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Machine Learning Based Vehicle Performance Analyzer

Documentation

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1. INTRODUCTION

1.1 Project Overview

The automotive industry is extremely competitive. With increasing fuel prices and picky consumers. Automobile makers are constantly optimizing their processes to increase fuel efficiency. So, we can help the predicting processor done easier by developing the application.

1.2 Purpose

The purpose of this project is to give the customer a portal to predict the performance of the vehicle (miles per gallon). Now a days fuel prices are increasing and automobile industries try to optimize the vehicle for running them using less fuel. This application helps them to predict the performance of the vehicle.

2. LITERATURE SURVEY

2.1 Existing Problem

It is hard to predict the performance of the vehicle. It takes us a lot of time and hard work to predict the performance. if the vehicle designing engineer able to predict the performance of vehicle with less amount of the time, It make the Engineer design and testing process easier for them.

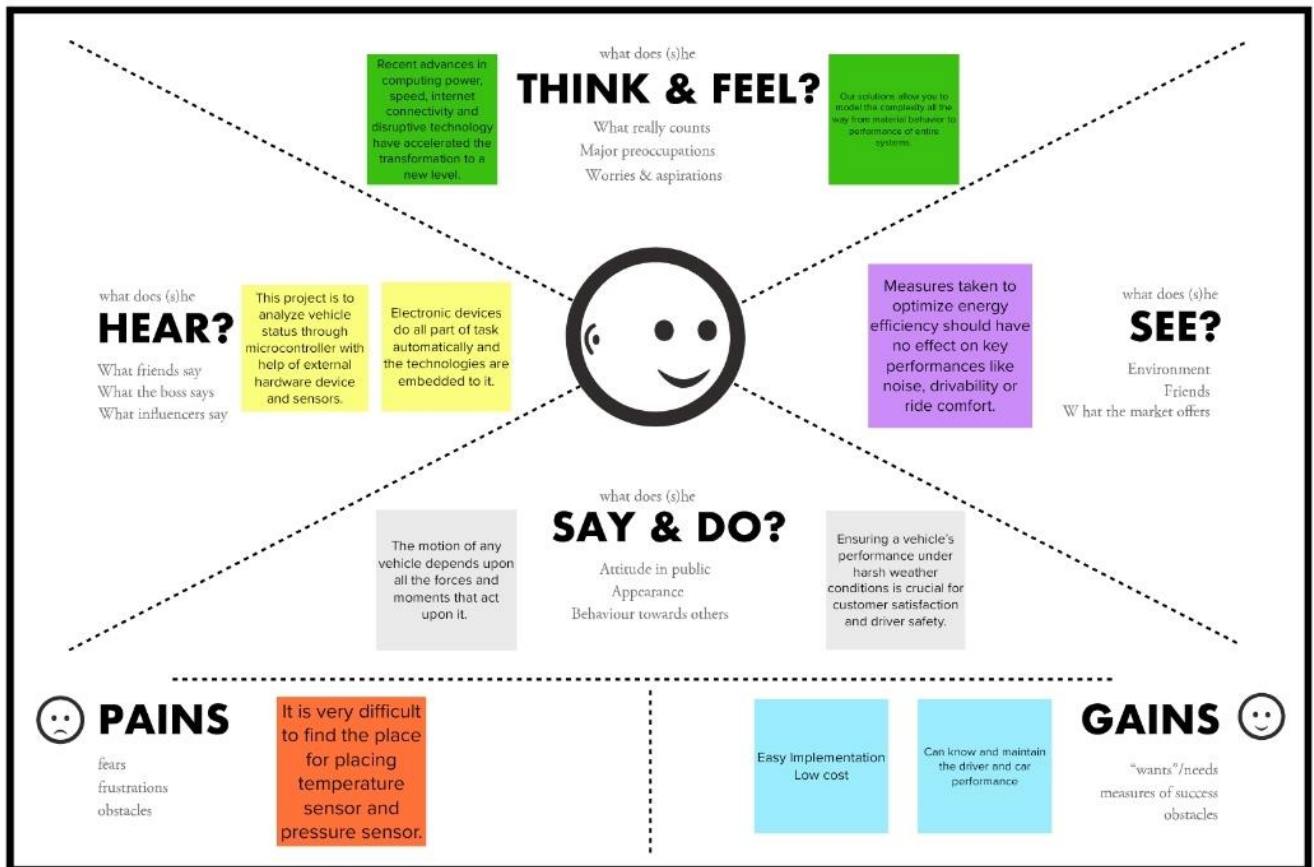
2.2 References

https://www.researchgate.net/publication/273951090_Simulation_for_prediction_of_vehicle_efficiency_performance_range_and_lifetime_A_review_of_current_techniques_and_their_applicability_to_current_and_future_testing_standards

<https://www.etssolution-asia.com/blog/vehicle-performance-engineering>

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2) Ideation & Brainstorming

Template



Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

- 10 minutes to prepare
- 1 hour to collaborate
- 2-8 people recommended

[Share template feedback](#)



Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes



Team gathering

Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.



Set the goal

Think about the problem you'll be focusing on solving at the brainstorming session.



Learn how to use the facilitation tools

Use the Facilitation Superpower to run a happy and productive session.

[Open article](#)



Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes



research

To determine Factors, such as terrain, temperature, weather, the length and amount of time between and last all about the performance of a vehicle over time.



Key rules of brainstorming

To run an smooth and productive session

 Stay on topic.	 Encourage wild ideas.
 Defer judgment.	 Listen to others.
 Go for volume.	 If possible, be visual.



Need some inspiration?

See a full-sized version of this template in action your next.

[Open example](#)

5

2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

SABAREES V

- The main goal of current study is to predict the performance
- The data helps to improve certain behavior of vehicle
- The analysis based on engine type and horsepower etc.,
- The performance objectives like mileage, feasibility and cost.

SANTHOSH T

- Analysis depends on the driving distance
- Performance varies with power of vehicle
- The braking performance want to be checked frequently
- Keep checking on tyre alignment for safety

SANTHOSH KUMAR G

- Design of the body must incorporate standards of safety
- Requirements for pollution controls to be included
- Vehicle to be flexible to perform in every situation
- To increase the performance structure and weight to be good

SANTHOSH KUMAR S

- The fuel consumption plays the major role in performance
- Including and checking the conditions of the Air bag
- Attributes includes mainly with integrated safety
- The steering working plays major role in performance

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you can break it up into smaller sub-groups.

20 minutes

General Checkings

The conditions of tyre and engine conditions

The general conditions like fuel and air checkings

Safety Precautions

Checking conditions of Airbags and other safety gears

The braking and steering conditions checking frequently



4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes



+

After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

- Share the mural**
Share a view link to the mural with stakeholders to keep them in the loop about the outcomes of the session.
- Export the mural**
Export a copy of the mural as a PNG or PDF to attach to emails, include in slides, or save in your drive.

Keep moving forward

- Strategy blueprint**
Define the components of a new idea or strategy.
[Open the template](#)
- Customer experience journey map**
Understand customer needs, emotions, and obstacles for an experience.
[Open the template](#)
- Strengths, weaknesses, opportunities & threats**
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.
[Open the template](#)

[Share template feedback](#)

3.3 Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To determine Factors such as terrain, temperature, weather, trip length and environment, driving behaviour and load all affect the performance of a vehicle over time.
2.	Idea / Solution description	The main goal of current study is to predict the performance and the data helps to improve certain behaviour of vehicle.
3.	Novelty / Uniqueness	Factors such as terrain, temperature, weather, trip length and environment, driving behaviour and load all affect the performance of a vehicle over time
4.	Social Impact / Customer Satisfaction	To identify how the reasons which are influencing customer satisfaction. (Reasons: Features, Performance, Maintenance Cost, Mileage, Aesthetics).
5.	Business Model (Revenue Model)	Performance Analyzer integrates, cleanses, harmonizes, and models revenue management data to highlight insights and unlock profitable growth.
6.	Scalability of the Solution	solutions to optimize safety and performance linked to ADAS by validating resulting behaviour when integrating active and passive safety systems.

3.4 Proposed Solution fit

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) <p>Growing your business in any industry requires you to know your customer. You can examine many different areas to become more familiar with those who are likely to frequent your business. Most companies implement marketing campaigns to a target market based on a set of criteria or consumer segments.</p>	6. CUSTOMER CONSTRAINTS <p>The objective of constraint-based supply planning is to derive an optimal time-phased replenishment plan for all item/locations that achieves desired customer service while respecting inventory policies and real-world constraints at all echelons of the supply chain.</p>	5. AVAILABLE SOLUTIONS <p>With the increasing availability and complexity of active safety systems, the mutual interaction between these systems and their interaction with the passive safety systems poses a significant challenge to find the right balance between these to maximize real world safety performance.</p>	Explore AS, differentiate
	2. JOBS-TO-BE-DONE / PROBLEM <p>To determine Factors such as terrain, temperature, weather, trip length and environment, driving behavior and load all affect the performance of a vehicle over time</p>	9. PROBLEM ROOT CAUSE <p>The general conditions like fuel and air checking. The braking performance want to be check frequently</p>	7. BEHAVIOUR <p>Simcenter helps you to use complexity as a competitive advantage. Our solutions allow you to model the complexity all the way from material behavior to performance of entire systems. This includes coverage for a broad range of physics including structures, flow, electromagnetics, motion, thermal and much more.</p>	
	Focus on J&P, tap into BE, understand RC			

Identify strong TR & EM	3. TRIGGERS <p>The performance of a vehicle can be evaluated using following indicators: the maximal speed that can be reached, the accelerating time from zero to a certain speed, the maximal climbing angle, the mileage in a certain condition and the hydrogen consumption in a specific cycle</p>	10. YOUR SOLUTION <p>Requirements for pollution controls to be included. Attributes includes mainly with integrated safety, including and checking the conditions of the Air bag.</p>	8. CHANNELS of BEHAVIOUR <p>8.1 ONLINE: It states estimation methods based on the battery ECM concept can accurately predict the state of the battery under different operating conditions</p> <p>8.2 OFFLINE: An offline evaluation approach based MCPE to maintain tradeoff between sorting reliability and simplicity.</p>	Extract online & offline CH of BE
	4. EMOTIONS: <p>BEFORE: Students seek help from the education consultancy firms to help them successfully secure the admission in the universities. AFTER: Students can use the system to secure the admission in the universities which are best suitable for their profiles</p>			

4.REQUIREMENT ANALYSIS

4.1Functional requirement

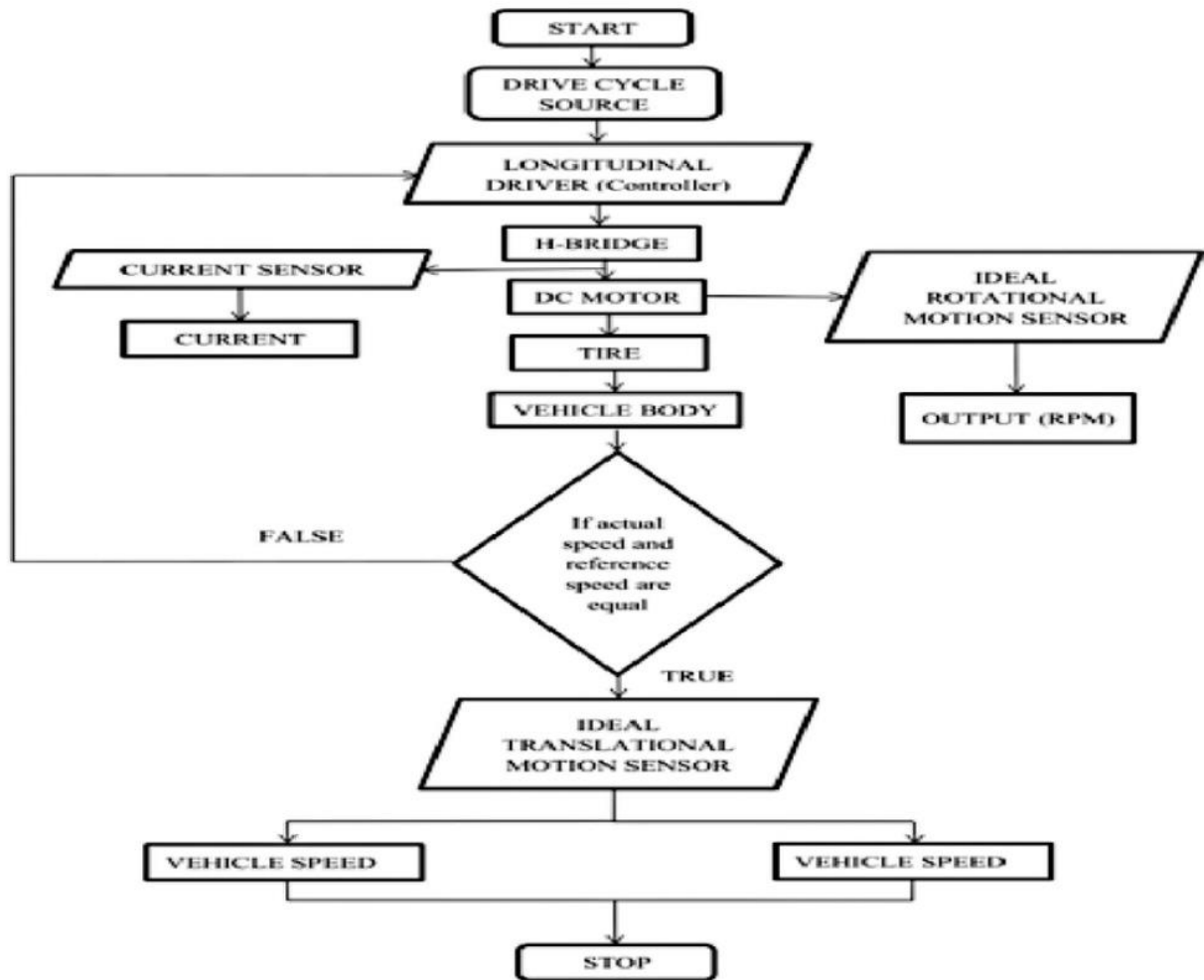
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Google O-Auth
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Vehicle Data Collection	User input through a Form Sending the data to the server
FR-4	Query Processing	Predict the expected mileage using the ML model Look for newer cars that are like the current model.
FR-5	Report Generation	Show the expected mileage, graph the expected mileage throughout time. Suggest similar car models from the database.

4.2 Non-Functional Requirements

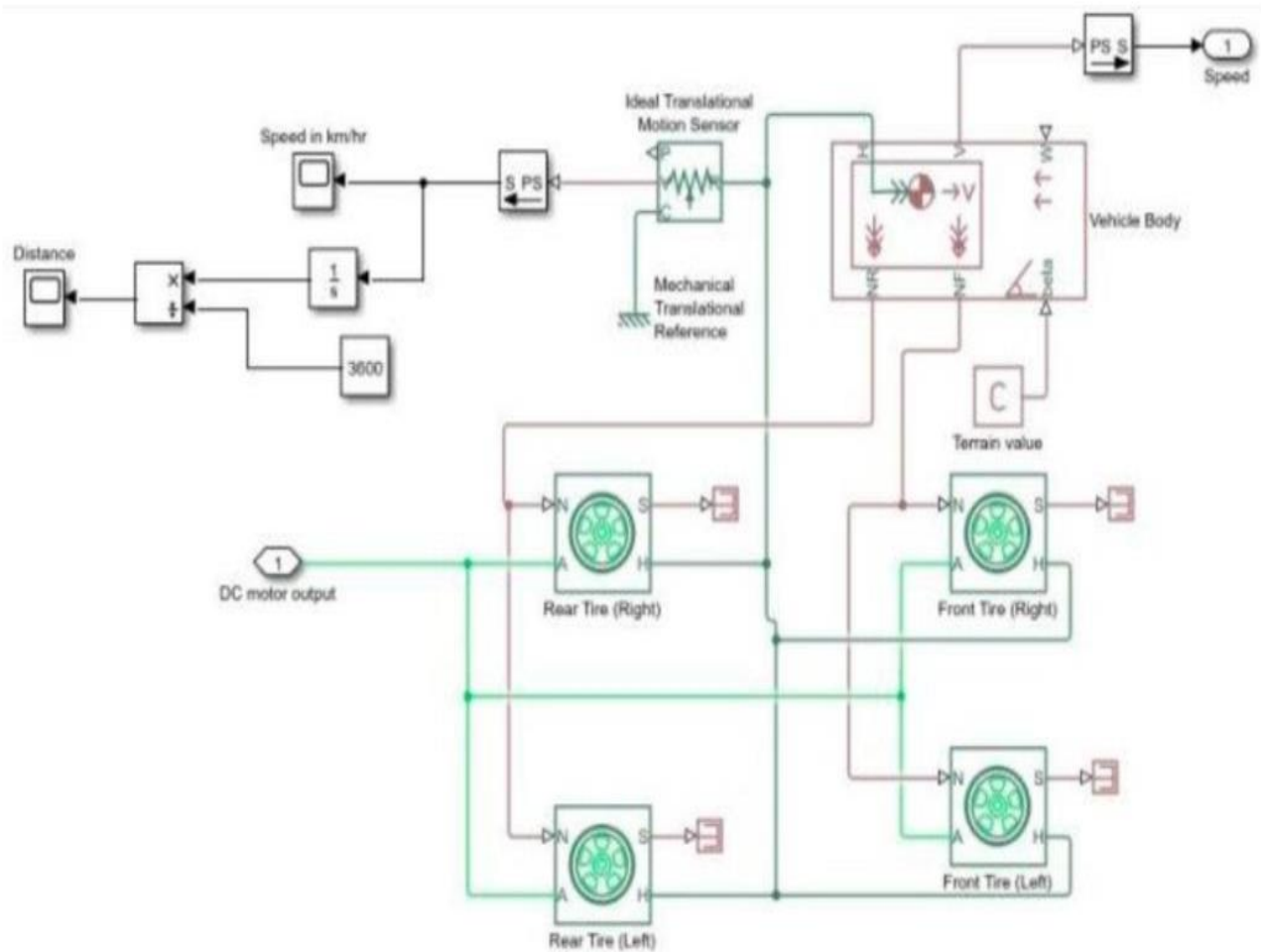
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	This application does not require any new specialized hardware to collect data. It tries to estimate mileage through data that the user can collect manually.
NFR-2	Security	Protected against all forms of web-based threats including but not limited to the OWASP Top 10 vulnerabilities, ensuring Confidentiality, Integrity, and Availability (CIA Triad).
NFR-3	Reliability	The application will give near perfect predictions regarding the efficiency and the remaining life span of the car and it will be devised such that the false positives will not affect the users badly in any way.
NFR-4	Performance	This application can support a reasonably large number of users accessing the services
NFR-5	Availability	Ensuring that the application would be available to all the users at all the time, minimizing the downtime of the services.
NFR-6	Scalability	This application can be extended for all the vehicles, not only for cars.

5.PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture



5.3 User Stories (yet to change)

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer	Visiting Webpage	USN-1	As a user, I can able to view the website using the good domain name	I can access the website	High	Sprint-4
	Design	USN-2	As a user, I can able to Enter the data	I can submit the data to the server to preict	High	Sprint-1
	Result	USN-3	As a user I can get the predicted performance	I get the MPG value	High	Sprint 3
	Design	USN-4	Good experience and less time consuming	I get user friendly UI	Low	Sprint 4
	Result	USN-5	Website is fast	I get result faster	Low	Sprint 4
	Result	USN-6	As a user I expect the prediction is highly accurate	High value	Medium	Sprint 3

6.PROJECT PLANNING &SCHEDULING

6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Download the dataset.	20	High	SABAREES, SANTHOSH T
Sprint-2	Data Pre-processing	USN-2	Import libraries and read the dataset	4	Medium	SANTHOSH T, SANTHOSH S
Sprint-2		USN-3	Handle the missing value and label the encoding	4	Medium	SANTHOSH G, SANTHOSH S
Sprint-2		USN-4	Split the dataset into train and test data	6	Medium	SANTHOSH T, SANTHOSH G
Sprint-3	Model Building	USN-5	Train the datasets to run smoothly and see an incremental improvement in the prediction rate for the available Machine Learning algorithms.	5	Low	SANTHOSH S,SABAREES
Sprint-3		USN-6	Build The Model with The Decision Tree Algorithm	6	Low	SANTHOSH G,SABAREES
Sprint-4	Application Building	USN-7	Build Python Code	5	Low	SANTHOSH S, SANTHOSH T
Sprint-4		USN-8	Output	5	Low	SANTHOSH G,SABAREES

6.2 Sprint Delivery Schedule

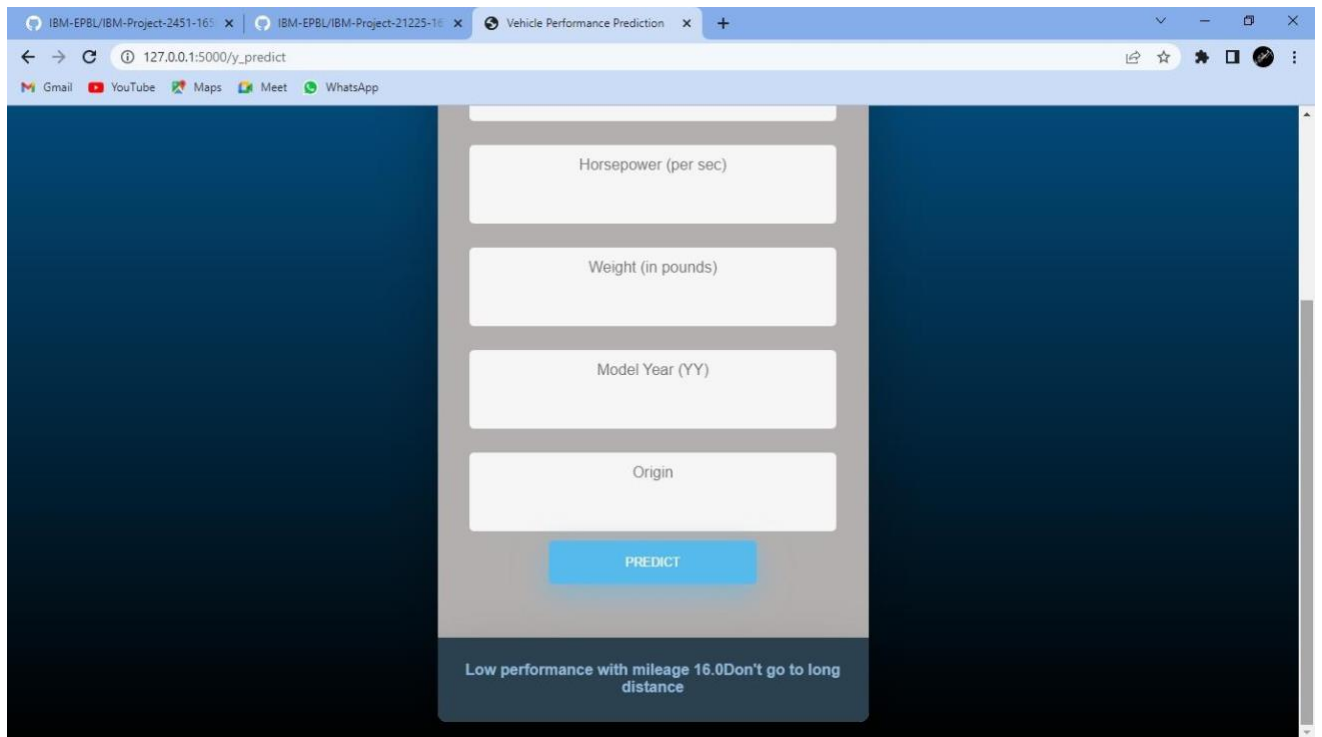
Sprint	Total Story points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on planned End Date)	Sprint Release Date (Actual)
Sprint-I	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

7.CODING & SOLUTION

7.1 GUI.

Created A GUI based interface for the easy utilization for the customer using HTML,CSS and Python

Output:



7.2 MODEL

Implantation of the model integrated with HTML and CSS in Appendix .

8 TESTING.

Input dataset:

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[ -0.76894131, -0.93625912, -0.93005317, -1.14421345, 1.92415451,
-1.15123272, -0.75260027],
[ 0.43724114, -0.23379038, 0.77015285, 0.57421047, 0.09810177,
0.62967978, 0.47613487],
[ 1.64342359, 0.71259112, 0.14944271, 1.34189126, 1.34137172,
0.37526371, -0.75260027],
[ 1.64342359, 1.27846872, 1.2289386 , 1.81076706, -0.79549851,
-0.38798451, -0.75260027],
[ -0.76894131, -0.69234636, -0.79511619, -0.90446084, -0.01845479,
-0.64240058, 0.47613487],
[ 0.43724114, 0.1272005 , -0.39030523, -0.05764987, 0.564328 ,
-0.38798451, -0.75260027],
[ -0.76894131, -0.30208595, 0.01450573, -0.14622843, -0.44582883,
1.13851192, -0.75260027],
[ -0.76894131, -0.6338073 , -0.49825482, -0.62455261, 0.17580614,
-0.89681665, -0.75260027],
[ -0.76894131, -0.70210287, -0.25536825, -0.27141945, -0.21271572,
-0.13356844, 0.47613487],
[ 1.64342359, 1.12236455, 0.95906463, 1.4375561 , -0.60123758,
-0.38798451, -0.75260027]]
```

Predicted Output:

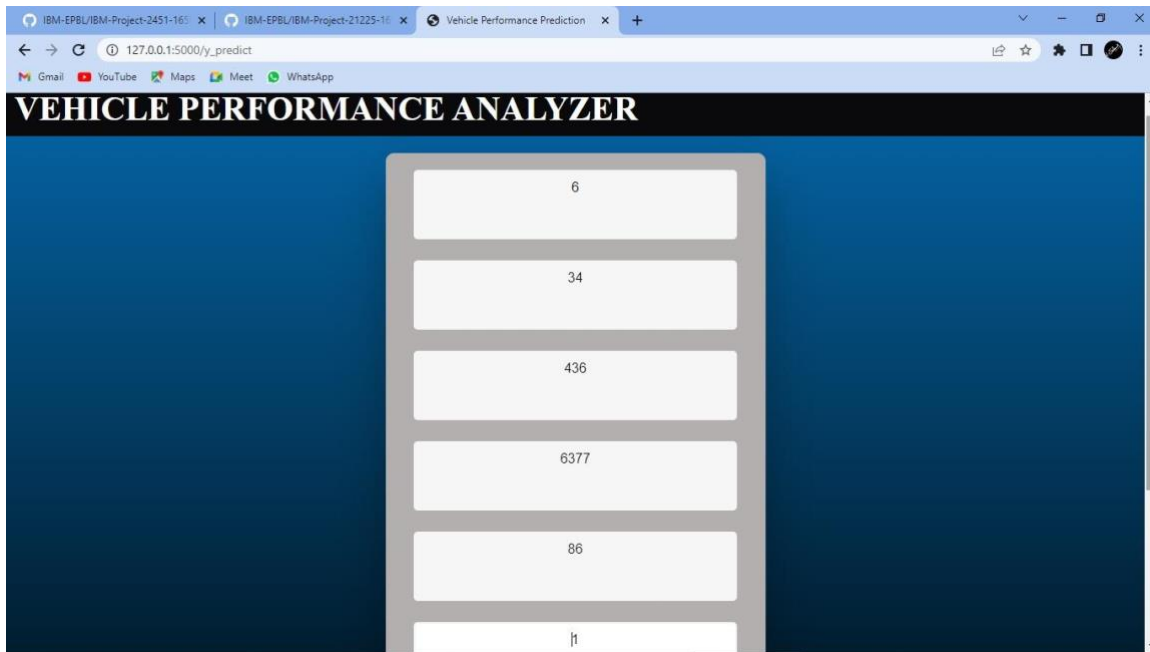
```
In [129]: y_pred = rf.predict(x_test)
```

```
In [130]: y_pred
```

```
Out[130]: array([[15.95333333, 38.0 , 31.13333333, 27.21333333, 15.04666667,
14.01666667, 32.60333333, 26.1 , 24.59666667, 14.36666667,
35.80333333, 19.54666667, 24.75333333, 18.00 , 28.08333333,
15. , 33.05 , 37.68333333, 18.44666667, 23.15333333,
17.1 , 18.73 , 29.83666667, 28.93333333, 26.99666667,
26.12666667, 34.61 , 26.51333333, 35.71066667, 23.57666667,
15.50666667, 34.23333333, 14.46333333, 13.65 , 23.53333333,
13.15 , 34.19666667, 11.7 , 33.33666667, 20.40333333,
28.61333333, 29.40333333, 37.87 , 11.10666667, 20.58666667,
21.13 , 31.33666667, 19.14 , 18.07333333, 17.82666667,
18.26666667, 17.97666667, 25.73 , 27.51333333, 25.50666667,
14.08333333, 26.15666667, 25.04666667, 19.56666667, 20.40333333,
21.79333333, 25.53 , 13.96666667, 13.4 , 27.88 ,
23.11666667, 20.21666667, 15.81333333, 30.93333333, 36.49333333,
24.40333333, 21.46666667, 19.47 , 31.60666667, 14.93333333,
14.61666667, 28.9 , 22.06 , 13.5 , 17.49 ]])
```

8.2 User Accepting Testing.

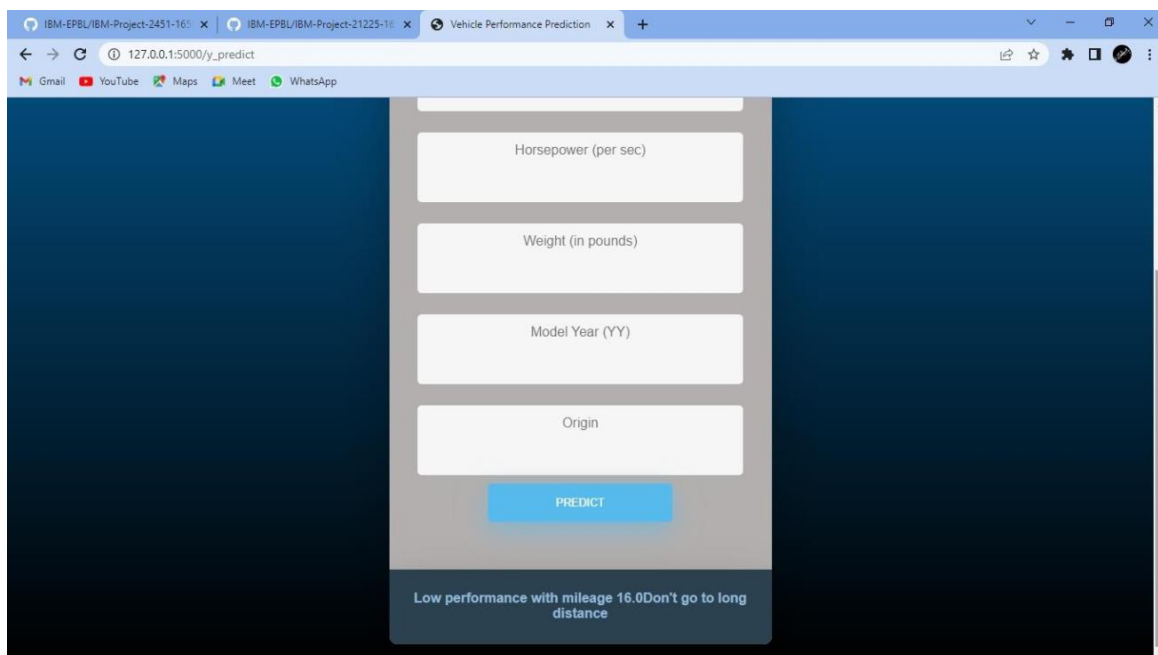
INPUT:



A screenshot of a web browser displaying the 'VEHICLE PERFORMANCE ANALYZER' application. The browser has three tabs: 'IBM-EPBL/IBM-Project-2451-16', 'IBM-EPBL/IBM-Project-21225-16', and 'Vehicle Performance Prediction'. The address bar shows '127.0.0.1:5000/y_predict'. The application interface has a dark blue background with a central light gray panel containing six white input fields. The values entered in the fields are 6, 34, 436, 6377, 86, and 11. The browser's top bar includes icons for Gmail, YouTube, Maps, Meet, and WhatsApp.

Input Field	Value
1	6
2	34
3	436
4	6377
5	86
6	11

Output:



A screenshot of the same web browser and application, showing the output of the prediction. The input fields now contain labels: 'Horsepower (per sec)', 'Weight (in pounds)', 'Model Year (YY)', and 'Origin'. Below these is a blue 'PREDICT' button. At the bottom of the central panel, a dark blue box displays the output text: 'Low performance with mileage 16.0Don't go to long distance'. The browser tabs and address bar remain the same.

Input Field	Label
1	Horsepower (per sec)
2	Weight (in pounds)
3	Model Year (YY)
4	Origin

PREDICT

Low performance with mileage 16.0Don't go to long distance

9.RESULTS

Model Evaluation

```
1 from sklearn.metrics import r2_score,mean_squared_error
```

```
1 acc = r2_score(y_test, y_pred)
```

```
1 acc
```

```
0.8570363544939325
```

```
1 err=np.sqrt(mean_squared_error(y_test,y_pred))
```

```
1 err
```

```
2.7436940578959117
```

10.ADVANTAGES AND DISADVANTAGES.

Advantages:

- Prediction of vehicle performance is faster and easier.
- Easy and wide range of access from everyday user to machinist in workshops.

Disadvantages:

- Accuracy need to be increased
- The dataset should be wide to for every region
- Values such as standard climate conditions need to be considered on the long run of vehicles

11.CONCLUSION.

The automotive industry is extremely competitive. With increasing fuel prices and picky consumers. Automobile makers are constantly optimizing their processes to increase fuel efficiency. The performance analysis of the car is based on the various parameters. These are the factors on which the health of the car is analyzed, improved to gain the competitive advantage. This application will solve the problems in evaluation of the vehicle

12.FUTURE SCOPE

- Developing the CSS and Animation of the Website
- Developing the High Accuracy Model
- Developing the Code to make API key highly secure

GITHUB LINK: <https://github.com/IBM-EPBL/IBM-Project-2451-1658471828>
(Consist of source code , demo video and related data files)