Project Report

Date	18 November 2022
Team ID	PNT2022TMID43435
Project Name	Car Resale Value Prediction

INTRODUCTION

1.1 Project Overview

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

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

1.2 Purpose

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

We will compare the performance of various machine learning algorithms like Linear Regression, Ridge Regression, Lasso Regression, Elastic Net, Decision Tree Regressor and choose the best out of it. Depending on various parameters we will determine the price of the car. Regression Algorithms are used because they provide us with continuous value as an output and not a categorized value because of which it will be possible to predict the actual price a car rather than the price range of a car. User

Interface has also been developed which acquires input from any user and display the price of a car according to user's inputs

2. LITERATURE SURVEY

2.1 Existing problems

In order to meet the needs of second-hand car value assessment, the used car value assessment system has been designed based on the improved replacement cost method. The system includes system management module, used car parameter management module, used car evaluation management module and evaluation information inquiry module. We enter the relevant basic information of second-hand car information, and figure out the used car's new rate, the purchase price and the selling price through the calculation to the system [1].

The global used car market size was valued at USD 1.57 trillion in 2021 and is expected to expand at a compound annual growth rate (CAGR) of 6.1% from 2022 to 2030. The used car shipment was recorded at 120.3 million units in 2021. The market has witnessed significant growth in the last few years as the price competitiveness among the new players has been one glowing spot in the used car industry. The inability of customers to buy new cars became one of the reasons for the growing used cars sales volume, which is complemented by the investments made by the industry participants to establish their dealership network in the market. These dealership networks helped market participants to brand and make used car options viable [2].

The paper investigates statistical models for forecasting the resale prices of used cars. First, a comparative analysis of alternative prediction methods provides evidence that random forest regression is particularly effective for resale price forecasting. It is also shown that the use of linear regression, the prevailing method in previous work, should be avoided. Second, the empirical results demonstrate the presence of heterogeneity in resale price forecasting and identify methods that can automatically overcome its detrimental effect on the forecast accuracy. Finally, the study confirms that the sellers of used cars possess informational advantages over market research agencies, which enable them to forecast resale prices more accurately [3].

The paper discussed about the multivariate used for the prediction of value need in the developed model. One of the most important uses of multivariate modelling is precisely that 'of controlling for confounding' to let emerge the effect of the risk factor of interest on the study outcome. In this paper, they discuss linear regression analysis for the examination of continuous outcome data and logistic regression analysis for the study of categorical outcome data. Furthermore, it focuses on the most important application of multiple linear and logistic regression analyses [4].

The study examined and compared the performances of the Random Forest, k-Nearest Neighbour and SVM classifiers for land use/cover classification using Sentinel-2 image data. An area of 30×30 km2 within the Red River Delta of Vietnam with six land use/cover types was classified using 14 different training sample sizes, including balanced and imbalanced, from 50 to over 1250 pixels/class. All classification results showed a high overall accuracy
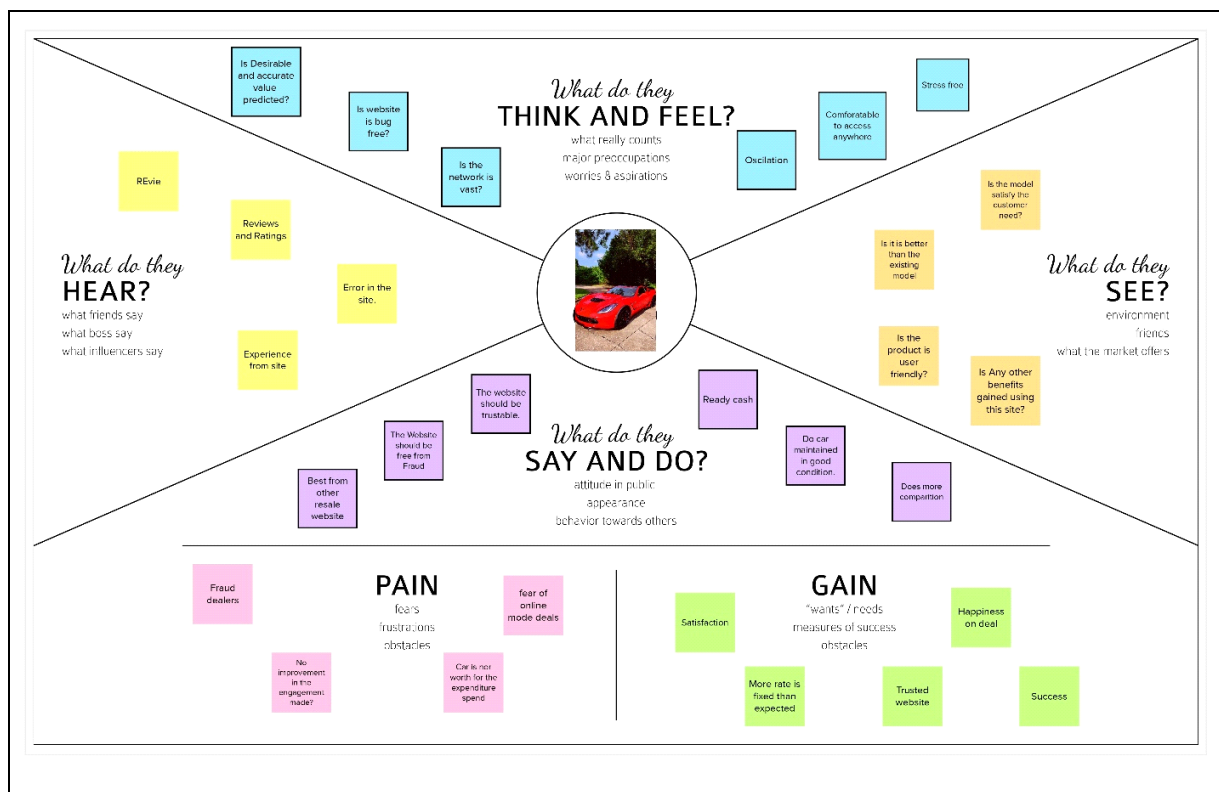
(OA) ranging from 90% to 95%. Among the three classifiers and 14 sub-datasets, SVM produced the highest OA with the least sensitivity to the training sample sizes, followed consecutively by RF and kNN. The high accuracy was achieved with both imbalanced and balanced datasets **[5].**

2.2 References:

[1] https://www.atlantis-press.com/article/25894858.pdf

[2] https://www.grandviewresearch.com/industry-analysis/used-car-market

[3]https://www.researchgate.net/publication/318667714_Car_resale_price_forecasting_The_impact_of_regression_method_private_information_and_heterogeneity_on_forecast_accuracy

[4]https://www.sciencedirect.com/science/article/pii/S008525381553085

[5] https://pubmed.ncbi.nlm.nih.gov/29271909/

3. IDEATION AND PROPOSED SOLUTION

3.1 Empathy Map Canvas

3.2 Ideation and Brainstorming

Step 1: Team Gathering, Collaboration and Choose the Problem Statement

Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

- 10 minutes to prepare
- 1 hour to collaborate
- 2-8 people recommended

Share template feedback

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

A — Team gathering
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

B — Set the goal
Think about the problem you'll be focusing on solving in the brainstorming session.

C — Learn how to use the facilitation tools
Use the Facilitation Superpowers to run a happy and productive session.

Open article →

1 — Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

PROBLEM
How might we [your problem statement]?

Key rules of brainstorming
To run an smooth and productive session

- Stay in topic.
- Encourage wild ideas.
- Defer judgment.
- Listen to others.
- Go for volume.
- If possible, be visual.

Step 2: Brainstorm and Group Ideas

2 Brainstorm

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

⏱ 10 minutes

Kiruthika P

Harish C

Pranesh J

Thanvandhiri A

3 Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

⏱ 20 minutes

The car images are collected by using the image processing scratch in car is detected	If the car has insurance, then the rate is fixed based on that.	The car is booked by the website and the reservation valid till 1 week
To get better Accuracy in cost K-Nearest Neighbor Classifier is used	Previous data of population is collected for training the model.	The price prediction also consider the current market rate of the car model

Step 3: Idea Prioritize

3.3 Proposed Solution

S. No.	Parameter	Description
1.	Problem Statement (Problem to besolved)	The Statement is to build an intelligent system to predict the resale value of the carusing the regression algorithm.
2.	Idea / Solution description	In order to predict the resale value of the carby considering the main factors which would affect the resale value of a vehicle. Aregression model is to be built that would give the nearest resale value of the vehicle. By using various regression algorithms and algorithm with the best accuracy will be taken as a solution, then it will be integratedto the web-based application where the useris notified with the status of his product.
3.	Novelty / Uniqueness	The Novelty of the project is to build a model, which give highest accuracy among the existing model. To give better accuracyK- Nearest Neighbor Algorithm is used.
4.	Social Impact / CustomerSatisfaction	For buying or selling purpose of the second-hand cars, it could be the best platform. Theoptimal value of the car is predicted and prevent the people from getting disappointed during price prediction of resale car.
5.	Business Model (Revenue Model)	It is automatic Machine Learning trained model. It behaves like an intelligent systemwith error free solution. The price is predicted not only by using the condition and previous status of the car, but also it considers the current market value of the particular model.
6.	Scalability of the Solution	The model is trained by setting vast population. The sample data include all possible model and features of the car. So, itcan predict the rate for all type of car in world wide.

3.4 Problem Solution fit

1. CUSTOMER SEGMENT(S)

Who is your customer?

CS

- ✓ Some who using car will use this website for selling a car.
- ✓ And who wished to buy second hand cars

6. CUSTOMER CONSTRAINTS

What constraints prevent your customers from taking action or limit their choice of solutions?

i.e. spending power, budget, no cash, network connection, available devices.

- ✓ Only the car owners have to use this website for selling purpose.
- ✓ The license verification is compulsory to access the website.
- ✓ Replacement option is valid for a week.

5. AVAILABLE SOLUTIONS

Which solutions are available to the customers when they face the problem or need 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 note-taking

- ✓ It is helpful for the person, who doesn't have basic knowledge on car value prediction.
- ✓ The replacement of regression algorithm with KNN, The accuracy increases with speed.

2. JOBS-TO-BE-DONE / PROBLEMS

Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.

- ✓ Working condition of a car.
- ✓ Chance of fake documentation
- ✓ Kilometres Driven.
- ✓ Chance of false rate prediction in other sites.

9. PROBLEM ROOT CAUSE

What is the real reason that this problem exists? What is the back

RC

- ✓ Chance of buying the theft cars.
- ✓ Worst working of engine.
- ✓ The rate is fixed incorrectly without the knowledge of current market-rate and the usage of car.

7. BEHAVIOUR

What does your customer do to address the problem and get the job done? i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)

BE

- ✓ Customer can address the outliers in prediction model with causes false output.
- ✓ They can address the delay in delivery and any disappointment they face in reality of using a car.

3. TRIGGERS

What triggers customers to act? i.e. seeing their neigh-bour installing solar panels, reading about a more efficient solution in the news.

TR

- ✓ The website correctness, time compatibility.
- ✓ Feedback of the previous user.

4. EMOTIONS: BEFORE / AFTER

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.

EM

- ✓ Before: No accurate result which makes the customer feel hopeless and disappointment due to false prediction.
- ✓ After: Hopeful, Satisfied Customer, Trust.

10. YOUR SOLUTION

If you are working on an existing business, write down your current solution first, fill 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 behavior.

SL

- ✓ The model is to predict the accurate value of the resale car.
- ✓ By considering all the factors the output is determined with less confusing comparison.
- ✓ By using our application customer can know the current rate of the car in the market.

8. CHANNELS of BEHAVIOUR

8.1 ONLINE
What kind of actions do customers take online? Extract online channels from #7\

CH

- ✓ Customers can choose the car on their own.
- ✓ Can pre-book the car which is valid till a week

8.2 OFFLINE
What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.

- ✓ Dealers are required to choose a car and to fix the price.
- ✓ Suggestion from friends.

4.REQUIREMENT ANALYSIS

4.1 Functional Requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration to the related websites	Registration through Form Registration through Gmail Registration through LinkedIn
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Users Profile	Personal details, Bank account, Is He/She interested inbuying a car
FR-4	Gather information about the vehicle	Through the registered websites they collectinformation
FR-5	Display the functionality of the vehicle	Details: Fuel type , Manufactured year , Miles Driven ,Record

4.2 Non-Functional Requirement

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	User friendly UI Simple and easy to Understand
NFR-2	**Security**	Aware of scams
NFR-3	**Reliability**	The system must perform without failure
NFR-4	**Performance**	The landing page must support several user must provide 5 second or less response time
NFR-5	**Availability**	Uninterrupted services must be available all time except the time of server updating.
NFR-6	**Scalability**	that can handle any amount of data and perform many computations in a cost-effective and time-saving way to instantly serve millions of users residing at global locations.

5. PROJECT DESIGN

5.1 Data Flow Diagram
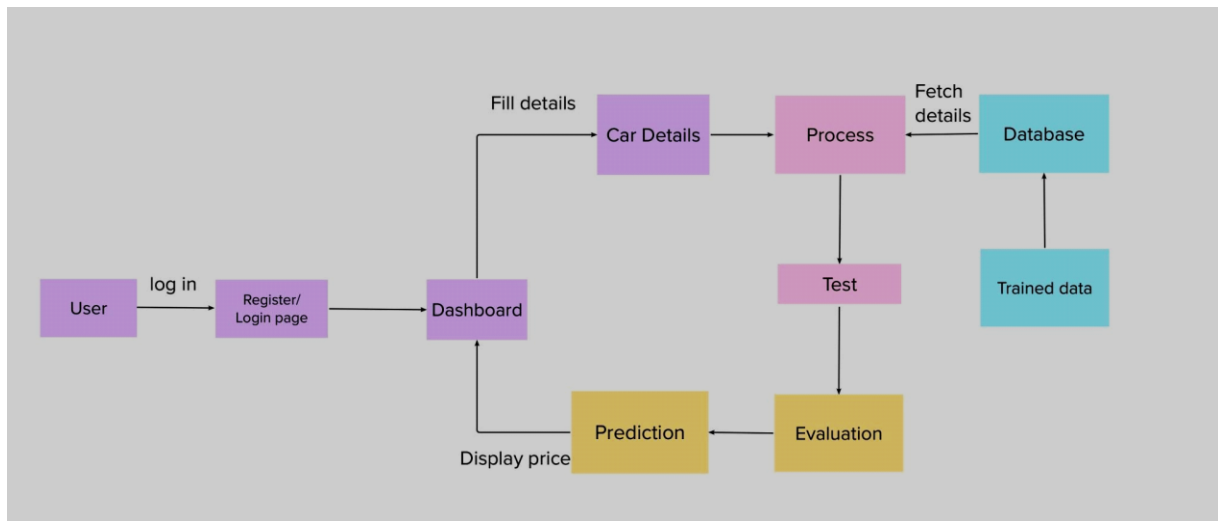
5.2 Solution and Technical Architecture
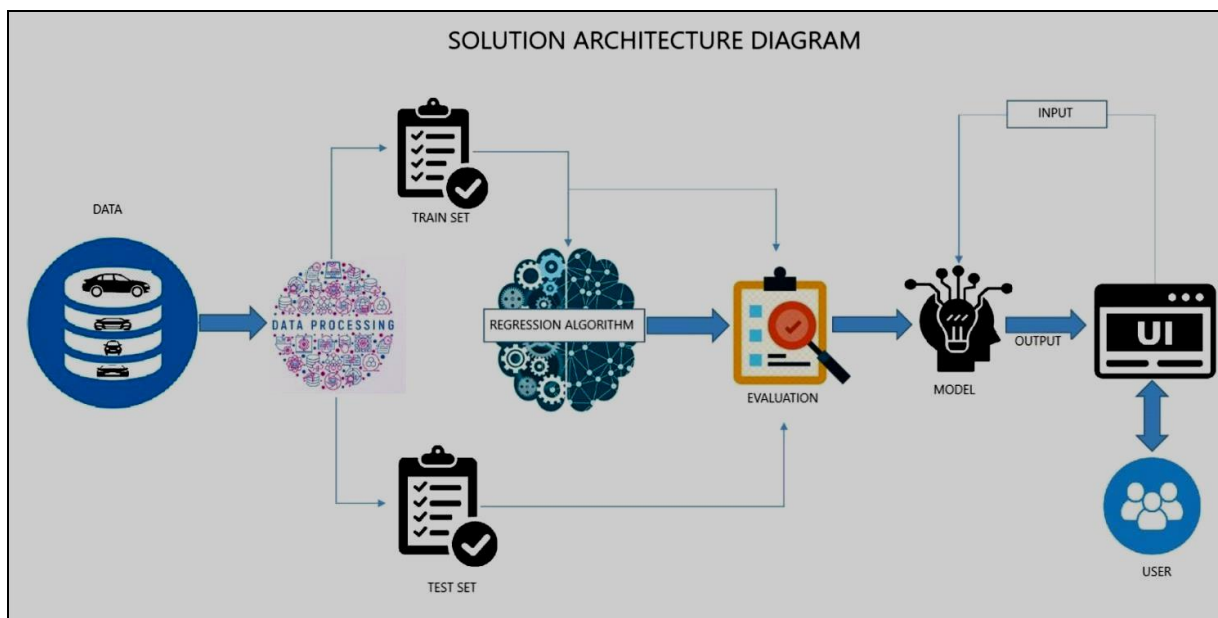
5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Web user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through mobile number	I can register & access the dashboard using mobile number	Medium	Sprint-1
		USN-4	As a user, I can register for the application through Gmail	I can register & access the dashboard	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can access the dashboard	High	Sprint-1
	Dashboard	USN-6	As a user, I can visit the home page	I can edit my profile	Medium	Sprint-1
	Car details	USN-7	As a user, I should give the car details like car model, engine and fuel type, etc…	I should the give car details	High	Sprint-2
	Car Price	USN-8	As a user, I can view the current rate of the used car price	I know the car price	High	Sprint-4
Admin	Model Building	USN-9	As an admin, I should train and test the given dataset	I can build the train and test model	High	Sprint-3
	Prediction Chart	USN-10	As an admin, I should send the prediction chart and the nearest service center location	I can provide chart	Medium	Sprint-3
	Predict	USN-11	As an admin, I will predict the price	I can predict the car price	High	Sprint-4

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	Pre-process data	USN-1	Collect Dataset	1	Low	Pranesh.J
Sprint-1		USN-2	Import required libraries	1	Low	Harish.C Thanvandhiri.A
Sprint-1		USN-3	Read and clean data sets	2	Low	Pranesh.J Kiruthika.P
Sprint-2	Model building	USN-1	Split data into independent and dependent variables	3	Medium	Kiruthika.P Thanvandhiri.A
Sprint-2		USN-2	Apply using regression model	3	Medium	Harish.C Kiruthika.P Pranesh.J Thanvandhiri.A
Sprint-3	Application building	USN-1	Build python flask application and HTML page	5	High	Harish.C Pranesh.J
Sprint-3		USN-2	Execute and test	5	High	Harish.C Kiruthika.P Pranesh.J Thanvandhiri.A
Sprint-4	Training the model	USN-1	Train machine learning model	5	High	Harish.C Thanvandhiri.A
Sprint-4		USN-2	Integrate flask	5	High	Harish.C Kiruthika.P Pranesh.J Thanvandhiri.A

6.2 Sprint Delivery 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 Report from JIRA
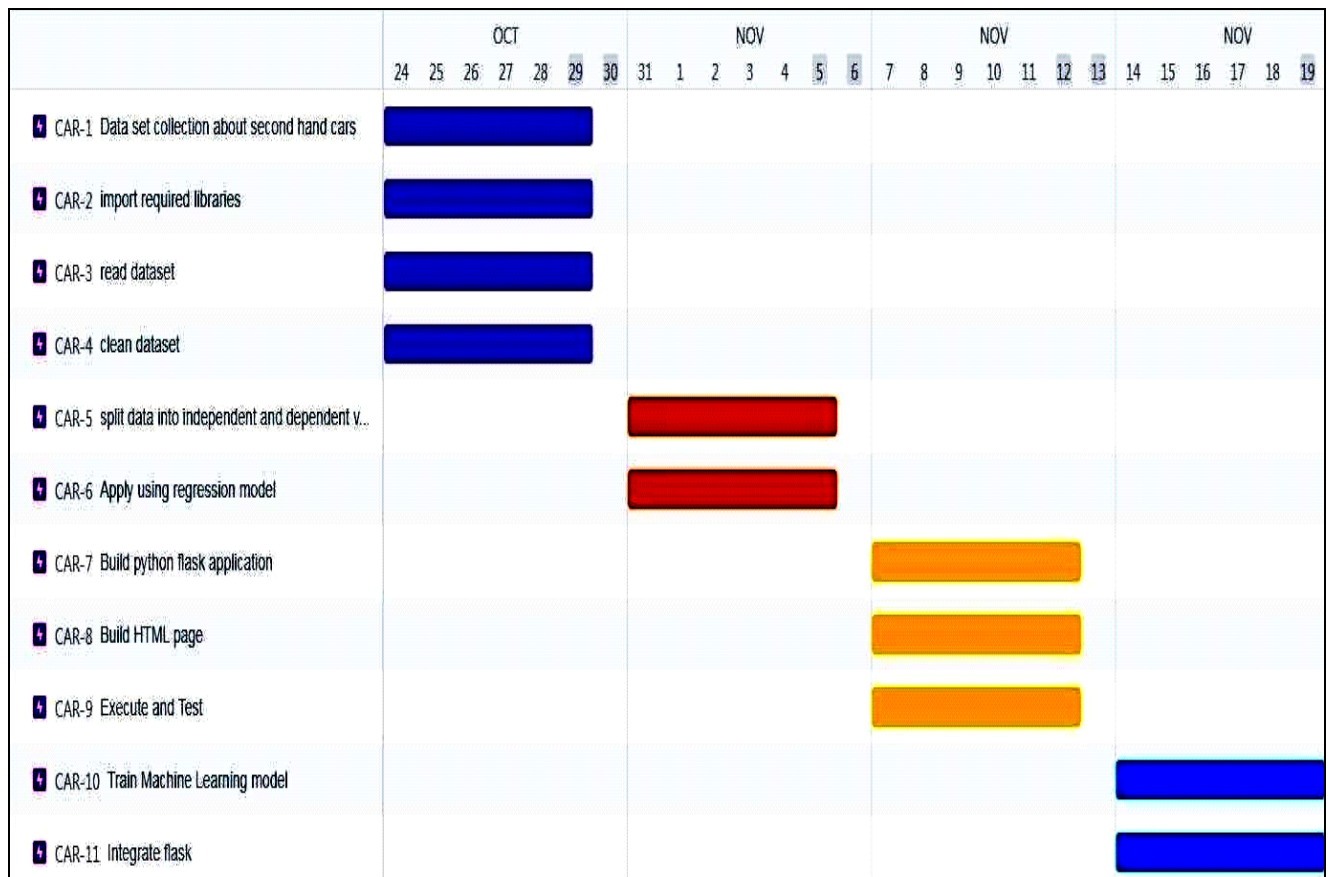
7. CODING AND SOLUTIONING

7.1 User Interface

 The home page of the application give the detail about the developed model, which is trained using the labelled dataset.

```html
</head>
    <body>
        <section>
            <div class="form-container">
                <h1>Get the accurate resale value of your car!!</h1>
                <form action="/predict">




                    <p>With difficult economic conditions, it is likely that
sales of reconditional second-hand car will increase. In most of then
countries, it is common to lease a car rather than buying itoutright. A lease
is a binding contract between a buyer and a seller in which the buyer must pay
fixed instalments for a pre-defined number of months/year to the
seller/financer. after car at its residual value, i.e. its expected resale
value. Thus,this application is of commercial interest to seller/financers to
beable to predict the residual value of cars with accuracy.</p><br><br>



                        <div class="que">
                            <a href="/predict">
                            <input type="submit" value="WANT TO KNOW THE
RESALE VALUE OF YOUR CAR??">
                            </a>
                        </div>



                    </div>
                </form>

            </div>
        </section>
    </body>





</html>
```

7.2 Prediction Page

The button "WANT TO KNOW THE RESALE VALUE OF YOUR CAR?", then the page is redirected to the predict page to, which is the main page of the application. In predict page the form is there to fill the details of the car to get the resale amount. After filling the required details, it returns the value of the car.

```html
</head>

<body>
  <main>
    <h1>car predictions</h1>
  </main>
  <div class="testbox">
    <form class="from" action="/y_predict" method="post">

      <div class="item">
        <p>Registration Year<span class="required">*</span></p>
        <div class="name-item">
          <input type="text" name="regyear" id="regyear" placeholder="year of
registration" required />
        </div>
      </div>

      <div class="item">
        <p>Registration Month<span class="required">*</span></p>
        <h3>Don't know-0,Jan-1,Feb-2,Mar-3,Apr-4,May-5,Jun-6,July-7,Aug-8,Sep-
9,Oct-10,Nov-11,Dec-12</h3>
        <div class="name-item">
```

```html
      <input type="text" name="regmonth" placeholder="month of
registration" required />
      </div>
    </div>

    <div class="item">
      <p>Kms driven<span class="required">*</span></p>
      <div class="name-item">
        <input type="text" name="kms" placeholder="kms" required />
      </div>
    </div>

    <div class="item">
      <p>Power of the car in PS<span class="required">*</span></p>
      <div class="name-item">
        <input type="text" name="powerps" placeholder="power (PS)" required
/>
      </div>
    </div>


    <div class="question">
      <p>Gearbox type<span class="required">*</span></p>
      <div class="question-answer">
        <label class="check-box"><input type="radio" value="manual"
name="gearbox" required />
          <span>Manual</span></label>
        <label class="check-box"><input type="radio" value="automatic"
name="gearbox" required />
          <span>Automatic</span></label>
        <label class="check-box"><input type="radio" value="not declared"
name="gearbox" required /> <span>Not
          declared</span></label>
      </div>
    </div>

    <div class="question">
      <p>Your car is damaged or repaired<span class="required">*</span></p>
      <div class="question-answer">
        <label class="check-box"><input type="radio" value="Yes" name="dam"
required /> <span>Yes</span></label>
        <label class="check-box"><input type="radio" value="No" name="dam"
required /> <span>No</span></label>
        <label class="check-box"><input type="radio" value="not declared"
name="dam" required /> <span>Not
          declared</span></label>
      </div>
    </div>
    <div class="item">
```

```html
<p>Model Type<span class="required">*</span></p>
<div class="model-item">
  <select name="model_type">
    <option value="not-declared">not-declared</option>
    <option value="grand">grand</option>
    <option value="golf">golf</option>
    <option value="fabia">fabia</option>
    <option value="3er">3er</option>
    <option value="2_reihe">2_reihe</option>
    <option value="c_max">c_max</option>
    <option value="3_reihe">3_reihe</option>
    <option value="passat">passat</option>
    <option value="navara">navara</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>
    <option value="andere">andere</option>
    <option value="civic">civic</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="one">one</option>
    <option value="fortwo">fortwo</option>
    <option value="1er">1er</option>
    <option value="b_klasse">b_klasse</option>
    <option value="a8">a8</option>
    <option value="jetta">jetta</option>
    <option value="c_klasse">c_klasse</option>
    <option value="micra">micra</option>
    <option value="vito">vito</option>
    <option value="sprinter">sprinter</option>
    <option value="astra">astra</option>
    <option value="156">156</option>
    <option value="escort">escort</option>
    <option value="forester">forester</option>
    <option value="xc_reihe">xc_reihe</option>
    <option value="fiesta">fiesta</option>
    <option value="scenic">scenic</option>
    <option value="ka">ka</option>
    <option value="a1">a1</option>
    <option value="transporter">transporter</option>
    <option value="focus">focus</option>
    <option value="a4">a4</option>
    <option value="tt">tt</option>
    <option value="a6">a6</option>
```

```html
<option value="jazz">jazz</option>
<option value="omega">omega</option>
<option value="slk">slk</option>
<option value="7er">7er</option>
<option value="combo">combo</option>
<option value="corsa">corsa</option>
<option value="80">80</option>
<option value="147">147</option>
<option value="glk">glk</option>
<option value="z_reihe">z_reihe</option>
<option value="sorento">sorento</option>
<option value="ibiza">ibiza</option>
<option value="mustang">mustang</option>
<option value="eos">eos</option>
<option value="touran">touran</option>
<option value="getz">getz</option>
<option value="insignia">insignia</option>
<option value="almera">almera</option>
<option value="megane">megane</option>
<option value="a3">a3</option>
<option value="r19">r19</option>
<option value="caddy">caddy</option>
<option value="mondeo">mondeo</option>
<option value="cordoba">cordoba</option>
<option value="colt">colt</option>
<option value="impreza">impreza</option>
<option value="vectra">vectra</option>
<option value="lupo">lupo</option>
<option value="berlingo">berlingo</option>
<option value="m_klasse">m_klasse</option>
<option value="tiguan">tiguan</option>
<option value="6_reihe">6_reihe</option>
<option value="c4">c4</option>
<option value="panda">panda</option>
<option value="up">up</option>
<option value="i_reihe">i_reihe</option>
<option value="ceed">ceed</option>
<option value="kangoo">kangoo</option>
<option value="5_reihe">5_reihe</option>
<option value="yeti">yeti</option>
<option value="octavia">octavia</option>
<option value="zafira">zafira</option>
<option value="mii">mii</option>
<option value="rx_reihe">rx_reihe</option>
<option value="6er">6er</option>
<option value="modus">modus</option>
<option value="fox">fox</option>
<option value="matiz">matiz</option>
```

```html
<option value="beetle">beetle</option>
<option value="rio">rio</option>
<option value="touareg">touareg</option>
<option value="logan">logan</option>
<option value="spider">spider</option>
<option value="cuore">cuore</option>
<option value="s_max">s_max</option>
<option value="a2">a2</option>
<option value="x_reihe">x_reihe</option>
<option value="a5">a5</option>
<option value="galaxy">galaxy</option>
<option value="c3">c3</option>
<option value="viano">viano</option>
<option value="s_klasse">s_klasse</option>
<option value="1_reihe">1_reihe</option>
<option value="sharan">sharan</option>
<option value="avensis">avensis</option>
<option value="sl">sl</option>
<option value="roomster">roomster</option>
<option value="q5">q5</option>
<option value="santa">santa</option>
<option value="leon">leon</option>
<option value="cooper">cooper</option>
<option value="4_reihe">4_reihe</option>
<option value="sportage">sportage</option>
<option value="laguna">laguna</option>
<option value="ptcruiser">ptcruiser</option>
<option value="clk">clk</option>
<option value="primera">primera</option>
<option value="espace">espace</option>
<option value="exeo">exeo</option>
<option value="159">159</option>
<option value="transit">transit</option>
<option value="juke">juke</option>
<option value="v40">v40</option>
<option value="carisma">carisma</option>
<option value="accord">accord</option>
<option value="corolla">corolla</option>
<option value="lanos">lanos</option>
<option value="phaeton">phaeton</option>
<option value="boxster">boxster</option>
<option value="verso">verso</option>
<option value="rav">rav</option>
<option value="kuga">kuga</option>
<option value="qashqai">qashqai</option>
<option value="swift">swift</option>
<option value="picanto">picanto</option>
<option value="superb">superb</option>
```

```html
<option value="stilo">stilo</option>
<option value="alhambra">alhambra</option>
<option value="911">911</option>
<option value="m_reihe">m_reihe</option>
<option value="roadster">roadster</option>
<option value="ypsilon">ypsilon</option>
<option value="galant">galant</option>
<option value="justy">justy</option>
<option value="90">90</option>
<option value="sirion">sirion</option>
<option value="signum">signum</option>
<option value="crossfire">crossfire</option>
<option value="agila">agila</option>
<option value="duster">duster</option>
<option value="v50">v50</option>
<option value="mx_reihe">mx_reihe</option>
<option value="meriva">meriva</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="seicento">seicento</option>
<option value="cc">cc</option>
<option value="carnival">carnival</option>
<option value="fusion">fusion</option>
<option value="bora">bora</option>
<option value="cl">cl</option>
<option value="tigra">tigra</option>
<option value="300c">300c</option>
<option value="500">500</option>
<option value="100">100</option>
<option value="q3">q3</option>
<option value="cr_reihe">cr_reihe</option>
<option value="spark">spark</option>
<option value="x_type">x_type</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="voyager">voyager</option>
<option value="calibra">calibra</option>
<option value="v70">v70</option>
<option value="bravo">bravo</option>
<option value="range_rover">range_rover</option>
<option value="forfour">forfour</option>
```

```html
<option value="tucson">tucson</option>
<option value="q7">q7</option>
<option value="c1">c1</option>
<option value="citigo">citigo</option>
<option value="jimny">jimny</option>
<option value="cx_reihe">cx_reihe</option>
<option value="cayenne">cayenne</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="freelander">freelander</option>
<option value="captiva">captiva</option>
<option value="range_rover_evoque">range_rover_evoque</option>
<option value="sandero">sandero</option>
<option value="note">note</option>
<option value="antara">antara</option>
<option value="900">900</option>
<option value="defender">defender</option>
<option value="cherokee">cherokee</option>
<option value="clubman">clubman</option>
<option value="arosa">arosa</option>
<option value="legacy">legacy</option>
<option value="pajero">pajero</option>
<option value="auris">auris</option>
<option value="c2">c2</option>
<option value="niva">niva</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="charade">charade</option>
<option value="croma">croma</option>
<option value="outlander">outlander</option>
<option value="gl">gl</option>
<option value="kaefer">kaefer</option>
<option value="doblo">doblo</option>
<option value="musa">musa</option>
<option value="amarok">amarok</option>
<option value="9000">9000</option>
<option value="kalos">kalos</option>
<option value="v60">v60</option>
<option value="200">200</option>
<option value="145">145</option>
<option value="b_max">b_max</option>
```

```html
        <option value="delta">delta</option>
        <option value="aveo">aveo</option>
        <option value="rangerover">rangerover</option>
        <option value="move">move</option>
        <option value="materia">materia</option>
        <option value="terios">terios</option>
        <option value="kalina">kalina</option>
        <option value="elefantino">elefantino</option>
        <option value="i3">i3</option>
        <option value="samara">samara</option>
        <option value="kappa">kappa</option>
        <option value="serie_3">serie_3</option>
        <option value="discovery_sport">discovery_sport</option>


    </select>
  </div>
</div>

<div class="item">
  <p>Brand of the model<span class="required">*</span></p>
  <div class="model-item">
    <select name="brand">
      <option value="audi">audi</option>
      <option value="jeep">jeep</option>
      <option value="volkswagen">volkswagen</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="honda">honda</option>
      <option value="fiat">fiat</option>
      <option value="opel">opel</option>
      <option value="mini">mini</option>
      <option value="smart">smart</option>
      <option value="hyundai">hyundai</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="seat">seat</option>
      <option value="lancia">lancia</option>
      <option value="porsche">porsche</option>
      <option value="citroen">citroen</option>
```

```html
        <option value="toyota">toyota</option>
        <option value="chevrolet">chevrolet</option>
        <option value="dacia">dacia</option>
        <option value="suzuki">suzuki</option>
        <option value="daihatsu">daihatsu</option>
        <option value="chrysler">chrysler</option>
        <option value="sonstige_autos">sonstige_autos</option>
        <option value="jaguar">jaguar</option>
        <option value="daewoo">daewoo</option>
        <option value="rover">rover</option>
        <option value="saab">saab</option>
        <option value="land_rover">land_rover</option>
        <option value="lada">lada</option>
        <option value="trabant">trabant</option>

      </select>
    </div>
  </div>

  <div class="item">
    <p>Fuel Type of the car<span class="required">*</span></p>
    <div class="model-item">
      <select name="fuel">
        <option value="diesel">diesel</option>
        <option value="petrol">petrol</option>
        <option value="not-declared">not-declared</option>
        <option value="lpg">lpg</option>
        <option value="others">others</option>
        <option value="hybrid">hybrid</option>
        <option value="cng">cng</option>
        <option value="electirc">electirc</option>
      </select>
    </div>
  </div>

  <div class="item">
    <p>Vehicle Type of the car<span class="required">*</span></p>
    <div class="model-item">
      <select name="vehicletype">
        <option value="coupe">coupe</option>
        <option value="suv">suv</option>
        <option value="small car">small car</option>
        <option value="limousine">limousine</option>
        <option value="convertible">convertible</option>
        <option value="bus">bus</option>
        <option value="combination">combination</option>
        <option value="not-declared">not-declared</option>
        <option value="others">others</option>
```

```
      </select>
    </div>
  </div>
  <h3 style="font-family:verdana">{{ ypred }}  c</h3>
  <div class="btn-block">
    <button type="submit" href="/">Apply</button>
  </div>
</form>
</div>
</body>

</html>
```

8.TESTING

8.1 Test Cases

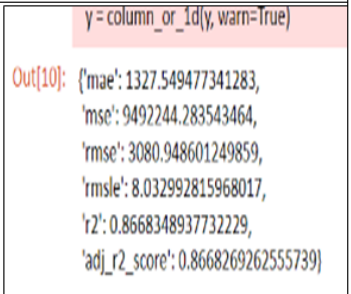| Test case ID	Feature Type	Compo nent	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Commnets	TC for Automation	BUG ID	Executed By
Home page	UI	Home Page	Verify user is able to see the Predict popup when user clicked on button	http generated in integrated Flask model	1.Enter URL and click go 2.Click on button in homepage 3.Verify predict page popup displayed or not	http://127.0.0.1:50 0	Predict popup should display	Working as expected	Pass				
Prediction page	Functional	Predict Page	Test the value of the car using the car details	Trained-ML Model and labels in HTML to get the input from user	1.Enter URL and click go 2.It is navigate to the predict page after the home page. 3.Enter the Registration year and month. 4. Enter the kms driven and power of the car value. 5. Enter the Whether the car is damaged or not 6. The model type, brand type, diesel type and click on apply 7.The predicted value is diplayed under the form	http://127.0.0.1:50 0	The page should display the predicted value at the end of the page	Working as expected	Pass				

8.2 User Acceptance Testing

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

Test Analysis

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	10	0	0	10
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

9. RESULTS

9.1 Performance metrics

S.No.	Parameter	Values	Screenshot
1.	Metrics	**Regression Model:** MAE -1327.549477341283 MSE – 9492244.283543464 RMSE – 3080.948601249859 RMSLE – 8.032992815968017 R2 score – 0.8668348937732229	y = column_or_1d(y, warn=True) Out[10]: {'mae': 1327.549477341283, 'mse': 9492244.283543464, 'rmse': 3080.948601249859, 'rmsle': 8.032992815968017, 'r2': 0.8668348937732229, 'adj_r2_score': 0.8668269262555739}

10. ADVANTAGES AND DISADVANTAGES

Advantages

- Good at learning complex and non-linear relationship.

- Highly Explainable and Easy to interpret.

- Robust to outliers.

- Consume less time

Disadvantages:

- Doesn't work in unlabelled data

- Future Value of Your Car is Unknown.

11. CONCLUSION

We started with understanding the use case of machine learning in the automatic industry and how machine learning has transformed the driving experience. Moving on, we looked at the various factor that affects the release value of a used car and performed exploratory data analysis (EDA). Before model building, the dataset is pre-processed by cleaning data and removing the outliers, Further, we build a Random Forest Regression model to predict the resale value of a used car. The performance is evaluated using various performance matric and release the appropriate accuracy rate in each metrics.

12. Future Scope:

The User Interface is just created to predict the resale value of the car using labelled data. It would be developed as an unsupervised learning model with the improved accuracy to predict the value of the car with is not in the dataset. The UI would be act as a medium for both seller and the buyer to sale or purchase the car with desirable features to make it useful for the buyers without the feel of disappointment and sellers to get the satisfactory price for their car.

13. APPENDIX

Source code:

```python
import pandas as pd
import numpy as np
from flask import Flask,render_template,Response,request
import pickle
from sklearn.preprocessing import LabelEncoder
import pickle

app = Flask(__name__)
filename = 'resale_model.sav'
model_rand = pickle.load(open(filename,'rb'))

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

@app.route('/predict')
def predict():
    return render_template('resalepredict.html')
@app.route('/y_predict',methods=['GET','POST'])
def y_predict():
    regyear = int(request.form['regyear'])
    powerps = float(request.form['powerps'])
    kms = float(request.form['kms'])
    regmonth = str(request.form.get('regmonth'))
    gearbox = request.form['gearbox']
    damage = request.form['dam']
    model  = request.form.get('model_type')
    brand = request.form.get('brand')
    fuelType = request.form.get('fuel')
    vehicletype= request.form.get('vehicletype')
    new_row =
{'yearOfRegistration':regyear,'powerPS':powerps,'kilometer':kms,'monthOfRegist
ration':regmonth,'gearbox':gearbox,'notRepairedDamage':damage,'model':model,'b
rand':brand,'fuelType':fuelType,'vehicleType':vehicletype}
```

```python
    print(new_row)
    new_df =
pd.DataFrame(columns=['vehicleType','yearOfRegistration','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)
        tr = mapper[i].fit_transform(new_df[i])
        new_df.loc[:,i+'_Labels'] = pd.Series(tr,index=new_df.index)
    labeled = new_df[
['yearOfRegistration','powerPS','kilometer','monthOfRegistration'] +
[x+"_Labels" for x in labels]]

    X = labeled.values
    print(X)
    y_prediction = model_rand.predict(X)
    print(y_prediction)
    return render_template('resalepredict.html',ypred="The resale value
predicted is {:.2f}$".format(y_prediction[0]))

if __name__ == '__main__':
    app.run(host='0.0.0.0',debug=True,threaded=False)
```

Github-link--https://github.com/IBM-EPBL/IBM-Project-47279-1660797975

Demo-link-
https://drive.google.com/file/d/1KCDcbAXhQbwPE5q7_JpYwZzIKHFZkrKl/view?usp=sharing

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