the data from the sensors are passed to the Arduino through the ADC and then passed to the Raspberry pi which acts as a hub of the entire information. Then finally the data uploaded on the cloud using the IEEE 802.15.4 module for the transparency in the system.[1]Then the data follows the 6LoWPAN module and IPv6/IPv4 for the network module. Then the data transfer protocol is followed like TCP or UDP and finally the data is accessed using the HTTP/MQTT/CoAP protocols. The user can access the information anytime from the cloud database. The major constituent of the vehicular pollution are the four wheelers as the fumes emitted by them are in huge amount as compared to the two wheelers. The fumes emitted by the vehicles includes Nitrogen Oxides, Carbon Dioxide, Carbon Monoxide, Particulate Matter and Hydrocarbons. These fumes get accumulated on the soil, plants or trees nearby, hence entering in the food chains of all the living organisms. To tackle with the vehicular air pollution, this paper provides the solution that can be helpful in finding out the vehicles that causes air pollution more

than the standard limit. Moreover, the vehicle causing air pollution can be sent notification to gets its vehicle checked and improvised. This model will not only help in catching the vehicles that causes the air pollution but also help in finding the new schemes that should be made in order to get the air pollution controlled.

1.2 Objectives

- To determine the pollution control efficiency of vehicle.
- Implement system to control air pollution through vehicle determining the level of contaminants in an airshed by vehicle to compare with standards and guidelines.
- Give alert messages if the the concentration of air pollutant emission exceeds the limit value.
- Stores all the data securely and user can access this data when required.
- To analyze the data extracted from system using machine learning.
- Gives notification to user for renewing PUC certificate after it expires.

1.3 Motivation

In a report issued by 'Greenhouse', around 1.2 million deaths are caused by the air pollution in India and the capital, New Delhi, is entitled as 'Airpocalypse' for being the most polluted city [2]. Kids and the mature individuals are the utmost susceptible to the air pollutions caused by the automobiles. Moreover, there is no regular or uniform check about the air pollution emitted by the Transport Department of India, due to which the vehicles emitting a large amount of air pollution is increasing in number. There are several registered vehicles which have not got their emitting fumes checked even once.

Furthermore, due to the increase in the number of vehicles the air pollution due to the emission by the vehicles is increasing at the alarming rate. People are still using the decade old vehicles that are major contributor to the air pollution as these vehicles do not have well defined engines that uses fuel in a clean manner. The prolonged exposure to the automobile air pollution can lead to several health problems related to cardiovascular and respiratory activities like asthma, lung cancer, bronchitis, heart attack and others. [3] According to the report issued by

the ‘Global burden of Disease Study of 2010’, 62,00,00 number of early deaths are caused due to the air pollution in India. Similarly, WHO states that 13 of 20 most polluted cities of world are of India. Moreover, the air pollution emitted by vehicles not only affects the human health but also the environment. The air pollution can result in the formation of the smog, acid rain, damage to the ozone layer and key contributor in the global warming. The pollutants and gas like Carbon Monoxide released during emission by the vehicles settles on the plants, and soil, thus leading to entrance in the food chain. [4] According to the study carried by the Central Pollution Control Board (CPCB) in 2008 along with National Environmental Engineering Research Institute (NEERI), vehicular pollution is the major contributor of hydrocarbon and Carbon Monoxide for the entire air pollution pollutants. The table below shows the average estimation of dangerous particles and gases that are emitted by the vehicular pollution along with the problems caused by them. There are several aspects which reveals the reason of air pollution in the country and some of them are (i) the adulterated fuel used in the vehicles (ii) unavailability of networked and proper transport system in the country (iii) the bad condition of the available roads (iv) use of faulty or bad condition of automobiles and the inferior quality of the engines (v) frequent jams and large number of vehicles. And the current automobiles laws are not stringent enough to maintain a uniform system for controlling the air pollution caused by the vehicles. And the schemes which are proposed for the automobiles are not implemented properly. So, to improve the air quality this model can act as a uniform system for the citizens to get their vehicles checked regularly at no cost.

Table 1.3 Average Estimation Of Toxic Product In Emission

Vehicular Pollution	**Affects**	**CAR**	**2-wheeler**	**BUS**
CO	nervous system, cardio vascular system, creating nausea, headaches	212.30	719.64	207.26
NOx	Infection of pulmonary diseases; irritation to noses, eye, and throat	22.14	62.15	679.73
PM	Altering of immune system and can cause long term disorders	3.22	16.36	31.36
HC	Can cause cancer	38.01	464.49	51.72

1.4 Organization Of Report

The details for the organization of report are as follows:

Chapter 1: Introduction

This chapter is the dive in and inception to the topics of what we are going todo in this project and why we have dived into it right away. The sections of this chapter are as follows:

1.1 Overview: Here we look over what is the project all about and the overallsummary of the project.

1.2 Objectives: The key aspects or goals on which the problem statement is focusedupon are stated here.

1.3 Motivation: This section discusses about the need and requirement whichled to the consideration and moving ahead with this project and problem formulation.

1.4 Organization of Report: It is the section which gives a detail about howthe report is constructed throughout in its chapters.

Chapter 2: Literature Survey

This chapter is the actual research and detailed study and survey of all the research papers, review, study and analysis done on the project about the existingsystem and problem statement.

The sections of this chapter are as follows:

2.1 Existing Systems: The section is the survey of several research papers/reviews/journals in recent years related to the problem statement and descriptions of the existing systems in a concise manner.

2.2 Limitations of Existing System: This section showcases the shortcoming and how the current solutions lack in some aspects.

Chapter 3: Proposed System

This chapter is the most key chapter as it is the one which mainly lays what theproject proposes to do and make a different change in the exchange system.

3.1 Problem Statement: This includes a concise description of our issue to be addressed or a condition to be improved upon. It identifies the gap between thecurrent system and desired system of a process or product.

3.2 Proposed Methodology/Techniques: This includes the methodology and approach decided to find a suitable solution for the problem and steps decidedto work towards our objectives and goals.

3.3 Design of the System: This section showcases how the system is designedat system and application layers, thereby laying functioning of the system.

3.4 Hardware/Software Requirement: Here we briefly discuss the hardwareand software requirements for both the client/server perspective and the user and admin roles to execute the system.

3.5 Implementation Details: The section gives a brief of how the proposed methodology and design is going to be implemented with the use of the existinghardware/software requirements.

3.6 Chapter 4: Results & Discussion

The focus of this chapter is to obtain and thus publish the results gathered after theimplementation of the proposed model and as well as the comparision with the existing models

Chapter 2

Literature Survey

2.1 Existing Systems

Tremendous innovations have been made in the technology and manufacturing of cars as well as in the pollution control department but still nothing significant achieved of it. This idea employs an MQ7 sensor which is economical and capable of detecting Carbon Monoxide gas emitted from the vehicle. The sensed percentage or proportion is send to RTO office who will check whether CO proportion is more than limit or within a limit. If it is less than the limit or within a limit then it will send a message to PUC office as well as to owner of vehicle which includes whether certificate is granted or not. This is done with the help of GSM at PUC office. The PIC16F877A Micro controller is used to transfer the information to the GSM system from the MQ7 sensor. There are two GSM modems involved one at PUC office and one at RTO office for communication. An RFID is used to collect the information of vehicle and owner with a particular serial number. This information will be displayed on an information portal which nothing but a 16x2 LCD. The aim of this system is that to make PUC measurement process easy with various functions like information portal, RFID techniques & communication through GSM and to make this process transparent.

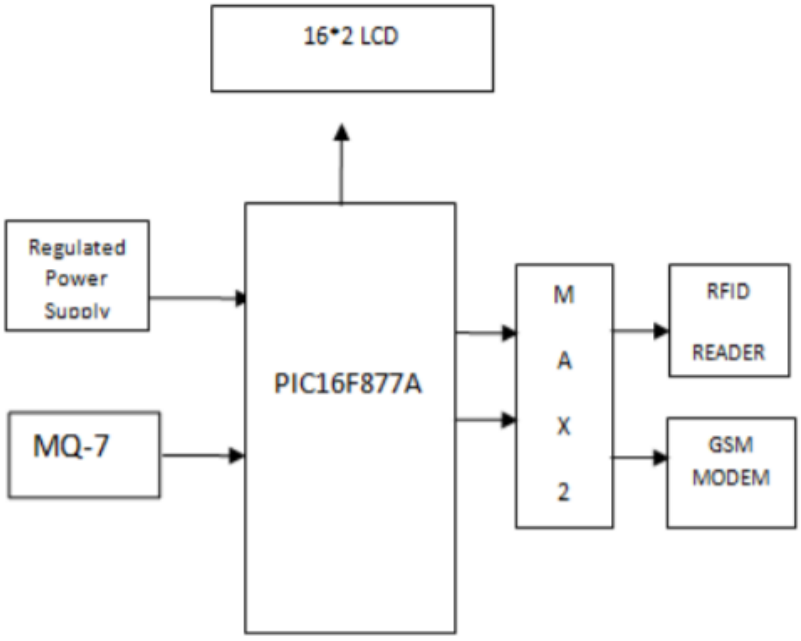


Fig. 2.1.1 Block Diagram

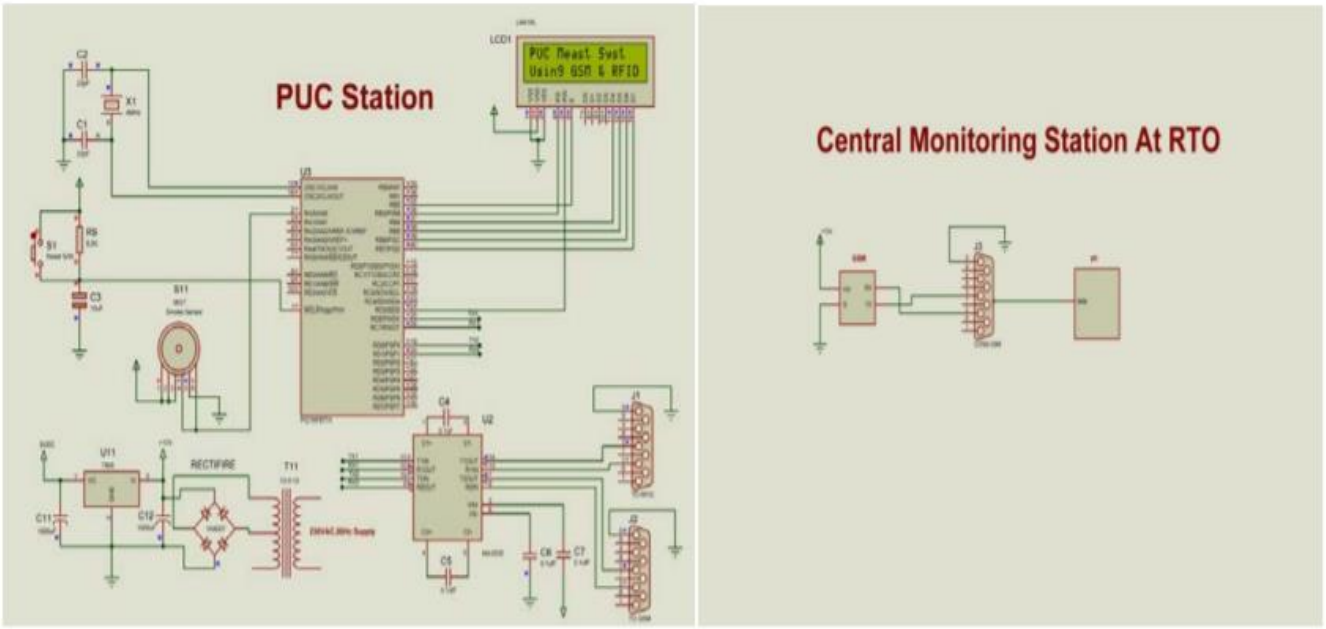


Fig. 2.1.2 Circuit Diagram

Working:

In this system we are going to sense Carbon monooxide which comes out of vehicle . MQ7 is the CO sensor which will be used by us to detect concentration of CO in vehicle.First owner will swipe his RFID card which will let his display on 16x2 LCD. PIC16F877A is a microcontrller which are going to use to control all the parts of the system. Using MQ7 sensor concentration of is CO is get recorded and report will be sent to centre office or RTO using GSM.Concentration of CO will be cheaked by office, if it exceeds limit then certificate of PUC will not be allocated to that vehicle else allocated .The report of allocation or disallocation of PUC certificate will be sent PUC centre through GSM.

2.2Limitations of Existing System

1. Very poor PUC compliance and ineffective tests :

The PUC system, the only system to check emissions from on-road vehicles in India is extremely weak in terms of lax norms, poor enforcement and poor quality test procedures. New data from the Delhi.

2.Serious concern over quality of checks in PUC centres :

A detailed audit that was carried out by the Central Pollution Control

Board in 2013 in 76 PUC centres exposed serious anomalies – non-compliance with the code of practice; unavailability of calibration certificate for testing instruments in several centres; poor condition of laboratory; leak test failure; and non-functioning analysers. This clearly brings out the ineffectiveness of the programme.

3. Smoke density test under PUC cannot check particulate emissions :

The PUC systems in our country are calibrated to check vehicles for hydrocarbons and monoxide only but not other components. This means that harmful pollutants like particulate matter and nitrogen oxides (NOX), which have a grave and lasting effect on health, are not checked.

4. There is no method to remind vehicle users to renew their PUC certificate:

Chapter 3

Proposed System

3.1 Problem Statement

Vehicular pollution is becoming the major concern for the present generation. Presently, person has to drive the vehicle to the authority in order to get the vehicles pollution limit checked. However, in this busy world, it becomes quite difficult for the people to take such necessary steps. There is no uniform or regular check for the emission of the vehicles which also act as a key aspect of increasing of air pollution. Moreover, the system has poor quality test procedures almost every vehicle passes the test. Therefore, the proposed model can be used in order to maintain the proper and the regular check of the emission of vehicles.

3.2 Proposed Methodology/Techniques

The proposed system is based on two units. It has two implementation parts: First, we monitor the emission level using an Arduino controller. This is called as vehicle unit.Second, we maintain the database for taking action on the vehicle owner. This is called as server unit. To reduce the complexity of multiple units, these two methods are used.

3.2.1 Hardware Implementation:

The proposed system is based on two units. It has two implementation parts: First, we monitor the emission level using an Arduino controller. This is called as vehicle unit. Second, we maintain the database for taking action on the vehicle owner. This is called as server unit. To reduce the complexity of multiple units, these two methods are used.

1)**Node MCU**: It is an open source Iot platform. It includes firmware which runs on the ESP8266 WiFi SoC from Espressif Systems, and hardware which is predicted on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits, and built on the Espressif Non-OS SDK for ESP8266.

Fig. 3.2.1.1 Node MCU

2) **MQ135 Gas Sensor** : The Sensitive material utilized in MQ135 gas sensor is SnO2. The conductivity of this material is lesser in clean air. The sensor conductivity goes up with hike in concentration of target pollution gas. MQ135 can monitor different kinds of toxic gases such as sulfide, ammonia gas, benzene series steam and CO2. The detection range varies between 10- 10,000 ppm along with voltage rate of about 5.0V±0.1V AC or DC.

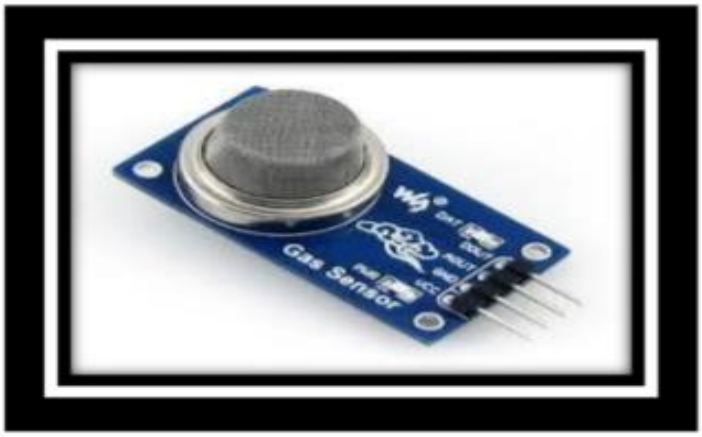


Fig.3.2.1.2 MQ135 Gas Sensor

3) **Wi-Fi Module :** The Wi-Fi Module is a self-contained SOC with integrated IP protocol stack that can give any microcontroller access to your Wi-Fi network. Wi-Fi module is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Every module comes pre-programmed with an AT command set firmware, meaning, we can simply connect to the Arduino device. The module is an extremely cost-effective board. The Wi-Fi Module is used to connect with any available internet hotspot and transfer sensor data to Thing Speak Platform via Wi-Fi. The Wi-Fi Module may be a self-contained SOC with integrated TCP/IP protocol stack which will give any microcontroller access to a Wi-Fi network

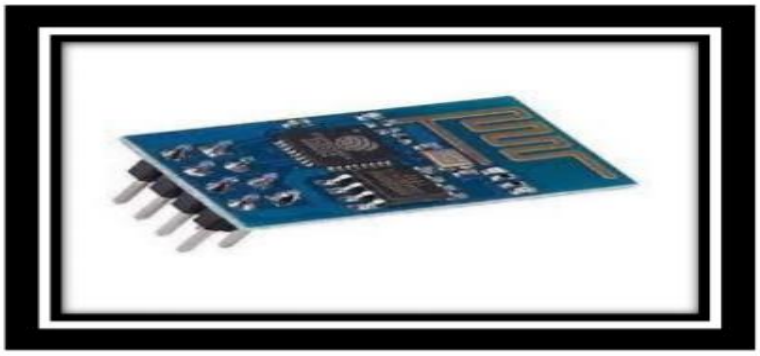


Fig.3.2.1.3 Wi-fi Module

4) **Arduino Uno** : It is the foremost flexible hardware platform used supported ATmega328P which may can be programmed consistent with the function where it is to be used. It has 6 analog inputs, 14 digital input/output pins (6 pins of these can be used as PWM outputs), a USB connection, a 16 MHz quartz crystal, SPI, serial interface, a reset button, a power jack and an ICSP header. The Arduino microcontroller isn't just for technical audience but is meant for designers and artists also due to its focus to usability supported its design which helps to achieve the intended goal.

Fig.3.2.1.4 Arduino Uno

5) **LCD Display** : LCD (Liquid Crystal Display) is an electronic display module: A 16x2 LCD display is very basic module and is very commonly used in different types of devices and circuits. These modules are advantageous and have better performance over seven segments and other multi segment LEDs. The 16X2 LCD display is employed to watch sensor values read by the Arduino board from MQ-135. It is interfaced with the Arduino UNO by connecting its data pins D4 to D7 with pins 6 down to 3 of the controllers respectively.

Fig.3.2.1.5 LCD Display

6) Buzzer: A Buzzer or beeper is an audio device. Whenever the pollution goes above the edge level the Buzzer starts beeping indicating Danger.

Fig.3.2.1.6 LCD Display

Hardware Diagram:

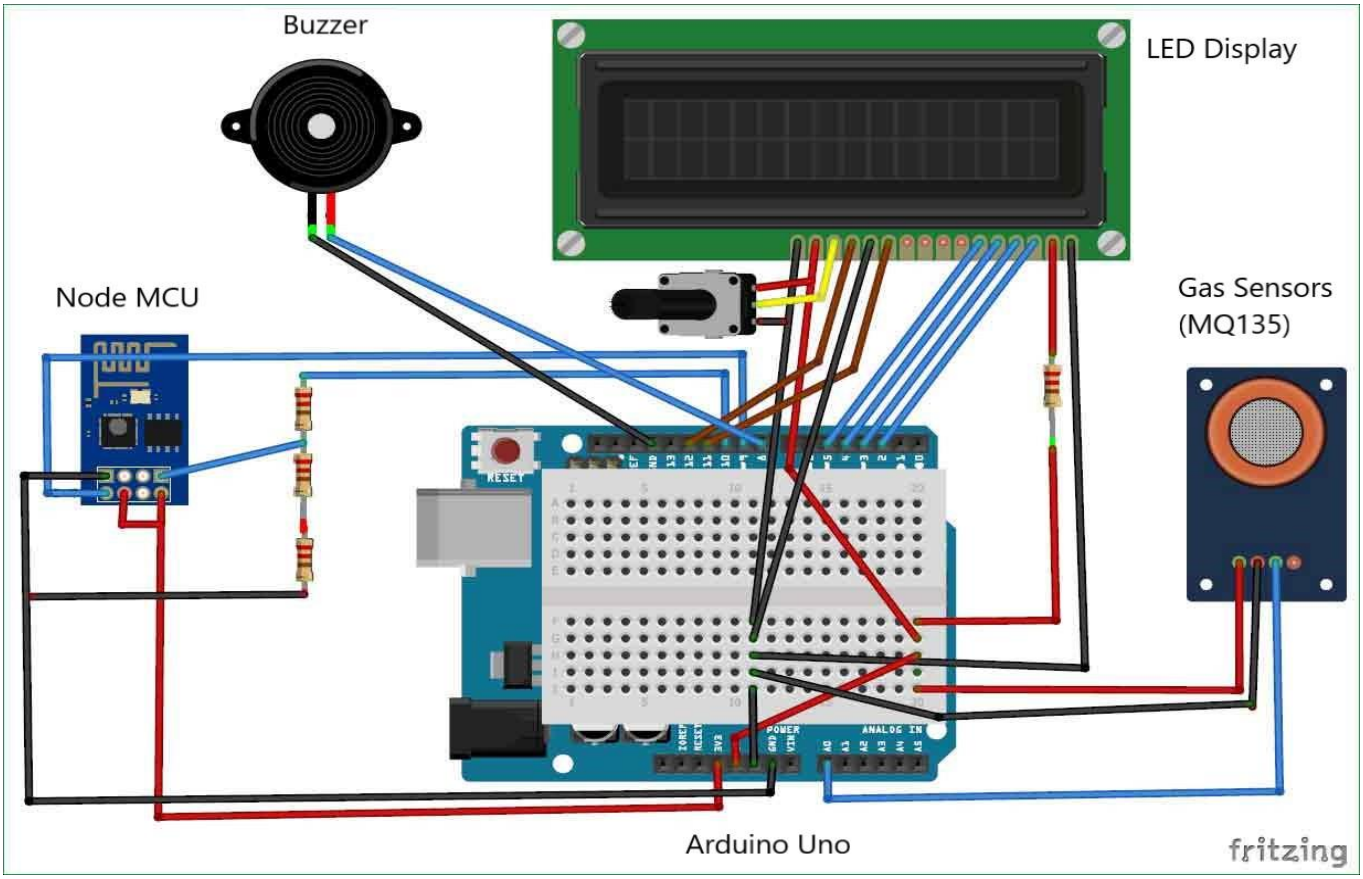


Fig.3.2.1.7 Hardware Diagram

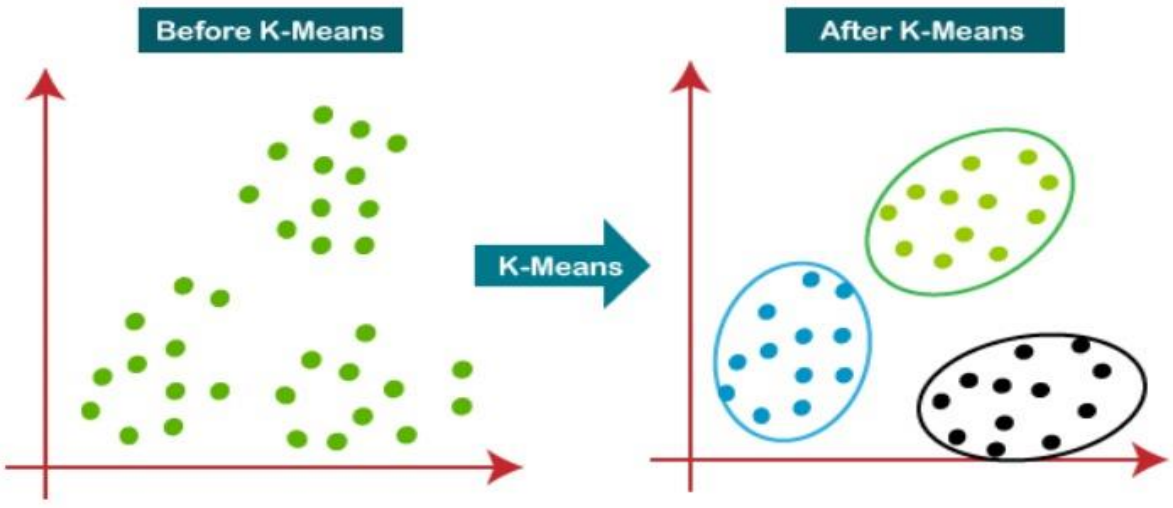
3.2.2Server Unit

The Server side unit consists of the database at the server. This database consists of data regarding pollution levels, temperature and humidity values and vehicle owner identity. The database is stored with the help of MySQL. The server will get the data from the vehicle when it crosses the threshold value of the pollution level. Then the owner has to tune the engine on the same day. If he fails to tune the engine, next day also the pollution level data will be sent to the police control room. Then, the corrective action will be taken on the vehicle owner.

Data Processing

K-means Clustering:

K-means clustering is one of the simplest and popular unsupervised machine learning algorithms. Typically, unsupervised algorithms make inferences from datasets using only input vectors without referring to known, or labelled, outcomes. A cluster refers to a collection of data points aggregated together because of certain similarities. We will define a target number k, which refers to the number of centroids you need in the dataset. A centroid is the imaginary or real location representing the center of the cluster. Every data point is allocated to each of the clusters through reducing the in-cluster sum of squares. In other words, the K-means algorithm identifies k number of centroids, and then allocates every data point to the nearest cluster, while keeping the centroids as small as possible.



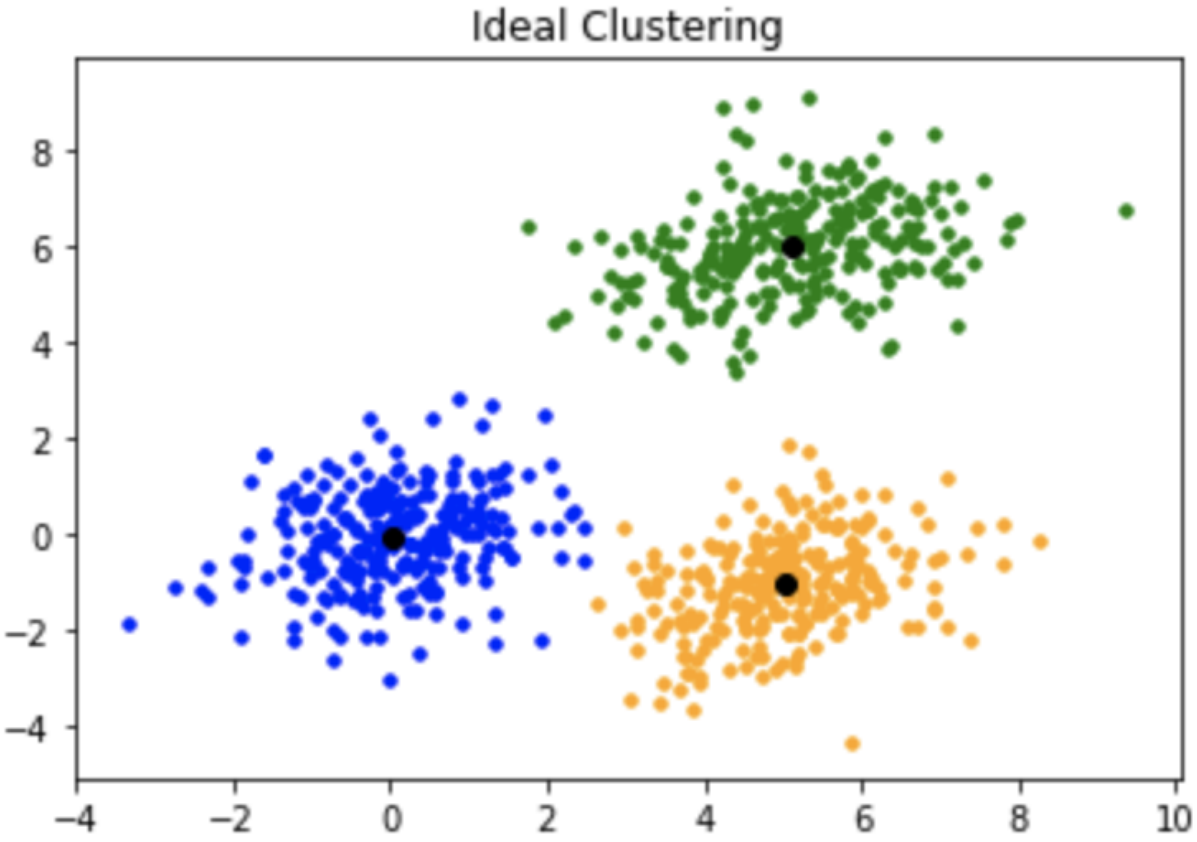
3.2.2.1 K-means Clustering

How the K-means algorithm works:

To process the learning data, the K-means algorithm in data mining starts with a first group of randomly selected centroids, which are used as the beginning points for every cluster, and then performs iterative (repetitive) calculations to optimize the positions of the centroids.

It halts creating and optimizing clusters when either.

- The centroids have stabilized there is no change in their values because the clustering has been successful.
- The defined number of iterations has been achieved



3.2.2.2 Ideal Clustering

3.3 Hardware/Software Requirement

Hardware Requirement:

- Minimum i3 processor
- 4GB RAM
- MQ135 Gas sensor
- Arduino Uno
- Node MCU (ESP8266)
- 16X2 LCD
- Breadboard
- 10K potentiometer
- 1K ohm resistors
- 220 ohm resistor
- Buzzer

Software Requirement:

- Python
- Necessary libraries(Pandas, Sklearn,etc)
- IDE (Jupyter Notebook)

3.3 Implementation Details

1. Sensor Module : Sensor module includes two sensors that are Carbon-monoxide sensor and temperature and humidity sensor for the purpose of sensing of the exhaust gases liberated from the vehicle. These sensed values are fed to the arduino controller for processing of the sensed data, where comparison is made between the sensed values and the defined threshold values the threshold, if sensed values are beyond the threshold value then the system makes the owner alert through alarm.

2. Display Module : The display module is developed to provide the user interface, where the users of the system are capable of interacting with the system either through LCD display or through different applications for the vehicle owner and for the police control room. The LCD display displays the amount of pollution level of different polluting factors that are Carbon-monoxide, temperature and humidity. The sensed data of these factors is continuously displayed on the LCD display , which is kept inside the vehicle and in front of the driver. One application is developed for the user, which displays all pollutants information; in addition to this it will also displays the status of sending SMS to ensure that the message is sent successfully. One more application is developed at the police control room that retrieves data from the database and displays only one record for a day which indicates that one day of time is given to the vehicle owner for making the tuning of the engine.

3. Alarm Module : This module requires an output device called buzzer, which generates an alarm only when the condition is satisfied with respect to the threshold value. That is, the pollution is beyond the threshold value.

4. Notification Module : This module involves informing the vehicle owner about his vehicle conditions by sending an Notification to inform him that the tuning of vehicle engine is required at that particular time, because the vehicle owner is unaware of his vehicle conditions. So providing such facilities makes vehicle owner to know the status of pollution increase through his vehicle.

Mathematical Calculations:

Here we have taken the Standard values of the gases, then we considered this standard value as 50% on a scale of 0 % to 100%.For Eg. CO_2 has Standard Value of 130 mg/Km. Therefore 130 is equivalent to 50%.That means its 50% good and 50% bad.If the value percentage exceeds 50% then

Bad in Percentage > Good in Percentage

If we have a vehicle whose CO_2 emission value is 129,then Bad in Percentage= 129/(130x2) X100

Bad in Percentage=49.615%.

Here, Good in Percentage =100-Bad in Percentage

Good in Percentage=50.385%.

Similarly , we will calculate for all other gases like NOX,HC,CO,PM and take average of all percentage of all gases.Then we will get good in percentage and bad in percentage . We can also divide the Vehicles in different groups based on good in percentage.

Chapter 4
Results and Discussion

4.1 Result and Analysis

1) Dataset for Diesel:

jupyter Vehicle pollution Last Checkpoint: 04/30/2021 (autosaved)

Logout

File Edit View Insert Cell Kernel Widgets Help

Not Trusted | Python 3

Run Code

```
In [12]: import pandas as pd

In [13]: CO_P=1000
         THC_P=100
         NOx_P=60
         CO_D=500
         HC_NOx_D=230
         NOx_D=180
         CO2=130
         PM=5

In [14]: diesel = pd.read_csv("C:/Users/mange/VehiclePollution/diesel.csv")
         diesel=diesel.drop(["Unnamed: 0"],axis=1)
         diesel.head()
```

Out[14]:

	Car_Manufacturer	Car_Model	Car_Fuel_Type	CO2_Emissions_In_Grams_Per_Km	CO_Emmisions_In_Milligrams_Per_Km	THC_Emissions_In_Milligrams_Per_Km
0	MERCEDES-BENZ	E-Class Saloon, Model Year 2011	Diesel	184	347.0	0.(
1	MERCEDES-BENZ	E-Class Saloon, Model Year 2011	Diesel	188	347.0	0.(
2	MERCEDES-BENZ	S-Class, Model Year 2011	Diesel	177	255.0	0.(
3	MERCEDES-BENZ	S-Class, Model Year 2011	Diesel	182	255.0	0.(
4	MERCEDES-BENZ	S-Class Limousine, Model Year 2011	Diesel	177	255.0	0.(

Image 4.1.1 Dataset for Diesel

In the above Image we have used pandas library and then set the limit for different gases. After that we displayed the dataset for diesel.

2) Data Calculation for Diesel:

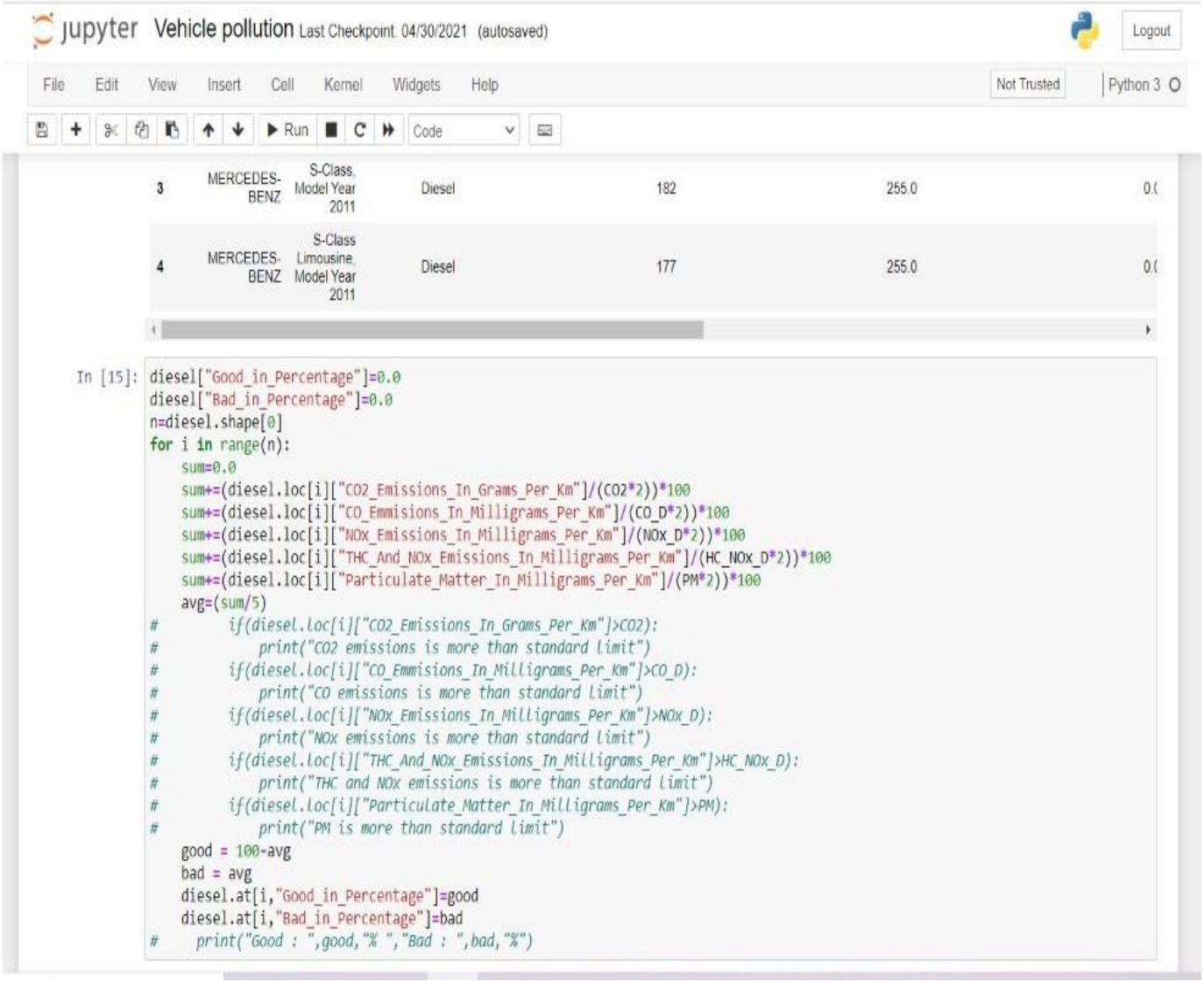


Image 4.1.2 Dataset Calculation for Diesel

In the above image we have used mathematical calculations to calculate average good in percentage and bad in percentage. We can also notify if any gas exceeds the Limit.

3) Ouput for Diesel:

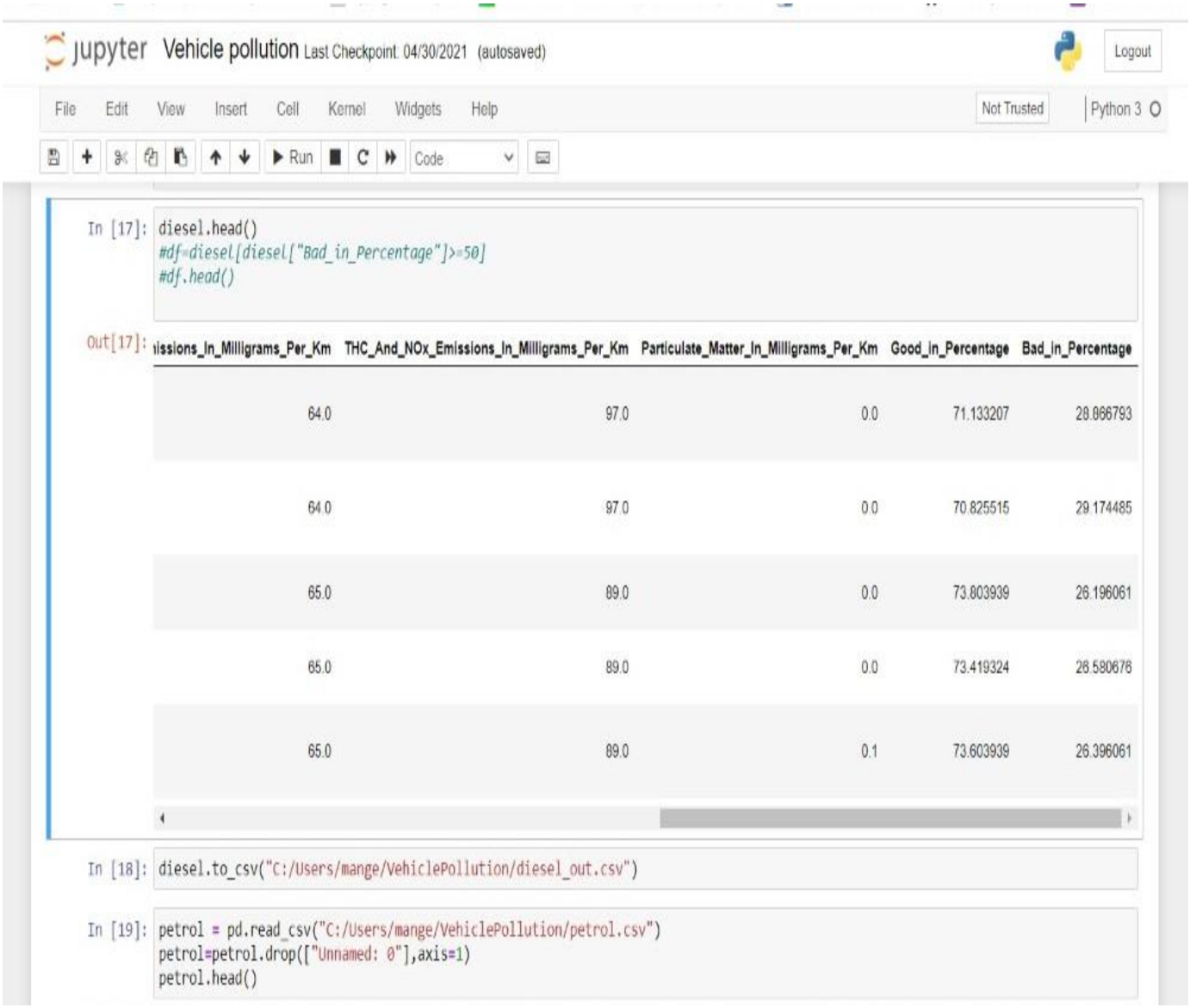


Image 4.1.3 Output for Diesel

In this we have displayed the average good in percentage and bad in percentage for Diesel.

4) Calculation for Petrol:

jupyter Vehicle pollution Last Checkpoint: 04/30/2021 (autosaved)

Logout

File Edit View Insert Cell Kernel Widgets Help

Not Trusted | Python 3

Run Code

In [20]:
```
petrol["Good_in_Percentage"]=0.0
petrol["Bad_in_Percentage"]=0.0
n=petrol.shape[0]
for i in range(n):
    sum=0.0
    sum+=(petrol.loc[i]["CO2_Emissions_In_Grams_Per_Km"]/(CO2*2))*100
    sum+=(petrol.loc[i]["CO_Emmisions_In_Milligrams_Per_Km"]/(CO_P*2))*100
    sum+=(petrol.loc[i]["NOx_Emissions_In_Milligrams_Per_Km"]/(NOx_P*2))*100
    sum+=(petrol.loc[i]["THC_Emissions_In_Milligrams_Per_Km"]/(THC_P*2))*100
    sum+=(petrol.loc[i]["Particulate_Matter_In_Milligrams_Per_Km"]/(PM*2))*100
    avg=(sum/5)
#         if(petrol.loc[i]["CO2_Emissions_In_Grams_Per_Km"]>CO2):
#             print("CO2 emissions is more than standard limit")
#         if(petrol.loc[i]["CO_Emmisions_In_Milligrams_Per_Km"]>CO_P):
#             print("CO emissions is more than standard limit")
#         if(petrol.loc[i]["NOx_Emissions_In_Milligrams_Per_Km"]>NOx_P):
#             print("NOx emissions is more than standard limit")
#         if(petrol.loc[i]["THC_Emissions_In_Milligrams_Per_Km"]>THC_P):
#             print("THC emissions is more than standard limit")
#         if(petrol.loc[i]["Particulate_Matter_In_Milligrams_Per_Km"]>PM):
#             print("PM is more than standard limit")
    good = 100-avg
    bad = avg
    petrol.at[i,"Good_in_Percentage"]=good
    petrol.at[i,"Bad_in_Percentage"]=bad
#     print("Good : ",good,"% ","Bad : ",bad,"%")
```

In [21]:
```
petrol.to_csv("C:/Users/mange/VehiclePollution/petrol_out.csv")
petrol.head()
```

Image 4.1.4 Calculation for Petrol

In the above image we have calculated average good in percentage and bad in percentage for petrol . We can also notify if any gas exceeds the Limit.

5) Ouput for Petrol:

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Run Code

```
    petrol.at[i,"Good_in_Percentage"]=good
    petrol.at[i,"Bad_in_Percentage"]=bad
#     print("Good : ",good,"% ","Bad : ",bad,"%")
```

In [21]:
```
petrol.to_csv("C:/Users/mange/VehiclePollution/petrol_out.csv")
petrol.head()
```

Out[21]:

ıissions_In_Milligrams_Per_Km	THC_And_NOx_Emissions_In_Milligrams_Per_Km	Particulate_Matter_In_Milligrams_Per_Km	Good_in_Percentage	Bad_in_Percentage
34.0	0.0	0.0	79.457949	20.542051
43.0	0.0	0.0	72.887949	27.112051
24.0	0.0	0.0	76.074615	23.925385
24.0	0.0	0.0	75.920769	24.079231
20.0	0.0	0.0	78.213590	21.786410

In [22]:
```
l=["11144","nano", "p","diesel",111,444,33,32,0,0 ]
import csv
file = open('C:/Users/mange/VehiclePollution/diesel.csv', 'a', newline='')
with file:
    writer = csv.writer(file)
    writer.writerow(l)
```

Image 4.1.5 Calculation for Petrol

In this we have displayed the average good in percentage and bad in percentage for Petrol.

6) **Data Clustering using K-mean:**

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Run Code

```
In [ ]: from sklearn.cluster import KMeans
        import pandas as pd
        from sklearn.preprocessing import MinMaxScaler
        from matplotlib import pyplot as plt
        %matplotlib inline

In [ ]: km = KMeans(n_clusters=4)
        y_predicted = km.fit_predict(petrol[['Good_in_Percentage']])
        y_predicted

In [ ]: petrol['cluster']=y_predicted
        petrol

In [ ]: km.cluster_centers_

In [23]: df1 = petrol[petrol.cluster==0]
         df2 = petrol[petrol.cluster==1]
         df3 = petrol[petrol.cluster==2]
         df4 = petrol[petrol.cluster==3]
         plt.scatter(df1.index,df1['Good_in_Percentage'],color='green')
         plt.scatter(df2.index,df2['Good_in_Percentage'],color='red')
         plt.scatter(df3.index,df3['Good_in_Percentage'],color='black')
         plt.scatter(df4.index,df4['Good_in_Percentage'],color='orange')
         #plt.scatter(km.cluster_centers_[:,0],km.cluster_centers_[:,1],km.cluster_centers_[:,2],km.cluster_centers_[:,3],color='purple',
         plt.ylabel('Good_in_Percentage')
         plt.xlabel('Index')
         plt.legend()
```

Image 4.1.6 Data Clustering using K-mean

In the above image we have used K-means algorithm for data Clustering.

7) Output using K-mean:

```
Out[19]: <matplotlib.legend.Legend at 0x29aefdc8f48>
```

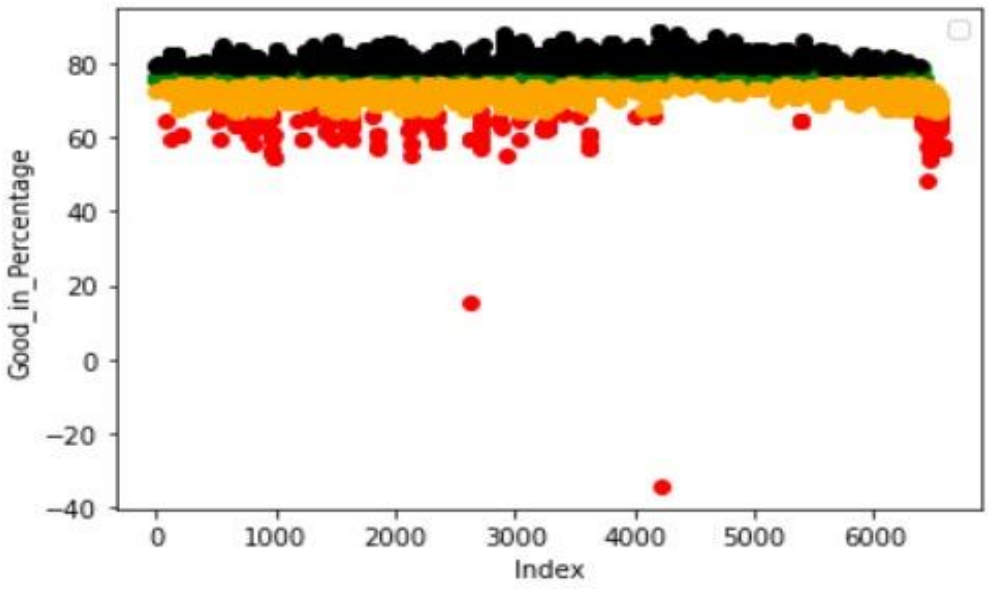

Image 4.1.7 Output using K-mean

In the above image we can see the data being clustered. We have got one exception for which good in percentage is negative.

Chapter 5
Conclusion and Further Work

5.1 Conclusion

We have analyzed the dataset of vehicle pollution, then separated the dataset into two category diesel and petrol.Researched on the standard values of pollutant gases of vehicle and calculated the percentage of each gas on the basis of standard values.Then we calculated average of percentage of each gas and added the average percentage in the data set.With the help of these percentage we can freely say that vehicle is good for environment or bad.With the help of these we can notifiy the vehicle owner.

5.2 Further Work

We will implement the hardware part for this project where we will be adding Various sensors which will help us to get the emission for gases such as NOX,CO, CO2, THC, PM. Then we will fetch this data using WIFI to our device. Then we will apply clustering algorithm to the ouput of the hardware. This will allow us to detect whether the emission from the vehicle is safe for the environment or not.

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Date: