1.INTRODUCTION

1.1 Project Overview

With difficult economic conditions, it is likely that sales of second-hand imported (reconditioned) cars and used cars will increase. In many developed countries, it is common to lease a car rather than buying it outright. After the lease period is over, the buyer has the possibility to buy the car at its residual value, i.e. its expected resale value. Thus, it is of commercial interest to sellers/financers to be able to predict the salvage value (residual value) of cars with accuracy.

In order to predict the resale value of the car, we proposed an intelligent, flexible, and effective system that is based on using regression algorithms. Considering the main factors which would affect the resale value of a vehicle a regression model is to be built that would give the nearest resale value of the vehicle. We will be using various regression algorithms and algorithm with the best accuracy will be taken as a solution, then it will be integrated to the web-based application where the user is notified with the status of his product.

1.2 Purpose

The main idea of making a car resale value prediction system is to get hands-on practice for python using Data Science. Car resale value prediction is the system to predict the amount of resale value based on the parameters provided by the user. User enters the details of the car into the form given and accordingly the car resale value is predicted.

2.LITERATURE SURVEY

2.1 Existing Problem

The primary issue with the used car market in India is the sheer lack of organized players. Unorganized and Semi-Organized participants take up almost 53% of the total market share. C2C (Consumer to Consumer) sales take up 32% leaving the organized sector with only about 15% market share.

2.2 References

1. https://www.kaggle.com/jpayne/852k-used-car-listings

2. N. Monburinon, P. Chertchom, T. Kaewkiriya, S. Rungpheung, S. Buya and P. Boonpou,

"Prediction of prices for used car by using regression models," 2018 5th International Conference on Business and Industrial Research (ICBIR), Bangkok, 2018, pp. 115-119.

3. Listiani M. 2009. Support Vector Regression Analysis for Price Prediction in a Car Leasing Application. Master Thesis. Hamburg University of Technology

4. Chen, Tianqi, and Carlos Guestrin. "Xgboost: A scalable tree boosting system." Proceedings of

the 22nd acm sigkdd international conference on knowledge discovery and data mining. ACM,2016.

5. Ke, Guolin, et al. "Lightgbm: A highly efficient gradient boosting decision tree." Advances in Neural Information Processing Systems. 2017.

6. Fisher, Walter D. "On grouping for maximum homogeneity." Journal of the American statistical Association 53.284 (1958): 789-798.

7. https://scikit-learn.org/stable/modules/classes.html: Scikit-learn: Machine Learning in Python, Pedregosa et al., JMLR 12, pp. 2825-2830, 2011.

2.3 Problem Statement Definition

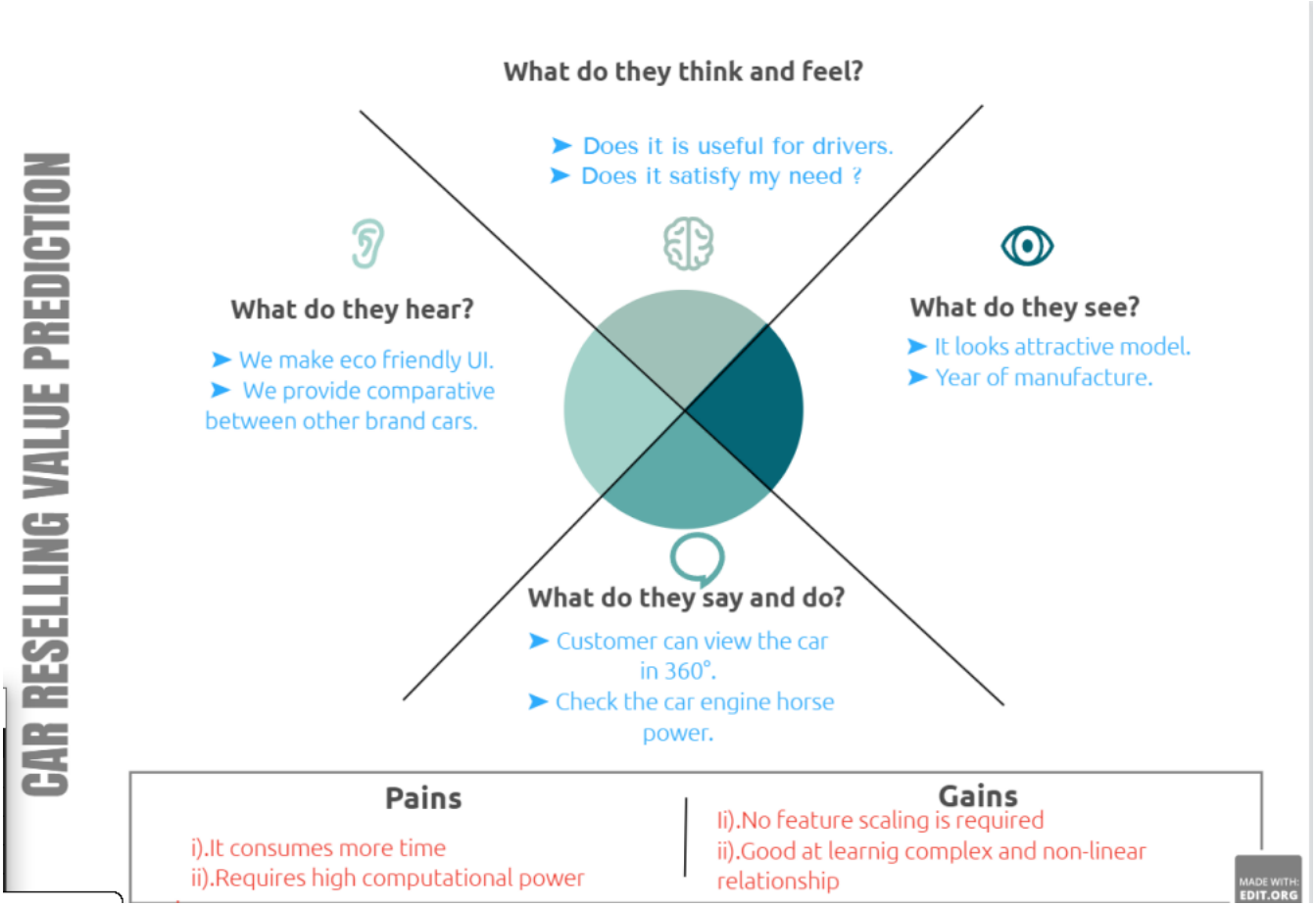
The main aim of this project is to predict the price of used cars using the various Machine Learning (ML) models. This can enable the customers to make decisions based on different inputs or factors namely

- Brand or Type of the car one prefers like Ford, Hyundai
- Model of the car namely Ford Figo, Hyundai Creta
- Location like Delhi, Chennai, Mumbai
- Year of manufacturing like 2020, 2021
- Type of fuel namely Petrol, Diesel
- Price range or Budget
- Type of transmission which the customer prefers like Automatic or Manual
- Mileage

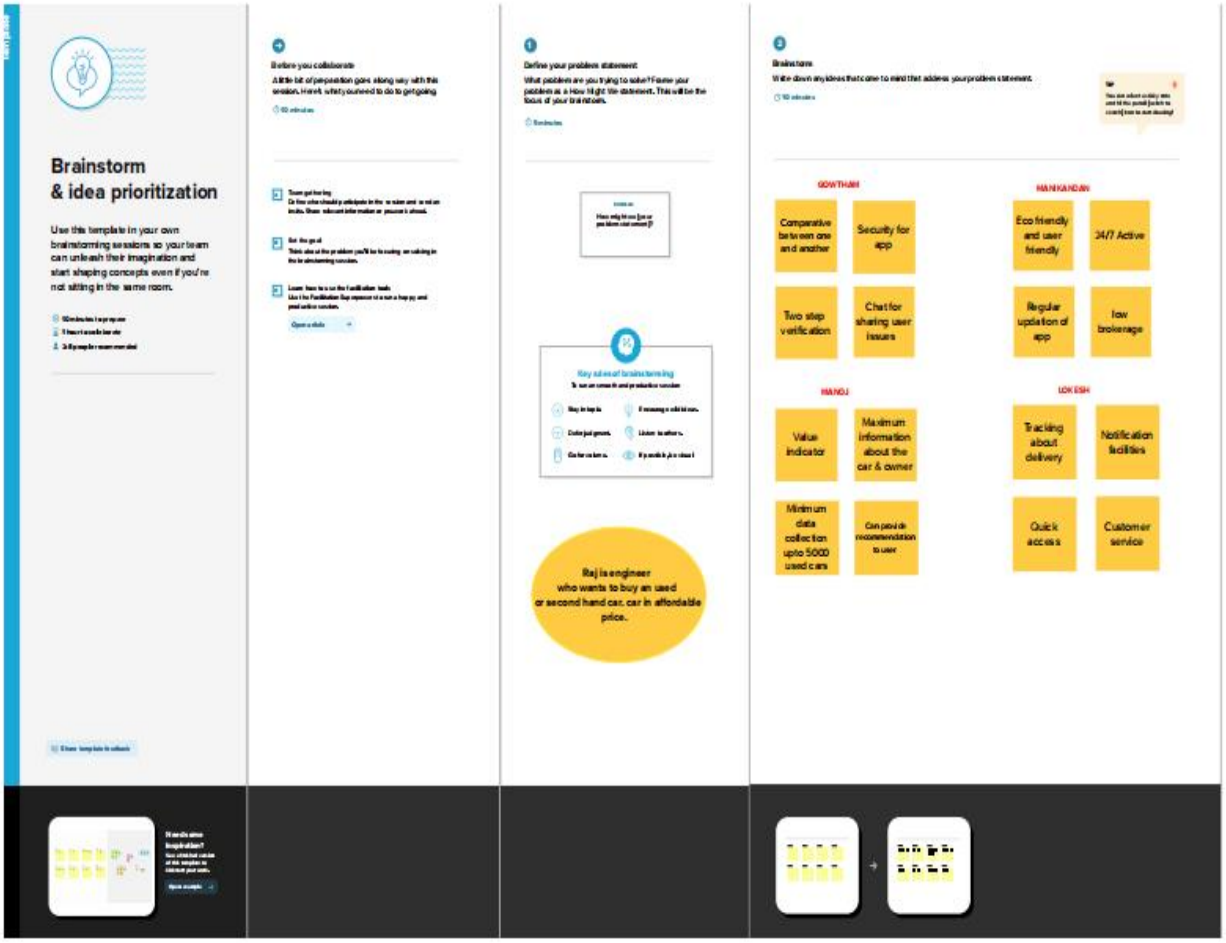
to name a few characteristic features required by the customer. The project Car Price Prediction deals with providing the solution to these problems. Through this project, we will get to know which of the factors are significant and tell us how they affect the car's worth in the market

3.IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming



Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, 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

Group 1

- low brokerage
- Regular updation of app

Group 3

- Value indicator
- Maximum information about the car & owner

Group 2

- Two step verification
- Comparative between one and another

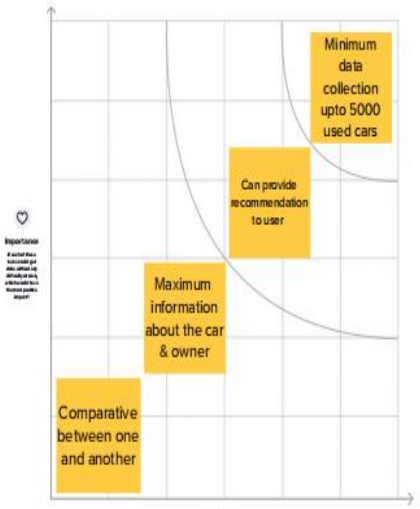
Group 4

- Can provide recommendation to user
- Regular updation of app

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 actions

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 archives.

Keep moving forward

Strategy blueprint
Define the components of a new idea or strategy.

Open the template →

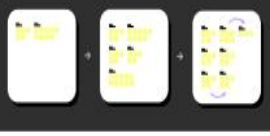
Customer experience journey map
Understand customer needs, motivations, and obstacles for an experience.

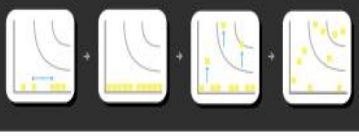
Open the template →

Strengths, weaknesses, opportunities & threats
Identify strengths, weaknesses, opportunities, and threats (SWOT) to develop a plan.

Open the template →

Share a template feedback





3.3 Proposed Solution

Proposed Solution Template:

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The prices of new cars in the industry is fixed by the manufacturer with some additional costs incurred by the Government in the form of taxes. So, customers buying a new car can be assured of the money they invest to be worthy. But due to the increased price of new cars and the incapability of customers to buy new cars due to the lack of funds, used cars sales are on a global increase. There is a need for a used car price prediction system to effectively determine the worthiness of the car using a variety of features.It is important to know their actual market value while both buying and selling.
2.	Idea / Solution description	The main idea of making a car resale value prediction system is to get hands-on practice for python using Data Science. Car resale value prediction is the system to predict the amount of resale value based on the parameters provided by the user.
3.	Novelty / Uniqueness	When buying a used car, people pay serious attention to the odometer value on the car. We can see that odometer changes the price of a car significantly . On the other hand, this does not mean that only low odometer cars are sold.
4.	Social Impact / Customer Satisfaction	Customer satisfaction is seen as an index to find the emotional state of a customer that defines the positive aspirations to define the joy of a customer. The marketers focus mainly on making their customers happy, however, the marketing or servicing tactics or campaigns cannot do this but a positive experience of a user with emotional bonding can do this.
5.	Business Model (Revenue Model)	Broadly, a used car's price is based on the make, model, variant, kilometres run, condition, registration year, ownership frequency or status, as well as the state of registration of the vehicle, said Gajendra Jangid, co-founder and chief marketing officer (CMO), Cars24.
6.	Scalability of the Solution	While exploring the data in the previous sections, it was seen that the data is not normally distributed. Without scaling, the machine learning models will try to disregard coefficients of features that has low values because their impact will be so small compared to the big value features.

4.REQUIREMENT ANALYSIS

4.1 Functional Requirement

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	**Manufacturing Year of Car**	Most Important is to check how old the car is. Remember - For Valuation Perspective its the Car Manufacturing year, and not Registration Year which matters. There can be a scenaro, like of registration year as 2016, as car registered in Jan 2016 but its 2015 Manufactured one - so for Valuation Perspective this car will come in category of 7 yr Old Car in 2022..
FR-2	**Physical Condition of Vehicl**e	Check and Inspect Interiors, Exteriors, Dents, Paint Peel Off, Rusts. Check Door Panels for evenness, Check Bonnet and visually inspect for any damage to body
FR-3	**Drive-ability Condition**	Any Noise from Engine, Suspension, Underneath, Cornering, Speed Lag, Glitches in Drive-ability and car value erodes substantially..
FR-4	**Car Functions**	AC Effectiveness, Power Window Function, Central Lock, Steering, Lights, Indicators, Door Locks etc are Working or not.

FR-5	**Service History**	Is Car Service History Documented on time. Where is car serviced - Authorized Workshop, any recommendation for replacement of Parts
FR-6	**Vehicle Model in Production**	If vehicle Model is discontinued, then the Spare Parts are slight costlier. Even in case of Maruti or Hyundai - for Esteem or Accent - Spares are slight costlier than the existing similar range. Same for other Manufacturer Models too

4.2 Non Functional Requirement

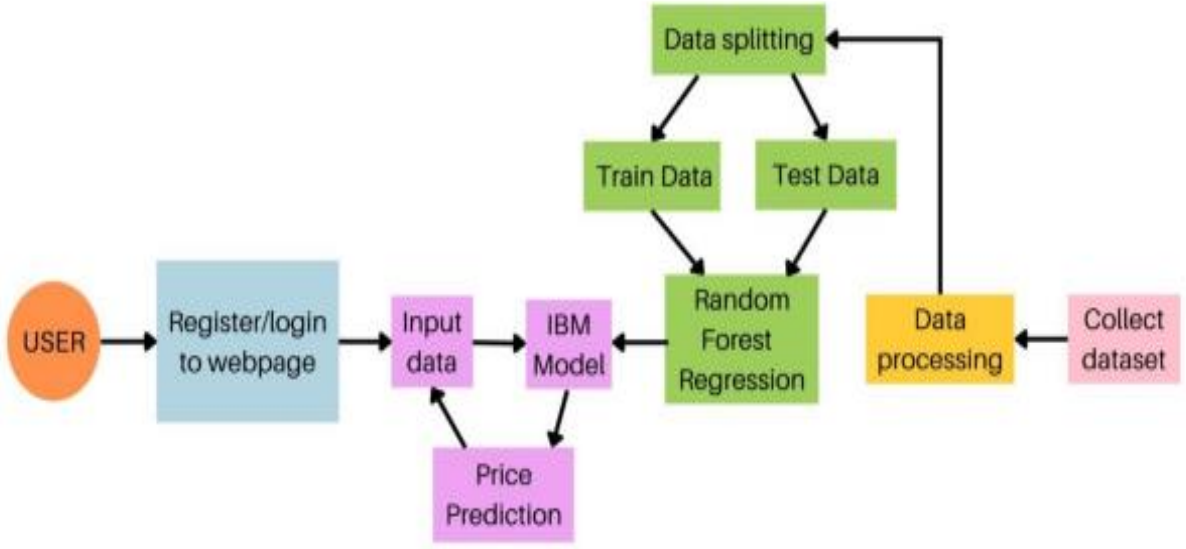
FR No.	Non-Functional Requirement	Description
NFR-1	**Security**	Users information in the web application areprotected by advanced secuirity system. Implementation of proper logging. Keep your application up to date. Authentication
NFR-2	**Usability**	An user friendly web application, dynamic and attractive user interface ,maintaning the records of users and easily satisfies the user needs.
NFR-3	**Reliability**	Fault less application. A piece of software operating without failure. The website's load time is not more than onesecond for users.
NFR-4	**Performance**	Fast and quick analyzation of car, is doneasa GPU used for the model is 10% more fast inanalyzing and uploading the user uploaded theimage. Occupation of less storage space.
NFR-5	**Availability**	Available in a google playstore, analy through camera
NFR-6	**Scalability**	It works in high speed authentication of people's information, quick response for queries from car experts , highly reliable,provide appropriate informations.

5.PROJECT DESIGN

5.1 Data Flow Diagrams

Data Flow Diagrams:

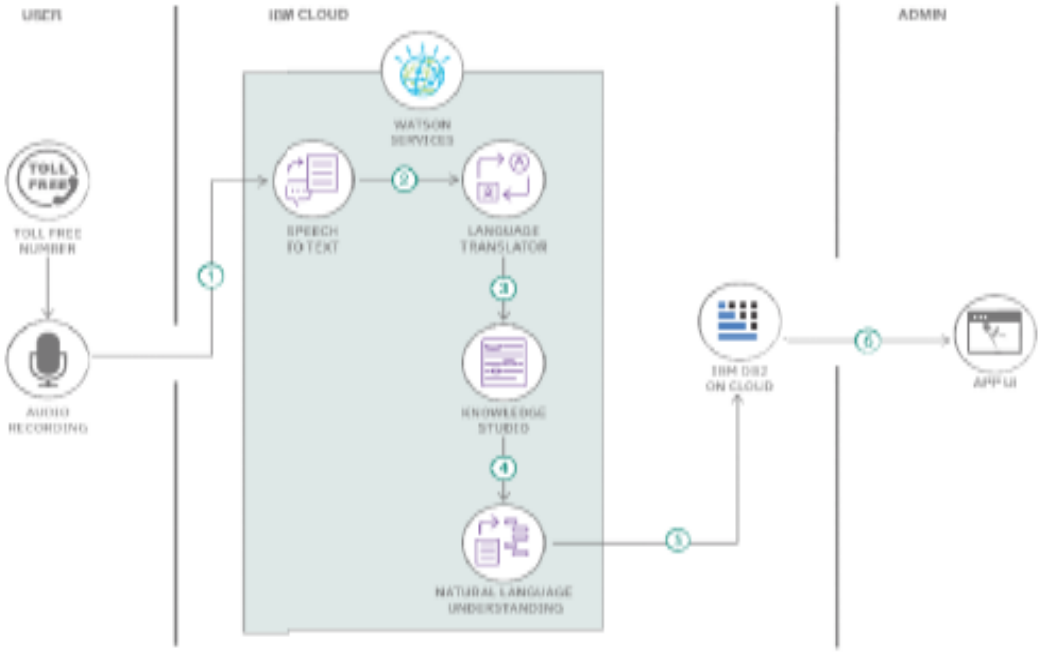
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data isstored.



5.2 Technical Architecture

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2

Example: Order processing during pandemics for offline mode



Reference: https://developer.ibm.com/patterns/ai-powered-backend-system-for-order-processing-during-pandemics/

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	To establish an connection between the flask andan HTML page.	Python Flask
2.	Security Implementations	To Protect the user information as well as their car details.	SHA-256, Encryptions
3.	Scalable Architecture	The model can be viewed and accessed in both computer as well as mobile phone.	Web UI, Mobile Android app
4.	Availability	The model can be available anywhere at any time.	IBM Cloud
5.	Performance	The model performance has high accuracy and with portable from one machine to another machine.	HTML,CSS

References:

https://c4model.com/

https://developer.ibm.com/patterns/online-order-processing-system-during-pandemic/

https://www.ibm.com/cloud/architecture

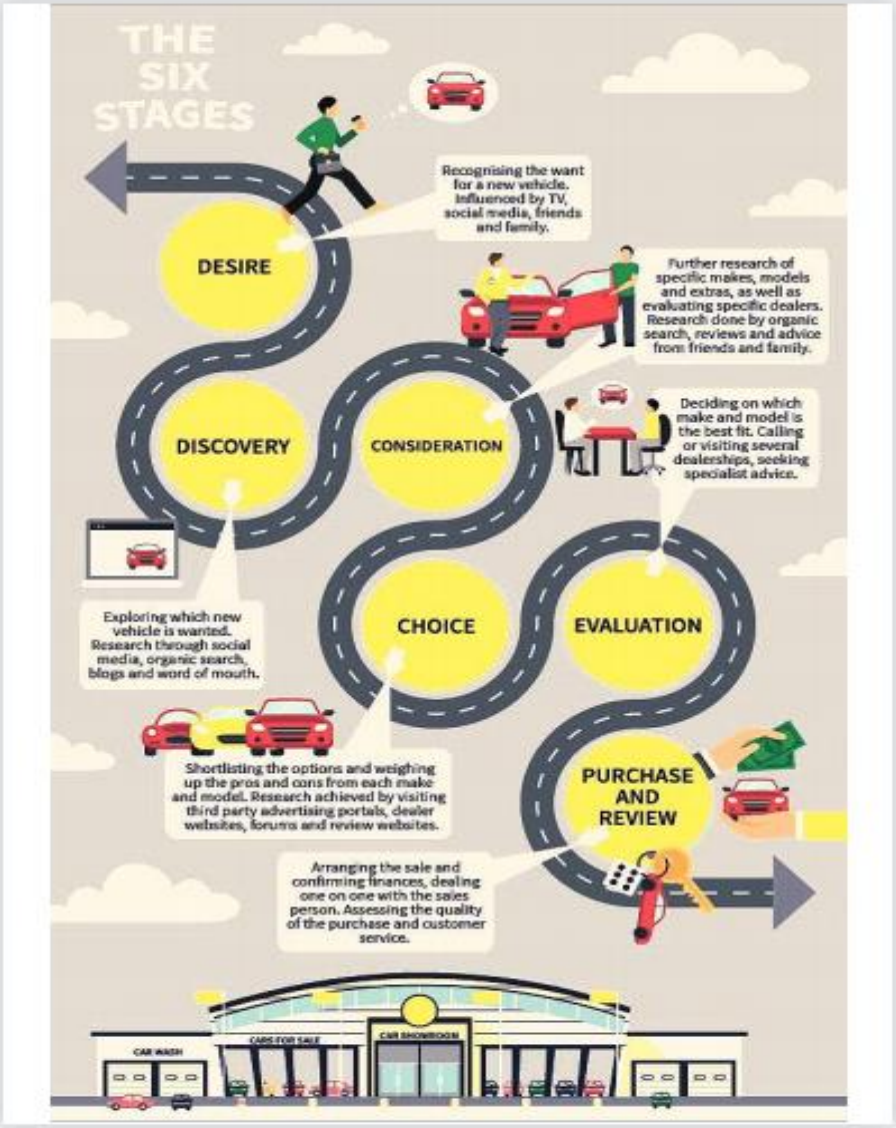
https://aws.amazon.com/architecture

https://medium.com/the-internal-startup/how-to-draw-useful-technical-architecture-diagrams-2d20c91da90d

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	The application interacts with Web UI	HTML, CSS.
2.	Application Logic-1 **Data Pre-processing**	Clean the dataset in order to remove the duplicate values, fill the missing values and replace the German words with English words.	Python
3.	Application Logic-2 **Build Python Flask**	Load the model and initialize Flask app. To fetch the parameter values from the UI, and return the prediction.	Python
4.	Application Logic-3 **Build an HTML Page**	To take the values from the user in a form and upon clicking on the button for submission it has to redirect to URL for **"y_predict"** which returns the predicted resale value	HTML, CSS.
5.	Cloud Database	Database Service on Cloud	IBM Cloudant
6.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
7.	External API-1	External API used in the application	IBM Weather API, etc.
8.	Machine Learning Model	To improve the predictive accuracy and control over-fitting.	Random Forest Regressor Python
9.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Heroku Platform

5.3 User Stories



User Stories:

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Web user)	HomePage	USN-1	Description about car resale Process	I can get an idea about how car resale works.	Low	Sprint-3
		USN-2	Details about the required data		Low	Sprint-3
	Registration	USN-3	As a user, I can register for the application by entering my username, email, phone number, and password, and confirming my password and verify it.	I can access my account.	Moderate	Sprint-3
		USN-4	As a user, I will receive a confirmation mail once I have registered for the application.	I can receive a confirmation OTP upon registration for verification.	High	Sprint-3
	Login	USN-5	As a user, I can log in to the web application by entering my email id & password.	I can log in successfully.	High	Sprint-2
	Main Page	USN-6	As a user, I submit my car model with release date.	I can access the page and can submit the car details.	Moderate	Sprint-4
	Price prediction	USN-7	The predicted resale price for the given car model will be displayed.	I got a predicted resale price successfully for my car model.	High	Sprint-4
Admin	Data collection	USN-8	Collect the required data for the Car resale prediction.		High	Sprint-1
	Data preprocessing	USN-9	Clean and analyze the data to avoid duplications	As a result I get the desired dataset to get trained.	High	Sprint-1
	Model Building	USN-10	Build the model using a Random forest regression to classify the data.	Successfully trained the model.	High	Sprint-1
	Deploy the model	USN-11	Deployment of ML model using IBM Watson Studio, object storage.	Deployed successfully.	High	Sprint-2
	Integrate the web app with the IBM model	USN-12	Use flask for the integration purpose.	Created the web app successfully.	Moderate	Sprint-2

6 PROJECT PLANNING &SCHEDULING

6.1 Sprint Planning & Estimation

TITLE	DESCRIPTION	DUE DATE
Literature survey & Information gathering	Literature survey on the selected topic and collect information by referring to the related papers and research projects, journals etc.	3 September 2022
Prepare Empathy Map	Prepare empathy map canvas to understand about the user problems, pains and gains. From the empathised details, prepare the problem statements to be solved.	10 September 2022
Ideation	Conduct a brainstorming session with the teammates and discuss ideas to solve the problem. Prioritize the top 3 ideas based on feasibility.	17 September 2022
Proposed Solution	Prepare the proposed solution which includes the novelty, feasibility, revenue, social impact, scalability etc.	24 September 2022
Problem Solution Fit	Prepare the problem solution fit which includes the causes, problems and solutions of the problem.	1 October 2022
Solution Architecture	Prepare solution architecture that indicates the data flow from the user, model and the website.	1 October 2022
Customer Journey	Prepare the customer journey map to understand the user needs and experience with the application.	8 October 2022

Functional Requirement	Prepare the functional requirement which includes all the features that will be available in the application.	15 October 2022
Technology Architecture	Prepare the technology architecture that defines about the technologies and the IBM cloud features used in the application.	15 October 2022
Data Flow Diagrams	Draw the data flow diagram to indicate the data flow from the user, during the model building and while predicting the result,	15 October 2022
Prepare Milestone & Activity List	Split the entire project into simpler tasks and prepare milestones and activity list of the project.	22 October 2022
Sprint Delivery Plan	Prepare a delivery plan of the project with specific due dates to complete each sprint consisting of a set of functional requirements.	22 October 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop, test and submit the code.	19 November 2022

MILESTONES	**ACTIVITY LIST**
Milestone – 1	Dataset collection and pre-processing
Milestone – 2	Training, Building and deploying the model
Milestone – 3	Create a homepage of the web application
Milestone – 4	Complete user authentication(registration/login)
Milestone – 5	Complete the user dashboard to add car and features
Milestone – 6	Integrate the model with the web application
Milestone – 7	Complete the price predicting feature

6.2 Sprint Delivery Schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Admin	Dataset collection	USN-1	Collect the required data for the Car resale prediction	2	High
	Data pre-processing	USN-2	Perform data cleaning to optimize the dataset	4	Medium
	Training & Building Model	USN-3	Build the model using regression algorithms to classify the data	6	High
	Deploy the model	USN-4	Deployment of ML model using IBM Cloud	5	High
	Integration	USN-5	Integrate the web app developed using flask with IBM model	5	High
Customer	Homepage	USN-6	Details about the application and the car resale Process	2	Low
	Registration	USN-7	As a user, I can register for the application by entering my email, password, and confirming my password.	4	High
	Confirmation	USN-8	As a user, I will receive confirmation email once I have registered for the application	4	High

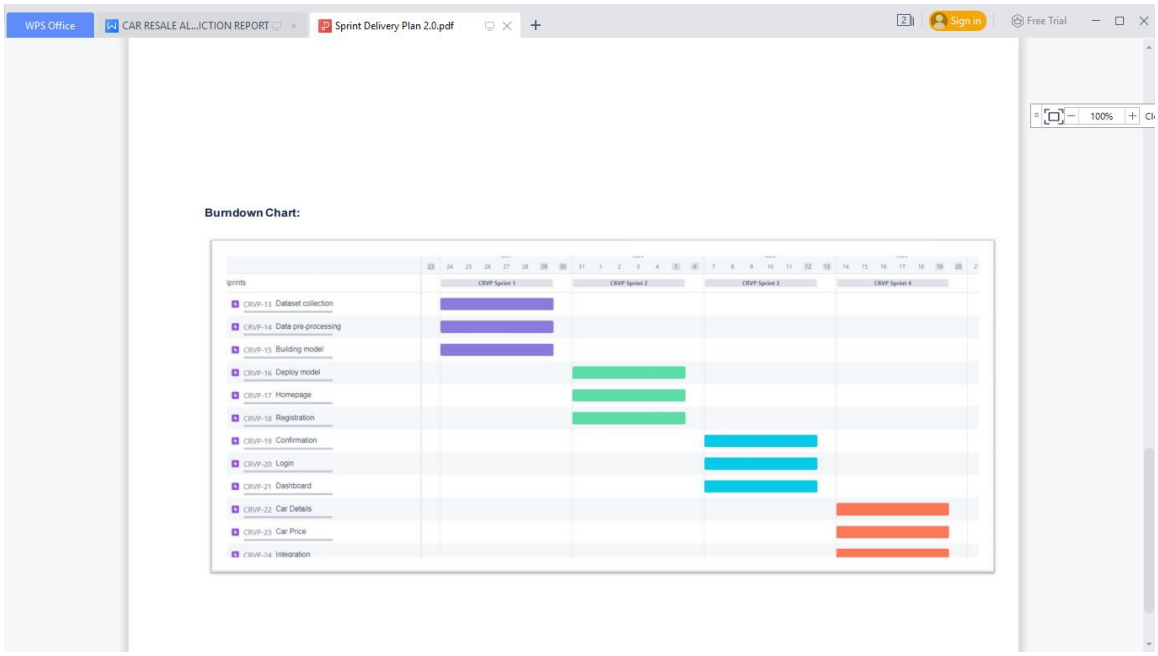
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
	Login	USN-9	As a user, I can log into the application by entering email & password	4	High
	Dashboard	USN-10	As a user, I can add new cars and get access to insert and update their details	5	High
	Car Details	USN-11	As a user, I should give the car details like car model, engine and fuel type, etc...	2	Medium
	Car Price	USN-12	As a user, I can view the current rate of the used car price	5	High

Project Tracker, Velocity & Burndown Chart: (4 Marks)

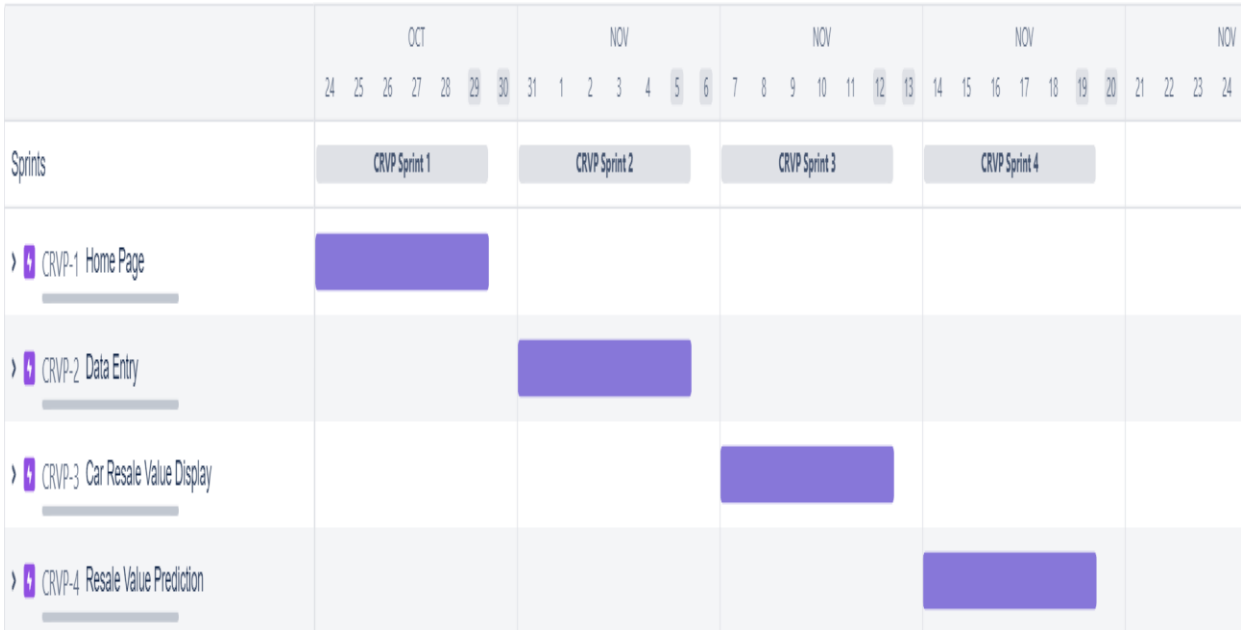
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	12	6 Days	24 Oct 2022	29 Oct 2022	12	29 Oct 2022
Sprint-2	12	6 Days	31 Oct 2022	05 Nov 2022	12	05 Nov 2022
Sprint-3	12	6 Days	07 Nov 2022	12 Nov 2022	12	12 Nov 2022
Sprint-4	12	6 Days	14 Nov 2022	19 Nov 2022	12	19 Nov 2022

Velocity:

$$AV = \frac{sprint\ duration}{velocity} = \frac{12}{6} = 2$$



6.3 Report from JIRA



7.CODING & SOLUTIONING

(Explain the features added in the project along with code)

7.1 Feature 1

index.html

```
<!DOCTYPE html>

<html lang="en">

<meta charset="UTF-8">

<meta name="viewport" content="width=device-width, initial-scale=1.0">

   <head>

      <title>Car Resale value Prediction  </title>

   </head>


<style>


input[type=text], select {

  width: 80%;

  padding: 12px 20px;

  margin: 8px 0;

  display: inline-block;

  border-radius: 4px;

  font-weight: bolder;

}
```

```
input[type=submit] {
  width: 80%;
  background-color: red;
  opacity: 0.7;
  color:red;
  padding: 14px 20px;
  margin: 8px 0;
  border: none;
  border-radius: 10px;
  cursor: pointer;
  font-size:100;
  font-weight: bolder;
}


input[type=submit]:hover {
  background-color: red;
  opacity: 0.9;
}
form{
    border-radius: 10px;
    padding-top: 5%;
    font-weight: bolder;
```

```
}
div {

  border-radius: 5px;
  margin-left: 35%;
  width: 30%;

}
h1{
    color:blue;
    font-size: 40px;
    font-weight: bolder;
}



body {
  background-image: url('https://c4.wallpaperflare.com/wallpaper/820/696/993/car-vehicle-vintage-car-muscle-car-wallpaper-preview.jpg');
  background-repeat: no-repeat;
  background-attachment: fixed;
  background-size: 100% 100%;
          text-align: center;
          padding: 0px;
       }
```

```
</style>

<body>

<h1>CAR RESALE VALUE PREDICTOR </h1>

<div>

 <form action="{{ url_for('predict')}}" method="post" >

<label for="Year">Purchase year </label><br>
<input type="text" id="Year" name="Year" required="required"><br>
<label for="Present_Price">Showroom Price ₹ (in lakhs)</label><br>
<input type="text" id="Present_Price" name="Present_Price" required="required"><br>
<label for="Kms_Driven">Kilometers Driven </label><br>
<input type="text" id="Kms_Driven" name="Kms_Driven"  required="required"><br>


<label for="Owner">Previous Owners </label><br>
<select id="owner" name="Owner">
    <option value="1">1</option>
    <option value="2">2</option>
    <option value="3">3</option>
```

```
   </select><br>
<label for="Fuel_Type_Petrol">Fuel Type</label><br>
   <select id="Fuel_Type_Petrol" name="Fuel_Type_Petrol" required="required">
     <option value="Petrol">Petrol </option>
     <option value="Diesel">Diesel </option>
     <option value="Cng">CNG </option>
   </select><br>

<label for="Transmission_Manual ">Type of Transmission </label><br>
   <select id="Transmission_Manual" name="Transmission_Manual"
required="required">
     <option value="manual car">Manual </option>
     <option value="automatic car ">Automatic </option>
    </select> <br />

    <label for="Seller_Type_Individual">Owner type </label><br>
    <select id="Seller_Type_Individual" name="Seller_Type_Individual"
required="required">
      <option value="dealer">Dealer </option>
      <option value="individual">Individual </option>
      </select><br>
    <br />
<input type="submit" style="background-color:skyblue "value="Calculate Selling Price">
<br />
<br />
```

```
</form>

</div>

<h3>{{ prediction_text }}</h3>

<br />

<br />

<br />


</body>

</html>
```

7.2 Feature 2

value.html

```
<!DOCTYPE html>
<html lang="en">
<meta charset="UTF-8">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
   <head>
      <title>Car Resale value Prediction  </title>
   </head>
<style>
/* div {
  border-radius: 5px;
  margin-left: 35%;
  width: 30%;

} */
h1{
   color:skyblue;
   font-size: 40px;
   font-weight: bolder;
}

body {
```

```
 background-image: url('https://c4.wallpaperflare.com/wallpaper/489/90/507/purple-car-car-plymouth-road-runner-plymouth-wallpaper-preview.jpg');

  background-repeat: no-repeat;

  background-attachment: fixed;

  background-size: 100% 100%;


          text-align: center;

          padding: 0px;

       }

      </style>

<body>

<h1>CAR RESALE VALUE PREDICTOR </h1>

<h2>{{ prediction_text }}</h2>

<br />

<br />

<br />


</body>

</html>
```

7.3 Database Schema

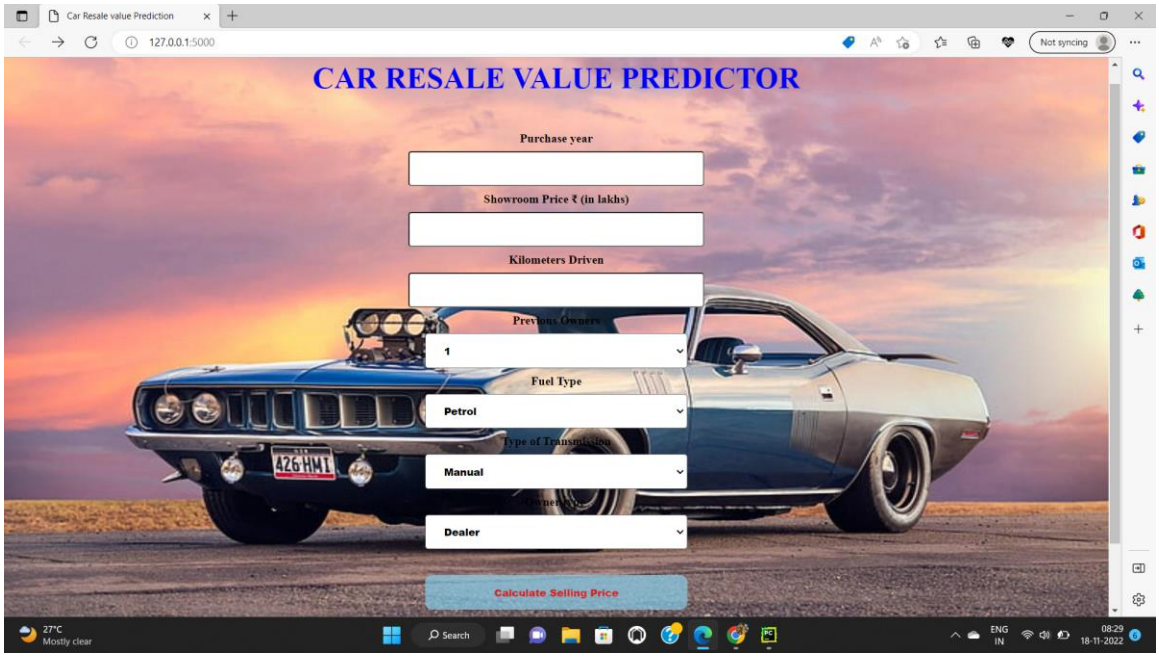
app.py

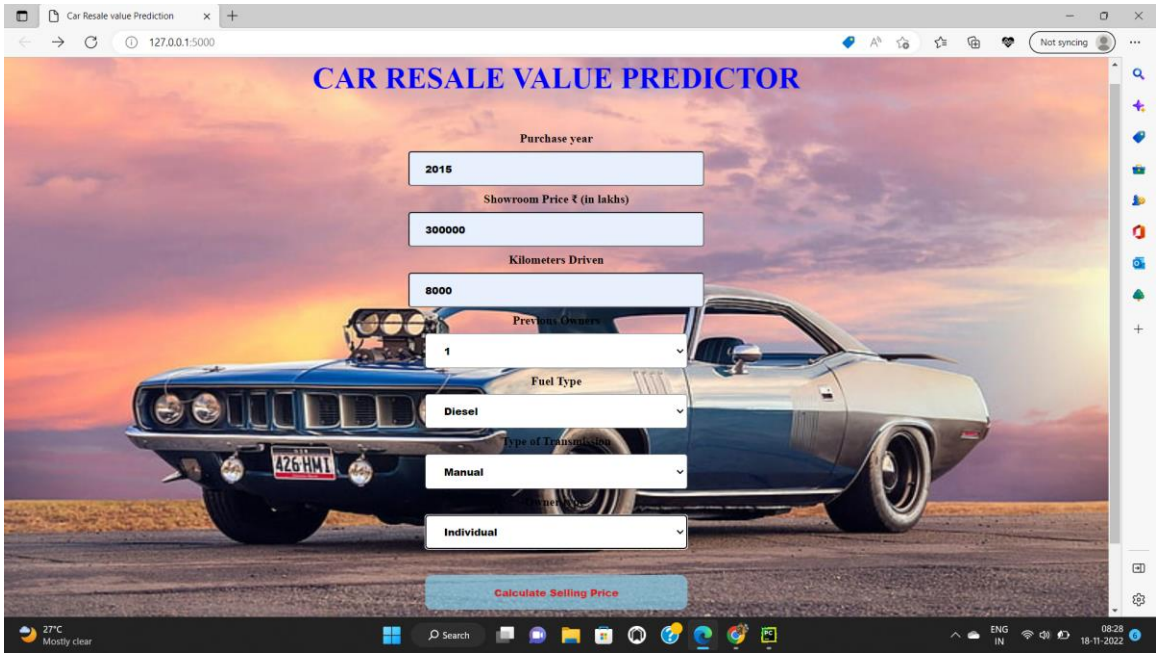
```
import pickle
import numpy as np
from flask import Flask, render_template, request
from sklearn.preprocessing import StandardScaler

app = Flask("car_model")

model = pickle.load(open('model.pkl', 'rb'))

@app.route('/', 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':
```

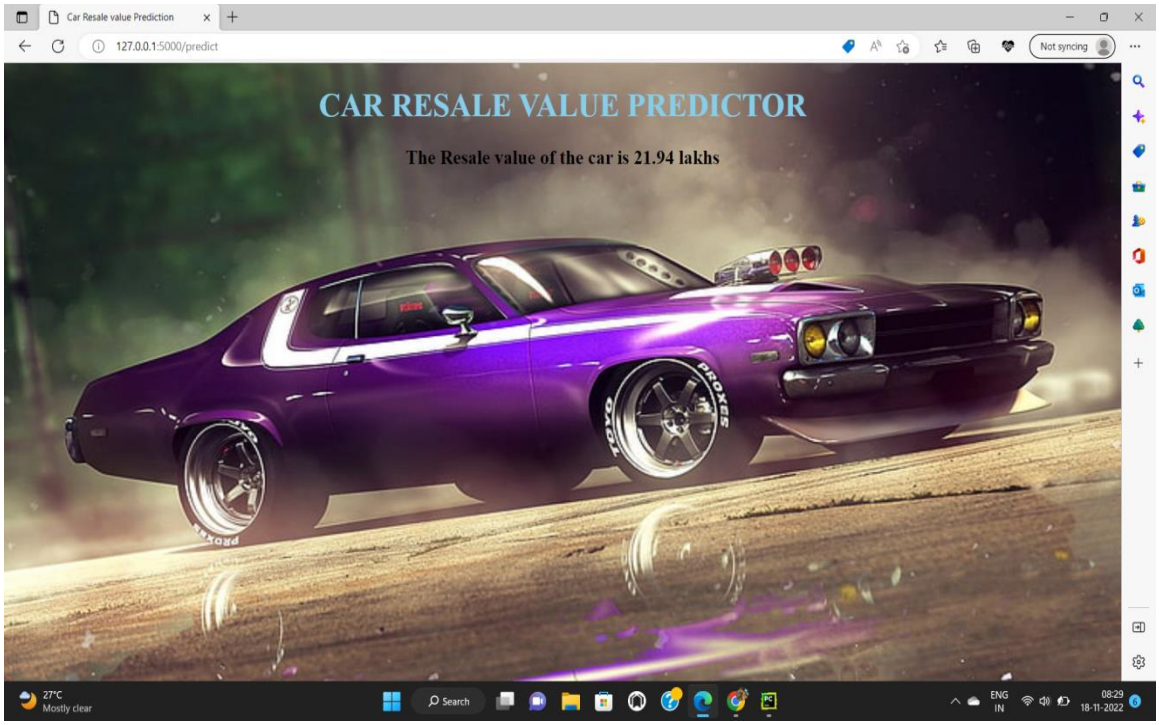
```
Year = int(request.form['Year'])
Year = 2020 - Year
Present_Price = float(request.form['Present_Price'])
Kms_Driven = int(request.form['Kms_Driven'])
Kms_Driven2 = np.log(Kms_Driven)
Owner = int(request.form['Owner'])
Fuel_Type_Petrol = request.form['Fuel_Type_Petrol']

if (Fuel_Type_Petrol == 'Petrol'):
    Fuel_Type_Petrol = 1
    Fuel_Type_Diesel = 0
elif (Fuel_Type_Petrol == 'Diesel'):
    Fuel_Type_Petrol = 0
    Fuel_Type_Diesel = 1
else:
    Fuel_Type_Petrol = 0
    Fuel_Type_Diesel = 0

Seller_Type_Individual = request.form['Seller_Type_Individual']
if (Seller_Type_Individual == 'Individual'):
    Seller_Type_Individual = 1
else:
    Seller_Type_Individual = 0
```

```
        Transmission_Manual = request.form['Transmission_Manual']
        if (Transmission_Manual == 'Mannual'):
            Transmission_Manual = 1
        else:
            Transmission_Manual = 0
        prediction = model.predict([[Present_Price, Kms_Driven2, Owner, Year,
Fuel_Type_Diesel,
                                     Fuel_Type_Petrol, Seller_Type_Individual, Transmission_Manual]])
        output = round(prediction[0], 2)

        if output < 0:
            return render_template('value.html', prediction_text="This car couldn't be sold")

        else:
            return render_template('value.html', prediction_text="The Resale value of the car
is {} lakhs".format(output))

    else:
        return render_template('index.html')

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

output:


Car Resale value Prediction
127.0.0.1:5000
Not syncing
CAR RESALE VALUE PREDICTOR
Purchase year
Showroom Price ₹ (in lakhs)
Kilometers Driven
Previous Owners
1
Fuel Type
Petrol
Type of Transmission
Manual
Dealer
Calculate Selling Price
27°C
Mostly clear
Search
ENG
IN
08:29
18-11-2022


Car Resale value Prediction
127.0.0.1:5000
Not syncing
CAR RESALE VALUE PREDICTOR
Purchase year
2015
Showroom Price ₹ (in lakhs)
300000
Kilometers Driven
8000
Previous Owners
1
Fuel Type
Diesel
Type of Transmission
Manual
Individual
Calculate Selling Price
27°C
Mostly clear
Search
ENG
IN
08:28
18-11-2022



8.TESTING

8.1Test Case

Missing values:

The trained ML model requires 4 feature inputs for predicting the output. Failing which, the model throws invalid Input error. All the fields in the html form have been marked required using CSS and thus user must input all fields. Output: User must input all the fields, failing which, form shows warningmessage "this field needs to be filled". Thus, there can be no errors in model prediction.

Invalid Input:

The trained ML model requires only numerical input for all 4 features. Thus, if user uses symbols such as comma while input, model may throw error. To overcome the same,

preprocessing script is deployed in backend which removes all unwanted characters like comma, whitespaces etc. so that model getsrequired input.

Output:

Due to python preprocessing script, model will get the desired input andthus will give accurate prediction.

8.2 User Acceptance Testing

i.Purpose of Document:

The purpose of this document is to briefly explain the test coverage and open issues of the Car resale value prediction project at the time of the release to User Acceptance Testing (UAT).

ii.Defect Analysis

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

9.RESULTS

9.1 Performance Metrics :

RMSE: Root Mean Squared Error is the metric used by us to evaluate our model. It is most commonly used to evaluate regression models. Root Mean Square Error as the namesuggests is calculated as the root of the mean squared errors of the predicted values. The formula is given

$$RMSE = \sqrt{\frac{\sum_{i=1}^{N} \|y(i) - \hat{y}(i)\|^2}{N}},$$

Where zfi is the predicted value, zoi is the actual value and N is the sample size We have used the sklearn.metrics package to calculate the RMSE.Our ensembled model had a RMSE value of 3545.68 and the individual model error rates are given below:

Decision Tree: 4136.24
Random Forest: 3167.32
XGBoost: 3333.48

10.ADVANTAGES &DISADVANTAGES

Advantages:

- ✧ This model is very quick in calculating the predictions.
- ✧ Good at learning complex and non-linear relationships.
- ✧ No feature scaling required.
- ✧ It easier for us to upload a better trained by version of the model onto the cloud.
- ✧ Robust to outliers.
- ✧ Highly explainable and easy to interpret .

Disadvantages:

- ✧ Requires high computational power.
- ✧ The datasets available and the dataset the model has trained on do not give sufficient information to the model as it does not have very useful information.
- ✧ Consumes more time

11.CONCUSION

Data used in this project is autos.csv file scraped from e-commerce site and then data preparation processed by using python programming language. We tested data by using multiple linear regression, random forest regression, and gradient boosted regression trees on that particular dataset. Each model was evaluated by using the same testing data. The results are then compared by using mean absolute error as a criterion. We concluded that random forest regression trees as recommended to develop the price evaluation model because high accuracy was achieved. More appropriate data engineering can be utilized to create the better training data.

12. FUTURE SCOPE

It can help with shaping the future of car resale market as our project opens up an insight into how the factors can be taken into for predicting the of value of used cars.

13.APPENDIX

GitHub & Project Demo Link:

GitHub Repo Link : https://github.com/IBM-EPBL/IBM-Project-48977-1660814746

Demo Link : https://drive.google.com/file/d/10VPMYXCnc-AHyFuohD66avLn_NB7cj-0/view?usp=drivesdk