Car Resale value Prediction

(RITHIESH C, SANKARAN B, MAGESH KUMAR N, JENISH T L)

(Team ID: PNT2022TMID54110)

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 across cities in the United States. Our results show that Random Forest model and K-Means clustering with linear regression yield the best results, but are compute heavy. Conventional linear regression also yielded satisfactory results, with the advantage of a significantly lower training time in comparison to the aforementioned methods.

1.2 Purpose

Now a days deciding whether a used car is worth the posted price when you see listings online can be difficult. Several factors, including mileage, make, model, year, etc. can influence the actual worth of a car. From the perspective of a seller, it is also a dilemma to price a used car appropriately. Based on existing data, the aim is to use machine learning algorithms to develop models for predicting used car prices.

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
- Model of the car
- Location
- Year of manufacturing
- Type of fuel
- 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

2 LITERATURE SURVEY

2.1 Existing Problem

Deciding whether a used car is worth the posted price when you see listings online can be difficult. Several factors, including mileage, make, model, year, etc. can influence the actual worth of a car. From the perspective of a seller, it is also a dilemma to price a used car appropriately. Based on existing data, the aim is to use machine learning algorithms to develop models for predicting used car prices.

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

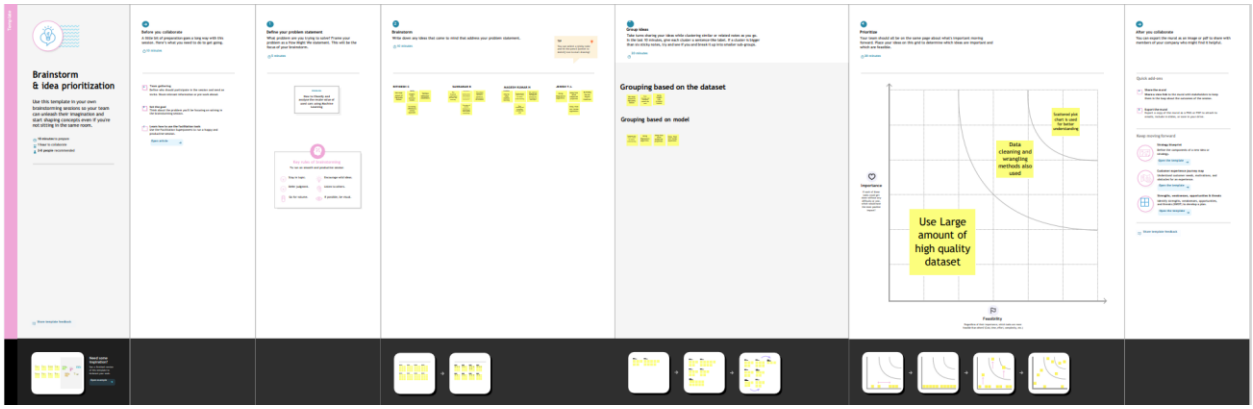
Data science aims to make our predictions to be more accurate by having the many previous data collected as dataset as in our project with difficult economic conditions, it is likely that sales of second-hand imported cars and used cars will increase. In many developed countries, it is common to lease 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 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

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Owner of a car	Sell	I don't know about its current value	Of it wear and tear	Confused
PS-2	Owner of a car	Find its resale value	I am concerned about the minor dents	Of a small accident	A little worried

3 IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

3.2 Ideation & Brainstorming

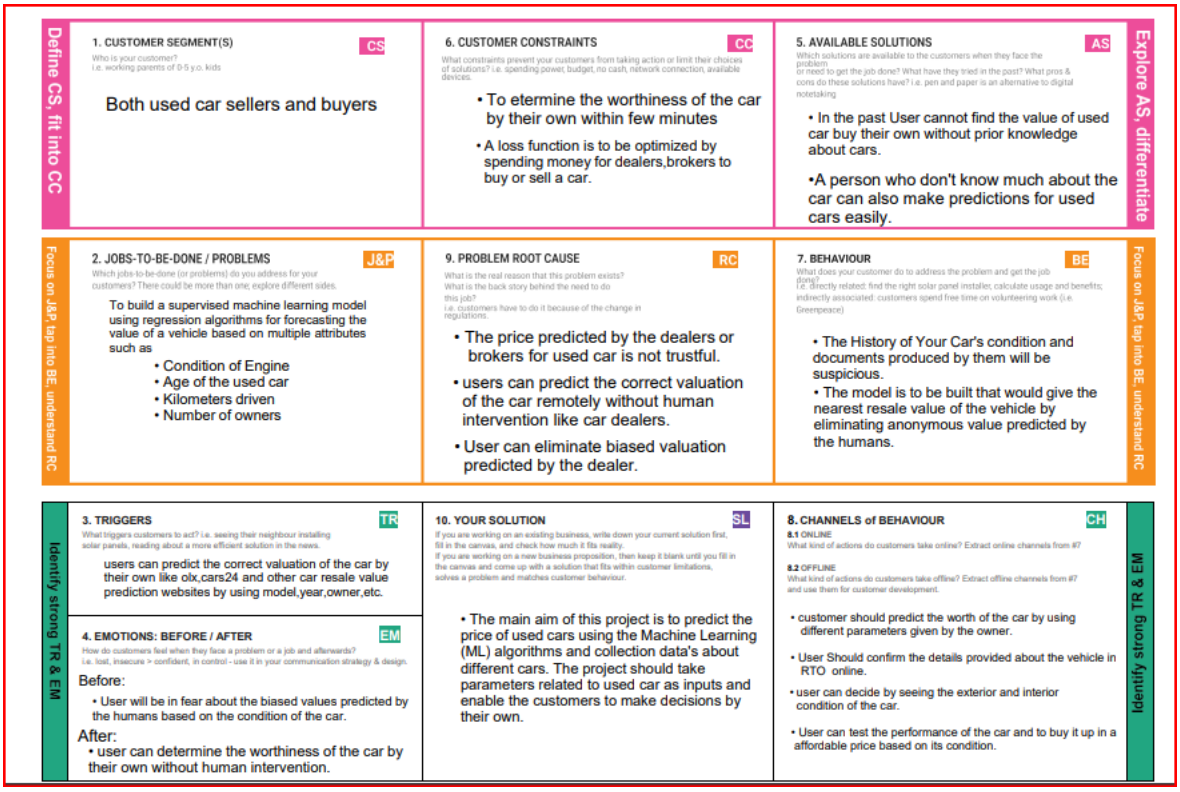


3.3 Proposed Solution

S.no	Parameter	Description
1	Problem Statement (Problem to be solved)	• The main aim of this project is to predict the price of used cars using the various Machine Learning (ML) models. • The project should take parameters related to used car as inputs and enable the customers to make decisions by their own.
2	Idea / Solution description	The model is to be built that would give the nearest resale value of the vehicle. By using these best accuracy value will be taken as a solution and it will be integrated to the web-based application where the user is notified with the status of his product.
3	Novelty / Uniqueness	Used car price prediction is effectively used to determine the worthiness of the car by their own within few minutes by using various features such as year, model, mileage(km), etc.
4	Social Impact / Customer Satisfaction	• If the user wants to buy or sell a own car it helps users to predict the correct valuation by their own. • A loss function is to be optimized and mainly a weak learner can make predictions for used cars easily

5	Business Model (Revenue Model)	It helps users to predict the correct valuation of the car remotely with perfect valuation and without human intervention like car dealers in the process to eliminate biased valuation predicted by the dealer.
6	Scalability of the Solution	Using Stored data and machine learning approaches, this project proposed a scalable framework for predicting values for different type of used cars present all over India.

3.4 Problem Solution fit



4 REQUIREMENT ANALYSIS

4.1 Functional requirement

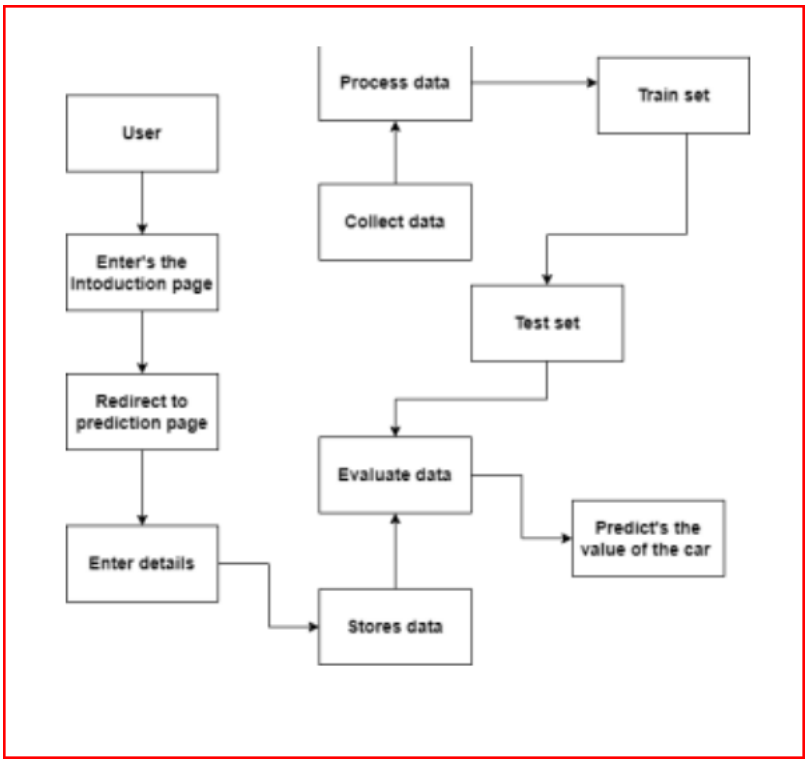
FR No.	Functional Requirements	Sub Registration
FR-1	Registration	Registration can be done using mobile number or gmail and needed some user information
FR-2	Login	User only log in by user id and password, Which is given during registration
FR-3	Delivery confirmation	Confirmation via email and phone number
FR-4	Assistance	Bot is integrated with the application to make the usability simple

4.2 Non-Functional requirement

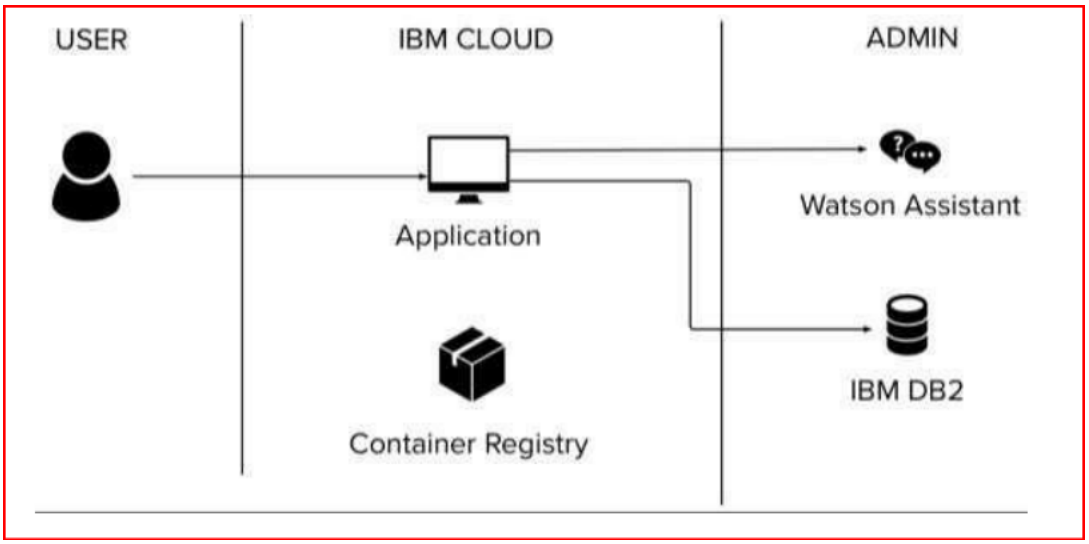
NFR No.	Non-Functional Requirements	Description
NFR-1	Usability	A user-friendly interface with chat bot to make usability efficient
NFR-2	Security	Secured connection HTTPS should be established for transmitting requests and responses
NFR-3	Reliability	The system should handle excepted as well as unexpected errors and exceptions to avoid termination of the program
NFR-4	Performance	The system shall be able to handle multiple requests at any given point in time and generate an appropriate response.
NFR-5	Availability	It is a cloud based web application so user can access without any platform limitations ,just using a browsers with a internet connection is enough for use the application

5 PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture



5.3 User Stories

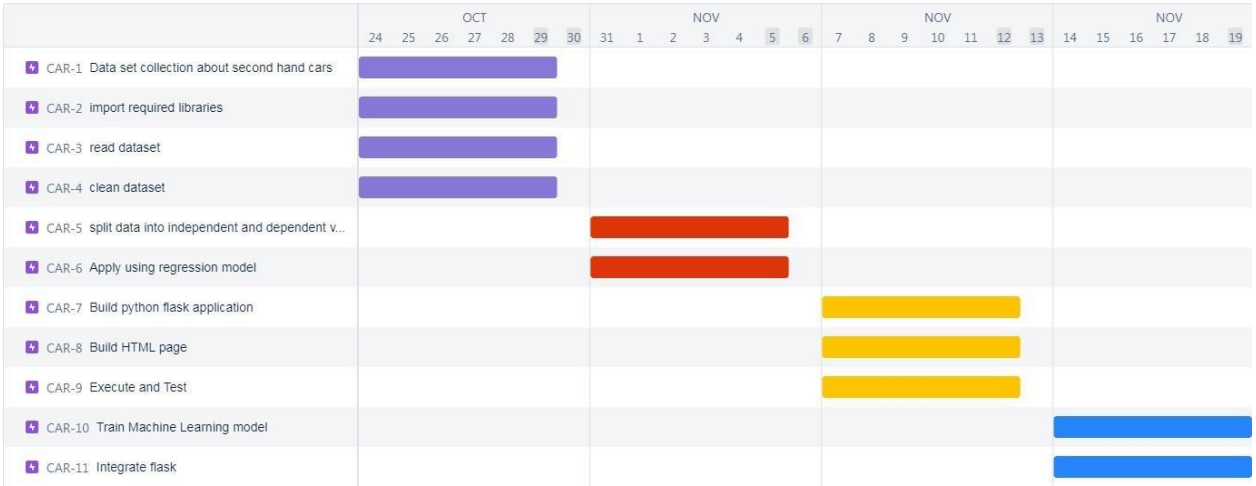
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority
Sprint-1	Pre-process data	USN-1	Collect Dataset	1	Low
Sprint-1		USN-2	Import required libraries	1	Low
Sprint-1		USN-3	Read and clean data sets	2	Low
Sprint-2	Model building	USN-1	Split data into independent and dependent variables	3	Medium
Sprint-2		USN-2	Apply using regression model	3	Medium
Sprint-3	Application building	USN-1	Build python flask application and HTML page	5	High
Sprint-3		USN-2	Execute and test	5	High
Sprint-4	Training the model	USN-1	Train machine learning model	5	High
Sprint-4		USN-2	Integrate flask	5	High

6 PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

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

6.2 Sprint Delivery Schedule



7 CODING & SOLUTIONING

7.1 Feature 1

We have created a webpage as simple and user friendly that a user should understand how to interface at the first time they the webpage for that we have used html for developing a webpage

This shows the document type is html

```
<!DOCTYPE html>
```

Webpage is created in English language

```
<html lang="en">
```

header part of the webpage

```
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Document</title>
</head>
```

body part of the webpage

```
<body>

  <div style="color:red">
    <form action="{{ url_for('predict')}}" method="post">
```

It gives the top most heading as Predctive analysis

```
      <h2>Predictive analysis</h2>
```

It gives the heading as Year

```
      <h3>Year</h3>
```

We needs to get a input to the year so we were using input tag to get a input the user needs to enter the year of the car purchased

```
      <input id="first" name="Year" type="number ">
```

It gives the heading as Showroom Price and using the input tag to get the showroom price from the user

<h3>What is the Showroom Price?(In lakhs)</h3>
<input id="second" name="Present_Price" required="required">

It gives the heading as How Many Kilometers Drived ? and using the input tag to get the Kilometers drived from the user

<h3>How Many Kilometers Drived?</h3><input id="third" name="Kms_Driven" required="required">

It gives the heading as How much owners previously had the car (0 or 1 or 3) ?and using the input tag to get the No of Owner used the car from the user

<h3>How much owners previously had the car(0 or 1 or 3) ?</h3>
<input id="fourth" name="Owner" required="required">

It gives the heading as What Is the Fuel type ? and using the input tag to get the Fuel Type of the car from the user

<h3>What Is the Fuel type?</h3>
<select name="Fuel_Type_Petrol" id="fuel" required="required">

Having the options as Petrol or Diesel or CNG

```
<option value="Petrol">Petrol</option>
<option value="Diesel">Diesel</option>
<option value="Diesel">CNG</option>
</select>
```

It gives the heading as Are you A Dealer or Individual and using the input tag to get the Seller Type and giving the options as Dealer or Individual of the car from the user

<h3>Are you A Dealer or Individual</h3>
<select name="Seller_Type_Individual" id="resea" required="required">

```
<option value="Dealer">Dealer</option>
<option value="Individual">Individual</option>
</select>
```

It gives the heading Transmission type and using the input tag to get the Type of Transmission and giving the options as is the car Manual or Automatic from the user

<h3>Transmission type</h3>
<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>
```

Using CSS to style our webpage

```
  <style>
    body {
      background-color: lightslategray;
      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: coral;
}

#research {
    width: 99px;
    height: 43px;
    text-align: center;
    border-radius: 14px;
    font-size: 18px;
}

#research:hover {
    background-color: coral;
}

#resea {
    width: 99px;
    height: 43px;
    text-align: center;
    border-radius: 14px;
    font-size: 18px;
}

#resea:hover {
    background-color: coral;
}

#sub {
    width: 120px;
    height: 43px;
    text-align: center;
    border-radius: 14px;
    font-size: 18px;
}

#sub:hover {
```

```
        background-color: darkcyan;
      }

      #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>
```

7.2 Feature 2

For the backend we have used python flask and using the collected dataset of the used cars details we made our backend that works simple and more accurate to give user more accurate value

Importing the libraries we needed using the keyword import

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

Flask constructer takes the name of the current module name and load the model pkl file and get the data from it and predict the values accordingly

```
app = Flask(__name__)
model = pickle.load(open('random_forest_regression_model.pkl', 'rb'))
```

@app.route keyword is used to link the pkl file and python code to the HTML file

```
@app.route('/',methods=['GET'])
```

Render template renders that if the webpage doesn't work properly it will move to that page

```
def Home():
    return render_template('index.html')
standard_to = StandardScaler()
@app.route("/predict", methods=['POST'])
```

Creating a function getting the inputs from the html input forms and predict the output accordingly

```
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']
        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_Type_Diesel,Fuel_Ty
pe_Petrol,Seller_Type_Individual,Transmission_Mannual]])
        output=round(prediction[0],2)
```

If the output is not predicted then it shows as Sorry you cannot sell this car if it's predicted then it show as you can sell the car at this price

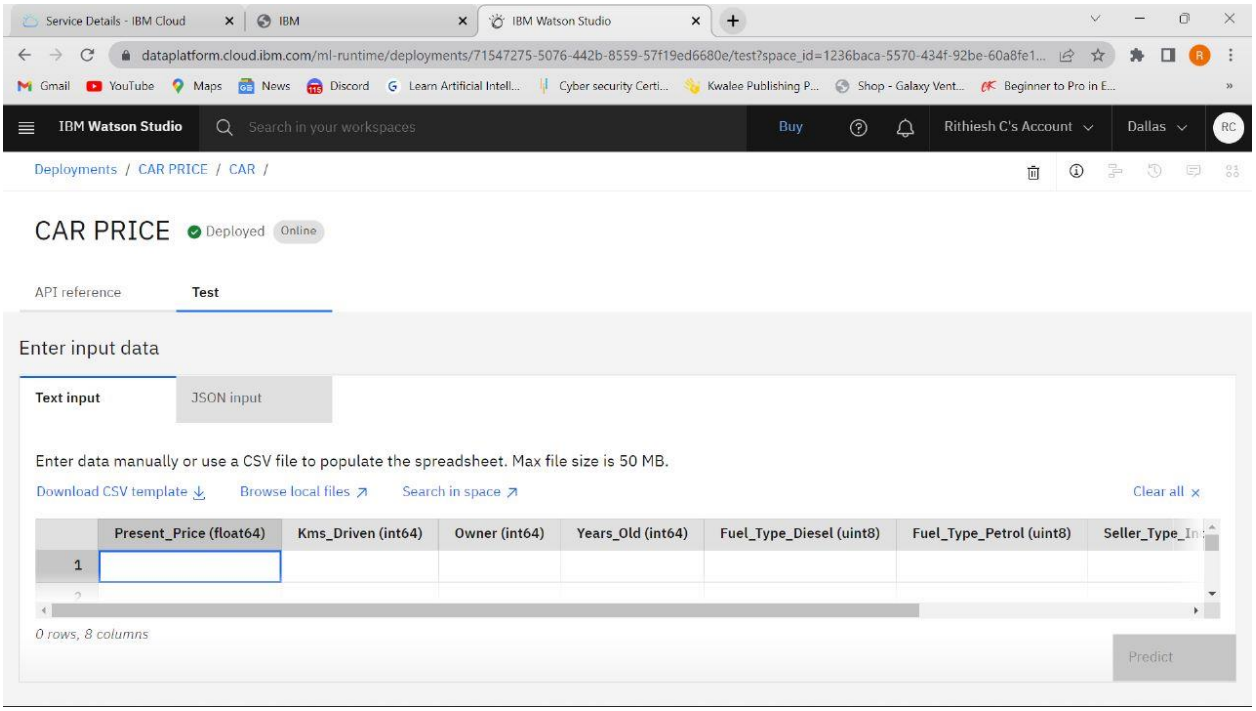
```
        if output<0:
          return render_template('index.html',prediction_texts="Sorry you cannot sell this car")
        else:
          return render_template('index.html',prediction_text="You Can Sell The Car at
{}".format(output))
    else:
        return render_template('index.html')

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

8 TESTING

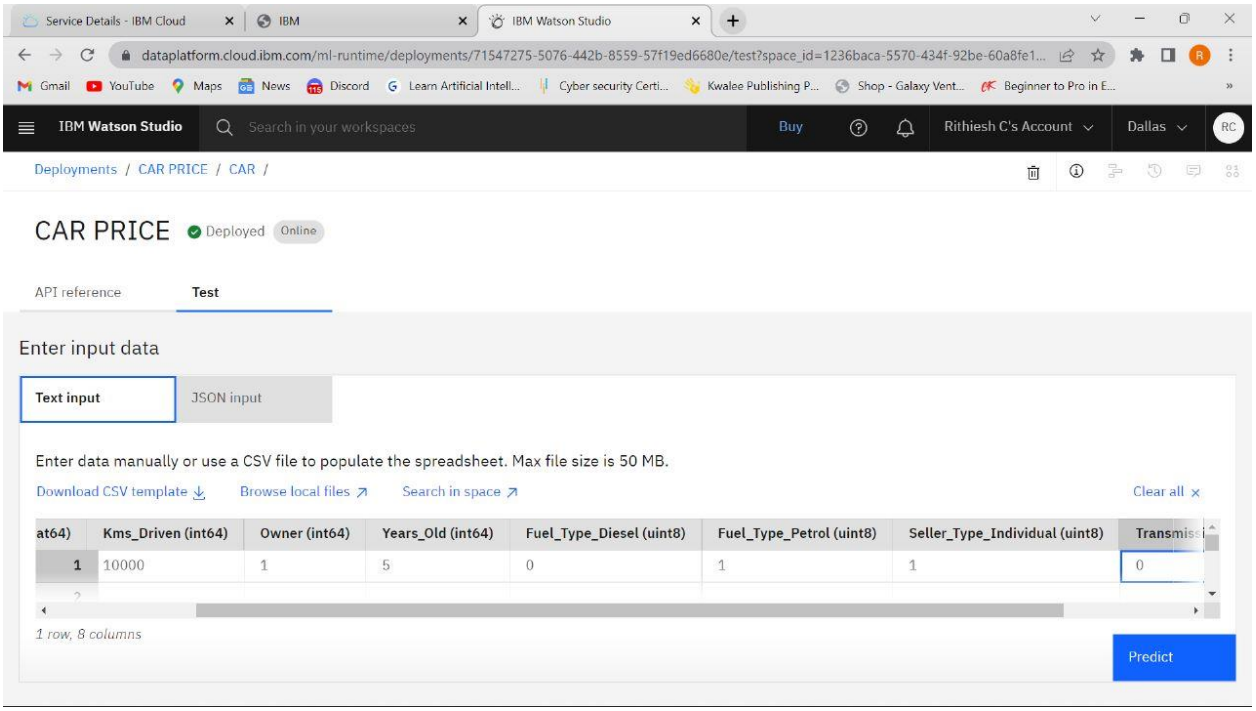
8.1 Test Cases

The test case has the Present_Price , Kms driven , Owner , Years_Old , Fuel_Type , Seller_Type , Transmission_Type to predict the value of the used car



8.2 User Acceptance Testing

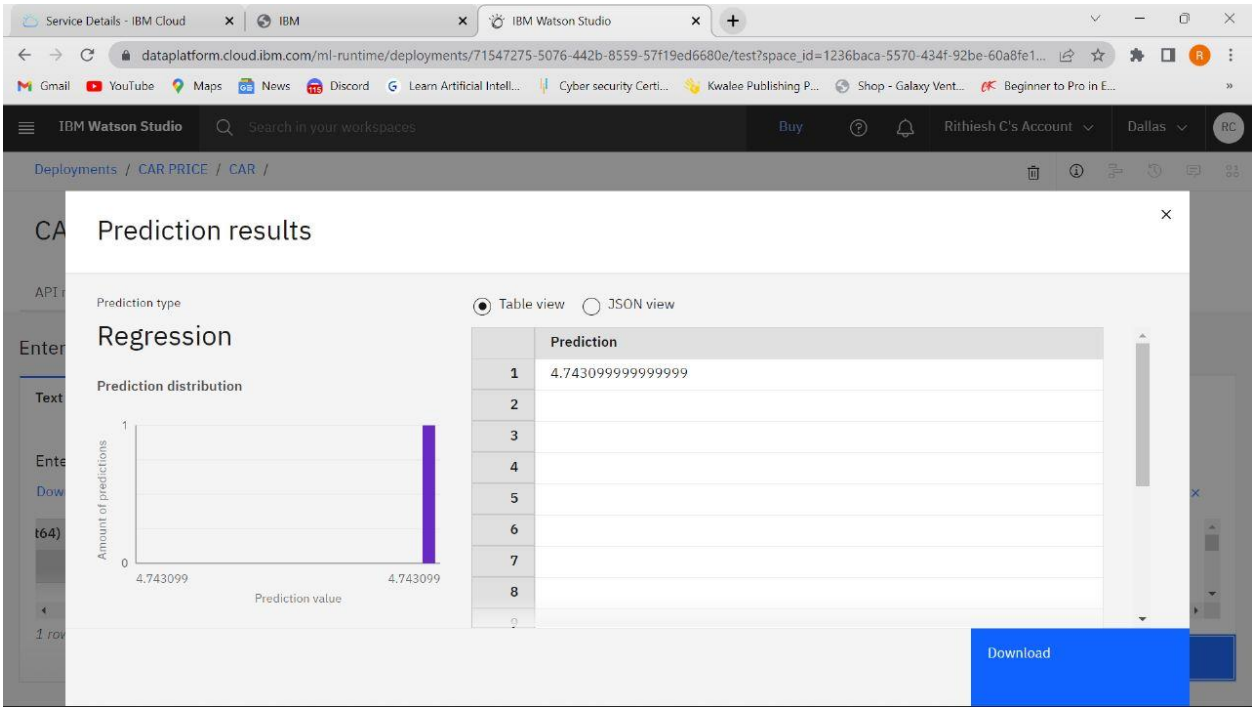
The inputs that are given by the user is acceptable and able to give the predicted output



9 RESULTS

9.1 Performance Metrics

The trained model gives the predicted output



10 ADVANTAGES & DISADVANTAGES

PROS

.1 Good at learning complex and non-linear relationships

.2 Highly explainable and easy to interpret

.3 Robust to outliers

.4 No feature scaling is required

CONS

.1 Consumes more time

.2 Requires high computational power

11 CONCLUSION

We started with understanding the use case of machine learning in the Automotive industry and how machine learning has transformed the driving experience. Moving on, we looked at the various factors that affect the resale value of a used car and performed exploratory data analysis (EDA), Further, we build a Random Forest Regression model to predict the resale value of a used car. Finally, we evaluated the performance of the model using the R squared score and Residual Plot.

We could have also used simpler regression algorithms like Linear Regression and Lasso Regression. Still, we need to make sure there are no outliers in the dataset before implementing them. Pair plots and scatter plots help visualize the outliers

12 FUTURE SCOPE

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. To correct for overfitting in Random Forest, different selections of features and number of trees will be tested to check for change in performance.

13 APPENDIX

Source Code

WEBSITE

FRONTEND -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>

  <div style="color:red">
    <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: lightslategray;
      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: coral;
}

#research {
    width: 99px;
    height: 43px;
    text-align: center;
```

```
   border-radius: 14px;
   font-size: 18px;
}

#research:hover {
   background-color: coral;
}

#resea {
   width: 99px;
   height: 43px;
   text-align: center;
   border-radius: 14px;
   font-size: 18px;
}

#resea:hover {
   background-color: coral;
}

#sub {
   width: 120px;
   height: 43px;
   text-align: center;
   border-radius: 14px;
   font-size: 18px;
}

#sub:hover {
   background-color: darkcyan;
}

#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>
```

BACKEND -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('/',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']
        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_Type_Diesel,Fuel_Type_Petrol
,Seller_Type_Individual,Transmission_Mannual]])
        output=round(prediction[0],2)
        if output<0:
            return render_template('index.html',prediction_texts="Sorry you cannot sell this car")
        else:
            return render_template('index.html',prediction_text="You Can Sell The Car at {}".format(output))
    else:
        return render_template('index.html')

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

GitHub & Project Demo Link

Github link :

https://github.com/IBM-EPBL/IBM-Project-34709-1660273047

Project demo link :

https://youtu.be/GUJEOywAf0g