CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

The used car market shows great potential in the global world. The price of a new car in the industry is fixed by the manufacturer with some additional costs incurred by the government in the form of taxes. But due to the increased price of new cars and the inability of customers to buy new cars due to the lack of funds, used car sales are on a global increase. 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.

MACHINE LEARNING

Machine Learning is a field of technology developing with immense abilities and applications in automating tasks, where neither human intervention is needed nor explicit programming. The power of ML is so great that we can see its applications trending almost everywhere in our day-to-day lives. ML has solved many problems that existed earlier and have made businesses in the world progress to a great extent. To develop an efficient and effective model which predicts the price of a used car according to the user's inputs.

➢ To achieve good accuracy.

➢ To develop a User Interface (UI)

➢ It is user-friendly

➢ It takes input from the user and predicts the price.

1.2 PURPOSE

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 in actual market value. It is important to know their actual market value while both buying and selling. By Machine learning concept, to find the best solution for car price prediction is possible.

1.3 OBJECTIVE

Car Price Prediction project is the ability to predict the price of a used car given various attributes (data) of that car. There is a saying that a car loses 10% of its value the moment the user drives it off a lot. Given that the user would expect that one of the main predictors is the amount of miles driven in the car, since more driving wears down the car. Additionally, the user would expect the brand (make) of the car to also be a factor in the price of a used car, since some brands of cars cost more and may be better made. The user expects to encounter some issues with multidisciplinary since some aspects of cars may be highly correlated. For example, larger cars will probably have larger engines and more doors. Larger engines are correlated with more cylinders.

CHAPTER 2
LITERATURE SURVEY

Author: Deep Pandya

Description: The first paper is Predicting the price of Used Car Using Machine Learning Techniques. In this paper, they investigate the application of supervised machine learning techniques to predict the price of used cars in Mauritius. The predictions are based on historical data collected from daily newspapers. Different techniques like multiple linear regression analysis, k-nearest neighbours, naïve bayes and decision trees have been used to make the predictions. The Second paper is Car Price Prediction Using Machine Learning Techniques. Considerable number of distinct attributes are examined for the reliable and accurate prediction. To build a model for predicting the price of used cars in Bosnia and Herzegovina, they have applied three machine learning techniques (Artificial Neural Network, Support Vector Machine and Random Forest). The Third paper is Price Evaluation model in second hand car system based on BP neural networks. Inthis paper, the price evaluation model based on big data analysis is proposed, which takes advantage of widely circulated vehicle data and a large number of vehicle transaction data to analyze the price data for each type of vehicles by using the optimized BP neural network algorithm. It aims to establish a second-hand car price evaluation model to get the price that best matches the car.

Author: Ashok Kumar

Description: Predicting the price of used cars is one of the significant and interesting areas of analysis. As an increased demand in the second-hand car market, the business for both buyers and sellers has increased. For reliable and accurate prediction it requires expert knowledge about the field because of the price of the cars dependent on many important factors .This paper proposed a supervised machine learning model using KNN (K Nearest Neighbor) regression algorithm to analyze the price of used cars. We trained our model with data of used cars which is collected from the Kaggle website. Through this experiment, the data was examined with different trained and test ratios. As a result, the

accuracy of the proposed model is around 85% and is fitted as the optimized model.

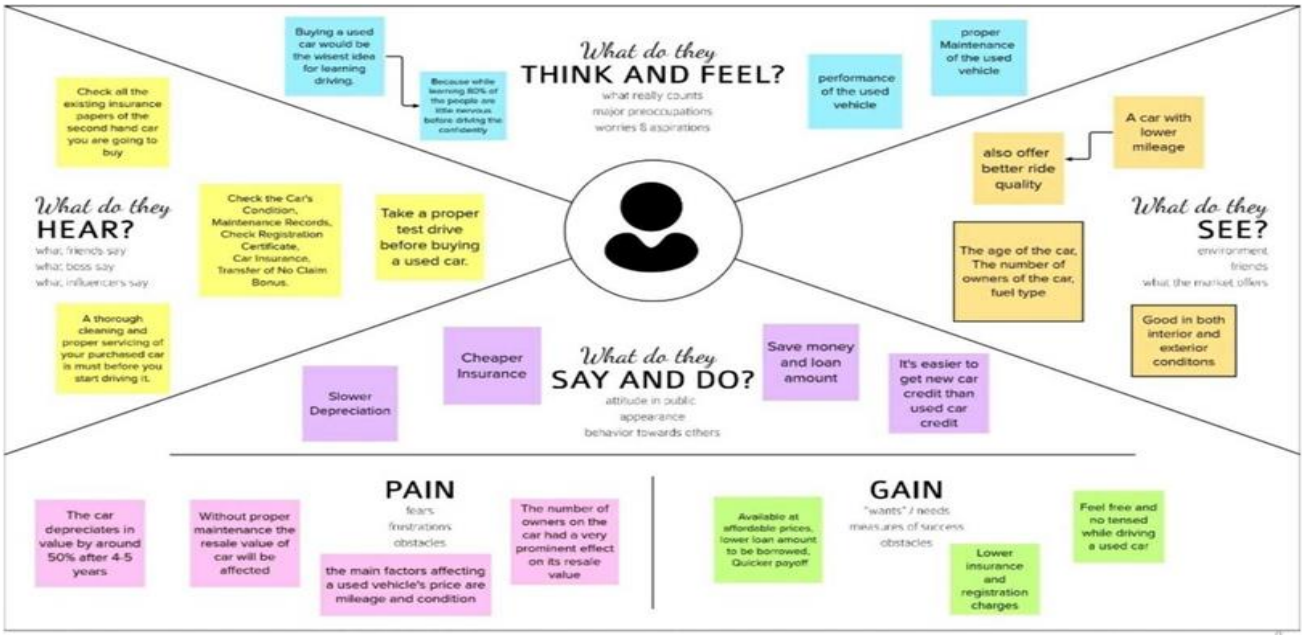
Author: Varun Nayak

Description: Vehicle price prediction especially when the vehicle is used and not coming direct from the factory, is both a critical and important task. With increase in demand for used cars and upto 8 percent decrease in demand for the new cars in 2013, more and more vehicle buyers are finding alternatives of buying new cars outright. People prefer to buy cars through lease which is a legal contract between buyer and seller. The seller category includes direct seller or third party, business entity or insurance company. Under lease contract, the buyers pay regular installments of the item purchased for a predefined period of time. These lease installments are dependent upon the estimated price of the vehicle and thus, sellers are interested to know about fair estimated price of their vehicles. It is found through studies that finding fair estimated price of a used car is important as well as challenging. So, there is a need of accurate price prediction mechanism for the used cars. Prediction techniques of machine learning can be helpful in this regard. Machine learning uses two techniques, i.e., inductive and deductive. The deductive learning is based on the usage of existing facts and knowledge to deduce new knowledge and facts while in inductive machine learning new computer programs are created by finding patterns and rules in the new data setswhich were never explored.

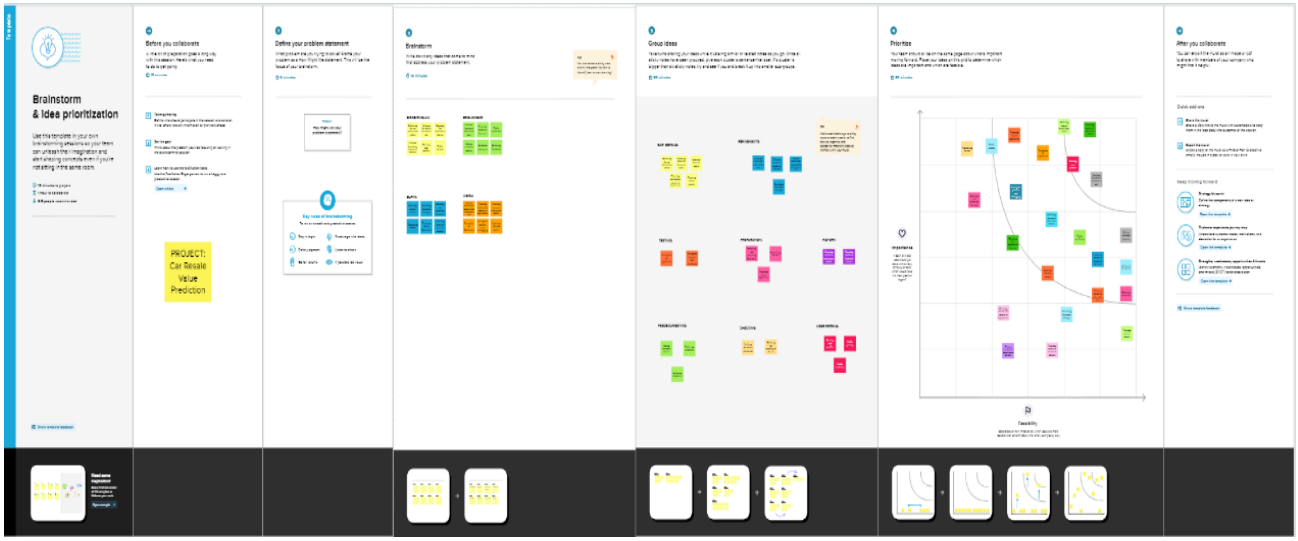
CHAPTER 3

IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS



3.2 IDEATION AND BRAINSTROMING

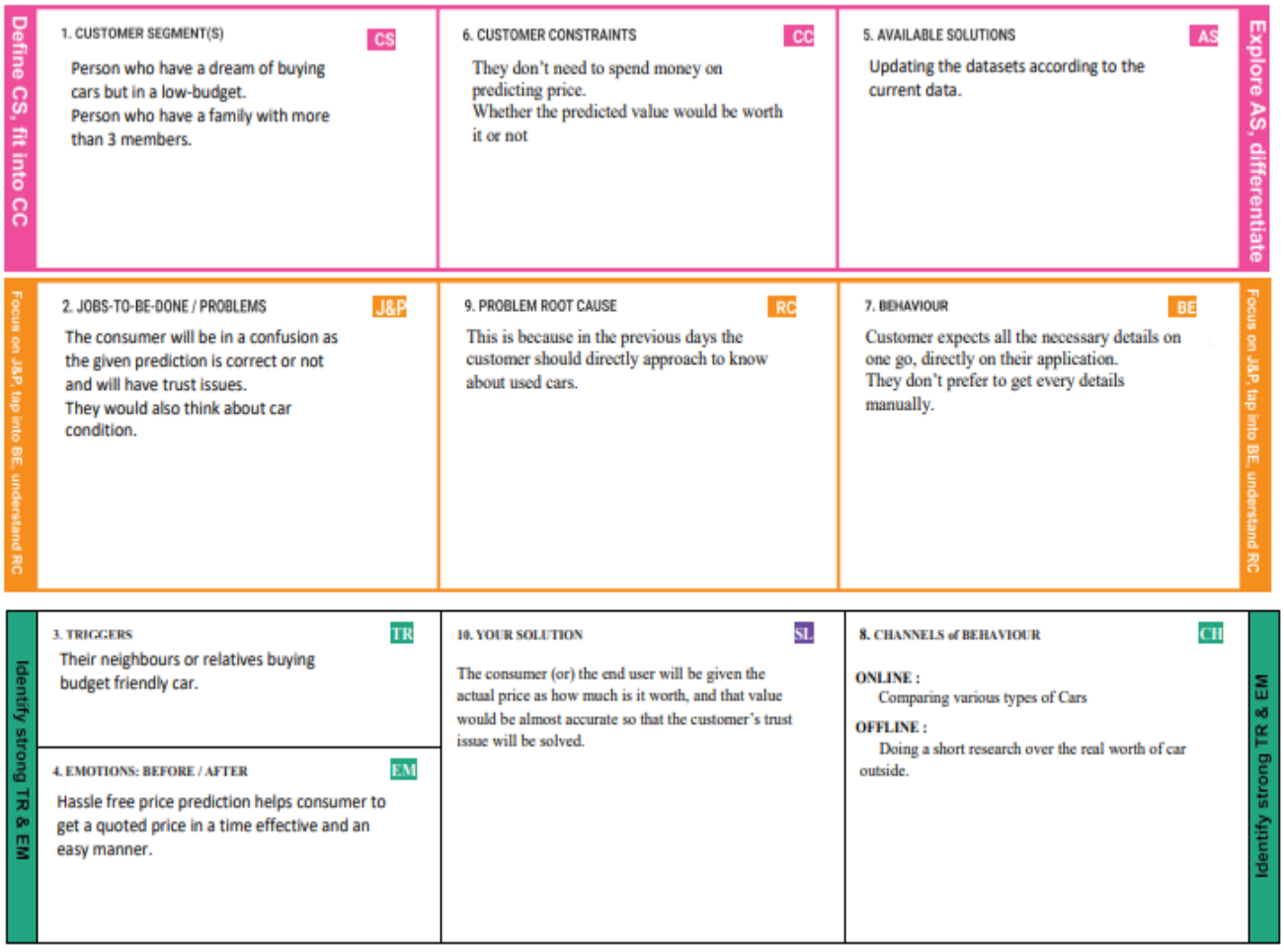


3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Car Resale Value Prediction: 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.
2.	Idea / Solution description	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.
3.	Novelty / Uniqueness	To predict the value, the most essential elements for forecast are brand and model, period use of vehicle, mileage of vehicle, gear type and fuel type utilized in the vehicle just as fuel utilization per mile profoundly influence cost of a vehicle because of continuous changes in the cost of a fuel. By forecasting the above details, AI can predict the value accurately.
4.	Social Impact / Customer Satisfaction	1) Enhanced resale value accuracy. 2) Improved relationships with customers. 3) Leads to increased quality of products and it's related after sales service.
5.	Business Model (Revenue Model)	This business plan addresses all relevant concerns by presenting a comprehensive account of a month-by-month marketing strategy coupled with an extensive report on all aspects of the needs of a successful used car center.

6.	Scalability of the Solution	The value of the car is predicting by using different regression algorithms like linear regression, random forest regression, decision tree regression and so on. Thus the car will got accurate price. Those algorithms gives the results with the user given details about the car, but the best and approximate result is got by random forest algorithm. As random forest regression algorithm gives more as 15% then other algorithms.

3.4 PROPOSED SOLUTION FIT



CHAPTER 4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Home page	Login to Home page and see website details
FR-2	Car's Data	Entering the required Data
FR-3	Prediction	Analysing the car price
FR-4	Predicted value	Displaying the predicted value (car price)

4.2 NON-FUNCTIONAL REQUIREMENTS

Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Used to predict the used car price
NFR-2	**Security**	Secured connection
NFR-3	**Reliability**	Prediction of accurate Price
NFR-4	**Performance**	High performance due to model
NFR-5	**Availability**	Available for all internet users
NFR-6	**Scalability**	High scalability , Multiple users can access at same time

4.3 PROJECT METHODOLOGY

There are two primary phases in the system:

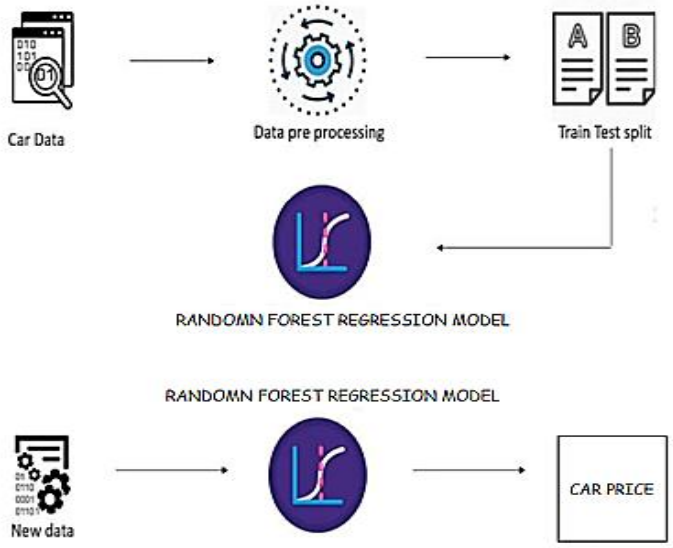
- Training Phase
- Testing Phase

Training Phase

The system is trained by using the data in the data set and fits a model (line/curve) based on the algorithm chosen accordingly.

Testing phase

The system is provided with the inputs and is tested for its working. The accuracy is checked. And therefore, the data that is used to train the model or test it, has to be appropriate. The system is designed to detect and predict the price of used cars and hence appropriate algorithms must be used to do the two different tasks. Before the algorithms were selected for further use, different algorithms were compared for its accuracy. The well-suited one for the task was chosen.



4.4 MODULE DESCRIPTION

Data Pre-Processing

Data preprocessing 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. When creating a machine learning project, it is not always a case that we come across clean and formatted data. And while doing any operation with data, it is mandatory to clean it and put it in a formatted way. So for this, the user can use data pre-processing task.

Training

A training model is a dataset that is used to train an ML algorithm. It consists of the sample output data and the corresponding sets of input data that have an influence on the output. The training model is used to run the input data through the algorithm to correlate the processed output against the sample output. The result from this correlation is used to modify the model.

Testing

In machine learning, model testing is referred to as the process where the performance of a fully trained model is evaluated on a testing set. This kind of ML testing is more similar to traditional testing. Users can write and run tests checking the performance of the program. Applying the tests, users catch bugs in different components of the ML program. For example, users can test that the hidden layers in a neural network are configured correctly.

Random forest Regression

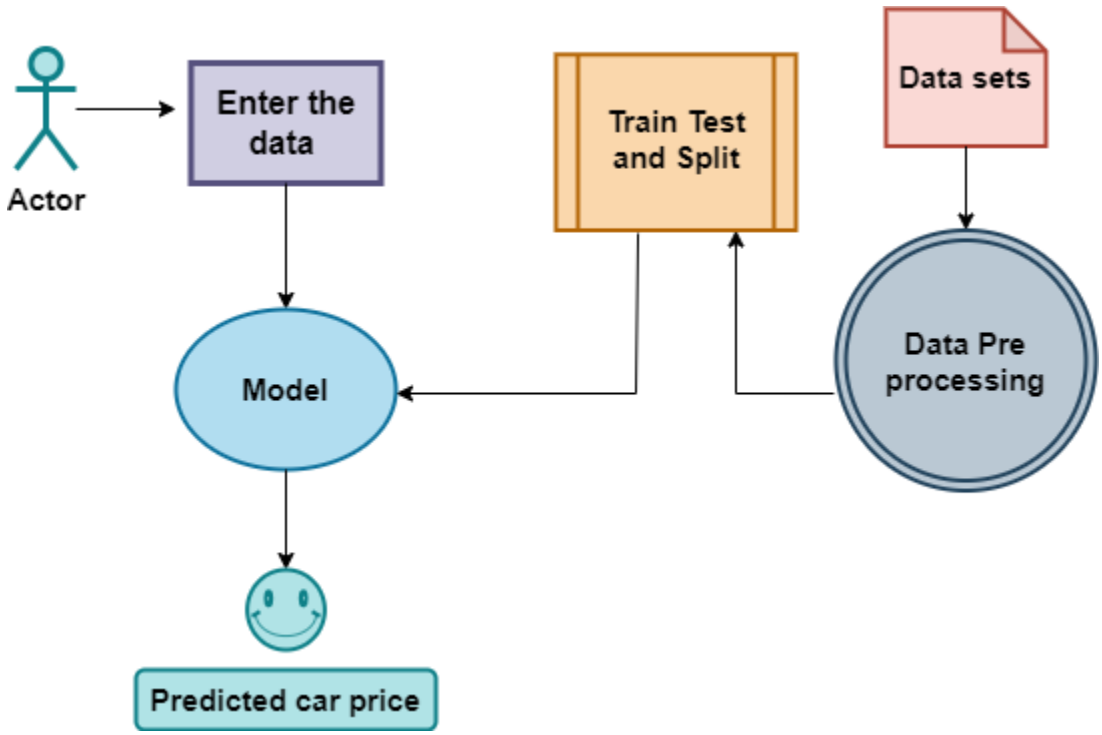
Random Forest Regression is a supervised learning algorithm that uses ensemble learning methods for regression. Ensemble learning method is a technique that combines predictions from multiple machine learning algorithms to make a more accurate prediction than a single model.

Prediction

"Prediction" refers to the output of an algorithm .It has been trained on a historical dataset and applied to new data when forecasting the likelihood of a particular outcome. Just like a hypothesis, a prediction is a type of guess. However, a prediction is an estimation made from observations.

CHAPTER 5
PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS



5.2 SOLUTION AND TECHNICAL ARCHITECTURE

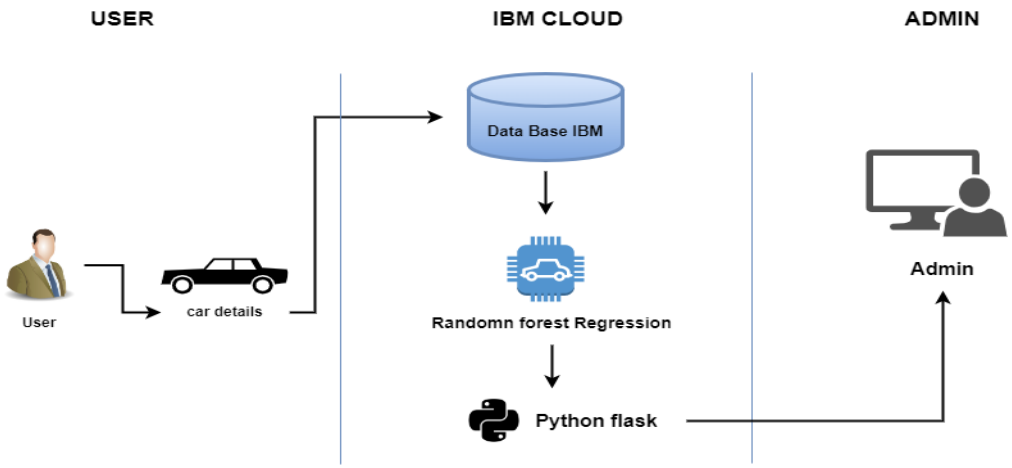


Table-1: Components & Technologies

S.No	Component	Description	Technology
1.	User Interface	The user interacts with application using Web UI.	HTML, CSS, JavaScript , ReactJS etc.
2.	Database	The dataset containing car details is used for training the model to predict the rate.	Python libraries like numpy, pandas etc.
3.	Cloud Database	The dataset is stored in the IBM cloud	IBM Cloud
4.	Machine Learning algorithms	The machine learning algorithms are used to predict the used cars rate.	Random forest Regression algorithm

Table-2: Application Characteristics

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Open-source frameworks used	Python Flask, Python, IBM Cloud
2.	Scalable Architecture	Scalability of architecture consists of 3 tiers	Web server-HTML, CSS, Java script Application server-Python Flask Database server-IBM Cloud

3.	Availability	The user can access through cloud	IBM Cloud hosting
4.	Performance	Multiple users can access the web application	IBM Load Balance

5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
customer (web user)	Dashboard	USN-1	User can visit the Home page	I can access website Details	High	Sprint-1
	Car Details	USN-2	Users should give their requirements like model, year, fuel type, owner etc...	I should give the car details	High	Sprint-2
	Car Price	USN-3	User can see the current price of the car	I can see the car price	High	Sprint-4
Admin	Model Building	USN-4	Admin should train and test the data set given	I can build train and test the model	High	Sprint-3
	Predict chart	USN-5	Admin should get the data set and predicted value of the car	I can predict the car price	High	Sprint-3
	Predict	USN-6	Admin should display the predicted price	I can display the car price	High	Sprint-4

CHAPTER 6

PROJECT PLANNING AND SCHEDULING

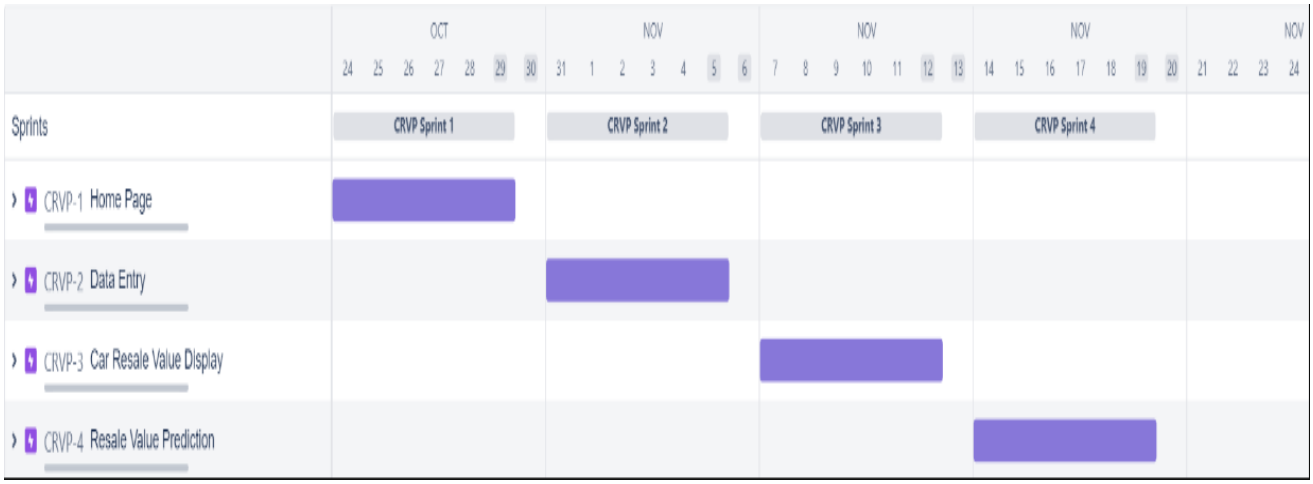
6.1 SPRINT PLANNING AND ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Home Page	USN-1	As a user, I can view the home page of the web application.	20	High	Siragirivelan
Sprint-2	Data Entry	USN-2	As a user, I can enter my car details in the application.	20	High	Srishangar
Sprint-3	Car resale value display	USN-3	As a user, I can view the resale value of my car.	20	High	Surya
Sprint-4	Resale Value Prediction	USN-4	As a user, I expect the application to predict the resale value of my car.	20	High	Vibish

6.2 SPRINT DELEIVERABLE 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



CHAPTER 7
ADVANTAGES AND DISADVANTAGES

7.1 DEMERITS OF THE EXISTING SYSTEM

The data needed for the price estimation of the used cars is less in the existing system. Only variant, model, brand and the model year of the car and the estimated price of the car given by the seller are the only information given in most of the existing systems. In the existing systems, the owners of the cars code the selling price of the cars which is favorable to the owner's hand. The satisfaction of the buyer and the seller is less and the estimated price isn't reasonable. And the brokerage and brokers are involved in the existing systems. In the existing system, mechanics are needed to give the final estimate of the cars after the inspection. Mileage and horsepower are neglected in the price estimation data.

7.2 MERITS OF THE NEWLY PROPOSED SYSTEM

The data needed for the price estimation of the used cars is more Compared to the existing system. Other than the variant, model and brand of the car, the mileage and Service records of the car is also needed for estimating price for greater accuracy. In the older or existing systems, the owners of the cars code the selling price of the cars which is favorable to the owner's hand. The satisfaction of the both seller and buyer are more and there is no brokerage and brokers involved as an external mediator. User friendly, more reliable, easily understandable, high accuracy in estimation of the price of used cars. There is less need for a mechanic to give a price estimate of the car after inspection. The more reasonable and best resale price is estimated through the newly proposed system which fulfills both the seller's and buyer's satisfaction.

APPENDIX

HTML

HOME PAGE

```
<!DOCTYPE html>
<html lang="en" dir="ltr">
  <head>
    <meta charset="utf-8">
    <title>Car Resale Value Prediction</title>
    <link rel="stylesheet" href="../static/css/home.css">
    <linkrel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/4.7.0/css/font-awesome.min.css">
  </head>
  <body>
    <section class="header">
      <nav>
        <a href="/"></a>
      </nav>
        <div class="text-box">
          <h1>Car Resale Value Prediction</h1>
          <a href="/search.html" class="visit-btn ">Check price</a>
        </div>
    </section>
  </body>
 </html>
```

SEARCH PAGE

```
<!DOCTYPE html>
<html lang="en" dir="ltr">
<head>
```

```
<link rel="stylesheet" href="../static/css/search.css">
<title>Car Resale Value Prediction</title>
</head>
<body>
        <section class="form">
        <form action="http://localhost:5000/predict" method="GET">
    <table border="0" align="center">
    <tbody>
                <h1>Get the Accurate Resale Value of Your Car</h1>
    <tr>
        <td><label for="year" padding:10px>Registration year : </label></td>
        <td><input id="year" maxlength="50" name="regyear" type="text" />
        <br>
        <br>
        </td>
        </tr>
        <tr>
        <td><label for="month">Registration Month : </label></td>
        <td><input id="month" maxlength="50" name="regmonth" type="text" />
        <br>
        <br>
        </td>
        </tr>
        <tr>
        <td><label for="power">Power of car in PS: </label></td>
        <td><input id="power" maxlength="50" name="powerps" type="text" />
        <br>
        <br>
        </td>
        </tr>
        <tr>
        <td><label for="kilometer">Kilometers that car have driven : </label></td>
        <td><input id="kilometer" maxlength="50" name="kms" type="text" />
        <br>
```

```
<br>
</td>
</tr>
<tr>
<td><label for="geartype">Gear type : </label></td>
<td><input type="radio" name="geartype" value="manual"/> Manual
<input type="radio" name="geartype" value="automatic"/> Automatic
<input type="radio" name="geartype" value="not-declared"/> Not declared
<br>
<br>
</td>
</tr>
<tr>
<td><label for="damage">Your car is repaired or damaged : </label></td>
<td><input type="radio" name="damage" value="yes"/> Yes
<input type="radio" name="damage" value="no"/> No
<input type="radio" name="damage" value="not-declared"/> Not declared
<br>
<br>
</td>
</tr>
<tr>
<td><label for="model">Model Type : </label></td>
<td>
<select name="model" id="model">
<option value="" disabled selected hidden>Choose Model Name...</option>
<option value="golf">Golf </option>
<option value="grand">Grand </option>
<option value="fabia">Fabia </option>
<option value="3er">3er </option>
<option value="2_reihe">2 Reihe </option>
<option value="andere">Andere </option>
<option value="c_max">C Max </option>
<option value="3_reihe">3 Reihe </option>
```

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<option value="ka">Ka </option>
<option value="polo">Polo </option>
<option value="twingo">Twingo </option>
<option value="a_klasse">A klasse </option>
<option value="scirocco">Scirocco </option>
<option value="5er">5er </option>
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<option value="arosa">Arosa </option>
<option value="c4">C4 </option>
<option value="civic">Civic </option>
<option value="transporter">Transporter </option>
<option value="punto">Punto </option>
<option value="e_klasse">E Klasse </option>
<option value="clio">Clio </option>
<option value="kadett">Kadett </option>
<option value="kangoo">Kangoo </option>
<option value="corsa">Corsa </option>
<option value="one">One </option>
<option value="fortwo">Fortwo </option>
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<option value="sportage">Sportage </option>
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<option value="5er">5er </option>
<option value="ibiza">Ibiza </option>
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<option value="rio">Rio </option>

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<option value="c3">C3 </option>
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<option value="corolla">Corolla </option>
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<option value="phaeton">Phaeton </option>
<option value="boxster">Boxster </option>
<option value="verso">Verso </option>
<option value="swift">Swift </option>
<option value="rav">Rav </option>
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<option value="stilo">Stilo </option>
<option value="alhambra">Alhambra </option>
<option value="911">911 </option>
<option value="mx_reihe">Mx Reihe </option>
<option value="m_reihe">M Reihe </option>
<option value="roadster">Roadster </option>
<option value="ypsilon">Ypsilon </option>
<option value="cayenne">Cayenne </option>
<option value="galant">Galant </option>
<option value="justy">Justy </option>
<option value="90">90 </option>
<option value="sirion">Sirion </option>
<option value="crossfire">Crossfire </option>
<option value="6_reihe">6 Reihe </option>
<option value="agila">Agila </option>
<option value="duster">Duster </option>
<option value="cr_reihe">Cr Reihe </option>
<option value="v50">V50 </option>
<option value="discovery">Discovery </option>
<option value="c_reihe">C Reihe </option>
<option value="v_klasse">V Klasse </option>
<option value="yaris">Yaris </option>
<option value="c5">C5 </option>

<option value="aygo">Aygo </option>
<option value="cc">Cc </option>
<option value="carnival">Carnival </option>
<option value="fusion">Fusion </option>
<option value="bora">Bora </option>
<option value="forfour">Forfour </option>
<option value="100">100 </option>
<option value="cl">Cl </option>
<option value="tigra">Tigra </option>
<option value="156">156 </option>
<option value="300c">300c </option>
<option value="100">100 </option>
<option value="147">147 </option>
<option value="q3">Q3 </option>
<option value="spark">Spark </option>
<option value="v70">V70 </option>
<option value="x_type">X Type </option>
<option value="5_reihe">5 Reihe </option>
<option value="ducato">Ducato </option>
<option value="s_type">S Type </option>
<option value="x_trail">X Trail </option>
<option value="toledo">Toledo </option>
<option value="altea">Altea </option>
<option value="7er">7er </option>
<option value="voyager">Voyager </option>
<option value="calibra">Calibra </option>
<option value="bravo">Bravo </option>
<option value="range_rover">Range Rover </option>
<option value="antara">Antara </option>
<option value="tucson">Tucson </option>
<option value="q7">Q7 </option>
<option value="citigo">Citigo </option>
<option value="jimny">Jimny </option>
<option value="cx_reihe">Cx Reihe </option>

<option value="wrangler">Wrangler </option>
<option value="lybra">Lybra </option>
<option value="range_rover_sport">Range Rover Sport </option>
<option value="lancer">Lancer </option>
<option value="159">159 </option>
<option value="freelander">Freelander </option>
<option value="captiva">Captiva </option>
<option value="c2">C2 </option>
<option value="500">500 </option>
<option value="range_rover_evoque">Range Rover Evoque </option>
<option value="sandero">Sandero </option>
<option value="note">Note </option>
<option value="900">900 </option>
<option value="147">147 </option>
<option value="defender">Defender </option>
<option value="cherokee">Cherokee </option>
<option value="clubman">Clubman </option>
<option value="samara">Samara </option>
<option value="2_reihe">2 Reihe </option>
<option value="1er">1er </option>
<option value="3er">3er </option>
<option value="601">601 </option>
<option value="3_reihe">3 Reihe </option>
<option value="4_reihe">4 Reihe </option>
<option value="5er">5er </option>
<option value="6_reihe">6 Reihe </option>
<option value="legacy">Legacy </option>
<option value="pajero">Pajero </option>
<option value="auris">Auris </option>
<option value="niva">Niva </option>
<option value="5_reihe">5 Reihe </option>
<option value="s60">S60 </option>
<option value="nubira">Nubira </option>
<option value="vivaro">Vivaro </option>

<option value="g_klasse">G Klasse </option>
<option value="lodgy">Lodgy </option>
<option value="850">850 </option>
<option value="serie_2">Serie 2 </option>
<option value="6er">6er </option>
<option value="charade">Charade </option>
<option value="croma">Croma </option>
<option value="outlander">Outlander </option>
<option value="gl">Gl </option>
<option value="doblo">Doblo </option>
<option value="musa">Musa </option>
<option value="amarok">Amarok </option>
<option value="156">156 </option>
<option value="move">Move </option>
<option value="9000">9000 </option>
<option value="v60">V60 </option>
<option value="145">145 </option>
<option value="aveo">Aveo </option>
<option value="200">200 </option>
<option value="300c">300c </option>
<option value="b_max">B Max </option>
<option value="delta">Delta </option>
<option value="terios">Terios </option>
<option value="rangerover">RangeRover </option>
<option value="90">90 </option>
<option value="materia">Materia </option>
<option value="kalina">Kalina </option>
<option value="elefantino">Elefantino </option>
<option value="i3">I3 </option>
<option value="kappa">Kappa </option>
<option value="serie_3">Serie 3 </option>
<option value="48429">48429 </option>
<option value="serie_1">Serie 1 </option>
<option value="discovery_sport">Discovery Sport </option>

```
</select>
<br>
<br>
</td>
</tr>
<tr>
<td><label for="brand">Brand :</label></td>
<td>
<select name="brand" id="brand">
<option value="" disabled selected hidden>Choose Brand Name...</option>
<option value="volkswagen">Volkswagen </option>
<option value="audi">Audi </option>
<option value="jeep">Jeep </option>
<option value="skoda">Skoda </option>
<option value="bmw">Bmw </option>
<option value="peugeot">Peugeot </option>
<option value="ford">Ford </option>
<option value="mazda">Mazda </option>
<option value="nissan">Nissan </option>
<option value="renault">Renault </option>
<option value="mercedes_benz">Mercedes Benz </option>
<option value="opel">Opel </option>
<option value="seat">Seat </option>
<option value="citroen">Citroen </option>
<option value="honda">Honda </option>
<option value="fiat">Fiat </option>
<option value="mini">Mini </option>
<option value="smart">Smart </option>
<option value="hyundai">Hyundai </option>
<option value="sonstige_autos">Sonstige Autos </option>
<option value="alfa_romeo">Alfa Romeo </option>
<option value="subaru">Subaru </option>
<option value="volvo">Volvo </option>
<option value="mitsubishi">Mitsubishi </option>
```

<option value="kia">Kia </option>
<option value="suzuki">Suzuki </option>
<option value="lancia">Lancia </option>
<option value="porsche">Porsche </option>
<option value="toyota">Toyota </option>
<option value="chevrolet">Chevrolet </option>
<option value="dacia">Dacia </option>
<option value="daihatsu">Daihatsu </option>
<option value="trabant">Trabant </option>
<option value="saab">Saab </option>
<option value="chrysler">Chrysler </option>
<option value="jaguar">Jaguar </option>
<option value="daewoo">Daewoo </option>
<option value="rover">Rover </option>
<option value="land_rover">Land Rover </option>
<option value="lada">Lada </option>
</select>

</td>
</tr>
<tr>
<td><label for="fuelType">Fuel Type :</label></td>
<td>
<select name="fuelType" id="brand">
<option value="" disabled selected hidden>Choose Fuel Type...</option>
<option value="petrol"> Petrol </option>
<option value="diesel"> Diesel </option>
<option value="not-declared"> Not Declared </option>
<option value="lpg">LPG </option>
<option value="cng">CNG </option>
<option value="hybrid">Hybrid </option>
<option value="others">Others </option>
<option value="electric">Electric </option>

```
        </select>
        <br>
        <br>
        </td>
        </tr>
        <tr>
        <td><label for="vehicletype">Vehicle type:</label></td>
        <td>
        <select name="vehicletype" id="vehicle" >
        <option value="" disabled selected hidden>Choose Vehicle Type...</option>
        <option value="coupe">Coupe </option>
    <option value="suv">SUV </option>
    <option value="kleinwagen">Kleinwagen </option>
    <option value="limousine">Limousine </option>
        <option value="cabrio">Cabrio </option>
        <option value="bus">Bus </option>
        <option value="kombi">Kombi </option>
        <option value="andere">Andere </option>
        <option value="volkswagen">Volkswagen </option>
        </select>
        <br>
        <br>
        </td>
        </tr>
        </tbody>
        </table>
        <input name="Submit" type="Submit" value="Submit" id="button"/>
        </form>
  </section>
</body>
</html>
```

PREDICT PAGE

```
<!DOCTYPE html>
```

```
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta http-equiv="X-UA-Compatible" content="IE=edge">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <link rel="stylesheet" href="../static/css/predict.css">
    <title>Car Resale Value Prediction</title>
</head>
<body>
        <section class="header">
      <nav>
        <a href="/"></a>
      </nav>
        <div class="text-box">
          <h1>The Predicted Car Resale Value is </h1>
                <h1>{{predict}}</h1>
        </div>
    </section>
</body>
</html>
```

CSS

HOME PAGE

```
*{
  margin: 0;
  padding: 0;
}

.header{
  min-height: 100vh;
  width: 100%;
  background-image: url(../Images/car.jpg);
  background-position: center;
  background-size: cover;
  position: relative;
```

```
}
nav{
   display:flex;
   padding: 2% 6%;
   justify-content: space-between;
   align-items: center;
}
.nav-links{
   flex: 1;
   text-align: right;
}
.nav-links ul li{
   list-style: none;
   display: inline-block;
   padding: 8px 12px;
   position: relative;
}
.nav-links ul li a{
   color:white;
   text-decoration: none;
   font-size: 13px;
}
.text-box{
   text-align: center;
   position: relative;
   color:   rgb(241, 241, 241);
   top:50%;
}
.text-box h1{
   margin-top: 50px;
   font-size: 55px;
}
h1{
   margin-bottom: 100px;
```

```
}
.visit-btn{
   display: inline;
   border: 3px solid rgb(7, 6, 6);
   border-radius: 2px;
   padding:10px 14px;
   font-size: 15px;
   background: transparent;
   color: white;
   text-decoration:none;
   margin-top: 50px;
}
.visit-btn:hover
{
   background-color: rgb(58, 108, 202);
   border: #fff;;
}
```

SEARCH PAGE

```
.header{
   width: 100%;
   text-align: center;
   font-size:20px;
   font-family: "Lucida Console";
   background-color:#43FFB6;
   border:0%;
   top:0px;
   bottom:0px;
   right:0px;
   left:0px;
   overflow-y:auto;
}
body{
```

```
        margin: 0;
}
.form{
background-image: linear-gradient(rgba(25,30,30,0.7),rgba(25,30,30,0.7)),url(../Images/car.jpg);
 background-position: center;
   background-size: cover;
   position: relative;
}
.form{
text-align: center;
padding:20px;
display: flex;
flex-direction: column;
align-items: center;
}
.form{
font-size:22px;
}
textarea {
   width: 100%;
   height: 150px;
   padding: 12px 20px;
   box-sizing: border-box;
   border: 2px solid rgb(131, 61, 61);
   border-radius: 4px;
   background-color: #e6e6e6;
   resize: none;
}
input[type=text] {
   transition: width 0.4s ease-in-out;
}
```

```
input[type=text] {
   width: 70%;
   height: 10%;
   padding: 10px 10px;
   margin: 5px 0;
}
#model{
 width: 70%;
 padding:5px 5px 5px 5px;
 color: black;
}
#brand{
width:70%;
padding:5px 5px 5px 5px;
color: black;
}
#vehicle{
width:70%;
padding:5px 5px 5px 5px;
color: black;
}
```

PREDICT PAGE

```
*{
color:rgba(247, 244, 244, 0.808);
}
option
{
   color: black;
}
```

```
#button{
   padding: 10px 10px;
   margin: 0;
   color: rgb(0, 0, 0);
   text-align:center;
   width:100px;
}
#button:hover
{
      background-color: rgb(153, 23, 0);
}
.header{
   min-height: 100vh;
   width: 100%;
   background-image:
linear-gradient(rgba(25,30,30,0.7),rgba(25,30,30,0.7)),url(../Images/car.jpg);
   background-position: center;
   background-size: cover;
   position: relative;
}

.text-box{
   text-align: center;
   position: relative;
   color:white;
   top:50%;
}
.text-box h1{
   margin-top: 50px;
   font-size: 55px;
}

.text-box p{
```

```
  margin: 10px 0 40px;
  font-size: 15px;
}

body{
        margin: 0;
}
nav{
  display:flex;
  padding: 2% 6%;
  justify-content: space-between;
  align-items: center;
}
```

PYTHON FLASK

```
# 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
import requests

# NOTE: you must manually set API_KEY below using information retrieved from your IBM Cloud account.
API_KEY = "qxfbFLITIJs7zvC2zCQmXDBJbJUFCg7XcOjzi8c_VOoA"
token_response = requests.post('https://iam.cloud.ibm.com/identity/token', data={"apikey":
 API_KEY, "grant_type": 'urn:ibm:params:oauth:grant-type:apikey'})
mltoken = token_response.json()["access_token"]

header = {'Content-Type': 'application/json', 'Authorization': 'Bearer ' + mltoken}


app = Flask(__name__)#initiate flask app
```

```
def load_model(file='Car resale Value Prediction.sav'):#load the saved model
        return pickle.load(open(file, 'rb'))

@app.route('/')
def index():#main page
        return render_template('home.html')

@app.route('/search.html')
def search_page():#predicting page
        return render_template('search.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)

        # NOTE: manually define and pass the array(s) of values to be scored in the next line
        payload_scoring = {"input_data": [{"fields": [['yearOfReg', 'powerPS', 'kilometer',
'monthOfRegistration','gearbox_labels','notRepairedDamage_labels',
Model_labels','brand_labels', 'fuelType_labels', 'vehicletype_labels']], "values": X}]}

        response_scoring=
requests.post('https://us-south.ml.cloud.ibm.com/ml/v4/deployments/3a954226-cb57-470d-ac48
-8856da8a9f68/predictions?version=2022-11-23',json=payload_scoring,
headers={'Authorization': 'Bearer ' + mltoken})
        predictions = response_scoring.json()
        print(response_scoring.json())
        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(host='localhost', debug=True, threaded=False)
```

CHAPTER 8

TEST CASE

Defect Analysis

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	2	3	1	1	7
Duplicate	1	0	3	0	4
External	2	0	0	1	3
Fixed	2	2	1	2	7
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	2	2	1	5
Totals	7	7	9	6	29

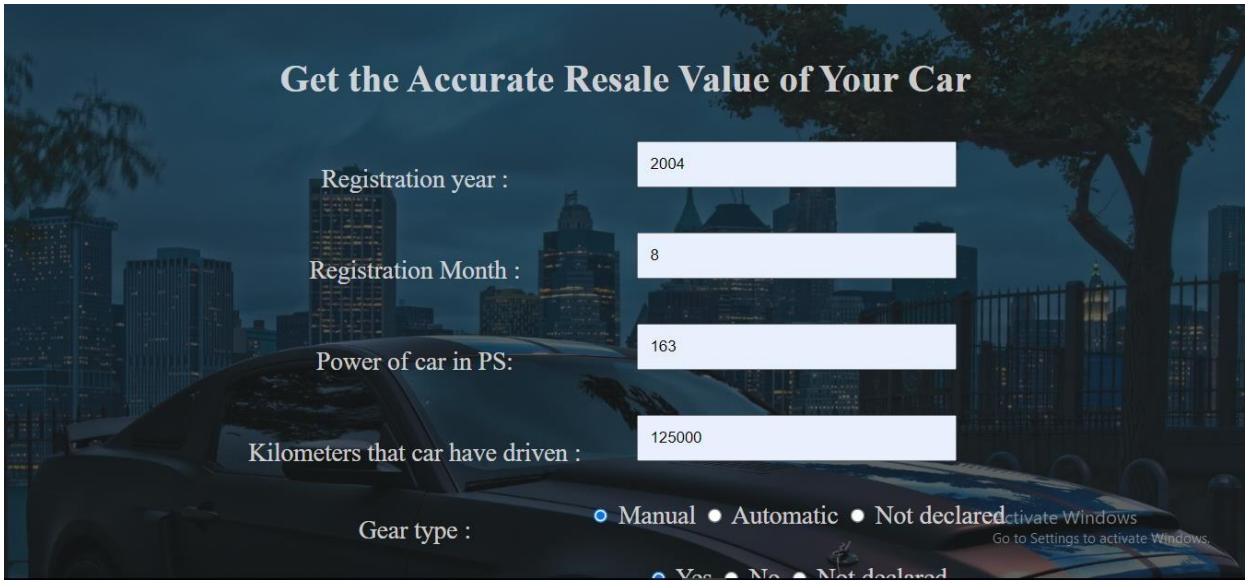
Test Case Analysis

Section	Total Cases	Not Tested	Fail	Pass
Home Page	5	0	0	5
Data Entry Page	15	0	0	15
Output Page	4	0	0	4
Hyper Parameter Tuning	3	0	0	3
Final Model Building	2	0	0	2
Flask Application	10	0	0	10
Train Model on IBM	3	0	0	3

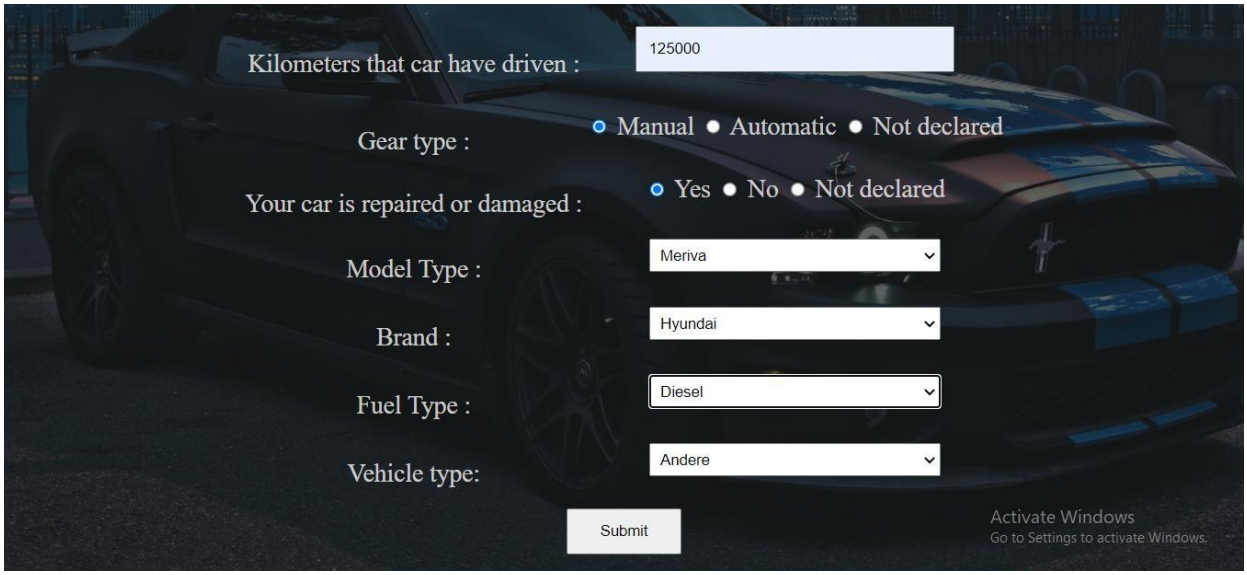
CHAPTER 9

RESULTS

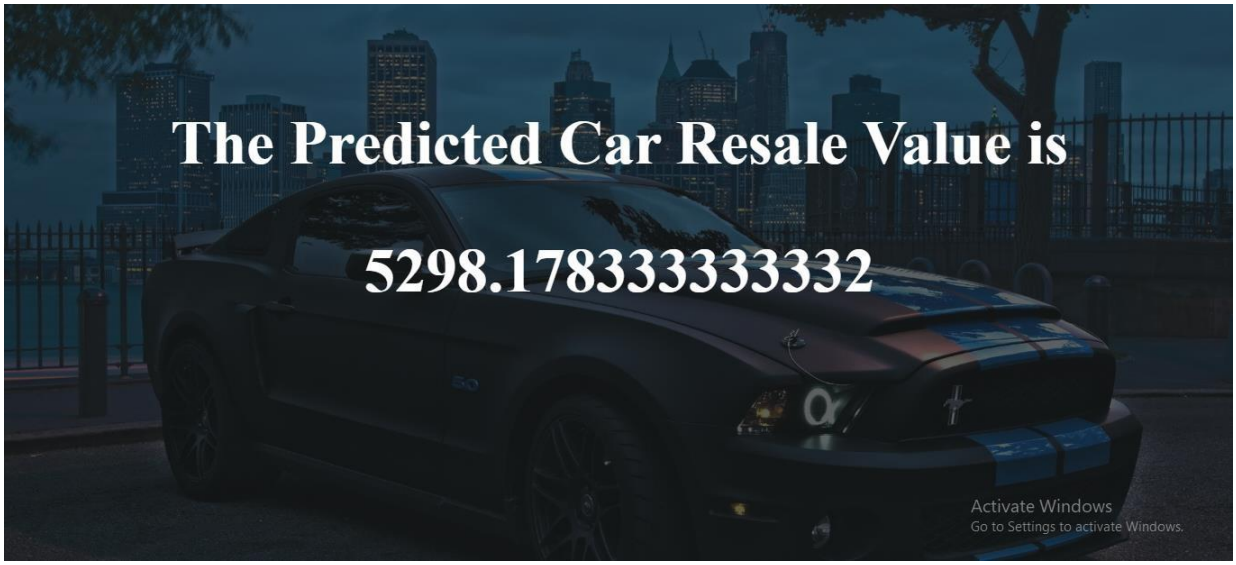
Home Page



Prediction Form



Prediction Form



Output Page

CHAPTER 10
CODING AND SOLUTIONS

Machine Learning has become a tool used in almost every task that requires estimation. Companies like Cars24 and Cardekho.com uses Regression analysis to estimate the used car prices. So we need to build a model to estimate the price of used cars. The model should take car-related parameters and output a selling price. The selling price of a used car depends on certain features as mentioned below: 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. Supervised Regression problems require labeled data where our target or dependent variable is the selling price of a car. All other features are independent variables.

- Fuel Type
- Manufacturing Year
- Miles Driven
- Number of Historical Owners
- Maintenance Record

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. Supervised Regression problems require labeled data where our target or dependent variable is the selling price of a car. All other features are independent variables. Following are some regression algorithms that can be used for predicting the selling price.

- Linear Regression
- Decision Tree Regressor
- Support Vector Regressor
- KNN Regressor Random
- Forest Regressor

Linear Models are relatively less complex and explainable, but linear models perform poorly on data containing the outliers. Linear models fail to perform well on non-linear datasets. In such cases, non-linear regression algorithms Random Forest Regressor and XGBoost Regressor perform better in fitting the nonlinear data.

Insights:

Diesel Fuel type cars are generally more expensive than petrol cars; the above plot supports our intuition. Gas fuel-type cars are relatively cheaper. CNG cars have a slight advantage over LPG cars in terms of fuel consumption and storage, and thus, the price of CNG cars is relatively higher than LPG cars. Correlation Matrix Visualizing the correlations is an effective way of determining the dependencies. In the given plot, the selling price has a high correlation with the manufacturing year, engine, max power, and transmission. The Engine and Manufacturing year has the same approximate correlation, so we can select any one of them in the final set of features.

Pair Plot :

A pairs plot allows us to see both distributions of single variables and relationships between two variables. Pair plots are a great method to identify trends for follow-up analysis and, fortunately, are easily implemented in Python!

Performance Evaluation :

In statistics, the coefficient of determination a.k.a “R squared”, is defined as the proportion of the variation in the dependent variable that is predictable from the independent variable(s). In our case, R squared is closer to 1, which indicates that the model is reliable in predicting the selling price. Random Forest is known for attaining high accuracy even without hyper-parameter tuning.

CHAPTER 11

11.1 CONCLUSION AND SCOPE FOR FUTURE WORK

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. Car Price Prediction was aimed to get different perspectives and eventually compared their performance with different models. Car price prediction can be a challenging task due to the high number of attributes that should be considered for the accurate prediction. The major step in the prediction process is collection and preprocessing of the data. In this research, linear regression and lasso regression, Random forest regressions were built to normalize, standardize and clean data to avoid unnecessary noise for machine learning algorithms. Data cleaning is one of the processes that increase prediction performance.

GITHUB LINK: https://github.com/IBM-EPBL/IBM-Project-46105-1660737933

YOUTUBE LINK:

REFERENCE

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[3] Wu, J. D., Hsu, C. C., & Chen, H. C. (2009). An expert system of price forecasting for used cars using adaptive Neuro-fuzzy inference. Expert Systems with Applications, 36(4), 7809-7817.

[4] Du, J., Xied es, L., & Schroeder, S. (2009). Practice Prize Paper—PIN Optimal Distribution of Auction Vehicles System: Applying Price Forecasting, Elasticity Estimation, and Genetic Algorithms to Used-Vehicle Distribution.Marketing Science, 28(4), 637-644.