HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

Approved by AICTE, New Delhi, Accredited with 'A' Grade by NAAC

(An Autonomous Institution, Affiliated to Anna University, Chennai)

COIMBATORE – 641 032

PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP

NALAIYA THIRAN PROJECT BASED LEARNINGON

MACHINE LEARNING BASED VEHICLE PERFORMANCE ANALYSER

A PROJECT REPORT SUBMITTED BY

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BACHELOR OF ENGINEERINGIN

COMPUTER SCIENCE ENGINEERING

HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

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COIMBATORE – 641 032

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BONAFIDE CERTIFICATE

Certified that project report "**MACHINE LEARNING BASED VEHICLE PERFORMANCE ANALYSER**" is the bonafide work of "MANI KANDAN S HARISH S KATHIRESH M MOHAMMAD ABUSALIF SM" who carried out the project work under my supervision.Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on thebasis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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G DEEBANCHAKKARAWARTHI

SUPERVISOR

Associate Professor,

Department of CSE,

HICET,

Coimbatore - 641 032.

Submitted for Project Viva-Voice conducted on ……

.....	.....
INTERNAL EXAMINER	EXTERNAL EXAMINE

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1 INTRODUCTION

1.1 Project overview

Predicting the performance level of cars is an important and interesting problem. The main goal of the current study is to predict the performance of the car to improve certain behavior of the vehicle. This can significantly help to improve the systems fuel consumption and increase the efficiency. The performance analysis of the car based on the engine type, no of engine cylinders, fuel type and horsepower etc.These are the factors on which the health of the car can be predicted. It is an on-going process of obtaining, researching, analyzing and recording the health based on the above three factors. The performance objectives like mileage, dependability, flexibility and cost can be grouped together to play a vital role in prediction engine and engine management system. This approach is the very important step towardsunderstandingthevehiclesperformance.

With the increasing population demographics and the dependency of man on motor vehicles as the primary source of transportation, the number of motor vehicles being registered for commercial as well as non-commercial activities on a daily basis is massive and yet continues to increase at an alarming rate. This has a direct and an unambiguous effect on the amount of fossil fuels being utilized globally and its subsequent environmental effects, which is of great concern in the present situation. Several attempts from various research sectors are ongoing in order to overcome this global issue and promising results are expected. This project is one such attempt at identifying the performance of small passenger cars in terms of fuel efficiency and map them with factors affecting it using machine learning techniques. The commencing activity while carrying out any such research activity will be

the identification of the problem and all its possible sources. In this case, two potential sources can be identified and they are; the vehicle characteristics and the driver/driving behaviour. The relevant data for this analysis was taken from the public source, Kaggle which is the data collected from the OBD of the car and models are built using techniques like Multiple Linear Regression, XGBoost, Support Vector Machine and Artificial Neural Network and their performance is compared to discover the firstrate technique in predicting the fuel efficiency and to propose the optimum driving behaviour in terms of throttle position to achieve better fuel efficiency.

Detection and recognition of plant diseases using machine learning are very efficient in providing symptoms of identifying diseases at its earliest. Plant pathologists can analyze the digital images using digital image processing for diagnosis of plant diseases. Application of computer vision and image processing strategies simply assist farmers in all of the regions of agriculture. Generally, the plant diseases are caused by the abnormal physiological functionalities of plants. Therefore, the characteristic symptoms are generated based on the differentiation between normal physiological functionalities and abnormal physiological functionalities of the plants. Mostly, the plant leaf diseases are caused by Pathogens which are positioned on the stems of the plants. These different symptoms and diseases of leaves are predicted by different methods in image processing. These different methods includedifferent fundamental processes like segmentation, feature extraction and classification and so on. Mostly, the prediction and diagnosis of leaf diseases are depending on the segmentation such as segmenting the healthy tissues from diseased tissues of leaves.

1.2 Purpose

Predicting the performance level of vehicle is an important and interesting problem. The main goal is to predict the performance of the vehicle to improve the certain behavior of the vehicle. This can significantly help to improve the system's fuel consumption and increaseefficiency.

The performance analysis of the vehicle is based on the engine type, no of engine cylinders, fuel type, and horsepower, etc. These are the factors on which the health of the car can be predicted. It is an on-going process of obtaining, researching, analyzing, and recording the health based on the above three factors. The performance objectives like mileage, dependability, flexibility, and cost can be grouped together to play a vital role in the prediction engine and engine management system. This approach is a very important step towards understanding the vehicle's performance.

2 LITERATURE SURVEY

Singh D, Singh M., "Internet of Vehicles for Smart and Safe Driving",International Conference on Connected Vehicles and Expo (ICCVE),Shenzhen, 19 -23 Oct.,2015. (This paper has discussed about smarttransportation services in cloud (Cloud-STS) for safety and convenience. STSprovide driver centric board services in the cloud networks. STS composed ofVehicle to WiFi networks (VtoWiFi), Vehicle to Cloud Network (VtoCN),Vehicle to Vehicle (VtoV), and Cloud Network to service provider (CNtoSP).The idea is to utilize the

(WiFi enabled) Smart Highways and 3Dcameraenabled dash board

navigation device to enhance accident prevention /monitoring and control.) Zhang, Y., Lin, W., and Chin, Y., "Data -Driven Driving Skill Characterization:Algorithm Comparison and Decision Fusion," SAE Technical Paper2009 -01 -1286, 2009, https://doi.org/10.4271/2009

-01 -1286.Azevedo, C. LCardoso. (By adapting vehicle control systemsto the skill level of the driver,the overall vehicle active safety provided to the driver can be furtherenhanced for the existing active vehicle controls, such as ABS, Traction Control, Vehicle Stability Enhancement Systems. As a follow-up to thefeasibility study in, this paper provides some recent results on data-drivendriving skill characterization. In particular, the paper presents anenhancement of discriminant features, the comparison of three different learning algorithms for recognizer design, and the performanceenhancement with decision fusion. The paper concludes with the discussionsof the experimental results and some of the future work.)

- J. E. Meseguer, C. T. Calafate, J. C. Cano and P. Manzoni, "DrivingStyles: Asmartphone application to assess driver behavior," 2013 IEEE Symposium onComputers and Communications (ISCC), Split,2013, pp.000535 -000540. oi:10.1109/ISCC.2013.6755001.(The DrivingStyles architecture integrates bothdata mining techniques and neural networks to generate a classification ofdriving styles by analyzing the driver behavior along each route. In particular,based on parameters such as speed, acceleration, and revolutions per minuteofthe engine (rpm), we have implemented a neural network based algorithmthat is able to characterize the type of road on which the vehicle is moving,as well as the degree of aggressiveness of each

driver. The final goal is toassist drivers at correcting the bad habits intheir driving behavior, whileoffering helpful tips to improve fuel economy. In this work we takeadvantage of two key-points: the evolution of mobile terminals and theavailability of a standard interface to access car data.)

Kenneth L. Clarkson. 1985. Algorithms for Closest -Point Problems(Computational Geometry). Ph.D. Dissertation. Stanford University, Palo Alto,CA. UMI Order Number: AAT 8506171.(This dissertation reports a variety ofnew algorithms for solving closest- point problems. The input to thesealgorithms is a set or sets of points in d-dimensional space, with an associated L (, p) metric. The problems considered are:(1) The all nearestneighbors problem. For point set A, find the nearest neighbors in A of eachpoint in A.(2) The nearest foreign neighbor problem. For point sets A and B,find the closest point in B to each point in A. The geometric inimumspanning tree problem.)Goszczynska H., Kowalczyk L., Kuraszkiewicz B. (2014) Correlation Matrices asa ool to Analyze the Variability of EEG Maps.

In: Piętka E., Kawa J., WieclawekW. (eds) InformationTechnologies in Biomedicine, Volume 4. Advances inIntelligent Systems and Computing, vol 284. Springer.(The aim of this paperis to present the selected examples of possible applications of image ofcorrelation coefficients matrix of EEG map series in the analysis of variation ofthetopography of the isopotential areas in EEG maps, and thus in the assessment of stationarity, spatio-temporal variability and trends of changesof bioelectric activity of the brain. The image of correlation coefficients matrix shows similiarity of all pairs of maps in a series.

The choice of segmentationthreshold of characteristic areas in images of the correlation coefficientsmatrix of EEG map series correspondingto the sequence similarityrelationships in a series of maps was based on the results of researchconducted on test series.)

2.1Existing problem

The existing problem is it is difficult to identify the performance of the vehicle. Factors such as terrain, temperature, weather, trip length and environment, driving behavior and load all affect the performance of a vehicle over time.

Reference

Byerly, A., Hendrix, B., Bagwe, R., Santos, E. and Ben-Miled, Z. (2019). A machine learning model for average fuel consumption in heavy vehicles, IEEE Transactions onVehicular Technology, 68(7), 6343-6351, doi: 10.1109/TVT.2019.2916299 . C¸ apraz, A. G., Ozel, P., S¸evkli, M. and Beyca, ¨ O. F. (2016). Fuel Consumption Models ¨Applied to Automobiles Using Real-time Data: A Comparison of Statistical Models,83, pp. 774-781, doi: 10.1016/j.procs.2016.04.166. Fayyad, U. M., Haussler, D. and Stolorz, P. E. (1996). Kdd for science data analysis: Issues and examples., KDD pp. 50-56.Freedman, D. A. (2009). Statistical models: theory and practice, cambridge university press.

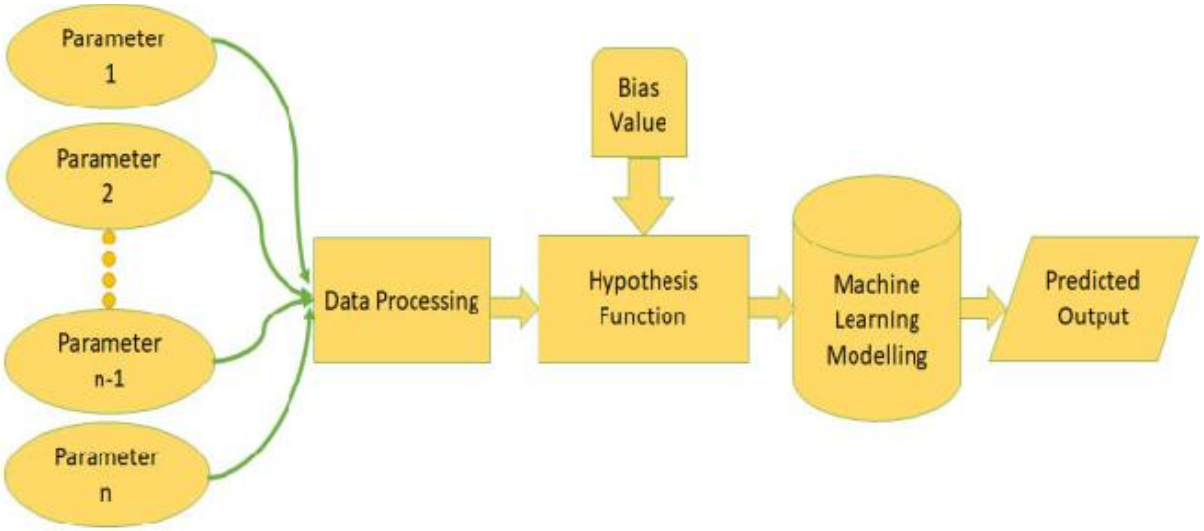
Abstract

With the increasing population demographics and the dependency of man

on motor vehicles as the primary source of transportation, the number of motor vehicles being registered for commercial as well as non-commercial activities on a daily basis is massive and yet continues to increase at an alarming rate. This has a direct and an unambiguous effect on the amount of fossil fuels being utilized globally and its subsequent environmental effects, which is of great concern in the present situation. Several attempts from various research sectors are ongoing in order to overcome this global issue and promising results are expected. This project is one such attempt at identifying the performance of small passenger cars in terms of fuel efficiency and map them with factors affecting it using machine learning techniques. The commencing activity while carrying out any such research activity will be the identification of the problem and all its possible sources. In this case, two potential sources can be identified and they are; the vehicle characteristics and the driver/driving behaviour.

2 3 Problem Statement Definition

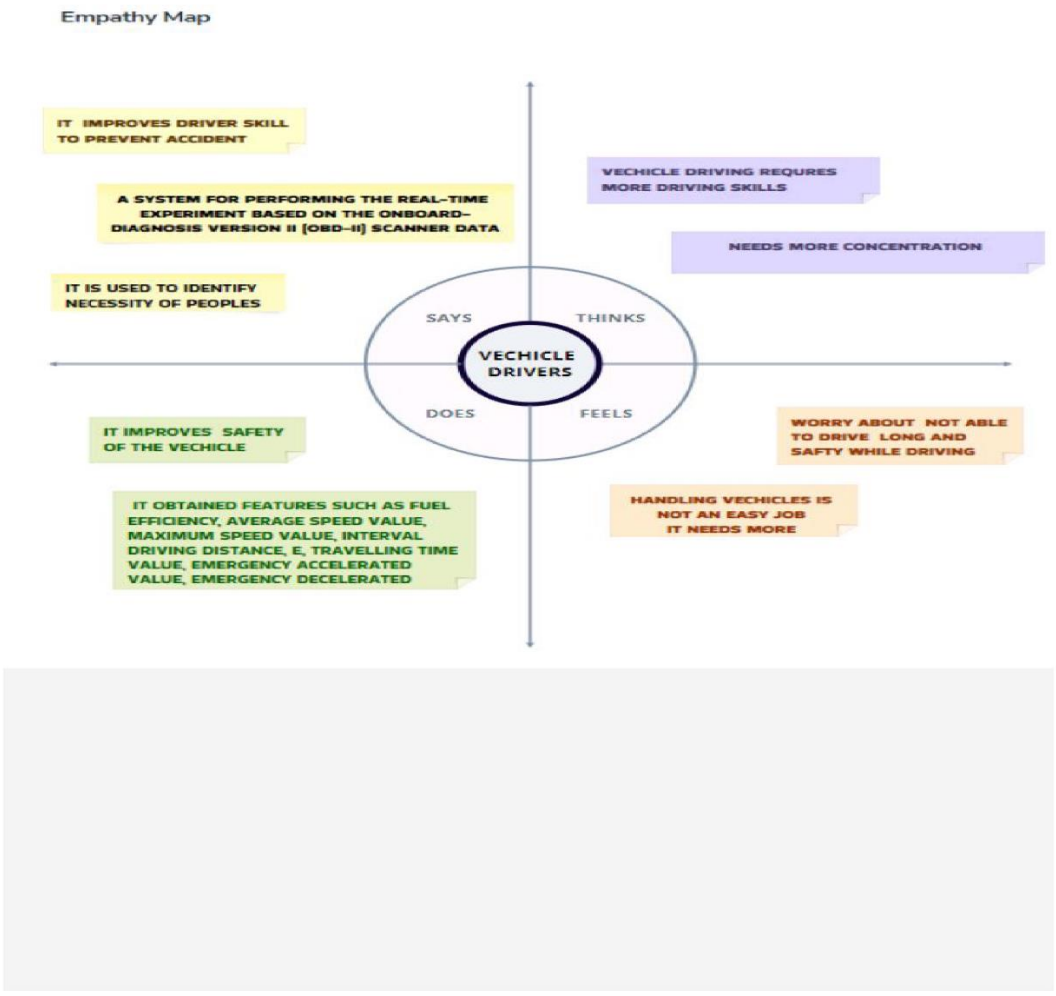
Predicting the performance level of cars is an important and interesting problem. The main goal of the current study is to predict the performance of the car to improve certain behavior of the vehicle. This can significantly help to improve the systems fuel consumption and increase the efficiency. The performance analysis of the car based on the engine type, no of engine cylinders, fuel type and horsepower etc



IDEATION & PROPOSED SOLUTION

Empathy Map Canvas

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviors and attitudes.

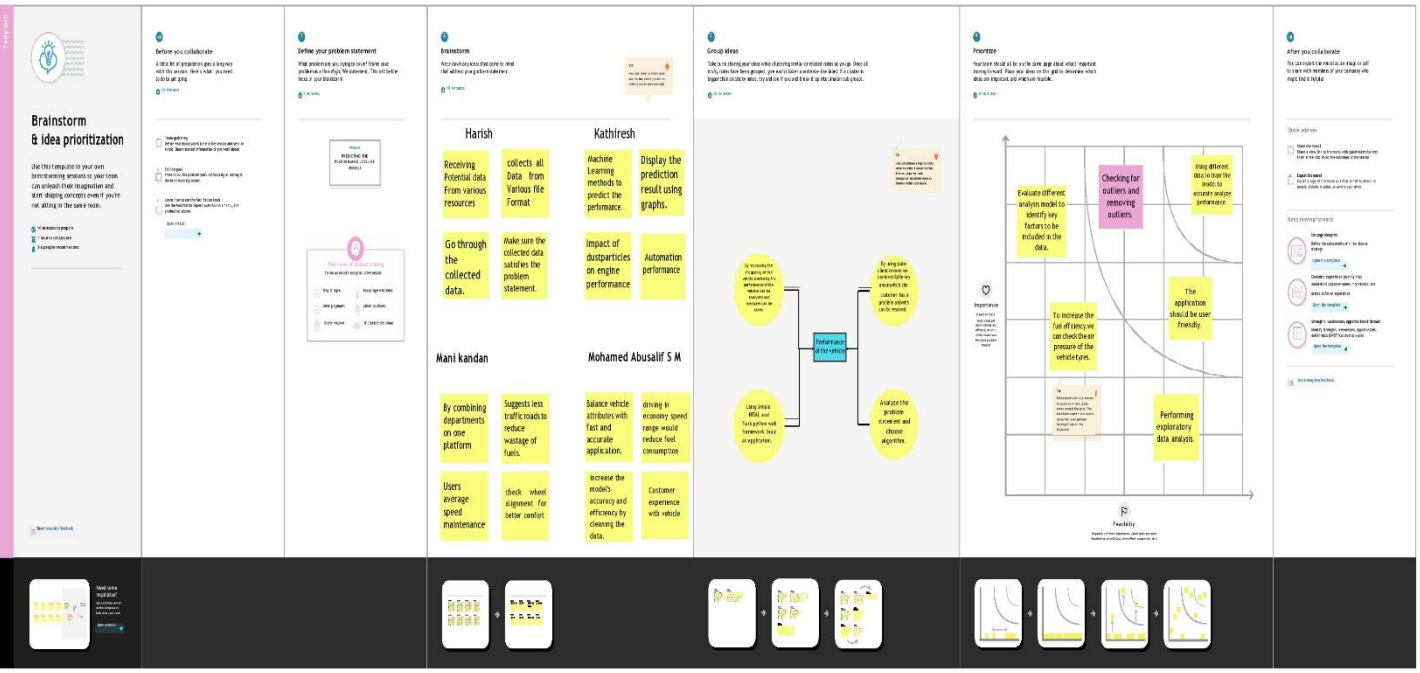


It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

Ideation & Brainstoming

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem-solving. Prioritizing volume over value, out-of-the-box

ideas are welcome and built upon. All participants are encouraged to collaborate, helping each other develop many creative solutions.



Proposed System

S.No.	Parameter	Description
1.	Problem Statement	The user is an Automobile manufacturer which is looking for new technologies to analyse the performance of its vehicles.
2.	Idea / Solution description	The variables that are measured across different parts of the car and its performance can be used to forecast the condition of the vehicle. This continual process of collecting, studying, analysing, and documenting vehicle's performance can be used to gain competitive advantage.
3.	Novelty / Uniqueness	Giving the public and the manufacturer the feature to analyse their vehicle's performance.
4.	Social Impact / Customer Satisfaction	The product improves vehicles performance, increases mileage, efficiency, lifetime, etc. These properties will have a positive response.
5.	Business Model	Selling the product as an application and/or selling through collaboration with vehicle manufacturers. Product can also be sold to Racing companies for them to dominate in their field

Proposed Solution means the combination of software, hardware, other products or equipment, and any and all services (including any installation,

implementation, training, maintenance and support services) necessary to implement the solution described by Vendor in its Proposal.

Problem fit solution

REQUIREMENT ANALYSIS

Functional Requirements:

FR No.	Functional Requirement(Epic)	Sub Requirement (Story/Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Reset Password	ResetpasswordthroughGmail Reset password through Mobile number
FR-4	Feedback	The user can submit the feedback through a contact form in the website or through Gmail.

Non Functional requirement

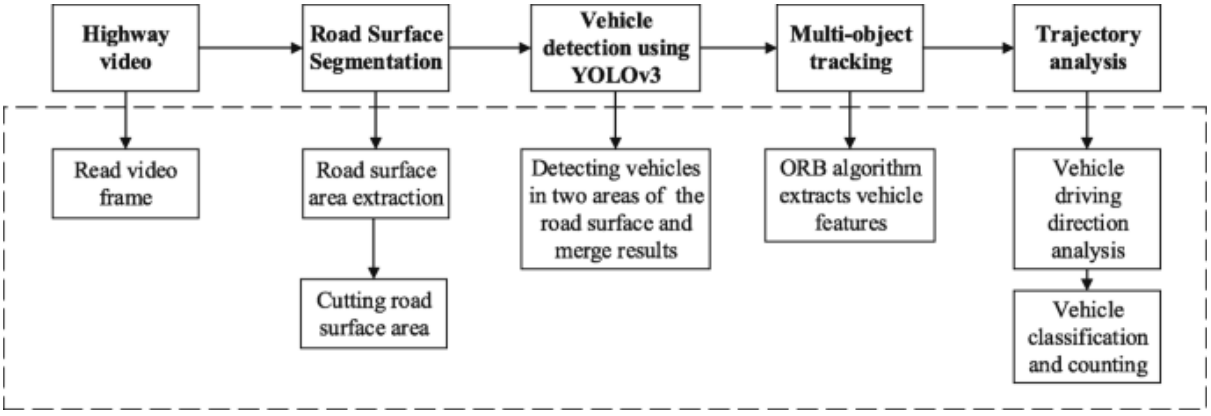
Following are the non-functional requirements of the proposed solution.

FR No.	Non-FunctionalRequirement	Description
NFR-1	Usability	The analyser allows the user to improve performance based on the results provided. It is easy to use with just the data required.
NFR-2	Security	The security is improved by using vehicle alarm, wheel lock, vehicle lock and also GPS tracker.
NFR-3	Reliability	The reliability rating is good due to best performance, less frequency of problem occurrence and cost for repairing is low.
NFR-4	Performance	Thevehicleisupgradedintheirqualityandinfrastructure to provide better performance likegoodmileage, smooth travel.
NFR-5	Availability	The data required is collected by research personsandthisdata canbe usedtoprovidebetterresults.

PROJECT DESIGN

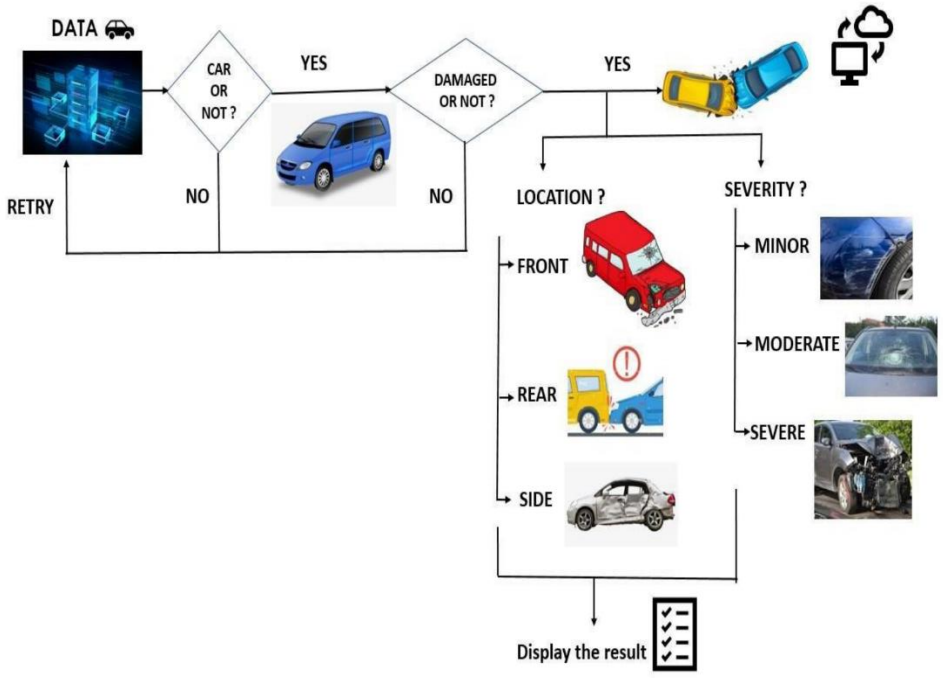
Data flow diagram

A data flow diagram (DFD) is **a graphical or visual representation using a standardized set of symbols and notations to describe a business's operations through data movement**. They are often elements of a formal methodology such as Structured Systems Analysis and Design Method (SSADM).



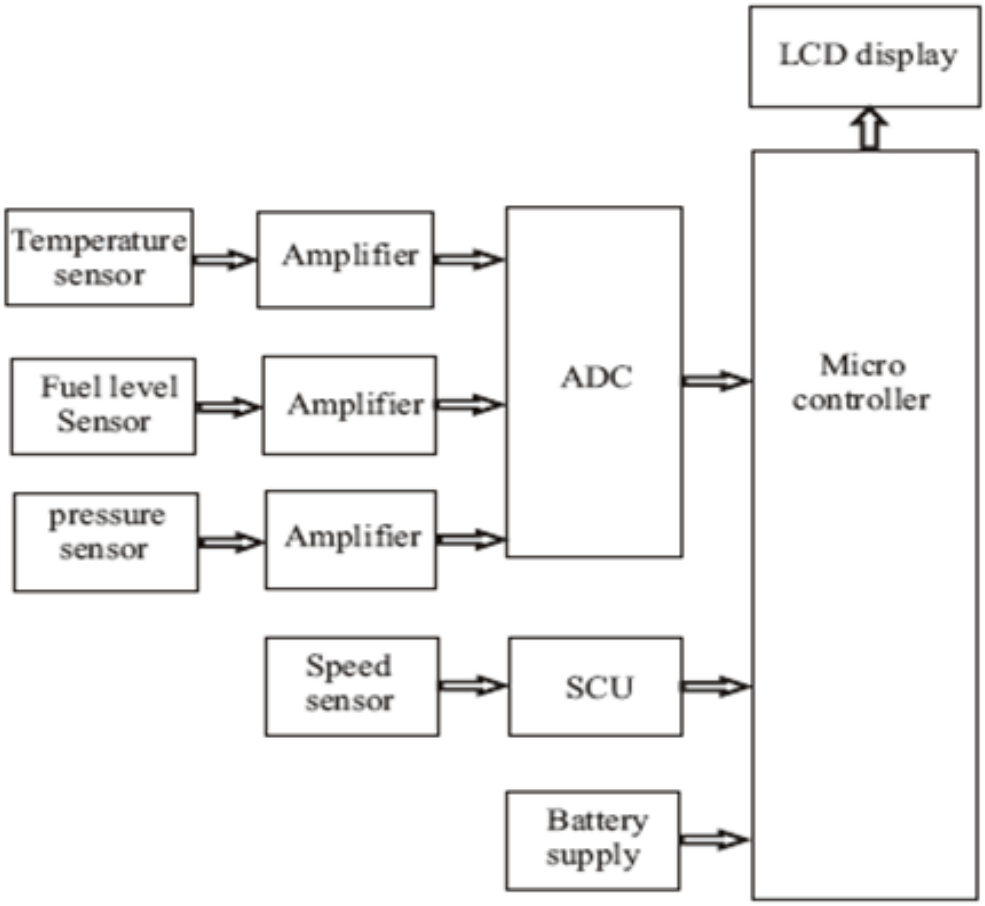
Solution Architecture

A solution architecture (SA) is an architectural description of a specific solution. SAs combine guidance from different enterprise architecture viewpoints (business, information and technical), as well as from the enterprise solution architecture (ESA).



Technical Architecture

Technical Architecture (TA) is **a form of IT architecture that is used to design computer systems**. It involves the development of a technical blueprint with regard to the arrangement, interaction, and interdependence of all elements so that system-relevant requirements are met.



PROJECT PLANNING & SCHEDULING

Sprint Planning & Estimation

Sprint planning is an event in scrum that kicks off the sprint. The purpose of sprint planning is to define what can be delivered in the sprint and how that work will be achieved. Sprint planning is done in collaboration with the whole scrum team.

Sprint	Total story point	Duration	Sprint start date	Sprint end date	Story points completed	Sprint release date
Sprint-1	20	6 days	27-oct-2022	28-oct-2022	20	04-nov-2022
Sprint-2	20	6 days	02-nov-2022	05-nov-2022	20	07-nov-2022
Sprint-3	20	6 days	08-nov-2022	12-nov-2022	20	12-nov-2022
Sprint-4	20	6 days	14-nov-2022	19-nov-2022	20	19-nov-2022

/elocity: average velocity = 80/20 =4 story points per day

User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Google OAUTH		Medium	Sprint-1
	Login	USN-4	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard	USN-5	As a user, I can upload vehicle data and get an analysis of the data		Medium	Sprint-2
Administrator	Login	USN-6	As an admin, I can log into the application by entering email & password	I can access my admin dashboard	High	Sprint-1

7 CODING & SOLUTIONING

7.1 Feature

In [5]:
```
import numpy as np
import pandas as pd
```

In [6]:
```
#Reading The Dataset

datas = pd.read_csv(r"C:\Users\sunda\Desktop\IBM\car performance.csv")
datas.head()
```

Out[6]:

	mpg	cylinders	displacement	horsepower	weight	acceleration	model year	origin	car name
0	18.0	8	307.0	130	3504	12.0	70	1	chevrolet chevelle malibu
1	15.0	8	350.0	165	3693	11.5	70	1	buick skylark 320
2	18.0	8	318.0	150	3436	11.0	70	1	plymouth satellite
3	16.0	8	304.0	150	3433	12.0	70	1	amc rebel sst
4	17.0	8	302.0	140	3449	10.5	70	1	ford torino

In [7]:
```
# Handling Missing Values

datas.isnull().any()
```

Out[7]:
```
mpg             False
cylinders       False
displacement    False
horsepower      False
weight          False
acceleration    False
model year      False
origin          False
car name        False
dtype: bool
```

In [8]:
```
# Splitting The Dataset Into Dependent And Independent Variable.

x = datas.iloc[:,1:8].values
```

In [9]:
```
y = datas.iloc[:,0].values
```

In [10]:
```
# Split The Dataset Into Train Set And Test Set

from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.2,random_state=0)
```

In [11]:
```
# Normalizing

from sklearn.preprocessing import StandardScaler
sd = StandardScaler()
x_train = sd.fit_transform(x_train)
x_test = sd.fit_transform(x_test)
```

In [12]:
```
x_train
```

In [12]:
```
x_train
```

Out[12]:
```
array([[ 1.49526939,  1.22961301,  1.24359144, ..., -0.79520768,
        -1.13752513, -0.73301171],
       [-0.85285735, -0.92367663, -1.16092059, ...,  1.24411524,
        -1.41177304,  0.5068698 ],
       [-0.85285735, -0.92367663, -0.68001818, ...,  0.05760009,
         1.05645814,  0.5068698 ],
       ...,
       [-0.85285735, -1.206235  , -1.45480539, ...,  1.42950823,
        -0.86327722,  0.5068698 ],
       [ 0.32120602,  0.56706235, -0.09224857, ..., -0.2390287 ,
        -1.41177304, -0.73301171],
       [-0.85285735, -0.99188037, -0.86703579, ...,  0.31715028,
        -0.31478141,  0.5068698 ]])
```

In [13]:
```
# Build The Model With The Random Forest Regressor

from sklearn.ensemble import RandomForestRegressor
d = RandomForestRegressor (n_estimators=30,random_state = 0)
d.fit(x_train,y_train)
```

Out[13]:
```
RandomForestRegressor(n_estimators=30, random_state=0)
```

In [14]:
```
# prediction

y_pred = d.predict(x_test)
y_pred
```

Out[14]:
```
array([14.38333333, 24.25666667, 14.21666667, 20.56666667, 18.47333333,
       30.21666667, 34.63333333, 21.15      , 16.30333333, 25.76      ,
       36.60333333, 36.27      , 19.53666667, 27.32333333, 16.54333333,
       32.99333333, 28.32333333, 27.49666667, 17.03      , 35.82      ,
       16.47333333, 23.54      , 23.16666667, 20.7       , 33.69666667,
       26.45      , 33.79666667, 30.37333333, 31.93666667, 16.57333333,
       20.26666667, 32.99      , 19.79666667, 34.08333333, 20.85666667,
       25.02      , 19.65333333, 17.14      , 34.78333333, 12.76666667,
       13.73333333, 15.2       , 28.32      , 32.76666667, 28.74333333,
       22.68666667, 20.54333333, 16.50666667, 23.38      , 29.88333333,
       34.31666667, 26.5       , 17.63      , 27.78333333, 15.96666667,
       12.96666667, 18.86666667, 26.91666667, 31.95666667, 15.68      ,
       20.81      , 25.97      , 19.84666667, 21.6       , 13.46666667,
       15.33333333, 14.2       , 18.90333333, 24.72666667, 14.21666667,
       34.87666667, 13.25      , 22.96666667, 18.77666667, 23.83333333,
       32.16666667, 28.17666667, 31.23666667, 31.94      , 14.35      ])
```

In [19]:
```
from sklearn.metrics import r2_score
accuracy = r2_score(y_test,r)
accuracy
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Input In [19], in ()
      1 from sklearn.metrics import r2_score
```

In [12]:
```
x_train
```

Out[12]:
```
array([[ 1.49526939,  1.22961301,  1.24359144, ..., -0.79520768,
        -1.13752513, -0.73301171],
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       25.02      , 19.65333333, 17.14      , 34.78333333, 12.76666667,
       13.73333333, 15.2       , 28.32      , 32.76666667, 28.74333333,
       22.68666667, 20.54333333, 16.50666667, 23.38      , 29.88333333,
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```
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Feature 2

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datas.head()
```

Out[5]:

	mpg	cylinders	displacement	horsepower	weight	acceleration	model year	origin	car name
0	18.0	8	307.0	130	3504	12.0	70	1	chevrolet chevelle malibu
1	15.0	8	350.0	165	3693	11.5	70	1	buick skylark 320
2	18.0	8	318.0	150	3436	11.0	70	1	plymouth satellite
3	16.0	8	304.0	150	3433	12.0	70	1	amc rebel sst
4	17.0	8	302.0	140	3449	10.5	70	1	ford torino

In [6]:
```
# Handling Missing Values

datas.isnull().any()
```

Out[6]:
```
mpg           False
cylinders     False
displacement  False
horsepower    False
weight        False
acceleration  False
model year    False
origin        False
car name      False
dtype: bool
```

In [7]:
```
# Splitting The Dataset Into Dependent And Independent Variable.

x = datas.iloc[:,1:8].values
```

In [8]:
```
y = datas.iloc[:,0].values
```

In [9]:
```
# Split The Dataset Into Train Set And Test Set

from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.2,random_state=0)
```

In [10]:
```
# Normalizing

from sklearn.preprocessing import StandardScaler
sd = StandardScaler()
```

In [4]:
```
import numpy as np
import pandas as pd
```

In [5]:
```
#Reading The Dataset

datas = pd.read_csv(r"C:\Users\sunda\Desktop\IBM\car performance.csv")
datas.head()
```

Out[5]:

	mpg	cylinders	displacement	horsepower	weight	acceleration	model year	origin	car name
0	18.0	8	307.0	130	3504	12.0	70	1	chevrolet chevelle malibu
1	15.0	8	350.0	165	3693	11.5	70	1	buick skylark 320
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In [6]:
```
# Handling Missing Values

datas.isnull().any()
```

Out[6]:
```
mpg             False
cylinders       False
displacement    False
horsepower      False
weight          False
acceleration    False
model year      False
origin          False
car name        False
dtype: bool
```

In [7]:
```
# Splitting The Dataset Into Dependent And Independent Variable.

x = datas.iloc[:,1:8].values
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# Split The Dataset Into Train Set And Test Set

from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.2,random_state=0)
```

In [10]:
```
# Normalizing

from sklearn.preprocessing import StandardScaler
sd = StandardScaler()
```

In [11]:
```
x_train
```

Out[11]:
```
array([[ 1.49526939,  1.22961301,  1.24359144, ..., -0.79520768,
        -1.13752513, -0.73301171],
       [-0.85285735, -0.92367663, -1.16092059, ...,  1.24411524,
        -1.41177304,  0.5068698 ],
       [-0.85285735, -0.92367663, -0.68001818, ...,  0.05760009,
         1.05645814,  0.5068698 ],
       ...,
       [-0.85285735, -1.206235  , -1.45480539, ...,  1.42950823,
        -0.86327722,  0.5068698 ],
       [ 0.32120602,  0.56706235, -0.09224857, ..., -0.2390287 ,
        -1.41177304, -0.73301171],
       [-0.85285735, -0.99188037, -0.86703579, ...,  0.31715028,
        -0.31478141,  0.5068698 ]])
```

In [12]:
```
# Build The Model With The Random Forest Regressor

from sklearn.ensemble import RandomForestRegressor
d = RandomForestRegressor (n_estimators=30,random_state = 0)
d.fit(x_train,y_train)
```

Out[12]:
```
RandomForestRegressor(n_estimators=30, random_state=0)
```

In [13]:
```
# prediction

y_pred = d.predict(x_test)
y_pred
```

Out[13]:
```
array([14.38333333, 24.25666667, 14.21666667, 20.56666667, 18.47333333,
       30.21666667, 34.63333333, 21.15      , 16.30333333, 25.76      ,
       36.60333333, 36.27      , 19.53666667, 27.32333333, 16.54333333,
       32.99333333, 28.32333333, 27.49666667, 17.03      , 35.82      ,
       16.47333333, 23.54      , 23.16666667, 20.7       , 33.69666667,
       26.45      , 33.79666667, 30.37333333, 31.93666667, 16.57333333,
       20.26666667, 32.99      , 19.79666667, 34.08333333, 20.85666667,
       25.02      , 19.65333333, 17.14      , 34.78333333, 12.76666667,
       13.73333333, 15.2       , 28.32      , 32.76666667, 28.74333333,
       22.68666667, 20.54333333, 16.50666667, 23.38      , 29.88333333,
       34.31666667, 26.5       , 17.63      , 27.78333333, 15.96666667,
       12.96666667, 18.86666667, 26.91666667, 31.95666667, 15.68      ,
       20.81      , 25.97      , 19.84666667, 21.6       , 13.46666667,
       15.33333333, 14.2       , 18.90333333, 24.72666667, 14.21666667,
       34.87666667, 13.25      , 22.96666667, 18.77666667, 23.83333333,
       32.16666667, 28.17666667, 31.23666667, 31.94      , 14.35      ])
```

In [14]:
```
# Model Evaluation

from sklearn.metrics import r2_score
accuracy = r2_score(y_test,y_pred)
accuracy
```

Out[14]:
```
0.8914224071232417
```

In [17]:
```
# save the model

import pickle
pickle.dump(d,open('regression.pkl','wb'))
```

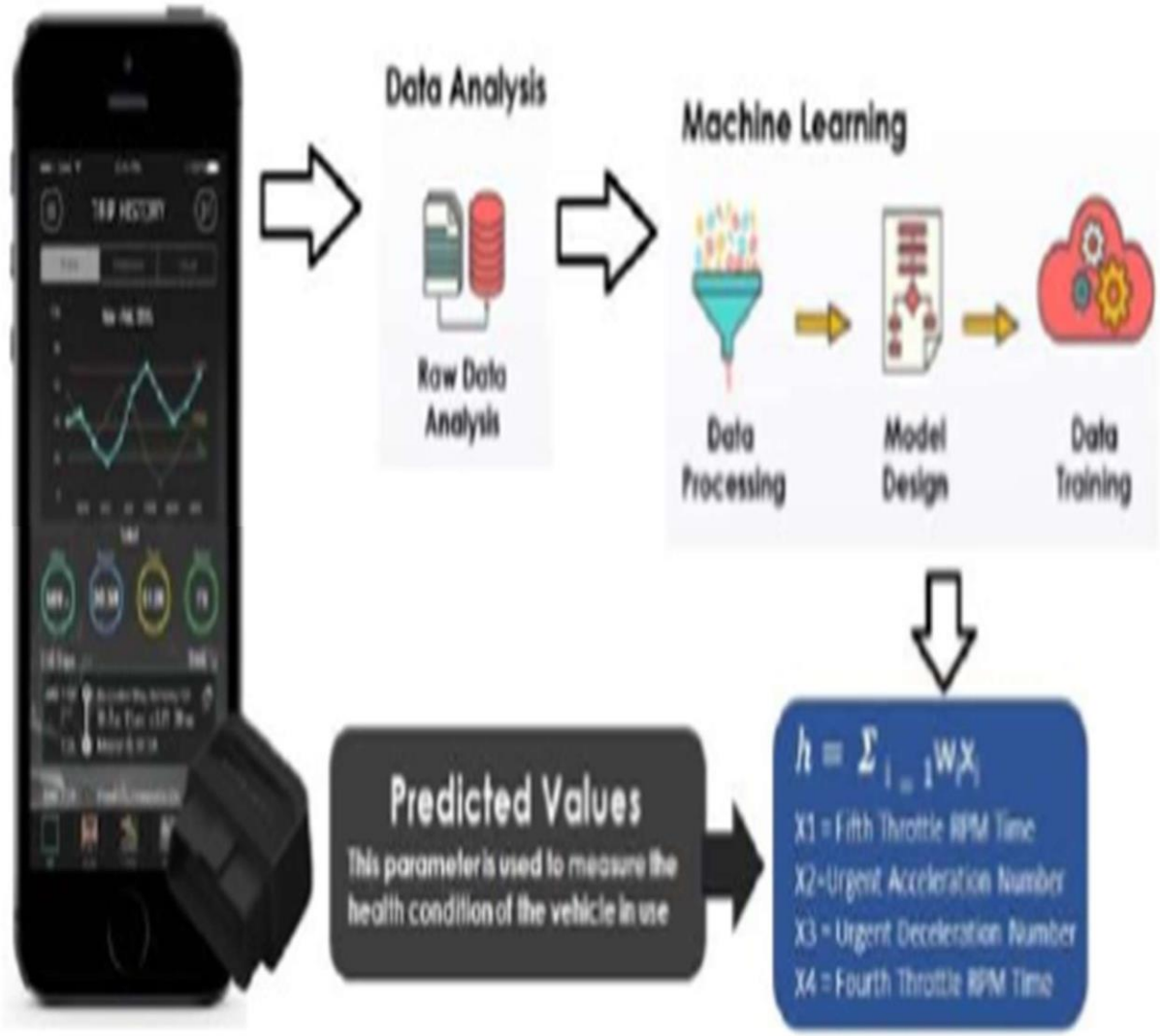
In [ ]:
```

```

In [ ]:
```

```

7.3Database Schema (if Applicable)



GIF Gesellschaft für Industrieforschung is an automotive company based out of Germany, covering the vehicle transmissions and the design, testing, and development of powertrain

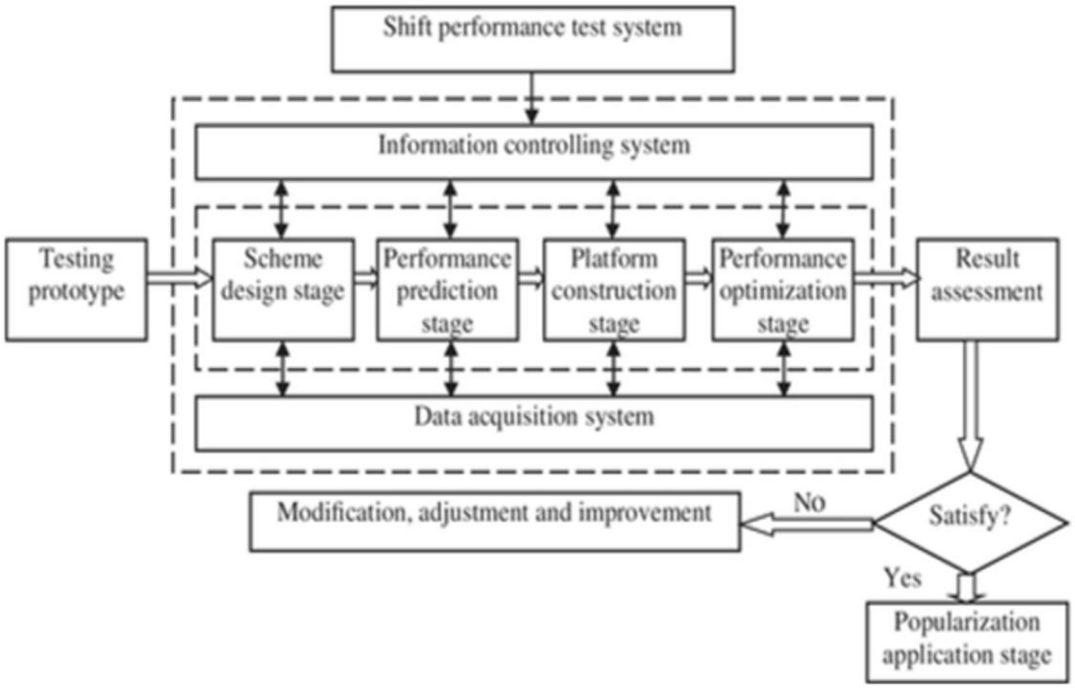
system. GSA system, which was developed by GIF, has proven in many years of testing to be a valuable tool, mainly by complex transmission and gear development projects. GSA system is not only applied for objectively assessing the change of gears in a vehicle, but also permits measuring and analyzing the influencing factors of gear shifting quality. Therefore, during the new development and integration of transmissions, transmission component testing, and quality assurance, GSAsystem is indispensable as the right tool. Based on GSA shifting performance test evaluation system, this project completes the control strategy research of improving the shifting quality of automobile transmission. The technical route to be adopted. The development process of transmission shifting performance is mainly divided into scheme design stage, performance prediction stage, platform construction stage, performance optimization stage, and popularization application stage. First, the research idea is clear, the research scheme is determined, and the theoretical research framework of shifting test and evaluation is constructed. Second, relevant materials are collected, the performance parameters of transmission and shifting control mechanism are summarized, and the shifting performance of the whole system is predicted. Third, the shifting control performance bench test and GSA test system are built to carry out the subjective and objective test and research of shifting performance, and the real-time acquisition of shifting performance is carried out. The performance indicators in the process are analyzed and evaluated to provide data support for improving the shifting performance of the system. Then the optimization improvement measures are specified and the shifting performance is re-evaluated to obtain the best matching relationship of the shifting performance and verify the effectiveness of the

control strategy research scheme. Finally, the shifting optimization test and analysis path based on GSA test technology is formed.

GSA test analysis means that the whole test system includes hardware acquisition equipment and software processing analysis tools. Through real-time measurement and analysis of the force, travel, acceleration, and other important parameters of the shifting lever knob, the performance ofthe whole vehicle is systematically evaluated from the aspects of the

shifting and selection force (travel), system stiffness, free play, and dynamic

impact.



8.2 User Acceptance Testing (UAT)

It is a process to check that system accepts requirements of a useror not. It's performed at a time when the system used by actual users. User acceptance testing comes after →Unit Testing
→Integration Testing →System Testing →Acceptance Testing in theprocess of testing

Alpha Testing

It is the type of testing, executed to identify all possible issues/bugs before releasing a product to every data users or public. It simulates real users by using Black Box and White Box testing techniques. The primary function is to carry out tasks executed by a typical user. Alpha testing carried out in a developed environment or in a lab environment where a product developedand the user of a product are internal employees of an organization.

Beta Training

It is the type of testing in which users of software or application are real users. In this application is tested in a real environment and considered as aform of an external User Acceptance testing. Beta version of a software released to a limited number of a user when tested in a Real-Time environment with the help of real users, to obtain feedback on product quality. Beta testing reduces failures, risks and provides increased quality ofa product through customer validation. It is a final test before shipping a product to the customers. In this type of testing, getting direct feedback from users is a significant benefit. It is required to test a product finally in a Real-Time environment.

9 RESULTS

9.1 Performance Metrics

The result analysis consisted of the collection of data from the OBD-II scanner through the app, which was then processed into the machine learning modeland finally trained as shown in Trained Output values were used as the benchmark for testing against the gathered data. To do so, we performed a k-foldcross-validation technique with k=10, to train the model. We performed several experiments on the parameters which are essential for the testing of vehicle's safety and economic efficiency. In our first experiment, a relationship between Maximum speed value and the travel time (red zone) is obtained. This relationship describes the total distances travelled while crossing the road given the signal was red.We clearly observed, as shown in Fig. 4, that given the speed of the car was high, it was more likely for the driver to cross the road at red signal and in turn this implies the increasing likelihood of meeting with an accident We performed a k-fold cross-validation technique [6] with k=10, to train the model. In the Hypothesis-1, ECN_DRVG_INDX, we found that majority of the data was congested in the lower left part of the graph suggesting an inverse logarithmic growth of the trend based on the training data. This showed a positive growth of the

ECN_DRVG_INDX based on the hypothesis value. However, the data scatters as the value on x-axis increases, hinting at a somewhat lesser correlation for predicted value based on hypothesis value.

Therefore, the ECN_DRVG_INDX is found to be an inverse logarithmic function

10 ADVANTAGES & DISADVANTAGES

Advantage

- Easy Implementation
- Low cost
- Can know and maintain the driver and car performance

Disadvantage

- It is very difficult to find the place for placing temperature sensor and pressure sensor.

11 CONCLUSION

In this paper we have obtained some newer insights about the car data analysis such as economic driving index (ECN_DRVG_INDX) and safety driving index (SFTY_DRVG_INDX.) The results have proven to be approximately 80% fitting the given features and are very helpful to be used in different use cases such as a parameter in finding the driver's driving performance in a driving school, as a good estimate for finding an optimal price for a used car that can be based on several factors which we have analyzed in this paper etc. We also found that the model used to train the data can be improved further by finding better hyper

parameter values for the features. It is also possible that different features can be considered for improving the hypothesis.

12 Future Scope

There is more scope in future for research and analysis of fuel efficiency by including other factors like the road condition and real-time traffic with the help of google maps, this would help in analysing much deeper. The knowledge discovered from the research and future work can be usedby the car manufacturing companies to improve the fuel economy by considering the characteristics that substantially influence the fuel efficiency.