Ignition Pollution Check

Vishal Yadav, Divyansh Khatana, Meghna Bajoria, Nallakaruppan M.K, SawarPratap Singh

Abstract: ***In an internal combustion engine, chemical reactions occur between oxygen present in air and hydrocarbon fuel. Engine works on stoichiometric air/fuel ratio when there is the correct ratio of air such that there is no excess oxygen left after combustion but in reality, the combustion process is not perfect which leads to emission of several types of pollutants. Therefore, it is important to study and gain knowledge about how much pollution is caused by these engines so that we can develop new methods for building a better environmentally friendly engine. Although, there are many other factors which cause pollution like factories, burning crackers, burning of waste material, emission of pollutants from automobiles etc yet our main focus is on pollution from cars because of the following reason-***

- ***The number of cars on roads is increasing day by day. Earlier travelling by car was considered a luxury but now it's a necessity as they are convenient to use, reduce travelling time and are comfortable. This is one of the reasons why the number of privately-owned cars has significantly increased. The price of a car is not very high these days and can easily be afforded by a man belonging to a middle-class family.***
- ***Due to drastic increase in the number of cars not only our fuel like petrol and diesel is being used in excess which has led to depletion of these resources but also utilisation of these fuels has led to emission of pollutants like carbon monoxide, carbon dioxide, smoke excess.***
- ***Level of these pollutants specially carbon dioxide CO_2 and CO has increased so much that it is unsafe in many metropolitan cities to even breathe. CO_2 in such dangerous amount can cause problems like asthma and other lung related problems.***

This paper, aims at measuring the factors related to a car that lead to main cause of pollution. Several cars running in Vellore Institute of technology, Vellore were selected for predicting the same.

I. INTRODUCTION

Cars play a major role in air pollution. This paper aims to highlight the major factors in cars that are responsible for air pollution. We have considered factors like ignition value, acceleration value, torque, distance, mileage and CO_2 produced by cars, these attributes have been grouped together to identify whether the given car is producing pollution in excess as compared to other cars. The ignition and acceleration value is the concentration of gas in a particular amount of air. We have used MQ9 sensor which detects the concentration of carbon monoxide.

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The Rs/R_0 ratio which we have calculated using the sensor along with Arduino is 9.8 in clean air. On this basis we can decide if the amount of CO emitted from the car is in excess or not. As R_S/R_O is directly proportional to COemitted therefore lower the ratio, lower the CO produced and better it is for the environment.

$$\frac{RS}{R0} \propto amount of CO emitted$$

The CO_2 produced depends on the mileage of the car. Approximately 2.62 Kg and 2.39Kg of carbon dioxide is produced by burning 1 litre of diesel and petrol respectively. Old cars may produce less carbon dioxide due to unburnt fuel present. We have recorded amount of CO_2 from cars based on their mileage. Other factors like max power, fuel type, cc engine, torque also play a role in carbon emission detection.

II. BACKGROUND

We used Arduino to measure the concentration of gas emitted from vehicles at the time of ignition and acceleration using MQ9 gas sensor. MQ9 gas sensor is used to detect concentration of carbon monoxide present. Using Arduino, we get the following dataset

Car name	Year	Car no	Ignition	Accelera	Torque	CC engin	Max pow	Fuel type	Distance	Mileage(	CO2 Produced
Nissan sunny XL	2018	TN 23 CJ 9147	30	25.23	134-200 N	1498	84.8 bhp	petrol	5	20	2.39
Etios Toyota GD	2016	TN49 BX 3047	34.35	5.36	179 Nm	1364	67 bhp	diesel	5	24	3.14
Ertika Hybrid	2019	KL 52 P 499	16.35	1.48	200 Nm	1248	89 bhp	petrol	10	22.5	5.38
Tiago XM Tata	2017	AP 03 CJ 6146	0.27	0.15	114 - 140	1199	83.8 bhp	petrol	15	25	8.96
Volks wagon Polo	2014	TN 23 BJ 9424	0.62	3.46	95- 250 N	1498	74 bhp	diesel	10	18	4.72
Ford Figo TDCI	2012	TN 23 BB 5391	5.62	2.76	215 Nm	1498	99 bhp	diesel	15	16	6.29
Alto 800	2011	TN 21 AR 8951	0.02	1.03	69Nm	796	47.5 bhp	petrol	20	25	11.95
Zest XE	2015	TN 48 AD 5548	10.3	1.67	140-190 N	1193	74 bhp	petrol	25	20	11.95
Swift desire	2018	TN 23 CX 6264	6.36	1.64	113 - 190	1248	74 bhp	diesel	20	25	13.1
Ford Figo TDCI	2011	TN 23 AM 0306	3.08	1.8	215 Nm	1498	99 bhp	diesel	25	16	10.48
Ciaz Vdit	2016	TN 09 CA 3150	4.71	1.49	200 Nm	1462	88.5 bhp	diesel	30	28	22.01
Innova 2.5G	2012	TN 07 BT 0022	1.69	2.29	200Nm	2494	100 bhp	diesel	35	10	9.17
TATA zest XMA	2015	TN 05 BC 0873	6.54	0.62	140-200 N	1248	89 bhp	petrol	30	20	14.34
Grand i10	2016	TN 23 CD 3642	1.87	3.9	90 Nm	1186	88.76 bhp	petrol	35	21.5	17.98
WagonR Lxi	2011	TN 23 AM 5402	0.035	0.67	113 Nm	998	81.80 bhp	petrol	40	21.5	20.55

III. ALGORITHM USED

In the given dataset above, we observe that we have certain strings values so we have to consider an algorithm which will provide accuracy. Hence, we use fuzzy logic i.e. grey analysis to analyse the dataset and give prediction based on the results.

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IV. PURPOSE

Since this paper tells us the factors which are most important when considering $CO_2$and CO emission, it can help the government to set a limitation on the number of such cars to be allowed on road, or set a target for car manufacturing companies so that they can take care of these factors and reduce CO_2 emission. To implement this, we have to consider the given data set and make a decision based on the ranks calculated. This analysis gives us ranks based on ignition value and CO_2 produced. Lower the rank, lower the pollution and hence better the car.

V. METHODOLOGY

This research applies grey relation analysis to find the best car i.e. the car which produces least amount of ignition value and hence causes the least pollution. The attributes are first selected, converted into quantitative values using fuzzy conversion scale. The data obtained is then pre-processed to obtain normalized values. According to these sequences a reference sequence is then defined. Then, the grey relation coefficient between all comparability sequence and the reference sequence is calculated. Finally based on these grey relation coefficients the grey relation grade between the reference sequence and every comparability sequence is calculated. If a comparability sequence translated from an alternative has the highest grey relation grade between the reference sequence and itself, then that alternative will be the best choice. Fuzzy logic is used here to convert linguistic data into crisp score.

VI. DATA VISUALIZATION

The data has been visualized on the basis of car number as very car has a unique number. Each car number is categorized into different colours. Each colour represents a car which also represents that car in graph of each attribute.

1) Selected attributes

Name: car name Type: Normal
Missing: 0(0%) Distinct: 14
Unique: 13 (87%)

No	Label	Count	Weight
1	Nissan sunny XL	1	1.0
2	Etios Toyota GD	1	1.0
3	Ertika Hybrid	1	1.0
4	Tiago XM Tata	1	1.0
5	Volks wagon Polo	1	1.0
6	Ford Figo TDCI	2	2.0
7	Alto 800	1	1.0
8	Zest XE	1	1.0
9	Swift desire	1	1.0
10	CiazVdit	1	1.0
11	Innova 2.5G	1	1.0
12	TATA zest XMA	1	1.0
13	Grand i10	1	1.0
14	WagonRLxi	1	1.0

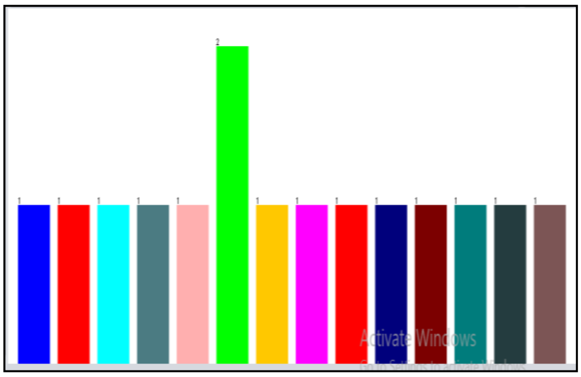

Figure 1: Data visualization with respect to car name

2) Selected attributes

Name: Year Type: Numeric
Missing: 0(0%) Distinct: 8
Unique: 3 (20%)

Statistic	Value
Minimum	2011
Maximum	2019
Mean	2014.733
StdDev	2.764

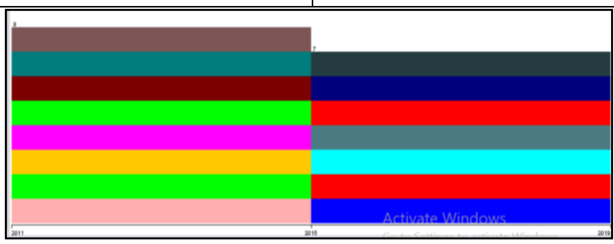

Figure 2: Data visualization with respect to year of purchase

3) Selected attributes

Name: Car number Type: Nominal
Missing: 0(0%) Distinct: 15
Unique: 15 (100%)

No	Label	Count	Weight
1	TN 23 CJ 9147	1	1.0
2	TN49 BX 3047	1	1.0
3	KL 52 P 499	1	1.0
4	AP 03 CJ 6146	1	1.0
5	TN 23 BJ 9424	1	1.0
6	TN 23 BB 5391	1	1.0
7	TN 21 AR 8951	1	1.0
8	TN 48 AD 5548	1	1.0
9	TN 23 CX 6264	1	1.0
10	TN 23 AM 0306	1	1.0
11	TN 09 CA 3150	1	1.0
12	TN 07 BT 0022	1	1.0
13	TN 05 BC 0873	1	1.0
14	TN 23 CD 3642	1	1.0
15	TN 23 AM 5402	1	1.0

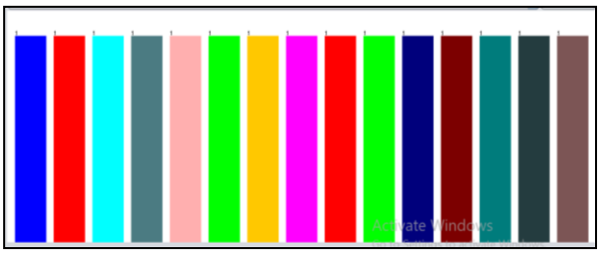

Figure 3: Data visualization with respect to car number

4) *Selected attributes*

Name: Ignition value Type: Numeric
Missing: 0(0%) Distinct: 15
Unique: 15 (100%)

Statistic	Value
Minimum	0.02
Maximum	34.35
Mean	8.121
StdDev	10.748

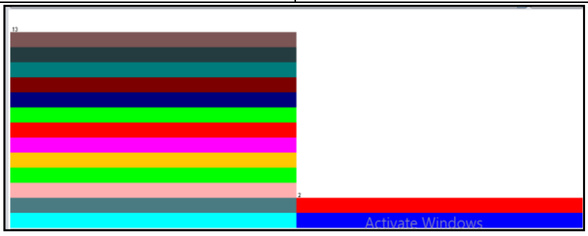

Figure 4: Data visualization with respect to ignition value

5) *Selected attributes*

Name: Accelerated value Type: Numeric
Missing: 0(0%) Distinct: 15
Unique: 15 (100%)

Statistic	Value
Minimum	0.15
Maximum	25.23
Mean	3.57
StdDev	6.148

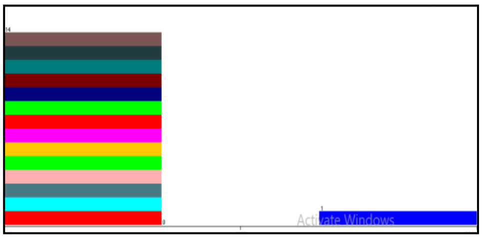

Figure 5: Data visualization with respect to accelerated value

6) *Selected attributes*

Name: Torque Type: Nominal
Missing: 0(0%) Distinct: 13
Unique: 11 (73%)

No	Label	Count	Weight
1	134-200 Nm	1	1.0
2	179 Nm	1	1.0
3	200 Nm	2	2.0
4	114 - 140 Nm	1	1.0
5	95- 250 Nm	1	1.0
6	215 Nm	2	2.0

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7	69 Nm	1	1.0
8	140-190 Nm	1	1.0
9	113 - 190 Nm	1	1.0
10	200 Nm	1	1.0
11	140-200 Nm	1	1.0
12	90 Nm	1	1.0
13	113 Nm	1	1.0

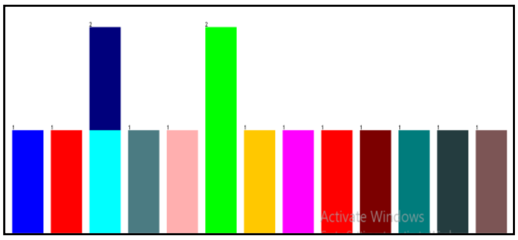

Figure 6: Data visualization with respect to torque

7) ***Name: CC engine Type: Numeric***

Missing: 0(0%) Distinct: 10 Unique: 8 (53%)

Statistic	Value
Minimum	796
Maximum	2494
Mean	1361.867
StdDev	372.574

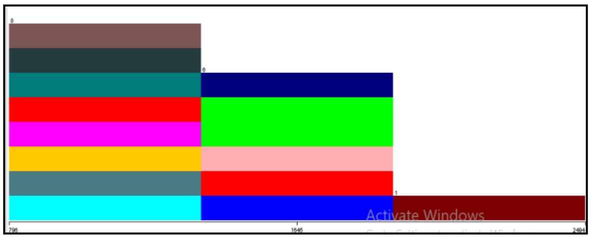

Figure 7: Data visualization with respect to CC engine

8) *Selected attributes*

Name: Max power Type: Nominal

Missing: 0(0%) Distinct: 11

Unique: 8 (53%)

No	Label	Count	Weight
1	84.8 bhp	1	1.0
2	67 bhp	1	1.0
3	89 bhp	2	2.0
4	83.8 bhp	1	1.0
5	74 bhp	3	3.0
6	99 bhp	2	2.0
7	47.5 bhp	1	1.0
8	88.5 bhp	1	1.0
9	100 bhp	1	1.0
10	88.76 bhp	1	1.0
11	81.80 bhp	1	1.0

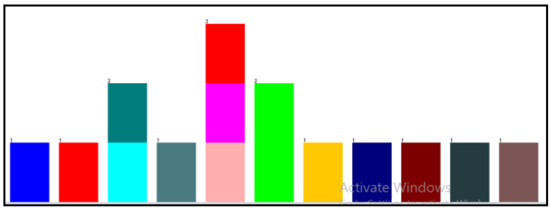

Figure 8: Data visualization with respect to Max power

9) *Selected attributes*

Name: Fuel type Type: Nominal

Missing: 0(0%) Distinct: 2

Unique: 0 (0%)

No	Label	Count	Weight
1	Petrol	8	8.0
2	Diesel	7	7.0

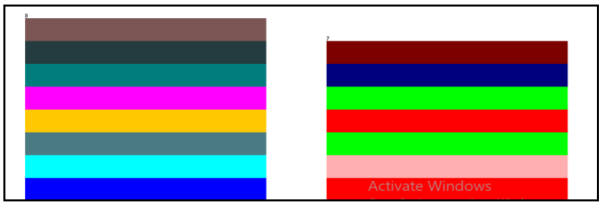

Figure 9: Data visualization with respect to Fuel type

10) *Selected attributes*

Name: Distance Type: Numeric

Missing: 0(0%) Distinct: 8

Unique: 1 (7%)

Statistic	Value
Minimum	5
Maximum	40
Mean	21.333
StdDev	11.255

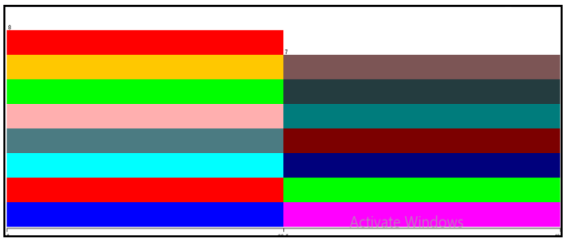

Figure 10: Data visualization with respect to distance

11) Selected attributes

Name: Mileage Type: Numeric
Missing: 0(0%) Distinct: 9
Unique: 5 (33%)

Statistic	Value
Minimum	10
Maximum	28
Mean	20.833
StdDev	4.562

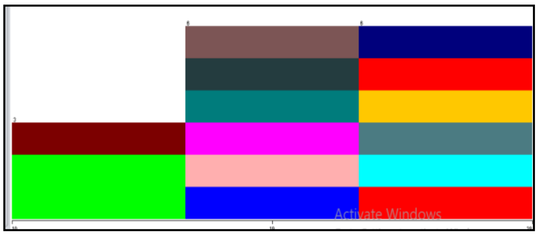

Figure 11: Data visualization with respect to mileage

12) Selected attributes

Name: CO_2 produced Type: Numeric
Missing: 0(0%) Distinct: 14
Unique:13 (87%)

Statistic	Value
Minimum	2.39
Maximum	22.01
Mean	10.827
StdDev	6.065

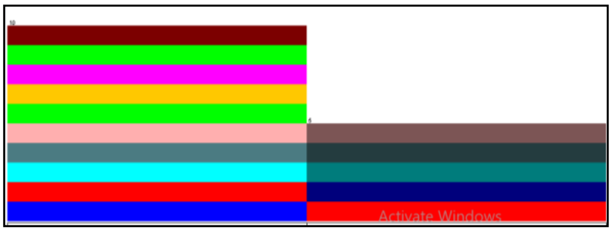

Figure 12: Data visualization with respect to c02 produced

VII. PRACTICAL IMPLEMENTATION

Step 1: We first find the maximum and minimum of each attribute using MAX formula and Min formula. Example: To calculate the maximum of ignition values we use the formula $MAX(A2{:}A16)$ and to calculate minimum for the same attribute we use the formula $MIN(A2{:}A16)$ The result for all the attributes is shown in the table below.

Step 2: Now, we decide whether we should take the minimum value or the maximum value of each attribute value. If we take the maximum value the formula is

$$\frac{Max - currentvalue}{Max - Min}$$

And the formula for the minimum value is

Ignition value	Accelerated value	CC engine	Max power	Distance	Mileage	CO_2 produced
30	25.23	1498	84.8	5	20	2.39
34.35	5.36	1364	67	5	24	3.14
16.35	1.48	1248	89	10	22.5	5.38
0.27	0.15	1199	83.8	15	25	8.96
0.62	3.46	1498	74	10	18	4.72
5.62	2.76	1498	99	15	16	6.29
0.02	1.03	796	47.5	20	25	11.95
10.3	1.67	1193	74	25	20	11.95
6.36	1.64	1248	74	20	25	13.1
3.08	1.8	1498	99	25	16	10.48
4.71	1.49	1462	88.5	30	28	22.01
1.69	2.29	2494	100	35	10	9.17
6.54	0.62	1248	89	30	20	14.34
1.87	3.9	1186	88.76	35	21.5	17.98
0.035	0.67	998	81.8	40	21.5	20.55
34.35	25.23	2494	100	40	28	22.01
0.02	0.15	796	47.5	5	10	2.39

$$\frac{Value - Min}{Max - Min}$$

We decide that for attribute

: ignition value- lower the ignition better the result

: accelerated value-higher the accelerated value better the result

: CC engine-higher the cc better the result

:Max power- higher max power, better the result

:Distance- higher the distance, better the result

: Mileage(km/l)-higher the mileage , better the result

: co2 produces-lower the co2 produced, better the result

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The table for the scenario is shown below

Ignition value	Accelerated value	CC engine	Max power	distance	Milage(km/l)	Co2 produced
0.126711	1	0.413428	0.710476	0	0.555556	1
0	0.207735	0.334511	0.371429	0	0.777778	0.961774
0.524323	0.05303	0.266196	0.790476	0.142857	0.694444	0.847604
0.992718	0	0.237338	0.691429	0.285714	0.833333	0.665138
0.982523	0.131978	0.413428	0.504762	0.142857	0.444444	0.881244
0.836877	0.104067	0.413428	0.980952	0.285714	0.333333	0.801223
1	0.035088	0	0	0.428571	0.833333	0.512742
0.700553	0.060606	0.233804	0.504762	0.571429	0.555556	0.512742
0.815322	0.05941	0.266196	0.504762	0.428571	0.833333	0.454128
0.910865	0.065789	0.413428	0.980952	0.571429	0.333333	0.587666
0.863385	0.053429	0.392226	0.780952	0.714286	1	0
0.951355	0.085327	1	1	0.857143	0	0.654434
0.810079	0.01874	0.266196	0.790476	0.714286	0.555556	0.390928
0.946111	0.149522	0.229682	0.785905	0.857143	0.638889	0.205403
0.999563	0.020734	0.118963	0.653333	1	0.638889	0.074414
1	1	1	1	1	1	1
0	0	0	0	0	0	0

0.36409	1	0.460163	0.633293	0.333333	0.529412	1	0.617184	2
0.333333	0.386918	0.429005	0.443038	0.333333	0.692308	0.928977	0.506702	13
0.512465	0.34555	0.405251	0.704698	0.368421	0.62069	0.766406	0.531926	11
0.985645	0.333333	0.395989	0.618375	0.411765	0.75	0.598901	0.584858	6
0.966226	0.365491	0.460163	0.502392	0.368421	0.473684	0.808072	0.563493	7
0.754008	0.358183	0.460163	0.963303	0.411765	0.428571	0.715536	0.584504	6
1	0.341317	0.333333	0.333333	0.466667	0.75	0.506453	0.533015	7
0.625433	0.347368	0.394884	0.502392	0.538462	0.529412	0.506453	0.492058	8
0.73027	0.34708	0.405251	0.502392	0.466667	0.75	0.47807	0.525676	7
0.848702	0.348624	0.460163	0.963303	0.538462	0.428571	0.548045	0.590838	4
0.785404	0.345645	0.451356	0.695364	0.636364	1	0.333333	0.606781	2
0.911335	0.353439	1	1	0.777778	0.333333	0.59132	0.709601	1
0.72472	0.33755	0.405251	0.704698	0.636364	0.529412	0.450827	0.54126	3
0.902708	0.370239	0.393602	0.700187	0.777778	0.580645	0.38622	0.58734	2
0.999127	0.338005	0.362047	0.590551	1	0.580645	0.350733	0.603015	1

This table is known as normalized matrix. The value of ΔMAX=1 and ΔMIN=1 always

Step 3: We calculate the deviation sequence in step 3 using the below formulas

$$\Delta MAX - Currentvalue$$

And to calculate the maximum and minimum of each attribute. The maximum value will always be 1 and the minimum value will always be 0.

Step 4: This is the final table showing grey relation coefficient. Let θ=0.5 then we use the formula

$$\frac{0.5}{currentvalue + 0.5}$$

The grey relation coefficient can be calculated as

$$\zeta_j(k)=\frac{\Delta\min+\zeta\Delta\max}{\Delta oi(k)+\zeta\Delta\max}$$

Now, we find the rank on the basis if which we deicide the car which produces the least CO2, whenever the new data comes it is classififed under these ranks and decision is taken that it is harmful or not.

VIII. Result

Following all the above steps, we get the rank of each car. The lowest rank represents the car.

Here car Wagon R Lxi and Innova 2.5G have rank 1 which have ignition value, acceleration value as 0.035,20.55 and 1.69,9.17 respectively. Car Etios Toyota GD has rank 13 which have ignition value, acceleration value as 34.35, 3.14. this result shows that how different factaor are compared based on different ignition values , CO_2 and so on to give the ranking of the best car which is best among them.

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IX. WHY GREY RELATION?

In our dataset decision tree cannot be applied because we cannot choose any root node as all our attributes are different from each other.

Also random forest cannot be used because the error is high, which is calculated using weka.

But when fuzzy grey relation is applied regression between each attributes is found we obtain 100% accuracy, so we choose grey relation for prediction.

Summary:

- Correlation coefficient 1
- Mean absolute error 0
- Root mean squared error 0
- Relative absolute error 0
- Root relative squared error 0
- Total number of Instances 15

X. EDITORIAL POLICY

The submitting author is responsible for obtaining agreement of all coauthors and any consent required from sponsors before submitting a paper. It is the obligation of the authors to cite relevant prior work.

Car name	Ignition value	CO2 Produced	Rank
Nissan sunny XL	30	2.39	15
Etios Toyota GD	34.35	3.14	14
Ertika Hybrid	16.35	5.38	12
Tiago XM Tata	0.27	8.96	10
Volks wagon Polo	0.62	4.72	11
Ford Figo TDCI	5.62	6.29	10
Alto 800	0.02	11.95	6
Zest XE	10.3	11.95	6
Swift desire	6.36	13.1	5
Ford Figo TDCI	3.08	10.48	5
CiazVdit	4.71	22.01	1
Innova 2.5G	1.69	9.17	4
TATA zest XMA	6.54	14.34	3
Grand i10	1.87	17.98	2
WagonRLxi	0.035	20.55	1

Authors of rejected papers may revise and resubmit them to the journal again.

XI. PUBLICATION PRINCIPLES

The contents of the journal are peer-reviewed and archival. The journal INTERNATIONAL JOURNAL OF ENGINEERING AND ADVANCED TECHNOLOGY (IJEAT) publishes scholarly articles of archival value as well as tutorial expositions and critical reviews of classical subjects and topics of current interest.

Authors should consider the following points:

1) Technical papers submitted for publication must advance the state of knowledge and must cite relevant prior work.
2) The length of a submitted paper should be commensurate with the importance, or appropriate to the complexity, of the work. For example, an obvious extension of previously published work might not be appropriate for publication or might be adequately treated in just a few pages.
3) Authors must convince both peer reviewers and the editors of the scientific and technical merit of a paper; the standards of proof are higher when extraordinary or unexpected results are reported.

Because replication is required for scientific progress, papers submitted for publication must provide sufficient information to allow readers to perform similar experiments or calculations and use the reported results. Although not everything need be disclosed, a paper must contain new, useable, and fully described information. For example, a specimen's chemical composition need not be reported if the main purpose of a paper is to introduce a new measurement technique. Authors should expect to be challenged by reviewers if the results are not supported by adequate data and critical details.

XII. CONCLUSION

In this paper we have collected ignition and CO2 values of different cars to detect the pollution level caused by them. We have done comparative study between different cars and proposed a fuzzy algorithm that distributes the data on the basis of rank. The grey analysis that we have applied here is a fuzzy algorithm that defines the grades for each row using which we can calculate the ranks. The steps mentioned above describes that how to find the grades and rank. Using data visualisation we have removed the attributes which are not suitable for including in the final dataset which has beenused for prediction like car name, car number and type of fuel.

From our result we concluded that lower the rank, better the car. Ignition value and amount of CO2 produced are two most important factors in deciding whether the car produces excess pollution or not. In our dataset we are dealing with 15 cars instances that have different ignition and CO2 values among which the first rank is of that car which has lowest ignition value but highest CO2 values. The rank is given on the basis of gradient which is decided on the basis of maximum and minimum values of the given attribute. On the basis of this result we can decide which cars gives excess pollution. Using this data the car manufacturing companies can try to take care of the factors which lead to increase in emission of pollutants from cars

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