

Project On
Car Resale Value prediction

Powered by **IBM** India

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1.1 INTRODUCTION

This project “Car Resale Value Prediction” aims to build a model to predict used cars' reasonable prices based on multiple aspects, including vehicle mileage, year of manufacturing, fuel consumption, transmission, road tax, fuel type, and engine size. This model can benefit sellers, buyers, and car manufacturers in the used cars market. Upon completion, it can output a relatively accurate price prediction based on the information that users input. The model building process involves machine learning and data science. The dataset used was scraped from listings of used cars. Various regression methods, including linear regression, polynomial regression, support vector regression, decision tree regression, and random forest regression, were applied in the research to achieve the highest accuracy. Before the actual start of model-building, this project visualised the data to understand the dataset better. The dataset was divided and modified to fit the regression, thus ensuring the performance of the regression.

Project Overview

A car price prediction has been a high interest research area, as it requires noticeable effort and knowledge of the field expert. Considerable number of distinct attributes are examined for the reliable and accurate prediction. To build a model for predicting the price of used cars, the applied three machine learning techniques are random forest, KN-N and linear regression algorithm. Respective performances of different algorithms were then compared to find one that best suits the

available data set. This ability to capture data, analyse it and use it to personalise a shopping experience or implement is the future of retail.

Parameters involved :

Car_name;Year;Selling_Price;Present_Price;Kms_Driven;Fuel_type;

Seller_type;Transmission;Owner and so on.

Purpose

Car resale value prediction helps the user to predict the resale value of the car depending upon 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. The most essential elements for forecast are brand and model, period use of vehicle, mileage of vehicle, gear type and fuel type utilised in the vehicle just as fuel utilisation per mile profoundly influences cost of a vehicle because of continuous changes in the cost of a fuel. In view of the differing highlights and factors, and furthermore with the assistance of master information the vehicle value forecast has been done precisely.

2. LITERATURE SURVEY

Existing problem

The problem is defined as the optimised way to estimate insurance cost based on the manufacturer with some additional costs incurred by the Government in the form of taxes. As the existing methods for estimating the cost takes a lot of time and energy and due to the increased price of new cars and the inability of customers to buy new cars due to the lack of funds, used cars sales are on a global increase.

The prices of new cars in the industry is fixed by the So, customers buying a new car can be assured of the money they invest to be worthy. There is a need for a used car price prediction system to effectively determine the worthiness of the car using a variety of features. Even though there are websites that offer this service, their prediction method may not be the best. Besides, different models and systems may contribute to predicting power for a used car's actual market value. It is important to know their actual market value while both buying and selling.

References

At present, under the guidance of the new generation of information technology, the rapid accumulation of data, the continuous improvement of computing power, the continuous optimization of algorithm models, and the rapid rise of multi-scene applications have made profound changes in the development environment of Machine Learning.

[1] Kanwal Noor, 2017, Vehicle Price Prediction System using Machine Learning Techniques International Journal of Computer Applications. Volume 167 - Number 9

[2] Mariana Lusitania et al, (2009). Support vector regression analysis for price prediction in a vehicle leasing application [3] Richardson, M. S. (2009). Determinants of used vehicle resale value.

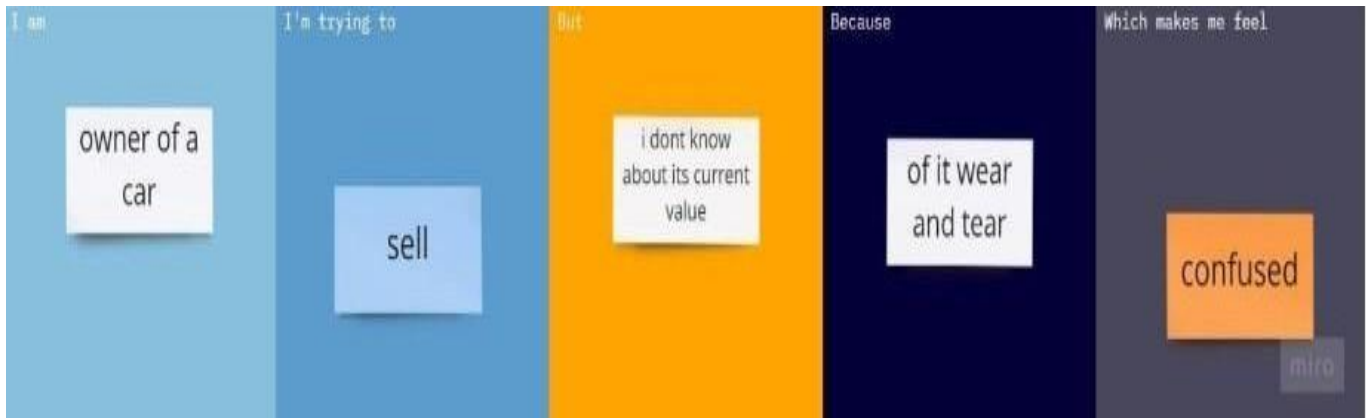
[3] Listiani, M. (2009). Support vector regression analysis for price prediction in a car leasing application (Doctoral dissertation, Master thesis, TU Hamburg-Harburg).

[4] T. D. Phan, "Housing Price Prediction Using Machine Learning Algorithms: The Case of Melbourne City Australia", *2018 International Conference on Machine Learning and Data Engineering (iCMLDE)*, pp. 35-42, 2018.

[5] K. Samruddhi and R. Ashok Kumar, "Used Car Price Prediction using K-Nearest Neighbor Based Model", *International Journal of Innovative Research in Applied Sciences and Engineering*, vol. 4, no. 3, pp. 686-689, 2020.

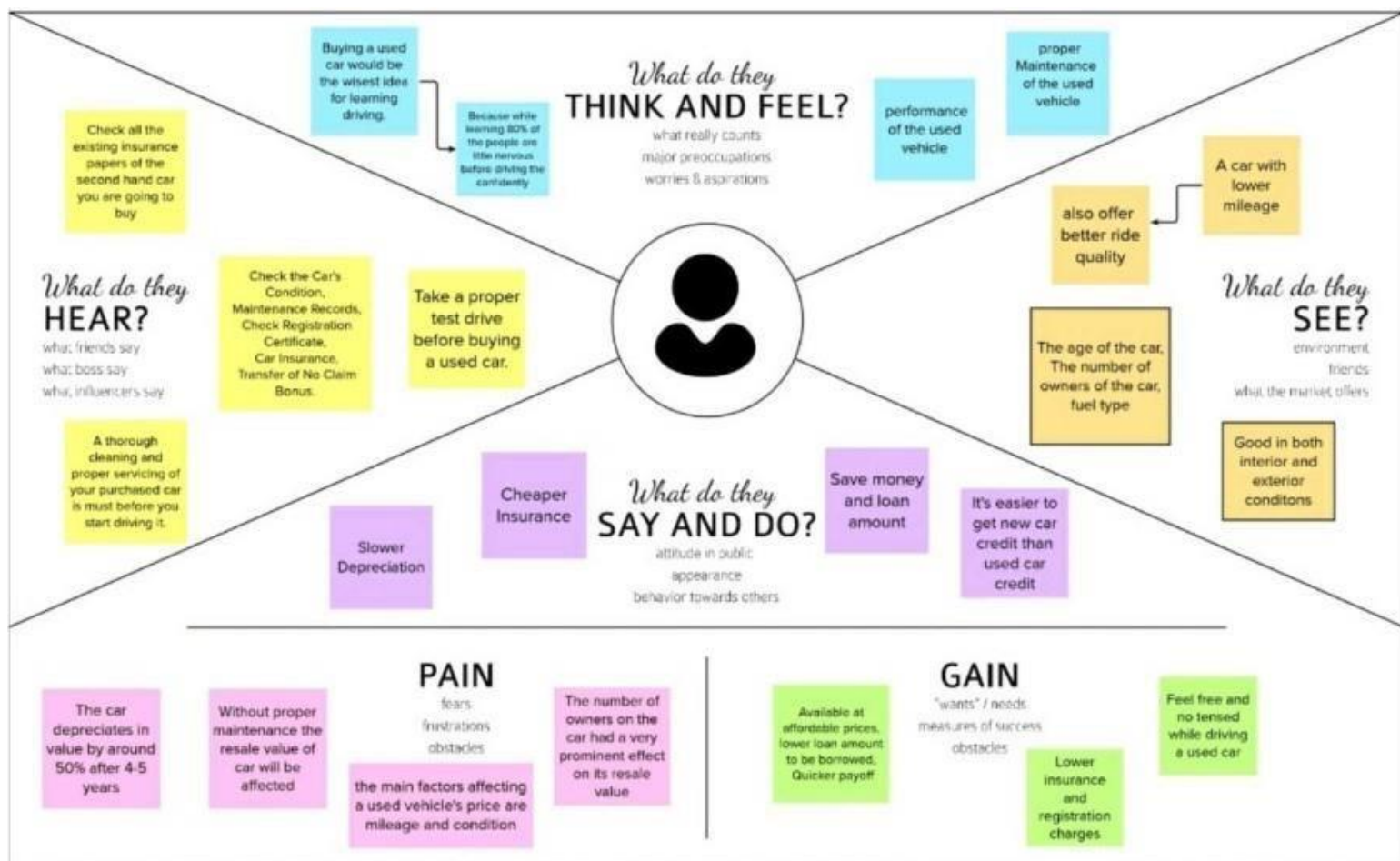
[6]O. Celik and U. O. Osmanoglu, "Prediction of The Prices of Second-Hand Cars", *Avrupa Bilim ve Teknoloji Dergisi*, no. 16, pp. 77-83, Aug. 2019.

Problem statement definition



3 .IDEATION& PROPOSED SOLUTION

Empathy Map Canvas



Ideation & Brainstorming

STEP 1:

- o Prediction using Car image.
- o By using the exterior and interior image of the car.
- o The value will be predicted based on the appearance of the car. If there are any damage or a number of scratches the car resale value will be quite affected.
- o By using neural network value of the car can be predicted.
- o Neural network algorithm is developed by considering the human brain that takes a set of units as input and transfers results to a predefined output.

STEP 2:

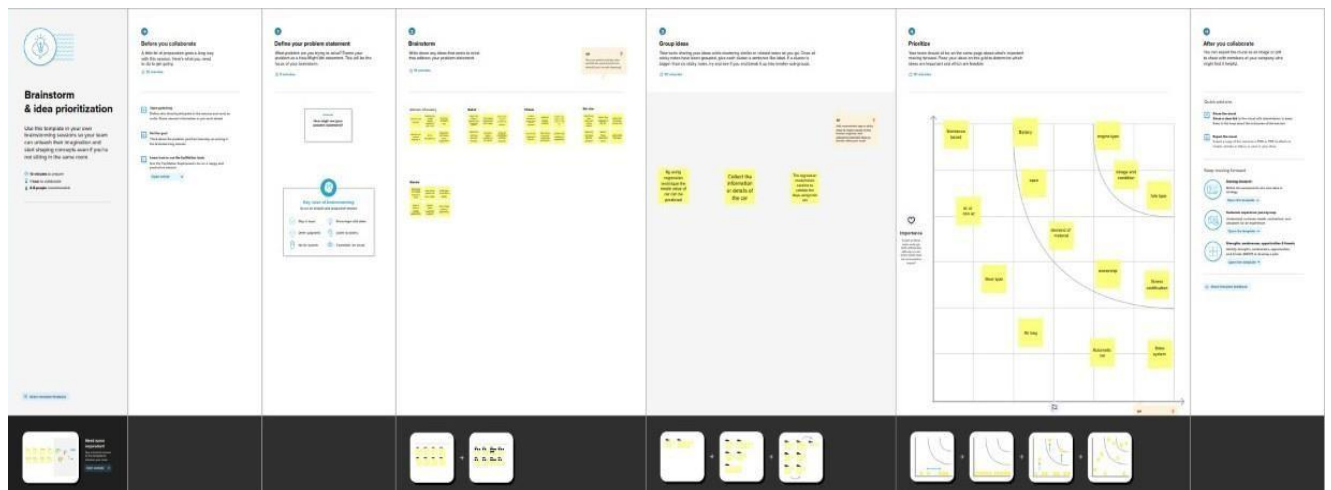
- o The main objective of this project is to predict the Prices of used cars, compare the prices and also estimate the lifespan of a particular car.
- o Insurance, Company claims, etc.
- o regression Algorithm is used to predict the value.
- o Regression model based on k-nearest neighbour machine learning algorithm was used to predict the price of a car.

STEP 3:

- o Prediction using engine car condition.
- o User should upload engine sound in the format of audio file.
- o By using Convolutional Neural Networks methodology price can be predicted.
- o CNNs for Machine Learning on sound data by spectrogram approach that just converts each song (or song segment) into a spectrogram: a two dimensional matrix

STEP 4:

- o Economic Conditions.
- o Kilo-metres Covered.
- o Its mileage (the number of kilometres it has run) and its horsepower
- o Car prediction using XGBoost algorithm accurate results will be monitored.
- o XGBoost as a regression model gave the best MSLE and RMSE values.



Proposed Solution

S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	To develop a webpage to predict the resale value of a car
2.	Idea / Solution description	To train the system with the dataset using a regression model
3.	Novelty / Uniqueness	By using the optimal regression model to predict the value in a less amount to time and predict its value

4.	Social Impact / Customer Satisfaction	The customer can get an idea about the resale value of their car .to have an idea whether to sell their vehicle or not based on their financial condition
5.	Business Model (Revenue Model)	The web based application has a friendly UI for the customer to enter their vehicles detail and the system predicts the value within few seconds
6.	Scalability of the Solution	T he solution given by the trained system is efficient and is nearly accurate value of the vehicle.

Proposed Solution fit

Define CS, fit into CC	1. CUSTOMER SEGMENT(S) <small>Who is your customer? i.e. working parents of 0-5 yrs kids</small> Both used car sellers and buyers	6. CUSTOMER CONSTRAINTS <small>What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available services.</small> <ul style="list-style-type: none"> To determine the worthiness of the car by their own within few minutes A loss function is to be optimized by spending money for dealers, brokers to buy or sell a car. 	5. AVAILABLE SOLUTIONS <small>Which solutions are available to the customers when they face the problem? Or how to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper is an alternative to digital estimating</small> <ul style="list-style-type: none"> In the past User cannot find the value of used car buy their own without prior knowledge about cars. A person who don't know much about the car can also make predictions for used cars easily. 	Explore AS, differentiate
	2. JOBS-TO-BE-DONE / PROBLEMS <small>Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one, suppose different sides.</small> To build a supervised machine learning model using regression algorithms for forecasting the value of a vehicle based on multiple attributes such as <ul style="list-style-type: none"> Condition of Engine Age of the used car Kilometers driven Number of owners 	9. PROBLEM ROOT CAUSE <small>What is the real reason that this problem exists? What is the back story behind the need to do this job? i.e. customers have to do it because of the change in legislation.</small> <ul style="list-style-type: none"> The price predicted by the dealers or brokers for used car is not trustful. users can predict the correct valuation of the car remotely without human intervention like car dealers. User can eliminate biased valuation predicted by the dealer. 	7. BEHAVIOUR <small>What does your customer do to address the problem and get the job done? i.e. manually research, find the right value panel, calculate usage and benefits, indirectly associated: customers spend free time on maintaining work (i.e. Greenpass)</small> <ul style="list-style-type: none"> The History of Your Car's condition and documents produced by them will be suspicious. The model is to be built that would give the nearest resale value of the vehicle by eliminating anonymous value predicted by the humans. 	
Identify strong TR & EM	3. TRIGGERS <small>What triggers customers to act? i.e. seeing their neighbour installing solar panels, reading about a more efficient solution in the news.</small> users can predict the correct valuation of the car by their own like olx, cars24 and other car resale value prediction websites by using model, year, owner, etc.	10. YOUR SOLUTION <small>If you are working on an existing business, write down your current solution first, fit in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.</small> <ul style="list-style-type: none"> The main aim of this project is to predict the price of used cars using the Machine Learning (ML) algorithms and collection data's about different cars. The project should take parameters related to used car as inputs and enable the customers to make decisions by their own. 	8. CHANNELS of BEHAVIOUR 8.1 ONLINE <small>What kind of actions do customers take online? Extract online channels from #7.</small> <ul style="list-style-type: none"> customer should predict the worth of the car by using different parameters given by the owner. User Should confirm the details provided about the vehicle in RTO online. user can decide by seeing the exterior and interior condition of the car. User can test the performance of the car and to buy it up in a affordable price based on its condition. 	Identify strong TR & EM
	4. EMOTIONS: BEFORE / AFTER <small>How do customers feel when they face a problem or a job and afterwards? i.e. lost, insecure - confident, in control - use it in your communication strategy & design.</small> Before:- User will be in fear about the biased values predicted by the humans based on the condition of the car. After:- user can determine the worthiness of the car by their own without human intervention.			

4 REQUIREMENT ANALYSIS

Functional Requirement

The functional Requirements of this project involves the better understanding of Pre-processing, Application designing using HTML & CSS and

IBM Watson Cloud. IBM Watson provides the services such as Database, deployment etc.

Hardware requirements Operating system- Windows 7,8,10

Software Requirements

- Python
- Pycharm
- PIP 2.7
- Jupyter Notebook
- Chrome

Non Functional Requirement

The Non - Functional Requirements of this project are,

- Highly accurate Image Predictive model
- better user responsive web application
- Cloud database for storing the informations

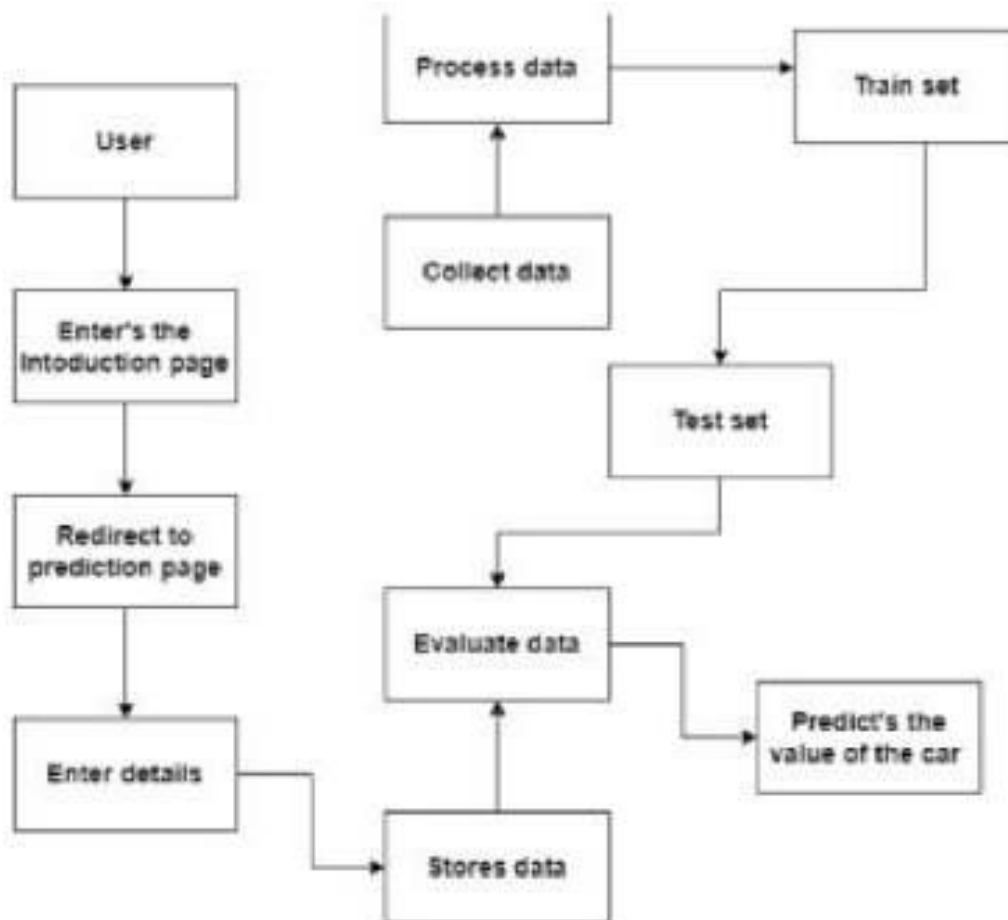
5. PROJECT DESIGN

Data Flow Diagrams

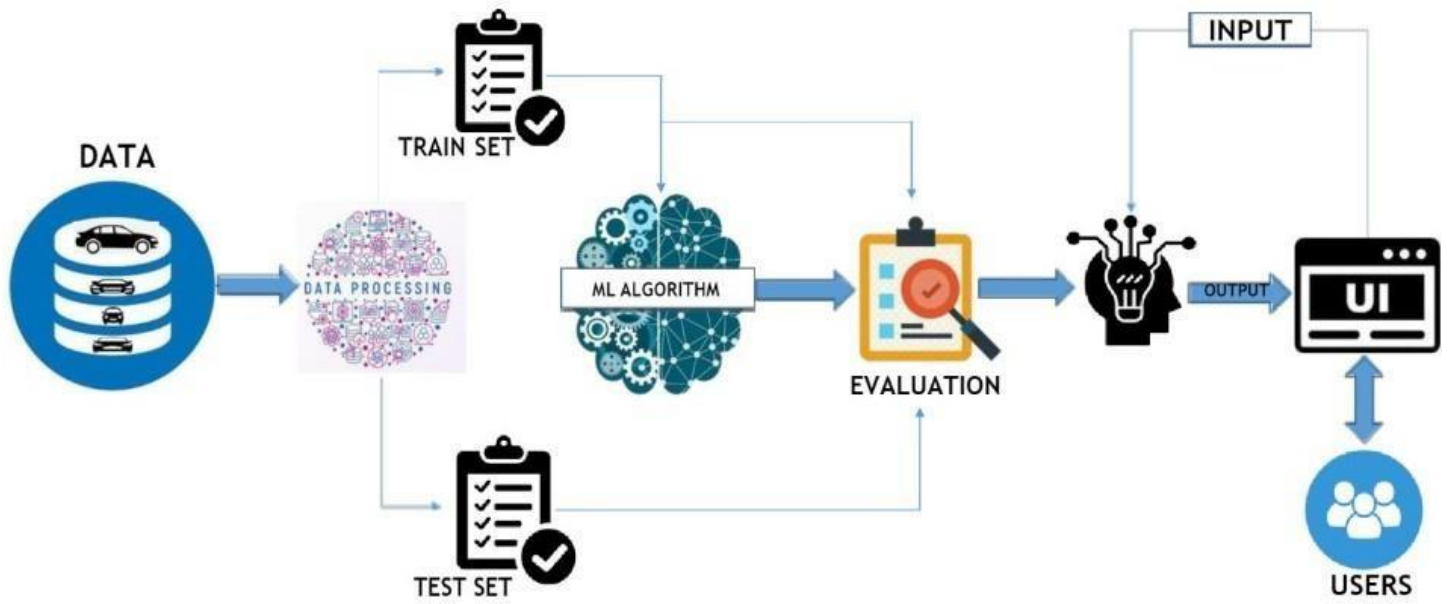
Solution & Technical Architecture

5.2 Solution & Technical Architecture

5.2 Solution & Technical Architecture



Solution & Technical Architecture



User Stories

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can enter into the website with the help of the Google chrome browser in Windows	2	High	N. Abhiram Chowdary A . Sai Siva P . Gokul M . Hitesh Y . Nanda
Sprint-1	Registration	USN-2	As a user, I can enter into the website through browser in Android	1	High	N. Abhiram Chowdary A . Sai Siva P . Gokul M . Hitesh Y . Nanda
Sprint-1	Registration	USN-3	As a user, I can enter into the website through browser in ios	2	Medium	N. Abhiram Chowdary A . Sai Siva P . Gokul M . Hitesh Y . Nanda
Sprint-1	Login	USN-4	As a user, I can find the car resale value prediction page in the website	1	High	N. Abhiram Chowdary A . Sai Siva P . Gokul M . Hitesh Y . Nanda

Sprint-2	Home Page	USN-5	As a user, I need to select the parameters like Year, Showroom price, Kilometres driven, fuel type etc and click on the submit button	2	High	N. Abhiram Chowdary A . Sai Siva P . Gokul M . Hitesh Y . Nanda
Sprint-3	Home Page	USN-6	As a user, I can see the accurate price for car resale after entering the details.	2	High	N. Abhiram Chowdary A . Sai Siva P . Gokul M . Hitesh Y . Nanda
Sprint-4	Home Page	USN-7	As a user, If I done a mistake while providing the details , I can reset the details and click the submit button.	1	Low	N. Abhiram Chowdary A . Sai Siva P . Gokul M . Hitesh Y . Nanda

6.PROJECT PLANNING

Sprint Planning and Estimation

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release (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

Sprint Delivery Schedule

- Pre -requisites
- Import Required libraries
- Collect Data Set
- Pre the process the data
- Choose the Appropriate Model
- Train the model on IBM
- Integrate with Flask endpoint
- Index..html
- Registration form.html
- Flask application
- App.py

7. CODING & SOLUTION

Feature 1

Import Libraries

```
In [1]: import pandas as pd
import numpy as np
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score
import pickle
```

```
In [2]: from lightgbm import LGBMRegressor
```

Import Preprocessed Data

```
In [6]: data = pd.read_csv('autos.csv', encoding='Windows-1252')
```

```
In [7]: data.head()
```

```
Out[7]:
```

	dateCrawled	name	seller	offerType	price	abtest	vehicleType	yearOfRegistration	gearbox	powerPS	model	kilometer	monthOfRegistration	fuelType
0	2016-03-24 11:52:17	Golf_3_1.6	privat	Angebot	480	test	NaN	1993	manuell	0	golf	150000	0	gas
1	2016-03-24 10:58:45	A5_Sportback_2.7_Tdi	privat	Angebot	18300	test	coupe	2011	manuell	190	NaN	125000	5	gas
2	2016-03-14 12:52:21	Jeep_Grand_Cherokee_"Overland"	privat	Angebot	9800	test	suv	2004	automatik	163	grand	125000	8	gas
3	2016-03-17 16:54:04	GOLF_4_1.4__3TÜRER	privat	Angebot	1500	test	kleinwagen	2001	manuell	75	golf	150000	6	gas
4	2016-03-31 11:01:27	BMW_116i_1.8i_16V	privat	Angebot	11000	test	sedan	2001	manuell	125	BMW	150000	2	gas

6.1 Feature 2

```
1 # Import Libraries
2 import pandas as pd
3 import numpy as np
4 from flask import Flask, render_template, Response, request
5 import pickle
6 from sklearn.preprocessing import LabelEncoder
7 import requests
8
9 # NOTE: you must manually set API_KEY below using information retrieved from your IBM Cloud account.
10 API_KEY = "Qo9j8ni7qMJ8j1C8VFDRFHbuGRAhYMcTlkVqnYglAGkE"
11 token_response = requests.post('https://iam.cloud.ibm.com/identity/token', data={"apikey":API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
12 mltoken = token_response.json()["access_token"]
13 header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' + mltoken}
14
15
16 app = Flask(__name__)#initiate flask app
17
18 def load_model(file='../Result/resale_model.sav'):#load the saved model
19     return pickle.load(open(file, 'rb'))
20
21 @app.route('/')
22 def index():#main page
23     return render_template('car.html')
24
25 @app.route('/predict_page')
26 def predict_page():#predicting page
27     return render_template('value.html')
28
29 @app.route('/predict', methods=['GET', 'POST'])
30 def predict():
31     reg_year = int(request.args.get('regyear'))
32     powerps = float(request.args.get('powerps'))
```

```

51 new_df = pd.DataFrame(columns=['vehicleType', 'yearOfReg', 'gearbox',
52                               'powerPS', 'model', 'kilometer', 'monthOfRegistration', 'fuelType',
53                               'brand', 'notRepairedDamage'])
54 new_df = new_df.append(new_row, ignore_index=True)
55 labels = ['gearbox', 'notRepairedDamage', 'model', 'brand', 'fuelType', 'vehicleType']
56 mapper = {}
57
58 for i in labels:
59     mapper[i] = LabelEncoder()
60     mapper[i].classes = np.load('../Result/'+str('classes'+i+'.npy'), allow_pickle=True)
61     transform = mapper[i].fit_transform(new_df[i])
62     new_df.loc[:,i+'_labels'] = pd.Series(transform, index=new_df.index)
63
64 labeled = new_df[['yearOfReg', 'powerPS', 'kilometer', 'monthOfRegistration'] + [x+'_labels' for x in labels]]
65
66 X = labeled.values.tolist()
67 print('\n\n', X)
68 #predict = reg_model.predict(X)
69
70 # NOTE: manually define and pass the array(s) of values to be scored in the next line
71 payload_scoring = {"input_data": [{"fields": [{"yearOfReg", "powerPS", "kilometer", "monthOfRegistration", "gearbox_labels", "notRepairedDamage_labels", "model_labels",
72
73 response_scoring = requests.post('https://us-south.ml.cloud.ibm.com/ml/v4/deployments/7f67cbcd-6222-413b-9901-b2a72807ac82/predictions?version=2022-10-30', json=payload_scoring)
74 predictions = response_scoring.json()
75 print(response_scoring.json())
76 predict = predictions['predictions'][0]['values'][0][0]
77 print("Final prediction :",predict)
78
79 return render_template('predict.html',predict=predict)
80
81 if __name__ == '__main__':
82     reg_model = load_model()#load the saved model
83     app.run(host='localhost', debug=True, threaded=False)

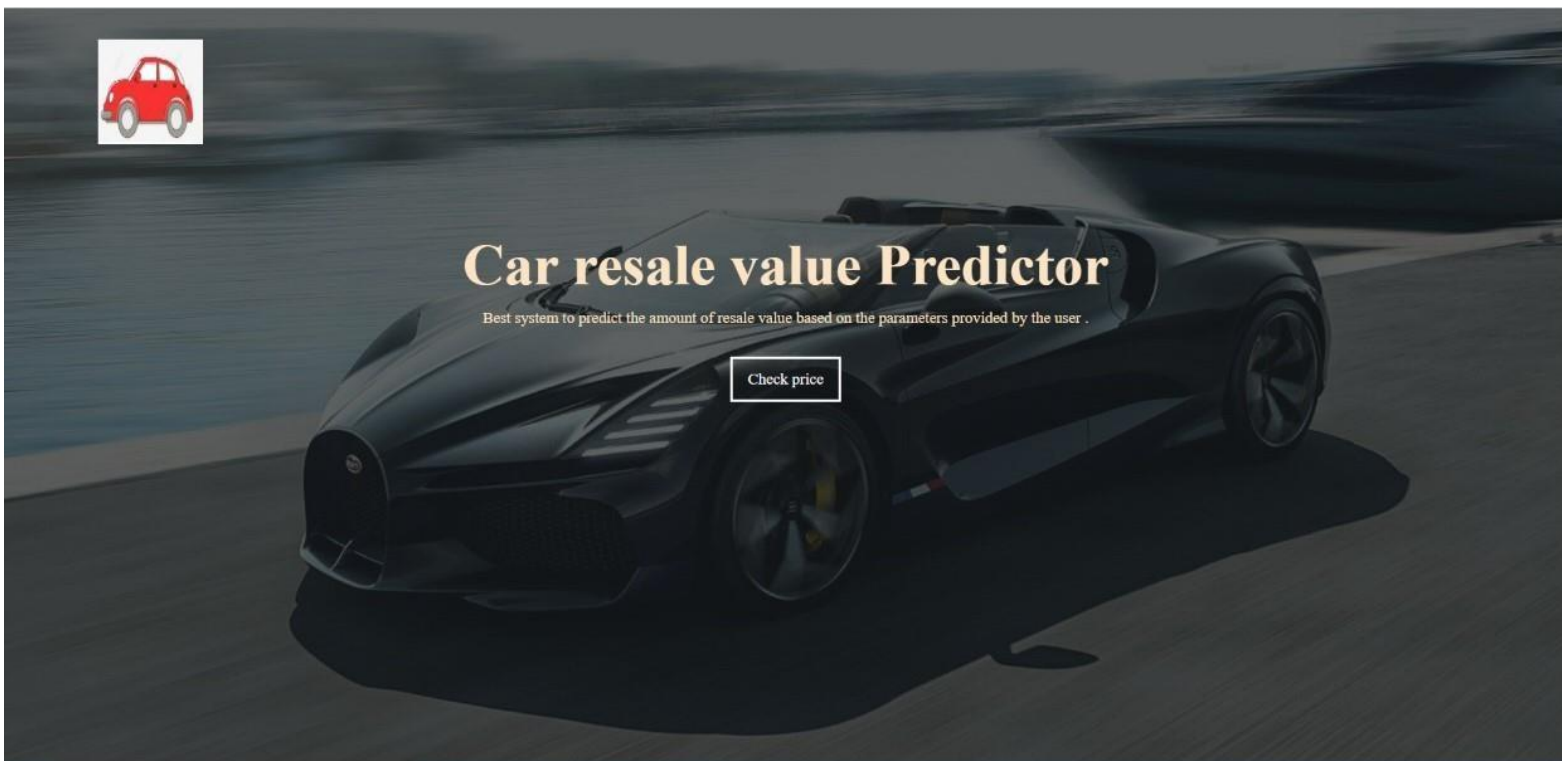
```

7. TESTING

Test Cases

1. User Login and Registration test
2. Database Update test
3. Prediction test

User Acceptance Testing



Get the Accurate Resale Value of Your Car

Registration year :

Registration Month :

Power of car in PS:

Kilometers that car have driven :

Gear type :

☐ Manual ☐ Automatic ☐ Not declared

Your car is repaired or damaged :

☐ Yes ☐ No ☐ Not declared

Model Type :

Choose Model Name... ▼

Brand :

Choose Brand Name... ▼

Fuel Type :

Choose Fuel Type... ▼

Vehicle type:

Choose Vehicle Type... ▼



The login web page is tested with the invalid user information to check the invalid login testing into the webpage.



Estimated Car resale value is 15578.736128175067

9. PERFORMANCE

Performance metrics

```
{'mae': 1325.112086905962,  
'mse': 9577053.62710202,  
'rmse': 3094.6815065692977,  
'rmsle': 8.03744027403009,  
'r2': 0.8661221626879432,  
'adj_r2_score': 0.8661152969113608}
```

The model is tested with the various damaged car images which is not used during the training and validation of the model which also shows that the model works with the accuracy of about 98% in the overall performance

10. ADVANTAGES AND DISADVANTAGES

- To develop an efficient and effective model which predicts the price of a used car according to the user's inputs and achieve good accuracy.

CONS:

- Less effective

11. CONCLUSION

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. The proposed system will help to determine the accurate price of used car price prediction.

12. FUTURE SCOPE

In future this machine learning model may bind with various websites which can provide real time data for price prediction. Also 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 as a user interface for interacting with users. 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.

Github Repo: <https://github.com/IBM-EPBL/IBM-Project-53991-1661587039>

13. APPENDIX

App.py

Import Libraries

import pandas as pd

import numpy as np

from flask import Flask, render_template, Response, request

import pickle

from sklearn.preprocessing import LabelEncoder

app = Flask(__name__)#initiate flask app

def load_model(file='model.sav'):#load the saved model

return pickle.load(open(file, 'rb'))

@app.route('/')

def index():#main page

return render_template('car.html')

```

@app.route('/predict_page')

def predict_page():#predicting page

    return render_template('value.html')


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

def predict():

    reg_year = int(request.args.get('regyear'))

    powerps = float(request.args.get('powerps'))

    kms= float(request.args.get('kms'))

    reg_month = int(request.args.get('regmonth'))


    gearbox = request.args.get('geartype')

    damage = request.args.get('damage')

    model = request.args.get('model')

    brand = request.args.get('brand')

    fuel_type = request.args.get('fuelType')

    veh_type = request.args.get('vehicletype')


    new_row = {'yearOfReg':reg_year, 'powerPS':powerps, 'kilometer':kms,

               'monthOfRegistration':reg_month, 'gearbox':gearbox,

               'notRepairedDamage':damage,

               'model':model, 'brand':brand, 'fuelType':fuel_type,

               'vehicletype':veh_type}


    print(new_row)


    new_df = pd.DataFrame(columns=['vehicletype','yearOfReg','gearbox',

                                   'powerPS','model','kilometer','monthOfRegistration','fuelType',

                                   'brand','notRepairedDamage'])

    new_df = new_df.append(new_row, ignore_index=True)

    labels = ['gearbox','notRepairedDamage','model','brand','fuelType','vehicletype']

    mapper = {}

```

```

for i in labels:

    mapper[i] = LabelEncoder()

    mapper[i].classes = np.load(str('classes'+i+'.npy'), allow_pickle=True)

    transform = mapper[i].fit_transform(new_df[i])

    new_df.loc[:,i+'_labels'] = pd.Series(transform, index=new_df.index)

    labeled = new_df[['yearOfReg', 'powerPS', 'kilometer', 'monthOfRegistration'] +
[x+'_labels' for x in labels]]

X = labeled.values.tolist()

print('\n\n', X)

predict = reg_model.predict(X)

#predict = predictions['predictions'][0]['values'][0][0]

print('Final prediction :',predict)

return render_template('predict.html',predict=predict)

if __name__ == '__main__':

    reg_model = load_model()#load the saved model

    app.run(debug=True)

```

