SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

Department of Electronics and Communication Engineering

Domain: Applied Data Science

Team ID: PNT2022TMID21861

Car Resale Value Prediction

A Project Report

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1. INTRODUCTION:

1.1 Project Overview:

Determining whether the listed price of a used car is a challenging task, due to the many factors that drive a used vehicle's price on the market. The focus of this project is developing machine learning models that can accurately predict the price of a used car based on its features, in order to make informed purchases. We implement and evaluate various learning methods on a dataset consisting of the sale prices of different makes and models . We will compare the performance of various machine learning algorithms like Linear Regression, Ridge Regression, Lasso Regression, Elastic Net, Decision Tree Regressor and choose the best out of it. Depending on various parameters we will determine the price of the car. Regression Algorithms are used because they provide us with continuous value as an output and not a categorized value because of which it will be possible to predict the actual price a car rather than the price range of a car. User Interface has also been developed which acquires input from any user and displays the Price of a car according to user's inputs.

1.2 Purpose:

The increased prices of new cars and the financial incapability of the customers to buy them, used car sales are on a global increase. Therefore, there is an urgent need for a used car price prediction system which effectively determines the worthiness of the car using a variety of features. Car Resale Value Prediction helps the user to predict the resale value of the car depending upon the various features like kilometres driven, fuel type etc., This resale value prediction system is made for general purpose to just predict the amount that can be roughly acquired by the user.

2. LITERATURE SURVEY:

2.1 Existing Problem

'Car Price Prediction Using Machine Learning Techniques' according to authors Enis Gegic, Becir Isakovic, Dino Keco, Zerina Masetic, Jasmin Kevric, in this paper they mainly concentrate on collecting various data from web portal by using web scrap techniques. And those have been compared with the help of different machine learning algorithms to predict the vehicle price in easy manner. They classified the price according to different ranges of price that is already given. Artificial neural network, support vector machine, random forest algorithms were used on different datasets to build classifiers model. In the existing system, to predict the price of vehicles both two wheelers and four wheelers, a lot of data mining algorithms and machine learning algorithms were widely used. The major drawback of this existing system is they need more attributes in order to predict the vehicle price. More comparison techniques must be used to get the result more efficiently. It is highly complicated to get sufficient data sets that were spread widely all over the world. The datasets can be collected only through online. But not on the offline mode. It is not possible for everyone to collect the data sets through online mode particularly in rural areas. The data sets will not have about the vehicles which were not used for long time and also the traditional model vehicles may or may not be included in the data sets.

'Predicting the Price of Used Cars Using Machine Learning Techniques' according to author Sameerchand Pudaruth they have done the predictions of car price from the historical data that has been collected from daily newspapers. For predicting the price of vehicles, they 4 have used supervised machine learning techniques. Other algorithms were also used to predict such as multiple linear regression, some decision tree algorithms. All these algorithms were

compared and found the best algorithm for prediction. They have faced some difficulties in comparing the algorithms, somehow, they have managed. The major drawbacks of existing system are the system is very slow due to most of the works about the keyword query just analyse individual points, and they are inappropriate to many applications that call for analysis of groups of different vehicle points. In the existing system shown above, authors proposed prediction model based on the single machine learning algorithm. However, it is noticeable that single machine learning algorithm approach did not give remarkable prediction results and could be enhanced by assembling various machine learning methods in an ensemble. In future, gaining advancement in this system model we could rely on this to predict the value. Generally, e-commerce platforms attract customers in different ways to use their system for buying or selling and the algorithm which is used in their system is such that the value is not accurate It is overpriced when a customer wants to buy a car and vice versa while selling. Also referring to the tremendous loss reported of worth more than a billion dollars in Germany due to mis-calculation of the car value which could be overcome using this prediction application. Further, we may add large historical data of car price which can help to improve accuracy of the machine learning model. We can build an android app for better user interaction and for better performance, we plan to judiciously design deep learning network structures, use adaptive learning rates and train on clusters of data rather than the whole dataset.

2.2 References:

➤ **Car Price Prediction Using Machine Learning Techniques**

Ref- TEM Journal. Volume 8, Issue 1, Pages 113-118, ISSN 2217- 8309, DOI:10.18421/TEM81-16, February 2019.

➤ **Predicting the Price of Used Cars Using Machine Learning Techniques**

Ref: International Journal of Information and Computation Technology. ISSN

0974-2239 Volume 4, Number 7 (2014).

2.3 Problem statement definition:

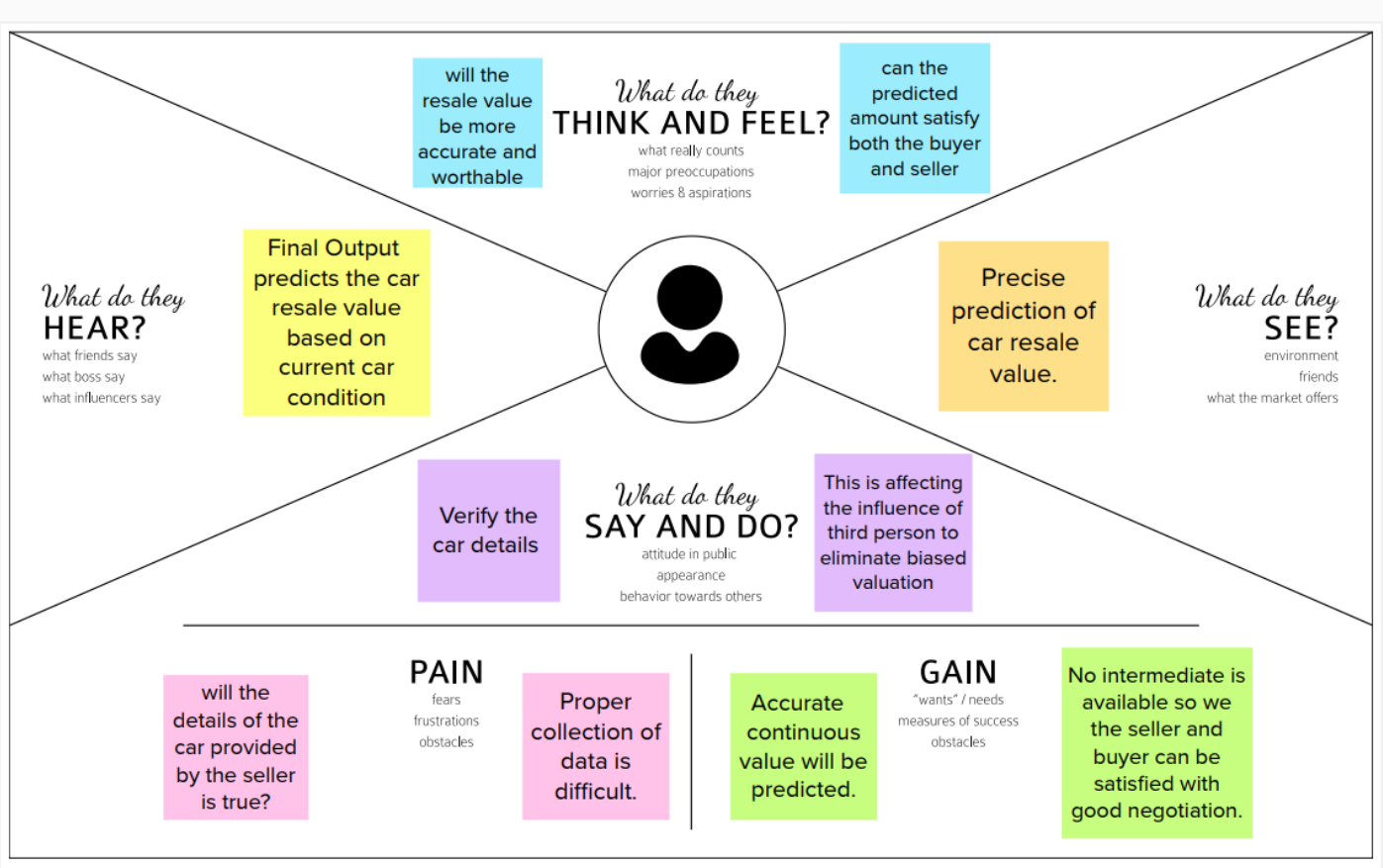
Machine learning has become a tool used in almost every task that requires estimation. We need to build a model to estimate the price of used cars. The model should take car related parameters and gives output as a selling price. The selling price of a used car depends on certain features as Fuel type, Manufacturing year, Miles driven, Number of owners. This is a supervised learning problem and can be solved using regression techniques. We need to predict the selling price of a car based on the given car's features. Regression problems require labelled data where our target or dependent variable is the selling price of a car. All other features are independent variables. Some regression algorithms are linear regression, Decision tree Regressor, Random Forest Regressor etc.,

3. IDEATION AND PROPOSED SOLUTION:

3.1 Empathy Map Canvas:

An empathy map is a simple, easy to digest visual that captures knowledge about a user’s behaviours and attitude. It is a useful tool to helps 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.

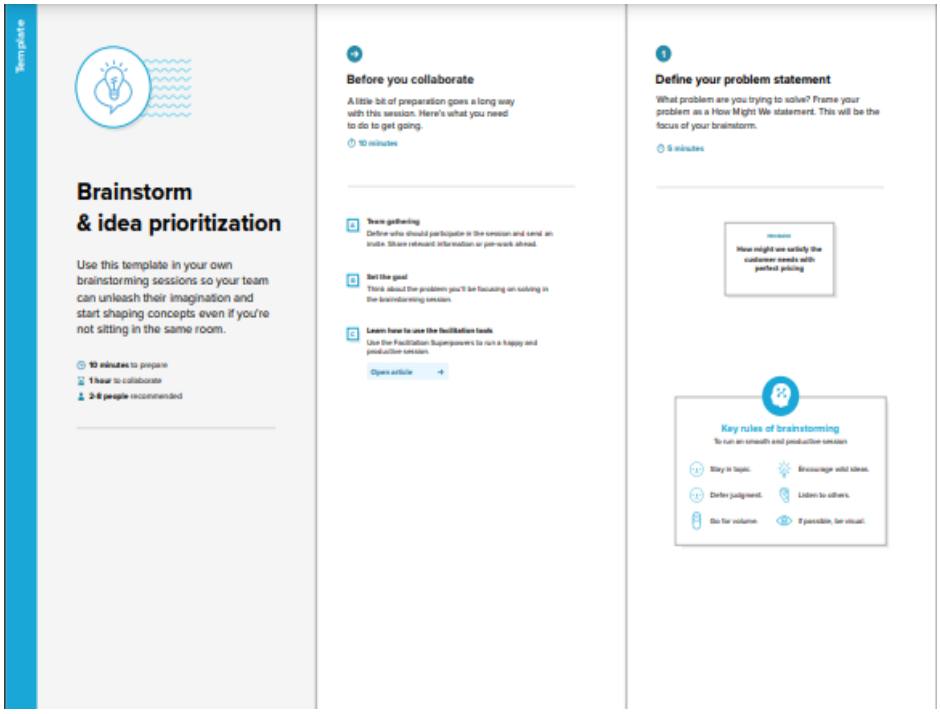
Empathy map for Car Resale value prediction:



3.2 Ideation and brainstorming:

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, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

Brainstorming and idea prioritization Template for Car Resale Value Prediction



2 Brainstorm

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

10 minutes

Vishal

- Research more on the usage of the car
- Try to find the accident history of the car if any
- Find whether the car has good interior design

Umashankar

- Check how many kilometers the car has covered to know the usage of the car
- Check the current demand of the car
- Check whether the car gives good mileage by drying its tank

Susiragul

- price estimation of the car can be arrived through individual inspection of parts of the vehicle
- Check the deprciation of the car
- Check the engine quality of the car

Santhosh

- Check whether the customer satisfaction is fulfilled after driving the car
- Check the logbook and vehicle history to know how many owners did the car had
- Check whether any alterations has been made to the car by the previous owmer

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 and break it up into smaller sub-groups.

20 minutes

Note the model of the car

Predict based on sale of that previous car

Check the car's condition for predicting the perfect price

Find the criminal records If any

Note the fuel capacity of the car and also its mileage

It will be an user friendly application

Can get a value of the car at 60 - 70 % accuracy rate

Check how many kilometers the car has covered

Have a view on registration certificate for clearance

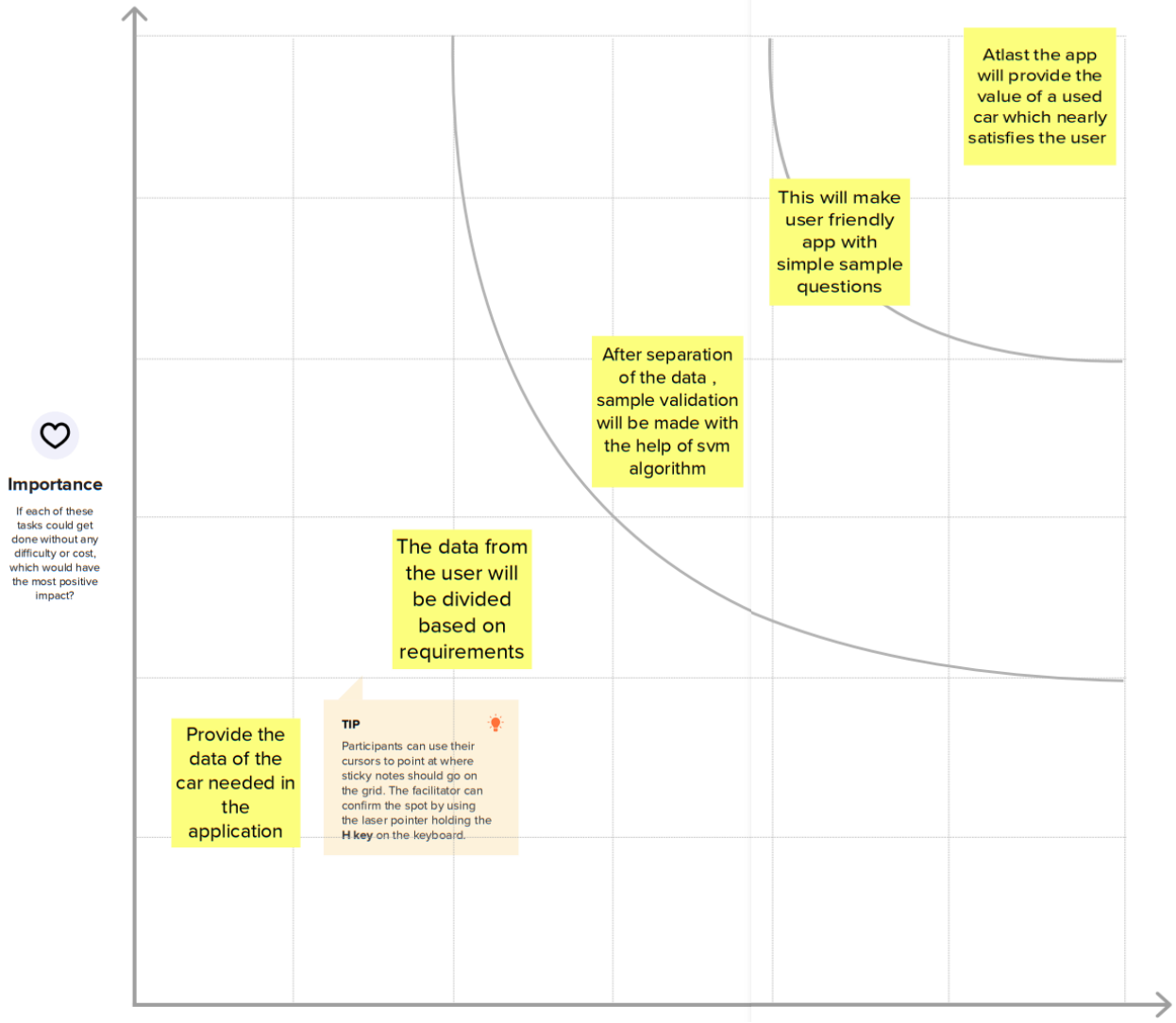
Check the road tax receipt and no objection certificate

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



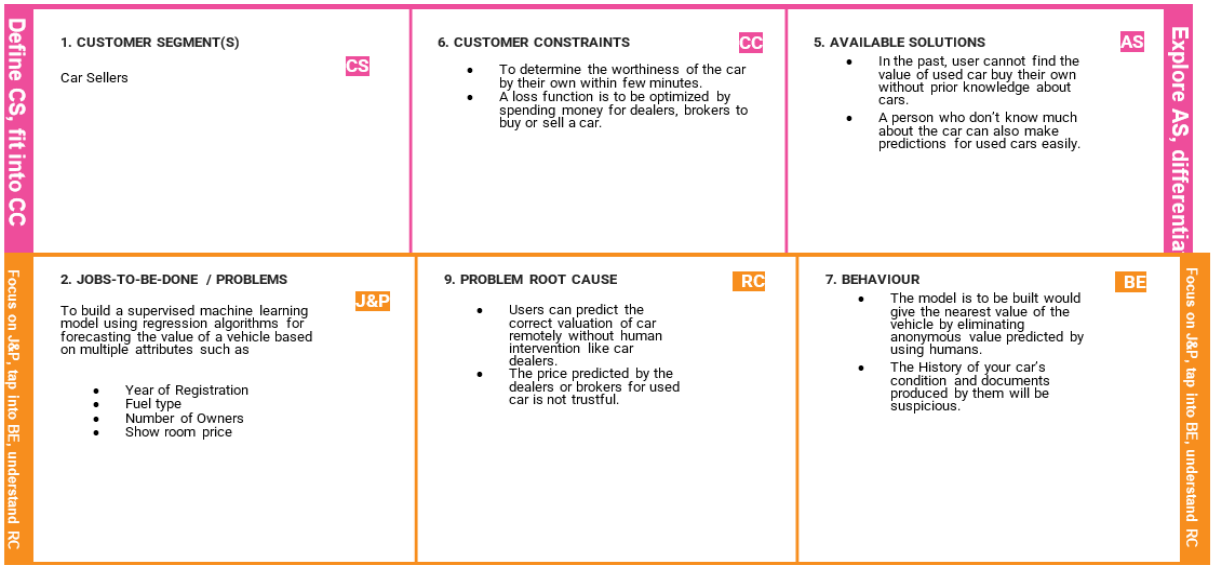
3.3 Proposed Solution:

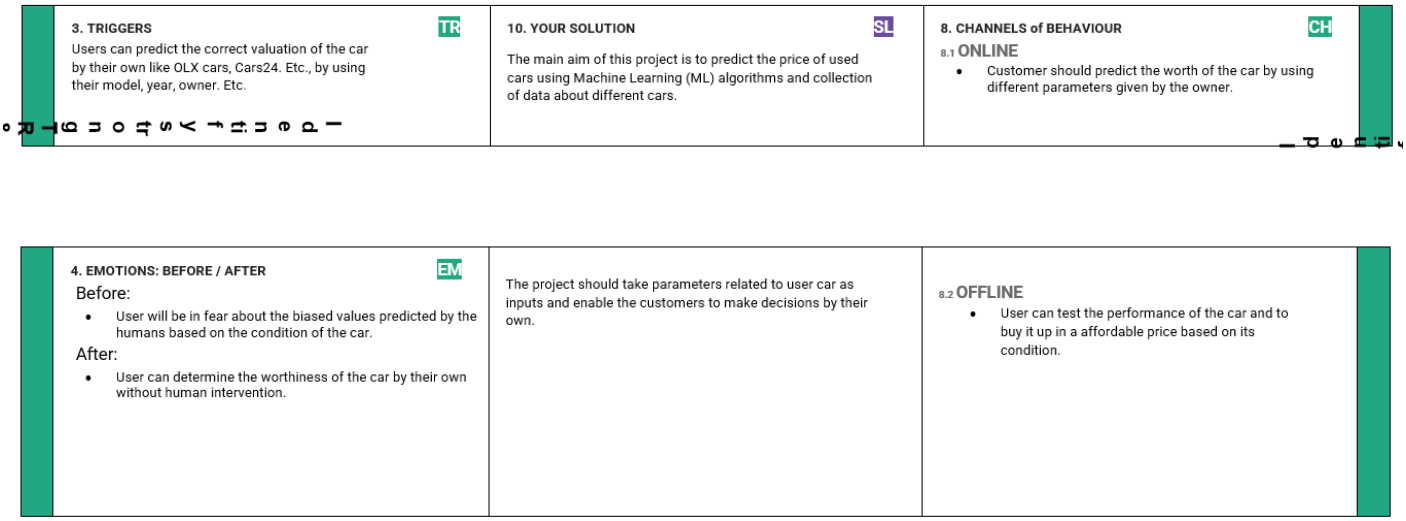
S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Currently, if anyone wants to sell their car, they have to take their car to a respective company workshop or have a to make an appointment for the company to get an es mate of the price. This process involves of lot of me and resources.
2.	Idea / Solution description	Especially for the first customers, a used purchase is more practical and affordable at the same me. Unless you really want the latest car in the market or that new car smell is all you are looking for, a used car can very well cater to almost all types of buyers quite conveniently
3.	Novelty / Uniqueness	Looks Matter for A Be er Car Resale Value. A Service Ensures Good Car Resale Value. Keep All Papers in Place. Novelty is car resale Get Phone Numbers, Address, Photos, Maps of Novelty Tata.
4.	Social Impact/ Customer Satisfaction	Became obsessed with customer feedback, create a sense of convenience, deliver fast responses, satisfaction is a company –wide focus. Customer Satisfaction, Look and style, fuel consumption, Pulling power, sea ng capacity, riding comfort, safety features and speed.

5.	Business Model (Revenue Model)	How to start a car merchant business. Generally, it is considered that if you want to start a car merchant business, you need a huge capital to invest. Dealer license.

		Location of the business. Keep a watch on the market. Make your catalog. Use a perfect marketing strategy.
6.	Scalability of the Solution	The size of the used car market in India was over 4.4 million units in 2020, according to Statista. The start-up has managed to strive ahead by leveraging a robust managed marketplace business model, while proving that it is economically viable and independent of scale due to the use of technology, economy of scale, economy of scope, asset light, and network effects.

3.4 Problem Solution Fit:





4. REQUIREMENT ANALYSIS:

4.1 Functional Requirement:

FR No.	Functional Requirement (Epic)	Sub Requirement (Story/ Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Profile	User Details
FR-4	Database	Car Database Customer Database
FR-5	Features and technology	Performance of the car , fuel capacity , mileage etc.,
FR-6	Feedback	Feedback through Form Feedback through Gmail Feedback through LinkedIn

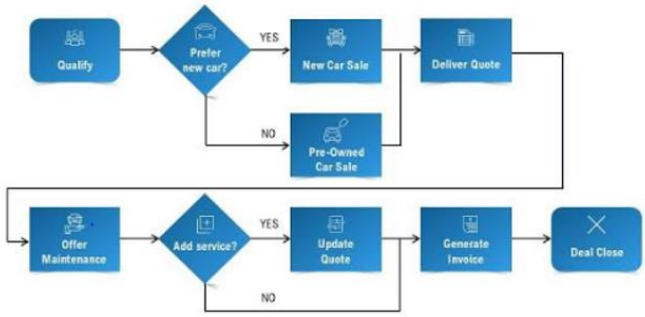
4.2 Non-Functional Requirement:

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Great UI (User Interface), Accuracy in value prediction
NFR-2	**Security**	Protect user password and Personal details
NFR-3	**Reliability**	Rate of occurrence of failure is less, Failure free.
NFR-4	**Performance**	Perform correct prediction value, The landing page support several users and must provide 5 second or less response me
NFR-5	**Availability**	Uninterrupted services must be available in all me except the me of server updated.
NFR-6	**Scalability**	that can handle any amount of data and perform many computations in a cost-effective and timesaving way to instantly serve millions of users residing at global locations

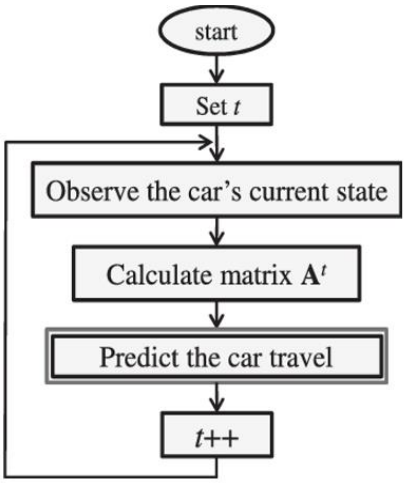
5. PROJECT DESIGN:

5.1 Data flow diagram

A Data flow diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

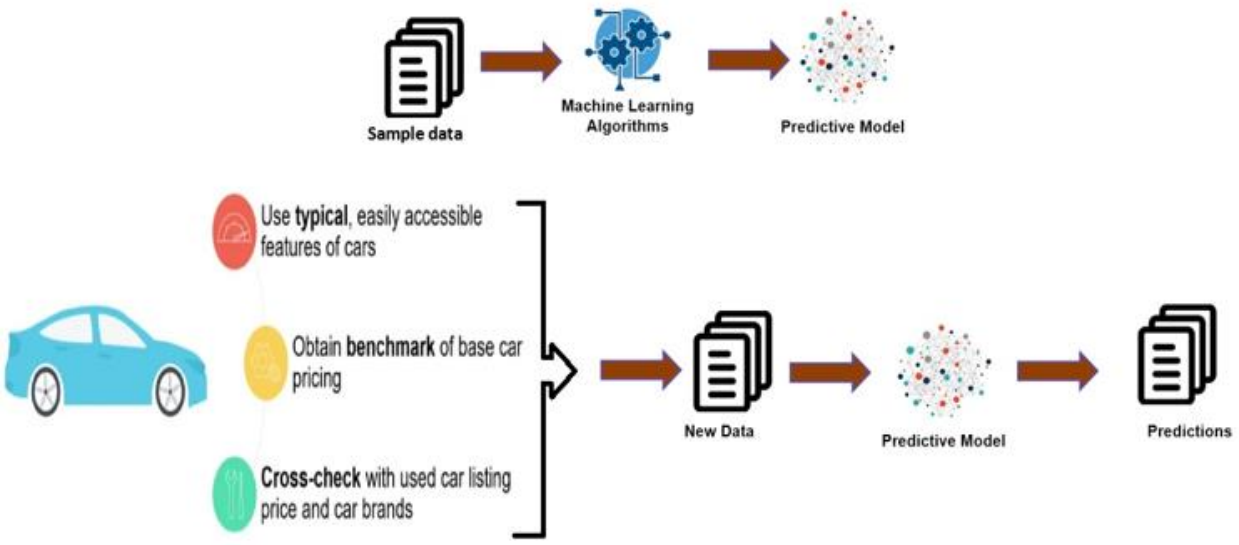


Flow of the process



DFD Level 0 (Industry Standard)

5.2 Solution and Technical Architecture



5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	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 Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail	I can register & access the application through G-mail	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can log into the application by entering email & password	High	Sprint-1
	Dashboard	USN-6	As a user, I can register & access the dashboard with Facebook Login	I can access the dashboard thorugh facebook login and get access to various tools	Medium	Sprint-1
Customer (Web user)	Registration	USN-6	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
Customer Care Executive	Access	USN-7	As a user, I can connect to the custmer care executive through contact number or email.	I can connect to the custmer care executive and clarify my doubts through contact number or email.	High	Sprint-1
Administrator	Documents verification	USN-8	As a user, I can get my details and documents verified virtually from the comfort of my home.	, I can get my details and documents verified virtually from the comfort of my home.	High	Sprint-1
	Login verification	USN-9	As a user, I can get my login details verified virtually from the comfort of my home through OTP.	I can get my login details verified virtually from the comfort of my home through OTP.	High	Sprint-1

6. PROJECT PLANNING AND SCHEDULING:

6.1 Sprint Planning and Estimation

Sprint	Functional (Requirements)	User Story Number	User story/Task	Story points	Priority
Sprint 1	Home page	USN 1	As a user, I can view the home page of the web application.	20	Low
Sprint 2	Car resale value display	USN 2	As a user, I can be redirected to the data entry page.	20	medium
Sprint 3	Required data entry	USN 3	As a user, I can enter my car details in the required fields.	20	medium
Sprint 4	Resale vale prediction	USN 4	As a user, I expect the application to predict the resale value of my car.	20	medium

6.2 Sprint Delivery and 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-1	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

6.3 Reports from JIRA

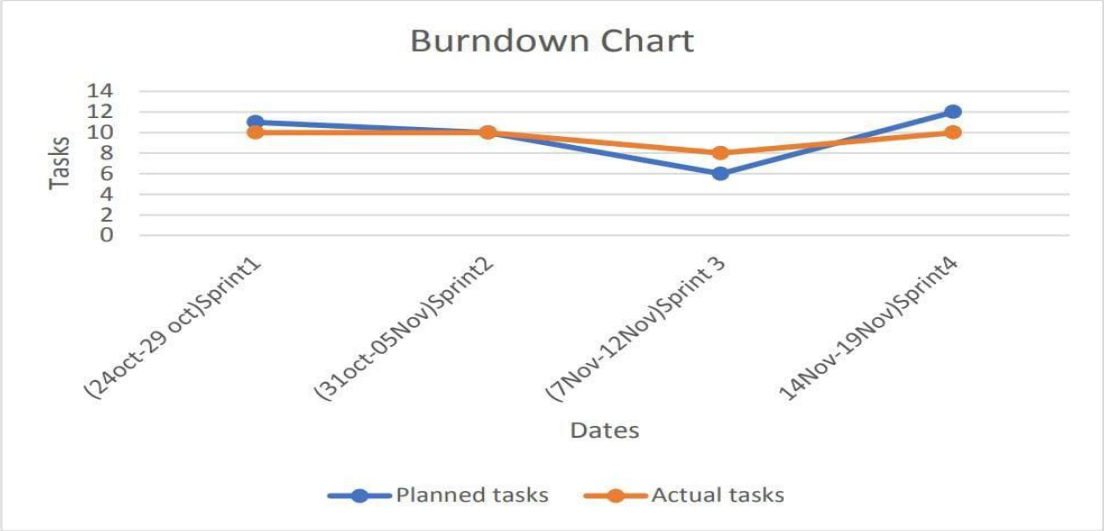
Velocity:

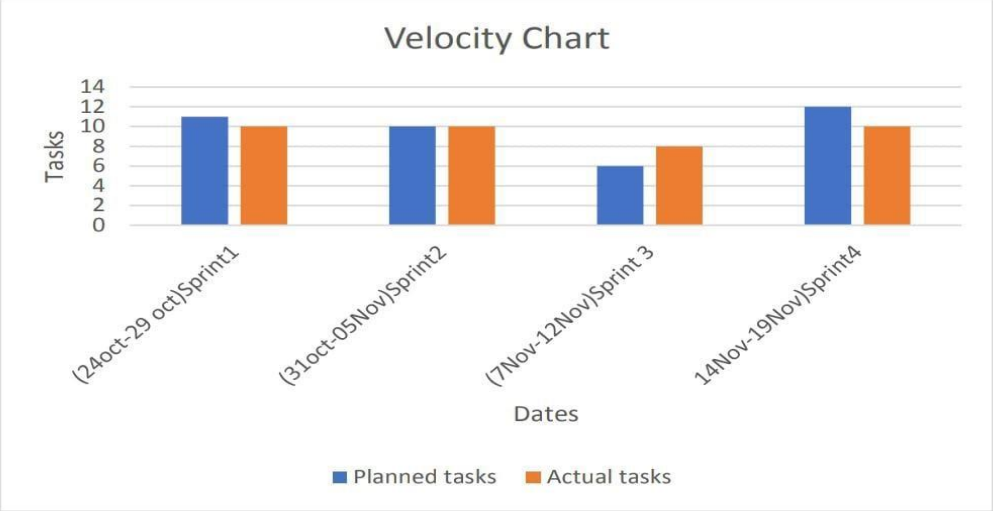
Imagine we have a 10-day sprint duration , and the velocity of the team is 20 (point per sprint). Lets calculate the teams average velocity(AV) per iteration unit(story points per day).

AV = Sprint duration/velocity = 20/10 =2

Burndown Chart:

A burndown chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as Scrum. However, burndown chart can be applied to any project containing measurable progress over time.





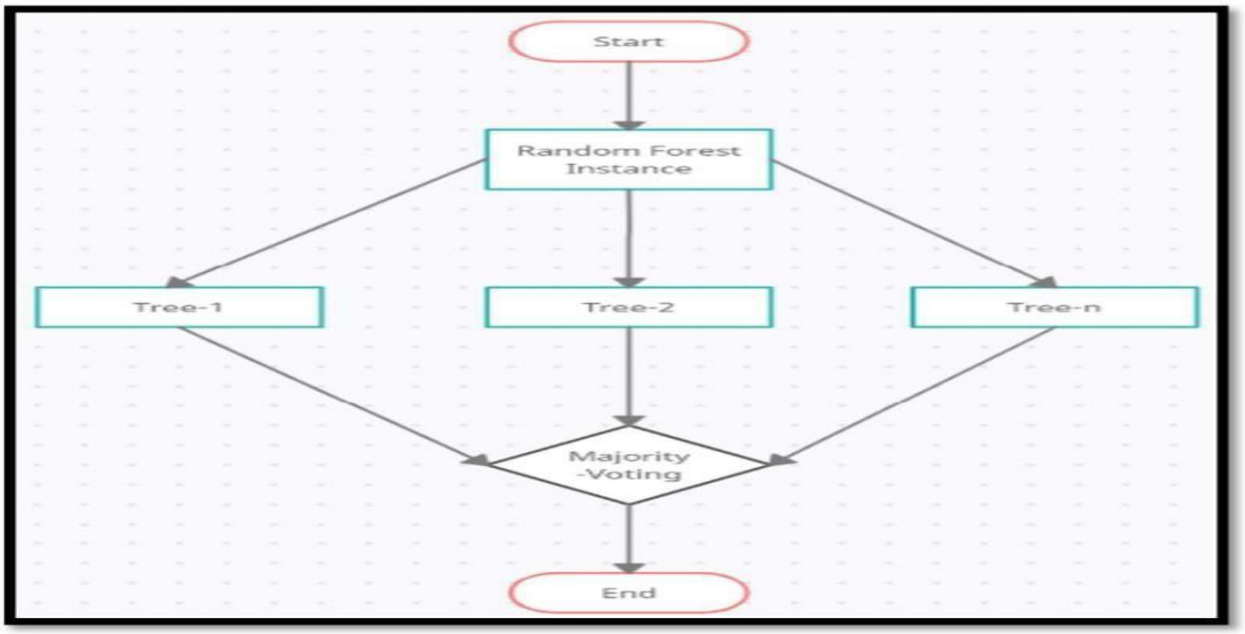
7.CODING AND SOLUTIONING:

7.1 Analysis of Algorithm:

There are several algorithms a person can use to predict a value as every algorithm itself has different significance and its own equation to predict. Algorithms like linear regression, Lasso regression, Ridge regression, Random forest regression, XGBoost, etc. have different equation through which we get a predicted value using past data.

Random Forest Regression:

We will see steps that has helped us to build this model for car value prediction; Firstly, we have imported dataset of different cars and their year, kms driven, fuel type, transmission, etc. These are the attributes which we are going to need to predict. Then we will be using feature engineering where we will correlate between attributes in our dataset.



Algorithms	Result
Linear Regression	0.872812
Lasso regression	0.836209
Ridge Regression	0.872582
Random Forest Regression	0.970449
XGBoost	0.919372

Here we can see Random forest regression is getting more accuracy than rest of the algorithms after comparing with our data which we are using in this project to predict the car value.

Dataset Description:

Dataset was collected from the website called Kaggle.Kaggle allows users to find and publish datasets, explore and build in a web based data science environment, work with other data science environment, work with other data scientists and machine learning engineers. The data set includes car name, year, selling price, present price, kilometres driven, fuel type, seller type, Transmission type and owner.

Dataset:

Car_name	Year	Selling_pric	Present_pric	Kms_Driven	Fuel_type	Seller_type	Transmission	
ritz	2014	3.35	5.59	27000	Petrol	Dealer	Manual	0
sx4	2013	4.75	9.54	43000	Diesel	Dealer	Manual	0
ciaz	2017	7.25	9.85	6900	Petrol	Dealer	Manual	0
wagon r	2011	2.85	4.15	5200	Petrol	Dealer	Manual	0
swift	2014	4.6	6.87	42450	Diesel	Dealer	Manual	0
vitara brezz	2018	9.25	9.83	2071	Diesel	Dealer	Manual	0
ciaz	2015	6.75	8.12	18796	Petrol	Dealer	Manual	0
s cross	2015	6.5	8.61	33429	Diesel	Dealer	Manual	0
ciaz	2016	8.75	8.89	20273	Diesel	Dealer	Manual	0
ciaz	2015	7.45	8.92	42367	Diesel	Dealer	Manual	0
alto 800	2017	2.85	3.6	2135	Petrol	Dealer	Manual	0
ciaz	2015	6.85	10.38	51000	Diesel	Dealer	Manual	0
ciaz	2015	7.5	9.94	15000	Petrol	Dealer	Automatic	0
ertiga	2015	6.1	7.71	26000	Petrol	Dealer	Manual	0
dzire	2009	2.25	7.21	77427	Petrol	Dealer	Manual	0
ertiga	2016	7.75	10.79	43000	Diesel	Dealer	Manual	0
ertiga	2015	7.25	10.79	41678	Diesel	Dealer	Manual	0

Data Pre-Processing:

Data pre-processing is a process of preparing the raw data and making it suitable for a machine learning model. It is the first and crucial step while creating a machine learning model. While creating a machine learning project, it is not always a case that we come across the clean and formatted data and while doing a any operation with data, it is mandatory to clean it and put in a formatted way. So for this, we use data pre-processing task.

Explanation of code:

Importing Dataset:

The data consists of some rows and columns. Since our target is to find the selling price, the target attribute y is also selling price, remaining features are taken for analysis and predictions.

```
df = pd.read_csv('/content/drive/MyDrive/Imarticus/autos.csv', sep=',', header=0, encoding='cp1252')
#df = pd.read_csv('autos.csv.gz', sep=',', header=0, compression='gzip',encoding='cp1252')
df.sample(10)
```

	dateCrawled	name	seller	offerType	price	abtest	vehicleType	yearOfRegistration	gearbox	powerPS	model	kilometer	monthOfRegi
35533	2016-04-01 16:52:24	Peugeot_206_5Tuerer_Klima_El_Fenster_2_Hand_8f...	privat	Angebot	999	control	kleinwagen	1999	manuell	75	2_reihe	150000	
104233	2016-03-26 20:58:26	Citroën_C4_Picasso_2.0_HDi_FAP_EGS6_Exclusive	privat	Angebot	9500	control	bus	2008	automatik	136	c4	125000	
81172	2016-04-01 22:53:21	Volkswagen_Passat_Variant_1.9_TDI_DPF_Comfortline	privat	Angebot	6666	test	kombi	2009	manuell	105	passat	150000	
362697	2016-03-09 14:37:44	BMW_E36_Limo	privat	Angebot	2900	test	NaN	2017	NaN	0	andere	150000	
147593	2016-03-21 08:54:07	Ford_Mondeo_an_Bastler	privat	Angebot	250	control	kombi	1999	manuell	0	mondeo	150000	
254916	2016-03-26 12:45:47	Golf_VII_2.0TDI_DSG_Cup	privat	Angebot	22500	control	limousine	2014	automatik	150	golf	40000	
264392	2016-03-27 16:59:13	Peugeot_307_Premium_4Tuerig_Diesel	privat	Angebot	2790	test	NaN	2017	manuell	109	3_reihe	150000	

Correlation:

```
In [20]: final_dataset.corr()
```

Out[20]:

	Selling_Price	Present_Price	Kms_Driven	Owner	no_year	Fuel_Type_Diesel	Fuel_Type_Petrol	Seller_Type_Individual	Transmission_Manual
Selling_Price	1.000000	0.878983	0.029187	-0.088344	-0.236141	0.552339	-0.540571	-0.550724	-0.367128
Present_Price	0.878983	1.000000	0.203647	0.008057	0.047584	0.473306	-0.465244	-0.512030	-0.348715
Kms_Driven	0.029187	0.203647	1.000000	0.089216	0.524342	0.172515	-0.172874	-0.101419	-0.162510
Owner	-0.088344	0.008057	0.089216	1.000000	0.182104	-0.053469	0.055687	0.124269	-0.050316
no_year	-0.236141	0.047584	0.524342	0.182104	1.000000	-0.064315	0.059959	0.039896	-0.000394
uel_Type_Diesel	0.552339	0.473306	0.172515	-0.053469	-0.064315	1.000000	-0.979648	-0.350467	-0.098643
uel_Type_Petrol	-0.540571	-0.465244	-0.172874	0.055687	0.059959	-0.979648	1.000000	0.358321	0.091013
_Type_Individual	-0.550724	-0.512030	-0.101419	0.124269	0.039896	-0.350467	0.358321	1.000000	0.063240
mission_Manual	-0.367128	-0.348715	-0.162510	-0.050316	-0.000394	-0.098643	0.091013	0.063240	1.000000

Now we are slicing the data into training and test set.

```
In [26]: ##independent and dependent features
         X=final_dataset.iloc[:,1:]
         y=final_dataset.iloc[:,0]
```

Elimination of unwanted features:

The Extra Trees Regressor library allows you to view feature importance and thereby remove the less important features from the data. It is always advised to

remove the unnecessary feature because they can definitely yield better accuracy scores.

```
In [29]: ### Feature Importance

         from sklearn.ensemble import ExtraTreesRegressor
         model = ExtraTreesRegressor()
         model.fit(X,y)

Out[29]: ExtraTreesRegressor()
```

```
In [30]: print(model.feature_importances_)

         [0.37357135 0.04555725 0.00107922 0.07372164 0.23153707 0.01240199
          0.12378753 0.13834395]
```

Training and Test Split:

The train-test split used to estimate the performance of machine learning algorithms that are applicable for prediction-based algorithms. This method is a fast and easy procedure to perform such that we can compare our own machine learning model results to machine results.

```
In [32]: 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)
```

Training the model:

We have used the random forest Regressor to predict the selling prices since this is a regression problem and that random forest uses multiple decision trees and has shown good results for my model.

```
In [33]: from sklearn.ensemble import RandomForestRegressor
         rf_random=RandomForestRegressor()

In [34]: ##Hyperparameters

         import numpy as np
         n_estimators = [int(x) for x in np.linspace(start = 100, stop = 1200, num = 12)]
         print(n_estimators)

         [100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200]
```

Hyper Parameter Optimization:

In [35]:
```
#Randomized Search CV

# Number of trees in random forest
n_estimators = [int(x) for x in np.linspace(start = 100, stop = 1200, num = 12)]
# Number of features to consider at every split
max_features = ['auto', 'sqrt']
# Maximum number of levels in tree
max_depth = [int(x) for x in np.linspace(5, 30, num = 6)]
# max_depth.append(None)
# Minimum number of samples required to split a node
min_samples_split = [2, 5, 10, 15, 100]
# Minimum number of samples required at each leaf node
min_samples_leaf = [1, 2, 5, 10]
```

In [36]:
```
from sklearn.model_selection import RandomizedSearchCV
```

In [37]:
```
random_grid = {'n_estimators': n_estimators,
               'max_features': max_features,
               'max_depth': max_depth,
               'min_samples_split': min_samples_split,
               'min_samples_leaf': min_samples_leaf}

print(random_grid)
```

```
{'n_estimators': [100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100, 1200], 'max_features': ['auto', 'sqrt'], 'max_dept
h': [5, 10, 15, 20, 25, 30], 'min_samples_split': [2, 5, 10, 15, 100], 'min_samples_leaf': [1, 2, 5, 10]}
```

In [40]:
```
rf_random.fit(X_train,y_train)
```

```
Fitting 5 folds for each of 10 candidates, totalling 50 fits
[CV] END max_depth=10, max_features=sqrt, min_samples_leaf=5, min_samples_split=5, n_estimators=900; total time=   0.9s
[CV] END max_depth=10, max_features=sqrt, min_samples_leaf=5, min_samples_split=5, n_estimators=900; total time=   0.8s
[CV] END max_depth=10, max_features=sqrt, min_samples_leaf=5, min_samples_split=5, n_estimators=900; total time=   0.8s
[CV] END max_depth=10, max_features=sqrt, min_samples_leaf=5, min_samples_split=5, n_estimators=900; total time=   0.8s
[CV] END max_depth=10, max_features=sqrt, min_samples_leaf=5, min_samples_split=5, n_estimators=900; total time=   0.8s
[CV] END max_depth=15, max_features=sqrt, min_samples_leaf=2, min_samples_split=10, n_estimators=1100; total time=   1.1s
[CV] END max_depth=15, max_features=sqrt, min_samples_leaf=2, min_samples_split=10, n_estimators=1100; total time=   0.9s
[CV] END max_depth=15, max_features=sqrt, min_samples_leaf=2, min_samples_split=10, n_estimators=1100; total time=   1.1s
[CV] END max_depth=15, max_features=sqrt, min_samples_leaf=2, min_samples_split=10, n_estimators=1100; total time=   0.9s
[CV] END max_depth=15, max_features=sqrt, min_samples_leaf=2, min_samples_split=10, n_estimators=1100; total time=   1.0s
[CV] END max_depth=15, max_features=auto, min_samples_leaf=5, min_samples_split=100, n_estimators=300; total time=   0.2s
[CV] END max_depth=15, max_features=sqrt, min_samples_leaf=1, min_samples_split=15, n_estimators=300; total time=   0.2s
[CV] END max_depth=15, max_features=sqrt, min_samples_leaf=1, min_samples_split=15, n_estimators=300; total time=   0.2s
[CV] END max_depth=5, max_features=sqrt, min_samples_leaf=2, min_samples_split=10, n_estimators=700; total time=   0.6s
[CV] END max_depth=5, max_features=sqrt, min_samples_leaf=2, min_samples_split=10, n_estimators=700; total time=   0.7s
[CV] END max_depth=5, max_features=sqrt, min_samples_leaf=2, min_samples_split=10, n_estimators=700; total time=   0.6s
[CV] END max_depth=5, max_features=sqrt, min_samples_leaf=2, min_samples_split=10, n_estimators=700; total time=   0.6s
[CV] END max_depth=5, max_features=sqrt, min_samples_leaf=2, min_samples_split=10, n_estimators=700; total time=   0.6s
[CV] END max_depth=20, max_features=auto, min_samples_leaf=1, min_samples_split=15, n_estimators=700; total time=   0.7s
[CV] END max_depth=20, max_features=auto, min_samples_leaf=1, min_samples_split=15, n_estimators=700; total time=   0.7s
[CV] END max_depth=20, max_features=auto, min_samples_leaf=1, min_samples_split=15, n_estimators=700; total time=   0.7s
[CV] END max_depth=20, max_features=auto, min_samples_leaf=1, min_samples_split=15, n_estimators=700; total time=   0.7s
[CV] END max_depth=20, max_features=auto, min_samples_leaf=1, min_samples_split=15, n_estimators=700; total time=   0.6s
```

Out[40]:
```
RandomizedSearchCV(cv=5, estimator=RandomForestRegressor(), n_jobs=1,
                   param_distributions={'max_depth': [5, 10, 15, 20, 25, 30],
                                        'max_features': ['auto', 'sqrt'],
                                        'min_samples_leaf': [1, 2, 5, 10],
                                        'min_samples_split': [2, 5, 10, 15,
                                                              100],
                                        'n_estimators': [100, 200, 300, 400,
                                                         500, 600, 700, 800,
                                                         900, 1000, 1100,
                                                         1200]},
                   random_state=42, scoring='neg_mean_squared_error',
                   verbose=2)
```

Now we are finally use the model to predict the test dataset.

```
In [45]: predictions=rf_random.predict(X_test)

In [46]: predictions

Out[46]: array([ 7.02401874,  0.52168574,  4.93711392,  8.37186064, 12.32479143,
                 5.23432801,  3.36838423,  0.42969473,  3.93824504,  5.05868389,
                 2.85141883,  0.66126344,  5.06808233,  7.2587716 ,  7.45821224,
                12.63274799,  6.98157088,  4.1717805 ,  0.48428483,  1.30795166,
                 3.25008974,  5.1754389 ,  5.43804929, 10.44034459,  0.23723337,
                 0.6824487 ,  0.32796592,  0.68567623,  0.51177523,  4.85071808,
                 2.84296786,  5.88991838,  0.51368733,  7.11751535,  3.27218103,
                 1.14759745,  5.73088704,  5.50097307,  0.25750374,  7.76900176,
                 7.5946165 , 22.0146006 ,  5.06754404,  4.51565913,  5.60947326,
                10.30841657,  0.25539516,  0.75706951,  5.44377104,  6.76426193,
                 6.83967661,  2.98452932,  5.34145427, 22.01674346,  1.14759745,
                 1.14669807,  0.42096162,  2.75978594,  3.67714684,  2.53817549,
                 4.63683139])
```

```
In [50]: import pickle
         # open a file, where you ant to store the data
         file = open('random_forest_regression_model.pkl', 'wb')

         # dump information to that file
         pickle.dump(rf_random, file)
```

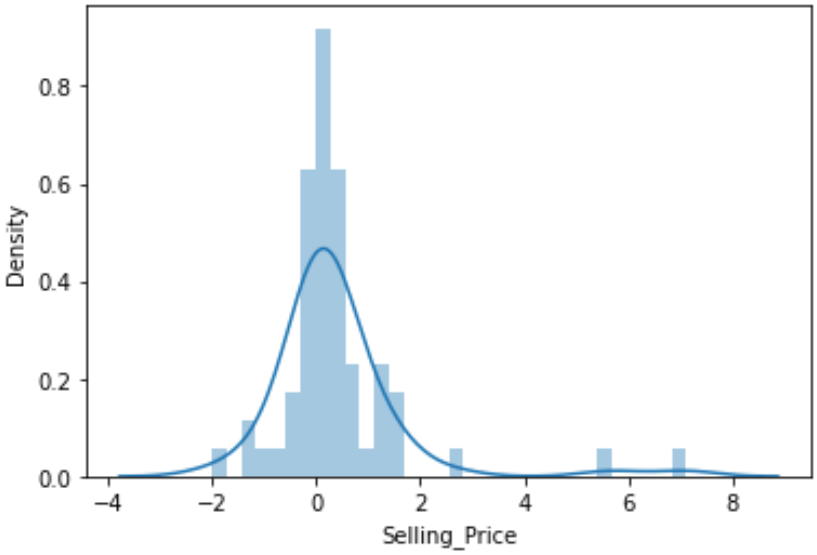
To use the flask framework for deployment it is necessary to pack this whole and import it into the python file for creating web application. Hence, we dump our model into the pickle file.

8. TESTING:

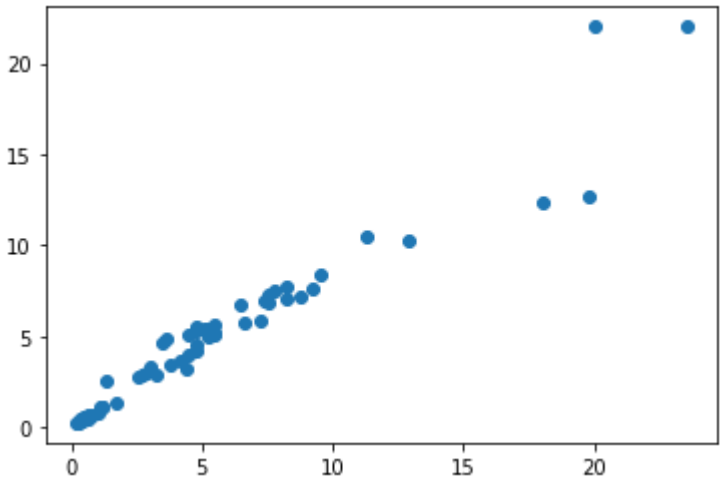
In the testing phase, we test the model using cross validation, we check the model is well or not and going is right or not, there are some technique of cross validation and we use confusion matrix for checking the model performance. We will test in all algorithms and we will get best suitable Seaborn is a python-based data visualization library based on matplotlib.

The graph, basically, shows that the model which we have created gives us a very good result as it is a normal distribution representation. The close range on the graph gives us the idea that is predicting more accurately.

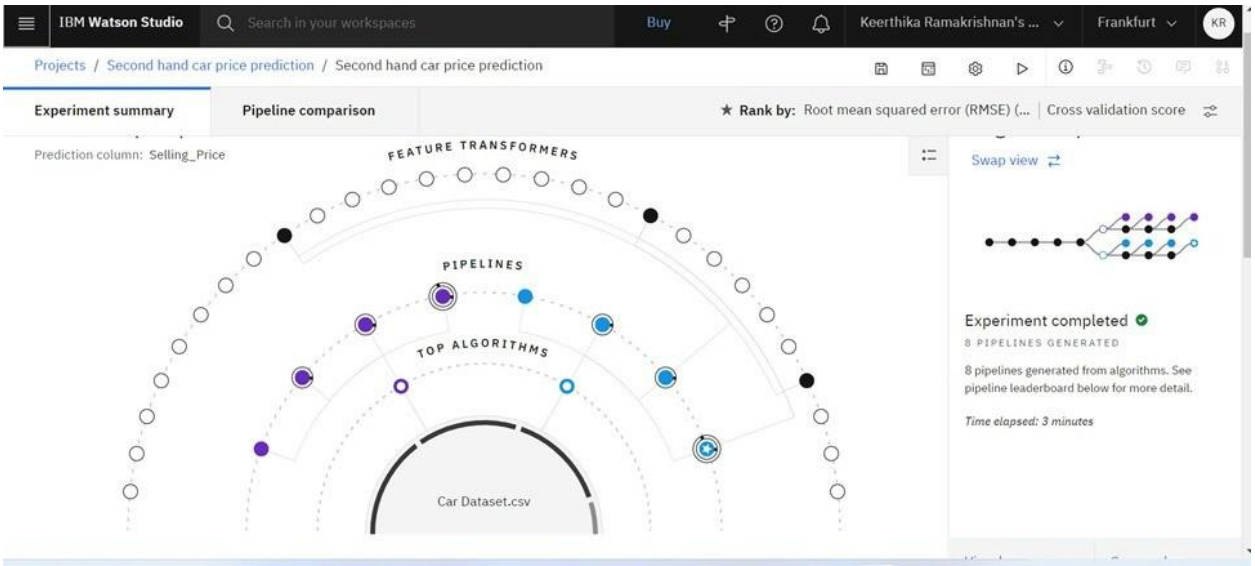
Distplot showing the distribution (Selling Price):



Scatterplot showing the Distribution:

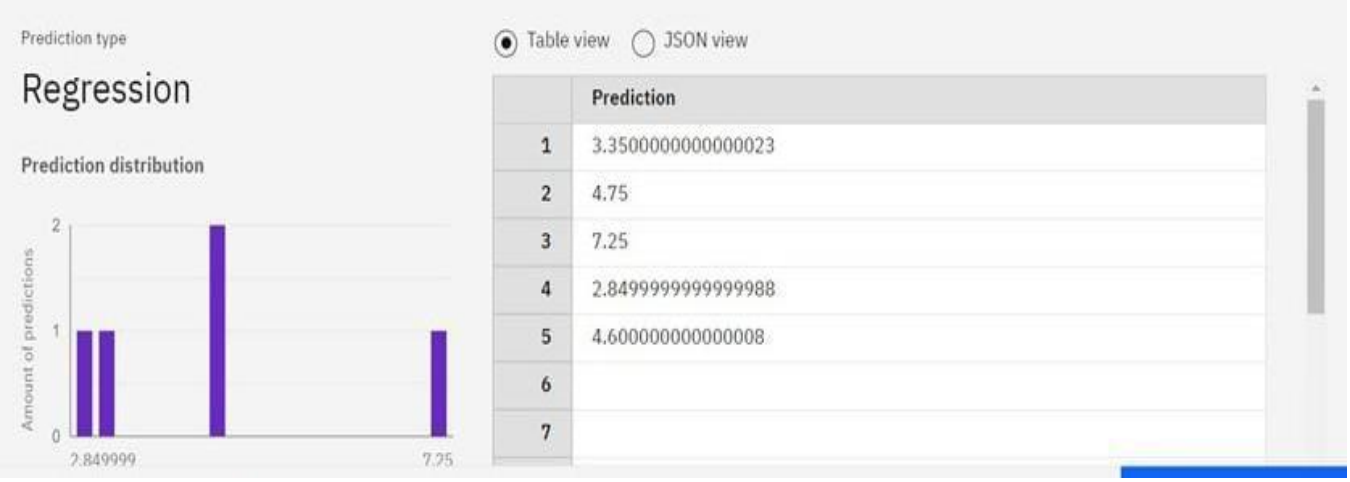


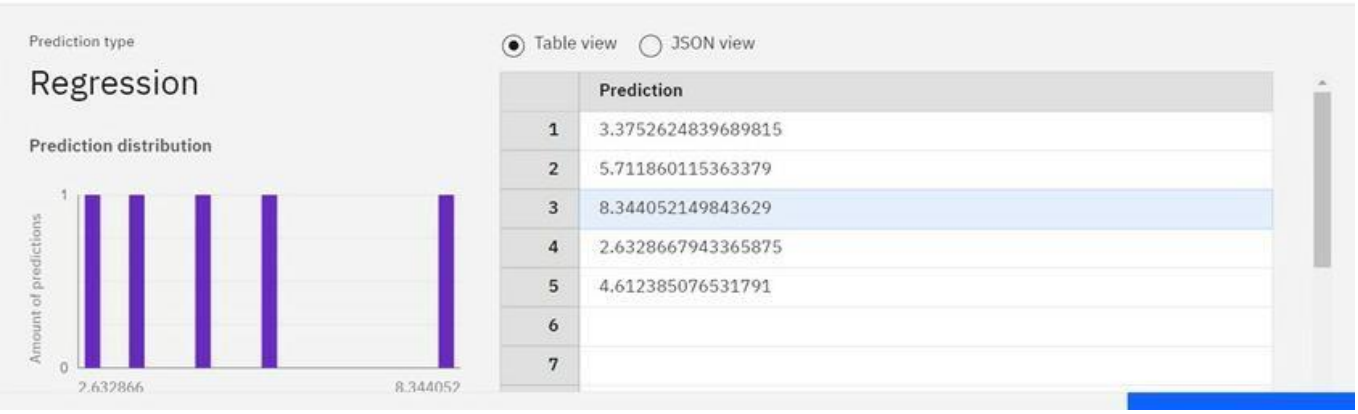
8.1 Test Cases:



ALGORITHMS	RESULTS
Random Forest Regression	0.970449
Lasso Regression	0.836209
Ridge Regression	0.872582
Linear Regression	0.872812

Prediction Results:





8.2 User Acceptance Testing:

Purpose of Document:

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

Defect Analysis:

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	2	0	3
External	3	3	0	2	8
Fixed	12	2	4	16	34
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	0	0	0	0
Totals	26	9	10	22	70

Test Case Analysis:

This report shows the number of test cases that have passed, failed, and untested

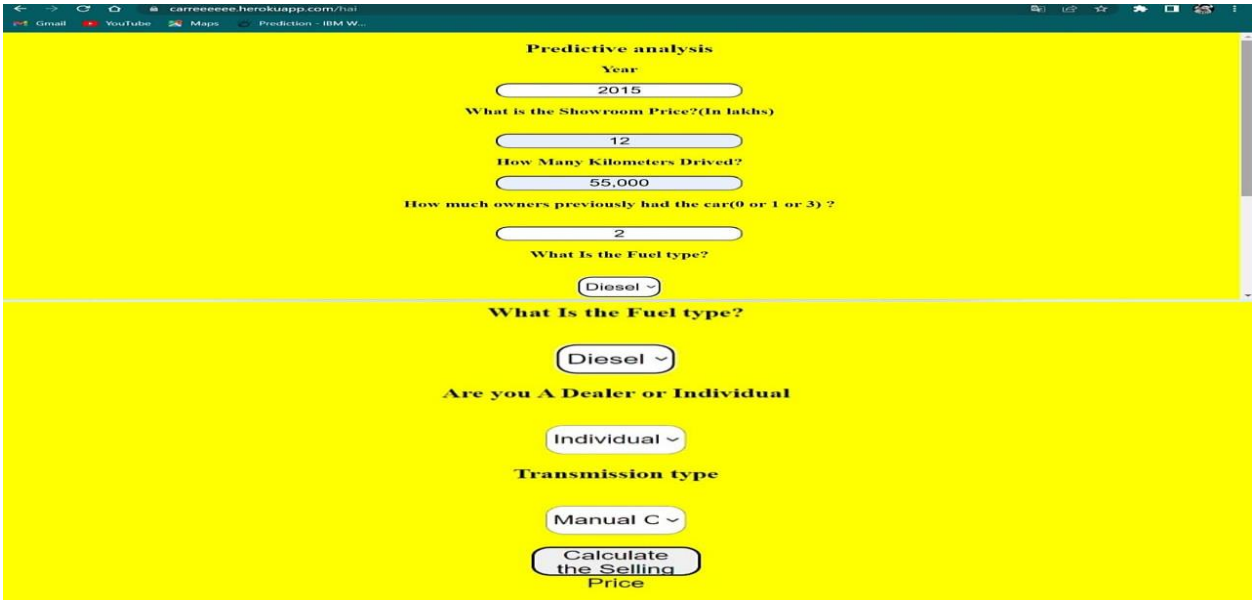
Section	Total Cases	Not Tested	Fail	Pass
Print Engine	8	0	0	8
Client Application	55	0	0	55
Security	5	0	0	5
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final ReportOutput	5	0	0	5
Version Control	2	0	0	2

9. RESULTS:

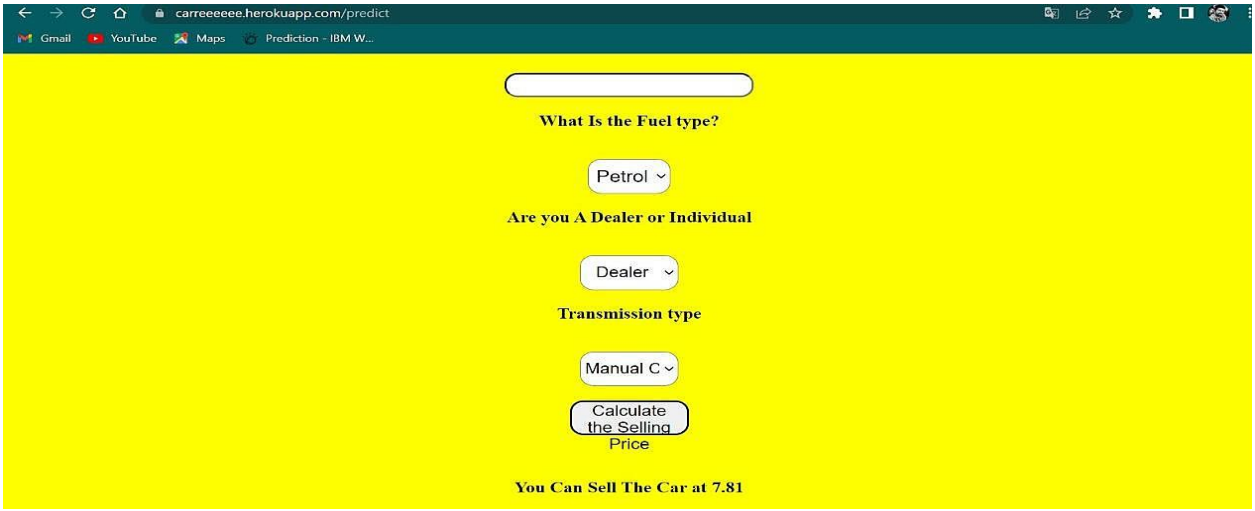
9.1 Performance Metrics:

In this we will be deploying the model on web. After testing and getting an output it would be stored in pickle file format using Python. We have used version-controlled system as GitHub and further deployed on Heroku platform making the whole process more dynamic.

Input:



Output:



10. ADVANTAGES AND DISADVANTAGES:

Advantages:

- ➤ Variants usually don't matter in the used car market. If you search well, you can get a top-spec less driven car in the used car market at a price which you would have otherwise paid for a lower variant in case of buying a new car.
- ➤ If you buy a car from a brand authorized dealership, you get a warranty on the repair.
- ➤ If we are buying a used car that was launched a year ago, you can save up to 20% on its original cost.

Disadvantages:

- ➤ Some cars may be lemons. They look fine on outside but can land in huge repair costs while you use them.
- ➤ Be a very informed customer and check each and every possible detail before buying.

11. CONCLUSION:

The model which we were making is to predict a value of second-hand car using machine learning techniques. We have collected the data of cars from Kaggle having attributes like different cars and their year, kms driven, fuel type, transmission, etc. The data is then processed using different algorithms where results of each algorithms is compared, getting Random Forest algorithm as the most accurate amongst them, so we have used Random Forest because irrespective of size it runs efficiently and gives more accuracy than any other algorithm. We have also used ExtraTressRegressor for averaging to improve the predictive accuracy and control overfitting. It works by creating a large number of unpruned decision trees from the training dataset. It adds randomization but still has optimization. Further it would be available in GUI as a Web application developed using Python flask making it user friendly so that users could give input and get the price of a car according to it.

12. FUTURE SCOPE:

- As a part of future work, we aim at the variable choices over the algorithms that were used in the project. We could only explore two algorithms whereas many other algorithms exist and might be more accurate. More specifications will be added to a system or provide more accuracy in terms of price in the system i.e.
  1) Horsepower
  2) Battery power
  3) Suspension
  4) Cylinder
  5) Torque
- As we know technologies are improving day by day and there is also advancement in-car technology, so our next upgrade will include hybrid cars, electric cars, and Driverless cars.

13. APPENDIX:

Detailed information, lengthy derivations, raw experimental observations etc. are to be presented in the separate appendices.

Web Application Code:

Python Flask Application:

```python
from flask import Flask, render_template, request
import jsonify
import requests
import pickle
import numpy as np
import sklearn
from sklearn.preprocessing import StandardScaler
app = Flask(__name__)
model = pickle.load(open('random_forest_regression_model.pkl', 'rb'))
@app.route('/')
def index():
    return render_template('index1.html')

@app.route('/hai')
def Hai():
    return render_template('index.html')

@app.route('/hello',methods=['GET'])
def Home():
    return render_template('index.html')

standard_to = StandardScaler()
@app.route("/predict", methods=['POST'])
def predict():
    Fuel_Type_Diesel=0
    if request.method == 'POST':
        Year = int(request.form['Year'])
        Present_Price=float(request.form['Present_Price'])
        Kms_Driven=int(request.form['Kms_Driven'])
        Kms_Driven2=np.log(Kms_Driven)
        Owner=int(request.form['Owner'])
        Fuel_Type_Petrol=request.form['Fuel_Type_Petrol']
```

```
        Owner=int(request.form['Owner'])
        Fuel_Type_Petrol=request.form['Fuel_Type_Petrol']
        if(Fuel_Type_Petrol=='Petrol'):
                Fuel_Type_Petrol=1
                Fuel_Type_Diesel=0
        else:
            Fuel_Type_Petrol=0
            Fuel_Type_Diesel=1
        Year=2020-Year
        Seller_Type_Individual=request.form['Seller_Type_Individual']
        if(Seller_Type_Individual=='Individual'):
            Seller_Type_Individual=1
        else:
            Seller_Type_Individual=0
        Transmission_Mannual=request.form['Transmission_Mannual']
        if(Transmission_Mannual=='Mannual'):
            Transmission_Mannual=1
        else:
            Transmission_Mannual=0
        prediction=model.predict([[Present_Price,Kms_Driven2,Owner,Year,Fuel
        output=round(prediction[0],2)
        if output<0:
            return render_template('index.html',prediction_texts="Sorry you
        else:
            return render_template('index.html',prediction_text="You Can Sel
    else:
        return render_template('index.html')

if __name__=="__main__":
    app.run(debug=True)
```

User Interface :

Index1.html:

```
<!DOCTYPE html>
<html lang="en">
 <head>
  <meta charset="UTF-8" />
  <meta name="viewport" content="width=device-width, initial-scale=1.0" />
  <title>Document</title>
  <link rel="stylesheet" href="style.css" />
 </head>
<body>
 <section class="hero">
   <div class="hero-container">
```

```
      <div class="column-left">
        <h1>Welcome to Car Resale Value Prediction</h1>
        <p>
          With difficult economic condition, it is likely that sales of secondhand car will increase. In many developed countries, it is common to lease a car rather than buying. In order to predict the resale value of the car we proposed a effective system based on using regression algorithms.
        </p>
      <a href ="index.html">
        <button>Get Started</button></a>
      </div>
      <div class="column-right">
        <img
          src="car image.jpg"
          alt="illustration
      "
          class="hero-image"
        />
      </div>
    </div>
  </section>
 </body>
</html>
```

Index.html:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
```

```
   <title>Document</title>
</head>
<body background ="final car.png">
<body>
       <div style="color:">
      <form action="{{ url_for('predict')}}" method="post">
         <h2>Predictive analysis</h2>
         <h3>Year</h3>
         <input id="first" name="Year" type="number ">
         <h3>What is the Showroom Price?(In lakhs)</h3><br><input id="second"
name="Present_Price" required="required">
         <h3>How Many Kilometers Drived?</h3><input id="third"
name="Kms_Driven" required="required">
         <h3>How much owners previously had the car(0 or 1 or 3) ?</h3><br><input
id="fourth" name="Owner" required="required">
         <h3>What Is the Fuel type?</h3><br><select
name="Fuel_Type_Petrol" id="fuel" required="required">
            <option value="Petrol">Petrol</option>
            <option value="Diesel">Diesel</option>
            <option value="Diesel">CNG</option>
         </select>
         <h3>Are you A Dealer or Individual</h3><br><select
name="Seller_Type_Individual" id="resea" required="required">
             <option value="Dealer">Dealer</option>
             <option value="Individual">Individual</option>
          </select>
                        <h3>Transmission type</h3><br><select
name="Transmission_Mannual" id="research" required="required">
            <option value="Mannual">Manual Car</option>
            <option value="Automatic">Automatic Car</option>
         </select>
```

```
        <br><br><button id="sub" type="submit ">Calculate the Selling
Price</button>
        <br>
    </form>
      <br><br><h3>{{ prediction_text }}<h3>
    </div>
    <style>
      body {
        background-color: yellow;
        text-align: center;
        padding: 0px;
      }
      #research {
        font-size: 18px;
        width: 100px;
        height: 23px;
        top: 23px;
      }
      #box {
        border-radius: 60px;
        border-color: 45px;
        border-style: solid;
         font-family: cursive;
         text-align: center; background-color:
          rgb(168, 131, 61); font-size: medium;
          position: absolute; width:
          700px;
        bottom: 9%;
         height: 850px;
        right: 30%;
        padding: 0px;
```

```
    margin: 0px;
    font-size: 14px;
 }
#fuel {
    width: 83px;
    height: 43px;
    text-align: center;
    border-radius: 14px;
    font-size: 20px;
 }
#fuel:hover {
    background-color: white;
 }
#research {
    width: 99px;
    height: 43px;
    text-align: center;
    border-radius: 14px;
    font-size: 18px;
 }
#research:hover {
    background-color: white;
  }
 #resea { width:
     99px; height:
     43px; text-
     align: center;
     border-
     radius: 14px;
    font-size: 18px;
  }
```

```
#resea:hover {
    background-color: white;
 }
 #sub {
    width: 120px;
    height: 43px;
    text-align: center;
    border-radius: 14px;
    font-size: 18px;
 }
 #sub:hover {
    background-color: #fdcc04;
 }
 #first {
    border-radius: 14px;
    height: 25px;
    font-size: 20px;
    text-align: center;
 }
 #second {
    border-radius: 14px;
    height: 25px;
    font-size: 20px;
    text-align: center;
  }
  #third { border-radius:
      14px; height: 25px;
      font-size: 20px; text-align:
      center;
  }
 #fourth {
```

```
            border-radius: 14px;
            height: 25px;
            font-size: 20px;
            text-align: center;
        }
    </style>
</body>
</html>
```

GitHuB Link:

https://github.com/IBM-EPBL/IBM-Project-18876-1659690976