CAR RESALE VALUE PREDICTION

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1.INTRODUCTION

Determining whether the listed price of a used car is a challenging task, due to the many factors that drive a used vehicle's price on the market. The focus of this project is developing machine learning models that can accurately predict the price of a used car based on its features, in order to make informed purchases. We implement and evaluate various learning methods on a dataset consisting of the sale prices of different makes and model. 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 displays the Price of a car according to user's inputs.

1.1. PROJECT OVERVIEW

Almost everyone wants their own car these days, but because of factors like affordability or economic conditions, many prefer to opt for pre-owned cars. Accurately predicting used car prices requires expert knowledge due to the nature of their dependence on a variety of factors and features. Used car prices are not constant in the market, both buyers and sellers need an intelligent system that will allow them to predict the correct price efficiently. In this intelligent system, the most difficult problem is the collection of the dataset which contains all important elements like the manufacturing year of the car, its gas type, its condition, miles driven, horsepower, doors, number of times a car has been painted, customer reviews, the weight of the car, etc. It is necessary to pre- process and transform collected data in the proper format prior to feeding it directly to the data mining model. As a first step, the dataset was statistically analysed and plotted. Missing, duplicated, and null values were identified and dealt with. Features were chosen and extracted using correlation matrices.
system is defined in the python language that predicts the amount of resale value based on the given information.The system works on the trained dataset of the machine learning program that evaluates the precise value of the car.User can enter details only of fields like purchase price of car, kilometers driven, fuel of car, year of purchase.Upon form submission, the data is sent to the ML model via Flask API and the model responds with a predicted resale value of the car based on user input. This prediction is displayed on the web page using a render template.Thus, with minimal information and without human intervention or manual examination, a user can predict the resale value of his car.

1. 2.PURPOSE

This resale value prediction system is made for general purpose to just predict the amount that can be roughly acquired by the user. We try to predict the amount of resale by best 70% accuracy so the user can get estimated value before he resales the car and doesn't make a deal in lossThe 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 predict Car resale value prediction system is made with the purpose of predicting the correct valuation of used cars that helps users to sell the car remotely with perfect valuation and without human intervention in the process to eliminate biased valuation.

2.LITERATURE SURVEY:

With the recent arrival of internet portals, buyers and sellers may obtain an appropriate status of the factors that ascertain the market price of a used automobile. Lasso Regression, Multiple Regression, and Regression Trees are examples of machine learning algorithms. We will try to develop a statistical model that can forecast the value of a pre-

owned automobile based on prior customer details and different parameters of the vehicle. [2] This paper aims to compare the efficiency of different models' predictions to find the appropriate one. On the subject of used automobile price prediction, several previous studies have been conducted. To anticipate the value of pre-owned automobiles in Mauritius, Pudaruth employed naive Bayes, knearest neighbours, multiple linear regression, and decision trees. However, because there were fewer carsobserved, their results were not good for prediction. In his article, Pudaruth concluded that decision trees and naive Bayes are ineffective for continuous-valued variables.[4] To anticipate the price of a vehicle, Noor and Jan employed multiple linear regression. They used a variable selection methodology to determine the variables that had the highest influence and then eliminated the remainder. Only a few variables are included in the data, which were utilised to create the linear regression model. With an R-square of 98 percent, the outcome was outstanding. [4] Peerun et al. conducted study to assess the neural network's performance in predicting used automobile prices. However, especially on higher-priced cars, the estimated value is not very close to the real price. In forecasting the price of a used car, they found that support vector machine regression outperformed neural networks and linear regression by a little margin. [4] To accurately anticipate the price of a car, many different approaches have been used in the digital world, ranging from machine learning approaches like multiple linear regression, k-nearest neighbor, and naive bayes to random forest and decision tree to the SAS enterprise miner. In [7], [8], [9], [10] and [11] all of these solutions took into account distinct sets of attributes when making predictions based on the historical data used to train the model. We attempted to construct a web application where a user may verify the effective market price of their automobiles using a model for prediction based on the factors that have the greatest impact on vehicle prices.

2.1. EXISTING PROBLEM:

The forecasts of vehicle cost from the chronicled information that has been gathered from every day papers. They have utilized the administered AI strategies for foreseeing the cost of vehicles. Numerous different calculations like various straight relapse, k-closest neighbor calculations, gullible based, and some choice tree calculations additionally been utilized. Every one of the four calculations are looked at and tracked down the best calculation for forecast. They have confronted a few challenges in looking at the calculations, by one way or another they have overseen. As indicated by creators Pattabiraman, this paper is more focused on the connection among vender and purchaser. To foresee the cost of four wheelers, more highlights are required like previously given value, mileage, make, model, trim, type, chamber, liter, entryways, voyage, sound, cowhide. Utilizing these highlights the cost of vehicle has been anticipated with the assistance of factual investigation framework for exploratory information examination. As per creators EnisGegic et al, in this paper the chiefly focus on gathering different information from web entryway by utilizing web scrap methods. Furthermore, those have been contrasted and the assistance of various AI calculation.

2. 2.REFERENCES:

[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.

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[5] Richardson, M. S. (2009). Determinants of used car resale value. Retrieved from: https://digitalcc.coloradocollege.edu/islandora/object

[6] Pudaruth, S., 2014. “Predicting the Price of Used Cars using Machine Learning Techniques.” Vol 4, Number 7 (2014), pp. 753-76.
[7] Gokce, E. (2020, January 10). “Predicting used car prices with machine learning techniques. “

2.3.PROBLEM STATEMENT DEFINITION:

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.

3.IDEATION & PROPOSED SOLUTION:

3.1.EMPATHY MAP CANVAS:

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user’s behaviours and attitudesIt is a useful tool to helps teams better understand their users.

Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user’s perspective along with his or her goals and challenges.

SAYS

Are there any warranties?

How well does this car run?

What do you think about this brand?

What are some good car repairs shops?

What interior options are there?

THINGS

Wants to find a car for a good reason

The car shopping takes a lot of time

Thinks that the country of origin for a car is important

That sales people are all jerks

That dealerships are "stealerships"

CUSTOMER

DOES

Searches for best deals and safety ratings online

Talks to people through social networking sites

Always makes sure car is clean and tidy

Contacts experts that they know

puts car seats in back of car to see if multiple will fit

FEELS

Hope the car represents them well

That cars commercials are not realistic

Wants to find a car for a good price

That leather makes everything look better

That they are being advantage of by the sales man

PAINS

1.Will I be able to arrange amount

2.How will the interior be?

3.Will the Engine be in good condition?

4.Will the paint be in good condition?

5.What if the car met with accident previouly?

GAINS

1.Can learn to drive

2.Can get luxury cars for lesser price

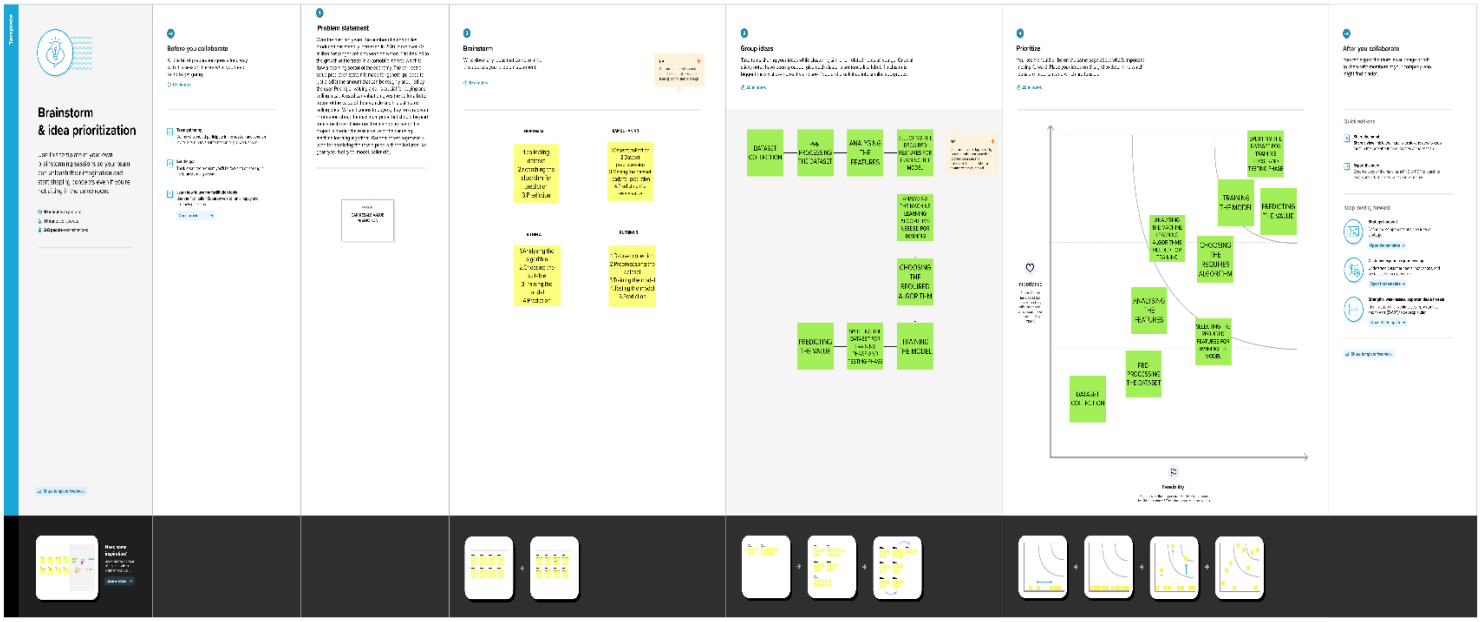
3.Less cost

4.Lesser depreciation value compared to new cars

5.Can get cars that are no longer available in market

2.2 IDEATION & BRAINSTORMING:

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, outof-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions



2.2. PROPOSED SOLUTION

In view of the differing highlights and factors, and furthermore with the assistance of master information the vehicle value forecast has been done precisely. 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. Various highlights like (discretionary) outside shading, entryway number, sort of transmission, measurements, security, cool, inside, if it has route will likewise impact the vehicle cost. In this, we applied distinctive methods(like relapse, grouping, bunching and so forth) and techniques(like regulated, solo, semi managed) to accomplish higher accuracy of the pre-owned car value expectation

A well-articulated customer problem statement allows you and your team to find the ideal solution for the challenges your customers face. Throughout the process, you'll also be able to empathize with your customers, which helps you better understand how they perceive your product or service.

I am	Describe customer with 3-4 key characteristics - *who are they?*	Describe the customer and their attributes here
I'm trying to	*List their outcome or "job" the care about - what are they trying to achieve?*	List the thing they are trying to achieve here
but	Describe what problems or barriers stand in the way – *what bothers them most?*	Describe the problems or barriers that get in the way here
because	Enter the "root cause" of why the problem or barrier exists – *what needs to be solved?*	Describe the reason the problems or barriers exist
which makes me feel	Describe the emotions from the customer's point of view – *how does it impact them emotionally?*	Describe the emotions the result from experiencing the problems or barriers

2.3. PROBLEM SOLUTION FIT:

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem. A problem-solution-fit occurs if a startup has proved both: 1) that there is a 'problem worth solving' for one or more clearly defined customer groups, and 2) that there is evidence that these customer groups would consider the value proposition of the solution the firm proposes.

Define CS, fit into CC

1. CUSTOMER SEGMENT(S)

CS

Who is your customer?
i.e. working parents of 0-5 y.o. kids

- Dealeis
- Avid Buyeis ovei the age of 18

6. CUSTOMER CONSTRAINTS

CC

What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.

Customeis aie hesitant due to stigma of computei piedicted values might not be accuiate.

5. AVAILABLE SOLUTIONS

AS

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 notetaking

Visit online websites to see how much othei people with similai cais aie selling theii cais foi.

By visiting dealeiships and getting estimates.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEMS

J&P

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

T'o build a supeivised machine leaining model that utilizes iegiession methods to accuiately piedict/anticipate the value of a Used cai based on the following factois:

- Condition of the cai
- Kilometeis diiven
- Life Span
- Damages
- No. of owneis

9. PROBLEM ROOT CAUSE

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 regulations.

T'he value pioposed by dealeis and othei paities foi a cai may be untiustwoithy and extiemely low.

Useis aie unsuie how much theii can actually sell foi oi at a piice which theycan bid foi.

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)

Pioviding false claims on damages inand on the cai.

T'o oveisell non-existent featuies.

Focus on J&P, tap into BE, understand RC

Identify strong TR & EM

3. T'RIGGERS

PR

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

Useis may othei sites to make a compaiison whichcateis the decision piocess.

4. EMOTIONS: BEÏORE / AÏI'ER

EM

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.

Befoie:
T'he usei might be conceined about the inaccuiate piediction based on human assessment.
Aftei:
without usei inteivention, the usei may decide the attiibutes of the cai on theii own

10. YOUR SOLUT'ION

SL

If you aie 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 behaviour.

A machine leaining model can be utilized to develop this system which can accuiately piedict the iesale value of the cai given a set of attiibutes of the cai.

8. CHANNELS of BEHAVIOUR

CH

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

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

Online:
Customeis don't just look at the infoimation piovided by cai biand websites but they also makea compaiison study on piicings on vaiious websites.

Offline:
If an usei is inteiested in buying a cai. T'hey would visit a lot of dealeiships to get a quotation and do a compaiison study.

Identify strong TR & EM

4.REQUIREMENT ANALYSIS:

4.1.FUNCTIONAL REQUIREMENT:

Following are the functional requirements of the proposed solution.

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

4.2 NON-FUNCTIONAL REQUIREMENTS:

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

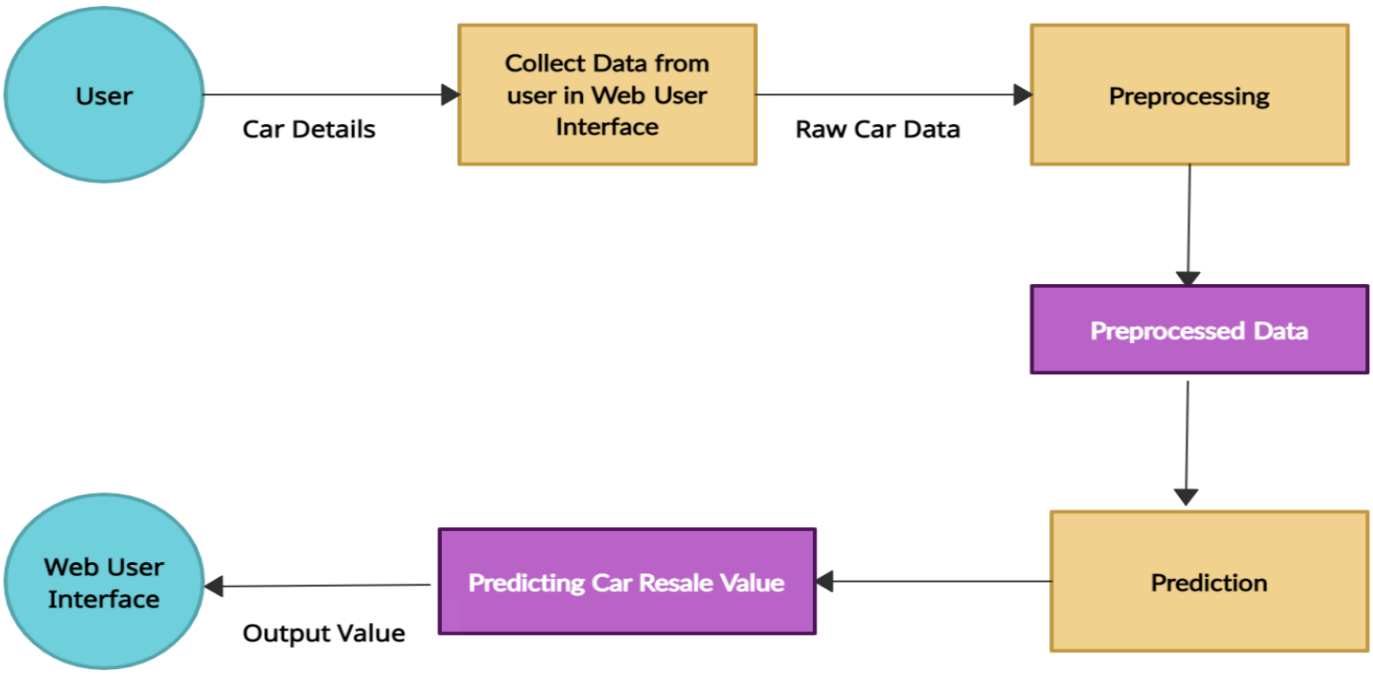
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	User friendly UI Simple and easy to Understand
NFR-2	**Security**	Aware of scams

NFR-3	**Reliability**	The system must perform without failure
NFR-4	**Performance**	The landing page must support several users must provide 5 second or less response time
NFR-5	**Availability**	Uninterrupted services must be available all time except the time of server updation.
NFR-6	**Scalability**	That can handle any amount of data and perform many computations in a costeffective and time-saving way to instantly serve millions of users residing at global locations.

5.PROJECT DESIGN:

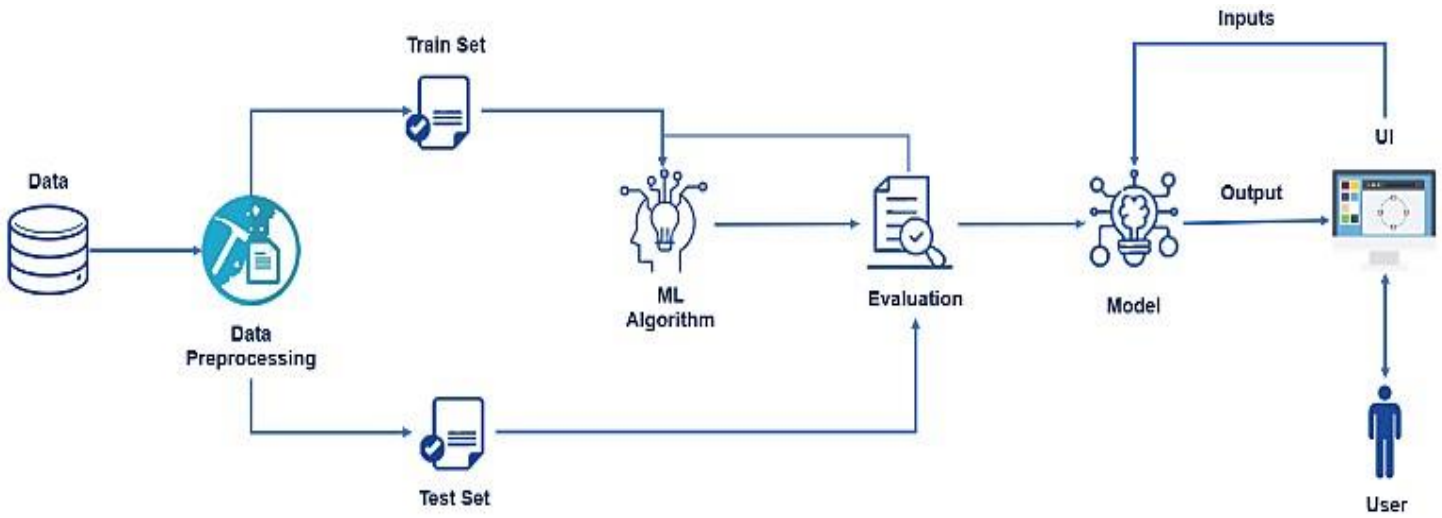
5.1 DATA FLOW DIAGRAMS:

A data flow diagram (DFD) maps out the flow of information for any process or system. It uses defined symbols like rectangles, circles and arrows, plus short text labels, to show data inputs, outputs, storage points and the routes between each destination. Data flowcharts can range from simple, even hand-drawn process overviews, to in-depth, multi-level DFDs that dig progressively deeper into how the data is handled.



5.2. SOLUTION & TECHNICAL ARCHIECTURE:

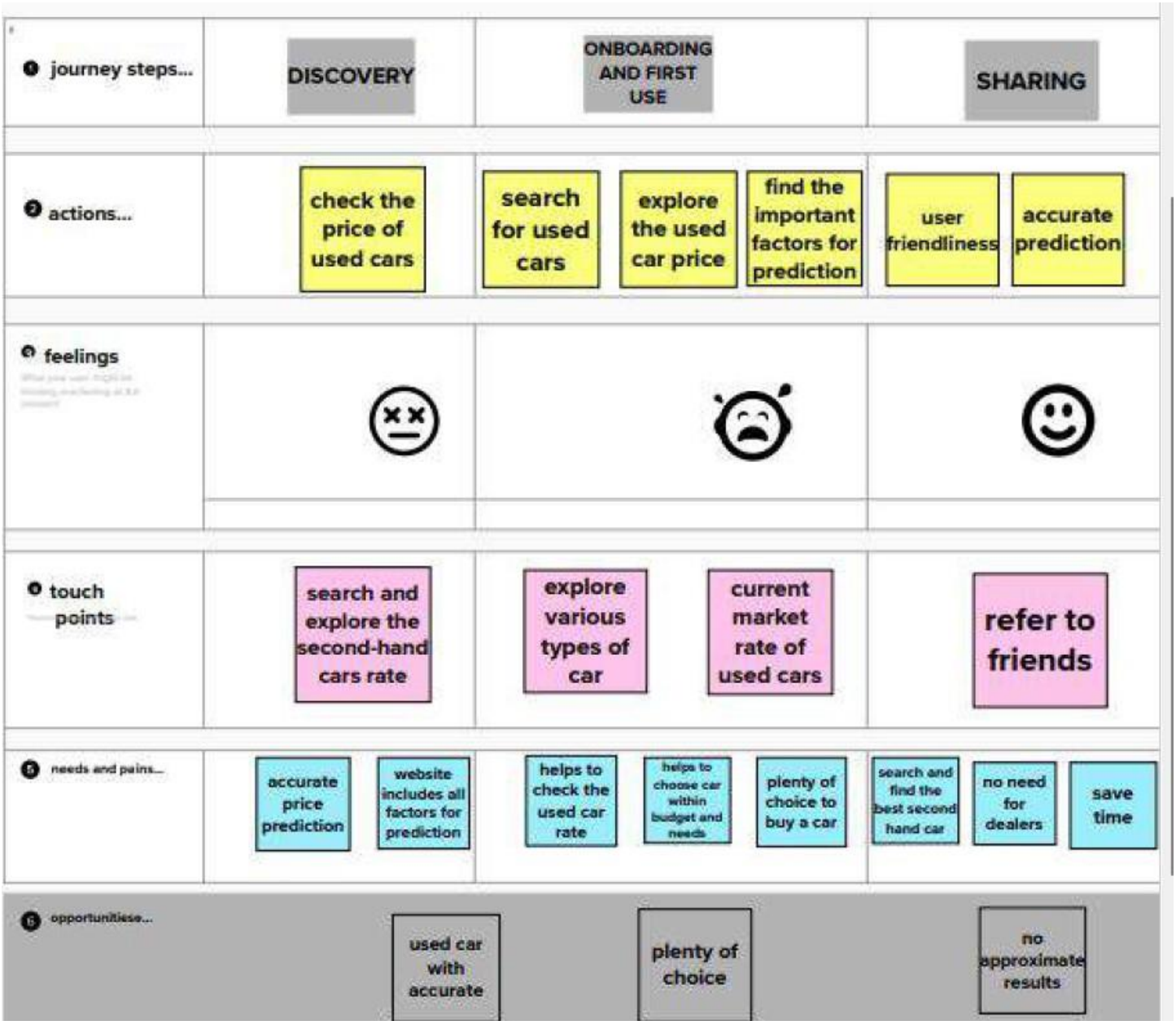
Solution architecture is the process of developing solutions based on predefined processes, guidelines and best practices with the objective that the developed solution fits within the enterprise architecture in terms of information architecture, system portfolios, integration requirements and many more. It can then be viewed as a combination of roles, processes and documentation that are intended to address specific business needs, requirements or problems through the design and development of applications and information systems.Solution architecture is the initial step taken when an organization aims to create a set of enterprise solutions, applications and processes that integrate with each other in order to address specific needs and requirements and that often lead to software architecture and technical architecture work.The solution architecture is described in a document that specifies a certain level of vision for all current and future solutions, applications and processes that the organization has. Design and development of solutions and applications then follow the guidelines specified in the solution architecture document to ensure that they conform to set standards that make integration and communication easier, and make the tracking of problems and inconsistencies between solutions easier as well.



5.3. USER STORIES

A user story is an informal, general explanation of a software feature written from the perspective of the end user. Its purpose is to articulate how a software feature will provide value to the customer. A user story is the smallest unit of work in an agile framework. It’s an end goal, not a feature, expressed from the software user’s perspective.

A user story is an informal, general explanation of a software feature written from the perspective of the end user or customer. The purpose of a user story is to articulate how a piece of work will deliver a particular value back to the customer. The user story for the project is as follows:



6.PROJECT PLANNING & SCHEDULING:

6.1. SPRINT PLANNING AND ESTIMATION

Sprint planning is an event in scrum that kicks off the sprint. The purpose of sprint planning is to define what can be delivered in the sprint and how that work will be achieved. Sprint planning is done in collaboration with the whole scrum team. In scrum, the sprint is a set period of time where all the work is done. However, before you can leap into action you have to set up the sprint. You need to decide on how

long the time box is going to be, the sprint goal, and where you're going to start. The sprint planning session kicks off the sprint by setting the agenda and focus. If done correctly, it also creates an environment where the team is motivated, challenged, and can be successful. Bad sprint plans can derail the team by setting unrealistic expectations. The following is the sprint planning and estimation for the project.

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

6.2 SPRINT DELIVERY SCHEDULE

Since sprints take place over a fixed period of time, it’s critical to avoid wasting time during planning and development. And this is precisely where sprint scheduling enters the equation.In case you’re unfamiliar, a sprint schedule is a document that outlines sprint planning from end to end. It’s one of the first steps in the agile sprint planning process—and something that requires adequate research, planning, and communication.

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

7. CODING & SOLUTIONING:

app_flask.py

```
 import pandas
from flask import Flask, render_template, request
import pandas as pd
import numpy as np
from sklearn.preprocessing import LabelEncoder
app =Flask(__name__)
import pickle
filename = 'resale_model.sav'
model_rand= pickle.load(open(filename, 'rb'))
@app.route('/')
def index():
    return render_template('home.html')
@app.route('/predict')
def predict():
    return render_template('predict.html')
@app.route('/y_predict', methods= ['POST'])
def y_predict():
    regyear = int(request.form['Registrationyear'])
    powerps = int(request.form['PowerofcarinPS'])
    kms =int(request.form['KilometersDriven'])
    regmonth =int(request.form.get('Registrationmonth'))
    gearbox =(request.form['Geartype'])
    damage =request.form['cd']
    model = request.form.get('model')
    brand =request.form.get('brand')
```

```
fuelType =request.form.get('fueltype')
vehicletype = request.form.get('vechicletype')
row = {'vehicleType': vehicletype,'yearOfRegistration':regyear,
      'gearbox': gearbox,'powerPS': powerps, 'model':model,'kilometer': kms,
      'monthOfRegistration': regmonth,'fuelType': fuelType,
      'brand': brand,'notRepairedDamage': damage}
print(row)
new_row = pd.DataFrame([row])
new_df = pd.DataFrame(columns = ['vehicleType', 'yearOfRegistration', 'gearbox',
                    'powerPS','model', 'kilometer', 'monthOfRegistration', 'fuelType',
                    'brand','notRepairedDamage' ])
new_df=pd.concat([new_df,new_row], ignore_index = True)
new_df['monthOfRegistration']= new_df['monthOfRegistration'].astype(int)
labels = ['gearbox', 'notRepairedDamage', 'model', 'brand', 'fuelType', 'vehicleType']
mapper = {}
for i in labels:
   mapper[i] = LabelEncoder()
   mapper[i].fit(new_df[i])
   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)
df_ev = np.exp(y_prediction)
```

```
    print("df_ev: {} ".format(df_ev))
    return render_template('predict.html',y = 'The resale value predicted is {:.2f}'.format(df_ev[0]))
if __name__=='__main__':
    app.run(debug= False)
```

home.html

```
<!DOCTYPE html>
<html>
<head>
<meta name="viewport" content="width=device-width, initial-scale=1">
<style>
.container {
  position: relative;
  font-family: Arial;
}
.text-block {
  position: absolute;
  bottom: 20px;
  right: 20px;
  background-color: #9BC92B ;
  color: white;
  padding-left: 20px;
  padding-right: 20px;
}
.container .btn {
  position: absolute;
  top: 50%;
  left: 12.5%;
  display:flex;
```

```
  transform: translate(-50%, -50%);
  -ms-transform: translate(-50%, -50%);
  background-color: #f1f1f1;
  color: black;
  font-size: 16px;
  padding: 16px 30px;
  border: none;
  cursor: pointer;
  border-radius: 5px;
  text-align: center;
  text-decoration: none;
}
.container .btn:hover {
  background-color: black;
  color: white;
}
.myflex{
  display: flex;
  align-items: center;
  background-color: #21222A;
  color: white;
  justify-content: space-between;
  font-size: x-large;
}
.myflex > h3{
  margin-right: auto;

  font-weight: 700;
```

```
  font-size: 30px;
}
.myflex >h4{
  margin-right: 20px;
  font-weight: 600;
}
.logo{
  width: 60px;
  margin-right: 20px;
 height: 90px;
}
.para1{
 display: flex;
  align-items: center;
 justify-content: space-between;
margin:10px;
text-align: justify;
tab-size: 8;
}
.para2{
display: flex;
  align-items: center;
 justify-content: space-between;
margin:10px;
text-align: justify;
tab-size: 8;
}
.para1 >h3{
```

```
  font-family: "Times New Roman", Times, serif;
  font-weight: normal;
}
.para2>h3
{
 font-family: "Times New Roman", Times, serif;
  font-weight: normal;
}

</style>
</head>
<body>

<header>
          <nav class='myflex'>
           <img src="{{url_for('static', filename='Car_1.jpg')}}" class="logo" alt="logo"><br>
           <h3>Car Price Predictor!</h3>
           <h4>Home</h4>
          </nav>
  </header>
<div class="container">
  background-image: url('Car_2.jpg');
  <img src="{{url_for('static', filename='Car_2.jpg')}}" alt="Nature" style="width:100%;">
  <a href="/predict" class="btn">Want to know the resale value of your car?</a>
  <div class="text-block">
    <h4>Hurray</h4>
    <p>A Car For All Budgets!!!</p>
  </div>
```

```
</div>

<div class="para">

    <div class="para1">

                    <h3 ><i>The growing world of e-commerce is not just restricted to buying electronics and

clothings but everything that you expect in a general store.Keeping the general store perspective aside and looking at the bigger picture, every day there are thousands or perhaps millions of deals happening in the digital marketplace.One of the most booming markets in the digital space is that of the automobile industry wherein the buying and selling of used cars take place.

The rise of e-commerce facilities and the practical aspect of unaffordability due to inflation have created a niche market for used vehicles.The only difference here is that you do not have to walk up to the dealer or individual sellers to get a used car price

quote, instead you get the used car valuation at the comfort of your home within 10 seconds.However, buyers and sellers face a major stumbling block when it comes to their used car valuation or say their second-hand car price.</i></h3>

    </div>

    <div class="para2">

        <h3><i>Traditionally, you would go to a showroom and get your vehicle inspected before learning about the price,

but now you do not need to do that anymore. With technologically advanced websites which is a well-known used car valuation tool, you can simply check your pre-owned car price online in a hassle-free manner. You can check used Audi car price, used Hyundai car price, second-hand Honda car price, and so on. As a seller, you will always look to make the most out of the deal, and as a buyer, you are not willing to spend an extra penny on the deal for Used car price. The difference in thoughts and expectations often keeps buyers from buying and sellers from selling the product. However, you need not hear from anyone else. Simply visit the website and with the help of a used car pricing calculator, you can get the right amount range for your used car.</i></h3>

</div>

</div>

</body>

</html>
```

Predict.html

```
<!DOCTYPE html>

<html>

  <head>

    <title>Prediction Form</title>

    <link href="https://fonts.googleapis.com/css?family=Roboto:300,400,500,700" rel="stylesheet">

    <link rel="stylesheet" href="https://use.fontawesome.com/releases/v5.5.0/css/all.css" integrity="sha384-
B4dIYHKNBt8Bc12p+WXckhzcICo0wtJAoU8YZTY5qE0Id1GSseTk6S+L3BlXeVIU" crossorigin="anonymous">
```

```
<style>
    html, body {
    min-height: 100%;
    }
    body, div, form, input, select, textarea, label {
    padding: 0;
    margin: 0;
    outline: none;
    font-family: Roboto, Arial, sans-serif;
    font-size: 14px;
    color: #666;
    line-height: 22px;
    }
    h1 {
    position: absolute;
    margin: 0;
    font-size: 40px;
    color: #fff;
    z-index: 2;
    line-height: 83px;
    }
    .testbox {
    display: flex;
    justify-content: center;
    align-items: center;
    height: inherit;
    padding: 20px;
    }
```

```
form {
width: 100%;
padding: 20px;
border-radius: 6px;
background: #fff;
box-shadow: 0 0 8px  #cc7a00;
}
.banner {
position: relative;
height: 300px;
background-image: url({{ url_for('static', filename='Car_2.png') }})
background-size: cover;
display: flex;
justify-content: center;
align-items: center;
text-align: center;
}
.banner::after {
content: "";
background-color: rgba(0, 0, 0, 0.2);
position: absolute;
width: 100%;
height: 100%;
}
input, select, textarea {
margin-bottom: 10px;
border: 1px solid #ccc;
border-radius: 3px;
```

```
}
input {
width: calc(100% - 10px);
padding: 5px;
}
input[type="date"] {
padding: 4px 5px;
}
textarea {
width: calc(100% - 12px);
padding: 5px;
}
.item:hover p, .item:hover i, .question:hover p, .question label:hover, input:hover::placeholder {
color: #cc7a00;
}
.item input:hover, .item select:hover, .item textarea:hover {
border: 1px solid transparent;
box-shadow: 0 0 3px 0 #cc7a00;
color: #cc7a00;
}
.item {
position: relative;
margin: 10px 0;
}
.item span {
color: red;
}
input[type="date"]::-webkit-inner-spin-button {
```

```
display: none;
}
.item i, input[type="date"]::-webkit-calendar-picker-indicator {
position: absolute;
font-size: 20px;
color: #cc7a00;
}
.item i {
right: 1%;
top: 30px;
z-index: 1;
}
input[type=radio], input[type=checkbox]  {
display: none;
}
label.radio {
position: relative;
display: inline-block;
margin: 5px 20px 15px 0;
cursor: pointer;
}
.question span {
margin-left: 30px;
}
.question-answer label {
display: block;
}
label.radio:before {
```

```
content: "";
position: absolute;
left: 0;
width: 17px;
height: 17px;
border-radius: 50%;
border: 2px solid #ccc;
}
input[type=radio]:checked + label:before, label.radio:hover:before {
border: 2px solid #cc7a00;
}
label.radio:after {
content: "";
position: absolute;
top: 6px;
left: 5px;
width: 8px;
height: 4px;
border: 3px solid #cc7a00;
border-top: none;
border-right: none;
transform: rotate(-45deg);
opacity: 0;
}
input[type=radio]:checked + label:after {
opacity: 1;
}
.btn-block {
```

```
margin-top: 10px;
text-align: center;
}
button {
width: 150px;
padding: 10px;
border: none;
border-radius: 5px;
background: #cc7a00;
font-size: 16px;
color: #fff;
cursor: pointer;
}
button:hover {
background: #ff9800;
}
@media (min-width: 568px) {
.name-item, .city-item {
display: flex;
flex-wrap: wrap;
justify-content: space-between;
}
.name-item input, .name-item div {
width: calc(50% - 20px);
}
.name-item div input {
width:97%;}
.name-item div label {
```

```
        display:block;
        padding-bottom:5px;
        }
        }

footer {
            text-align: center;
  padding: 3px;
  background-color: DarkSalmon;
  color: white;
}
    </style>
  </head>
  <body>
    <div class="testbox">
      <form action="/y_predict" method="post">
        <div class="banner">

          <h1>Prediction Form</h1>
        </div>
        <p>Enter car details</p>
        <div class="item">
          <label for="Registration year">Registration year<span>*</span></label>
          <input id="Registration_year" type="text" name="Registrationyear" required/>
        </div>
        <div class="item">
          <label for="Registration month">Registration month<span>*</span></label>
          <input id="Registration_month" type="text" name="Registrationmonth" required/>
```

```
    </div>
    <div class="item">
      <label for="Power of car in PS">Power of car in PS<span>*</span></label>
      <input id="Power_of_car_in_PS" type="text" name="PowerofcarinPS" required/>
    </div>
    <div class="item">
      <label for="Kilometers Driven">Kilometers Driven<span>*</span></label>
      <input id="Kilometers_Driven" type="text" name="KilometersDriven" required/>
    </div>
<div class="question">
      <label>Gear Box Type</label>
      <div class="question-answer">
        <div>
          <input type="radio" value="manual" id="radio_1" name="Geartype"/>
          <label for="radio_1" class="radio"><span>Manual</span></label>
        </div>
        <div>
          <input  type="radio" value="automatic" id="radio_2" name="Geartype"/>
          <label for="radio_2" class="radio"><span>Automatic</span></label>
        </div>
         <div>
          <input  type="radio" value="not-declared" id="radio_3" name="Geartype"/>
          <label for="radio_3" class="radio"><span>Not-declared</span></label>
        </div>
      </div>
    </div>
   <div class="question">
      <label>Car damaged/reparied</label>
```

```
  <div class="question-answer">
    <div>
      <input type="radio" value="Yes" id="d_radio_1" name="cd"/>
      <label for="d_radio_1" class="radio"><span>Yes</span></label>
    </div>
    <div>
      <input  type="radio" value="No" id="d_radio_2" name="cd"/>
      <label for="d_radio_2" class="radio"><span>No</span></label>
    </div>
     <div>
      <input  type="radio" value="not-declared" id="d_radio_3" name="cd"/>
      <label for="d_radio_3" class="radio"><span>Not-declared</span></label>
    </div>
  </div>
</div>
<div class="item">
  <p>Model Type</p>
  <select id="model" name="model">
    <option selected value="" disabled selected></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>

<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>

<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>

<option value="stilo">stilo</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>

<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_rove_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="g1">g1</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>
          <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>
          <option value="not-declared">not-declared</option>

        </select>
      </div>
<div class="item">
        <p>Brand of the car</p>
        <select id="brand" name="brand">
          <option selected value="" disabled selected></option>
          <option value="seat" >seat</option>
          <option value="lancia">lancia</option>
          <option value="porsche">porsche</option>
          <option value="citroen">citroen</option>
```

<option value="toyota" >toyota</option>

<option value="chevrolet">chevrolet</option>

<option value="dacia">dacia</option>

<option value="suzuki">suzuki</option>

<option value="chrysler">chrysler</option>

<option value="daihatsu" >daihatsu</option>

<option value="jaguar">jaguar</option>

<option value="daewoo">daewoo</option>

<option value="rover">rover</option>

<option value="sonstige_autos" >sonstige_autos</option>

<option value="saab">saab</option>

<option value="land_rover">land_rover</option>

<option value="lada">lada</option>

<option value="trabant">trabant</option>

<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>
        </select>
      </div>
<div class="item">
        <p>Fuel type of the car</p>
        <select id="fuel_type" name="fueltype">
          <option selected value="" disabled selected></option>
          <option value="diesel" >diesel</option>
          <option value="petrol">petrol</option>
          <option value="lpg">lpg</option>
          <option value="hybrid">hybrid</option>
          <option value="cng">cng</option>
          <option value="electric">electric</option>
          <option value="others">others</option>
          <option value="not-declared">not-declared</option>

        </select>
      </div>
<div class="item">
        <p>Vechicle Type</p>
        <select id="vechicle_type" name="vechicletype">
```

```
          <option selected value="" disabled selected></option>
          <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="others">others</option>
          <option value="not-declared">not-declared</option>
        </select>
      </div>
      <div class="btn-block">
        <button type="submit" >PREDICT</button>
      </div>
    </form>
  </div>
<footer>
          <h4> <b>{{y}}</b></h4>
        </footer>
 </body>
</html>
```

8.TESTING:

8.1 TEST CASES:

Project Name	Car Resale Value Prediction
Project Type	Applied Data Science Based Web Application
Developer	Nivetha M,Ramguhan R T,Rithin A,Ruthika R
Language	Python, html, css
Total Number of Testcases	45
Number of Testcases executed	45
Total Number of Testcases passed	44
Total Number of Testcases failed	1-System not useful for Blind People
Positive Testcases	33
Negative Testcases	12

8.2. User Acceptance Testing

1. Defect Analysis

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	19
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	38

Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	23	14	13	26	76

2.Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested.

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	23	0	0	23
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

Performance metrics are used to track progress. Metrics give some sort of concrete answer which easily can be followed up. There are different types of metrics used for testing.
The regression model can be evaluated on following parameters:

LINEAR REGRESSION MODEL

1. Mean Square Error (MSE): MSE is the single value that provides information about goodness of regression line. Smaller the MSE value, better the fit because smaller value implies smaller magnitude of errors.

2. Root Mean Square Error (RMSE): RMSE is the quadratic scoring rule that also measures the average magnitude of the error. It is the square root of average squared difference between prediction and actual observation.

3. Mean Absolute Error (MAE): This measure represents the average absolute difference between the actual and predicted values in the dataset. It represents the average residual from the dataset.

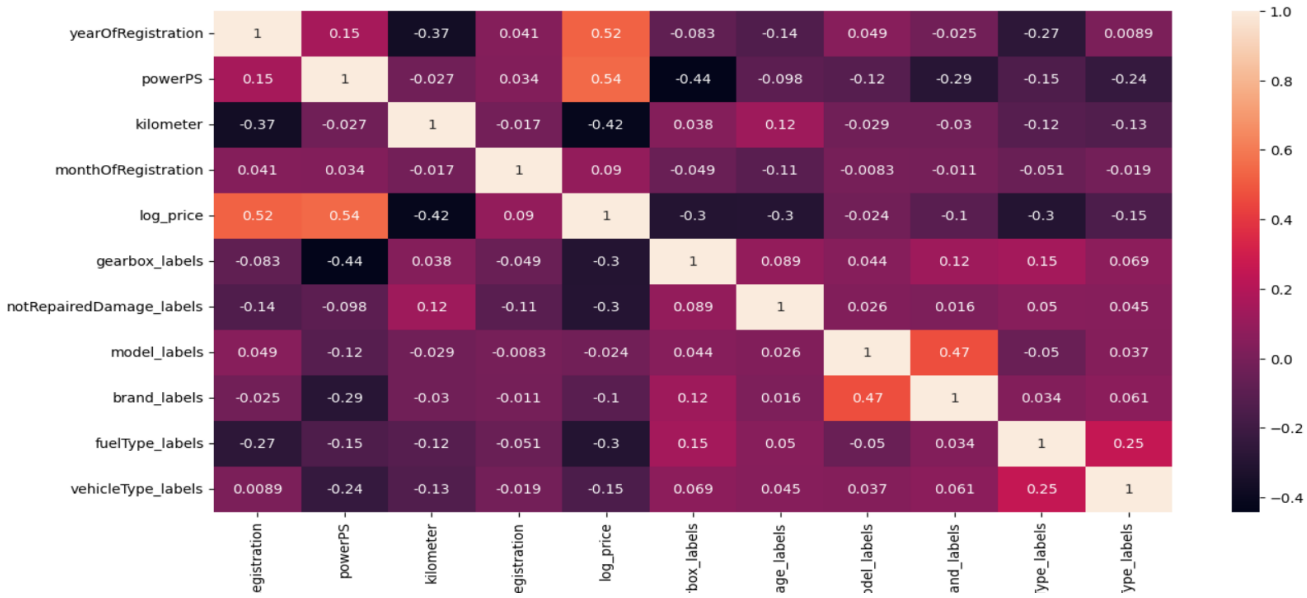
```
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score
lr = LinearRegression()

# Training Model
lr.fit(X_train,Y_train)

# Model Summary
y_pred_lr = lr.predict(X_test)

r_squared = r2_score(Y_test,y_pred_lr)

print("R_squared :",r_squared)
```

```
R_squared : 0.6295595631158426
```

```
from sklearn.ensemble import GradientBoostingRegressor
gbt = GradientBoostingRegressor()

# Training Model
gbt.fit(X_train,Y_train)

# Model Summary
y_pred_gbt = gbt.predict(X_test)

r_squared = r2_score(Y_test,y_pred_gbt)

print("R_squared :",r_squared)
```

```
c:\Users\nivet\anaconda3\lib\site-packages\sklearn\ensemble\_gb.py:494: DataConver
to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)

R_squared : 0.8307907757164501
```

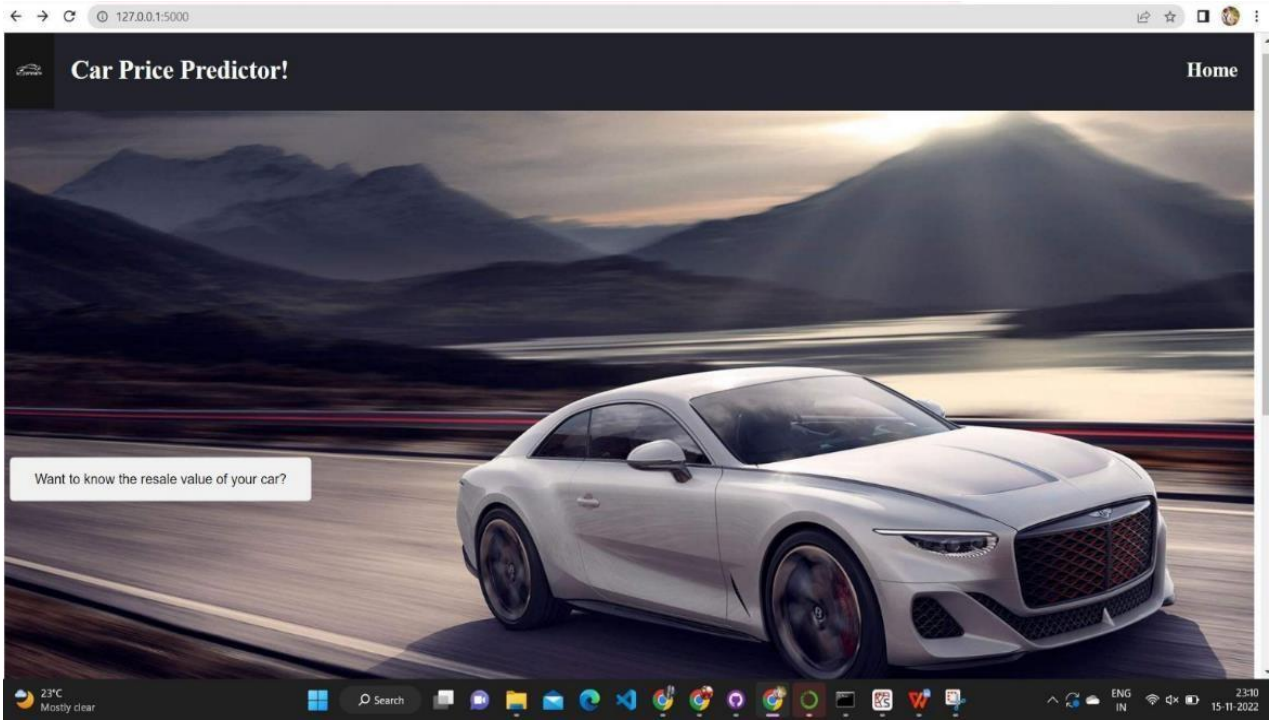
CLASSIFICATION MODEL



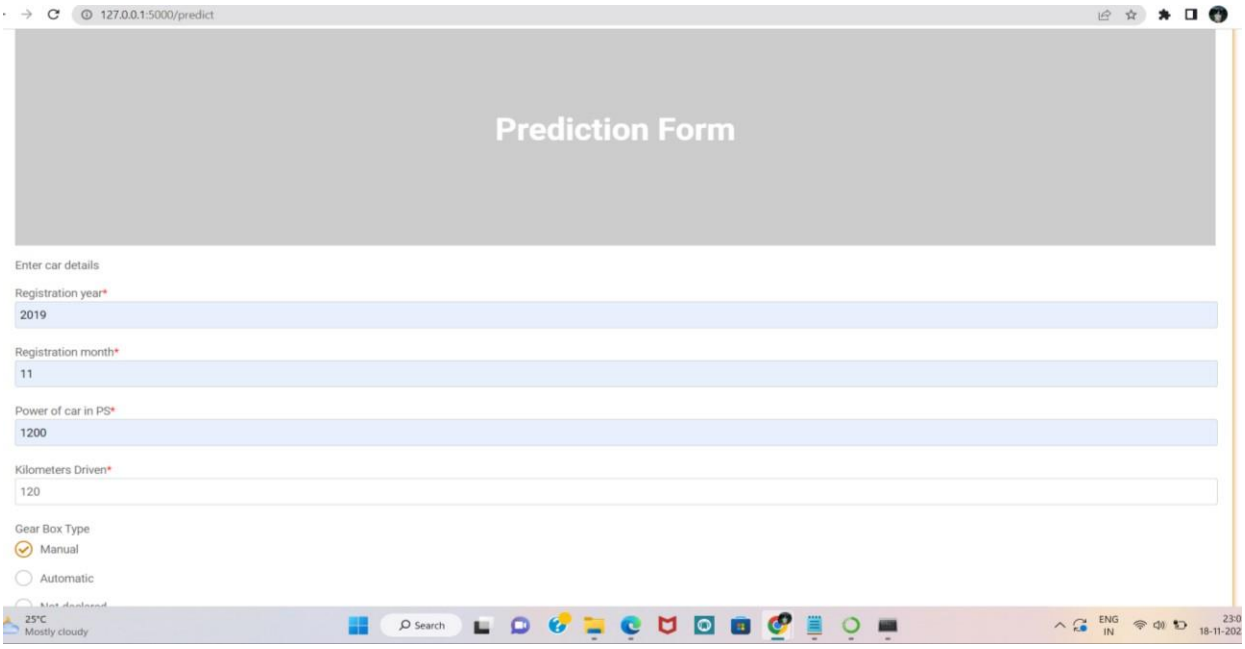
CLASSIFICATION REPORT

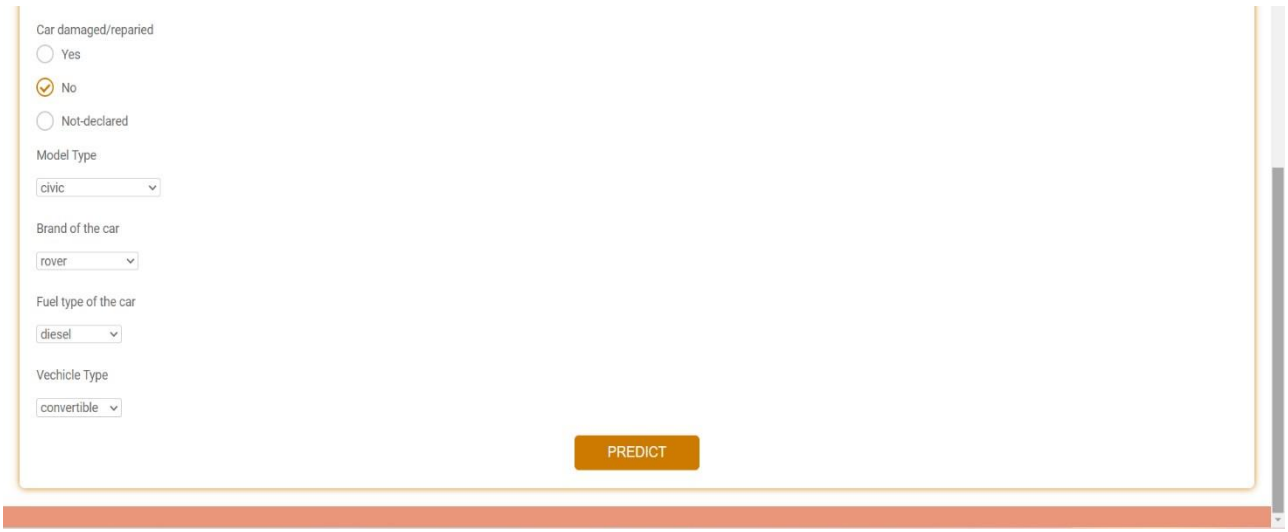
	Predicted Price	Actual Price	Residual	Difference%
83567	2208.98	1300.00	-908.98	69.92
83568	2044.81	1850.00	-194.81	10.53
83569	1542.36	2450.00	907.64	37.05
83570	3021.79	5590.00	2568.21	45.94
83571	1174.02	1150.00	-24.02	2.09

HOME PAGE

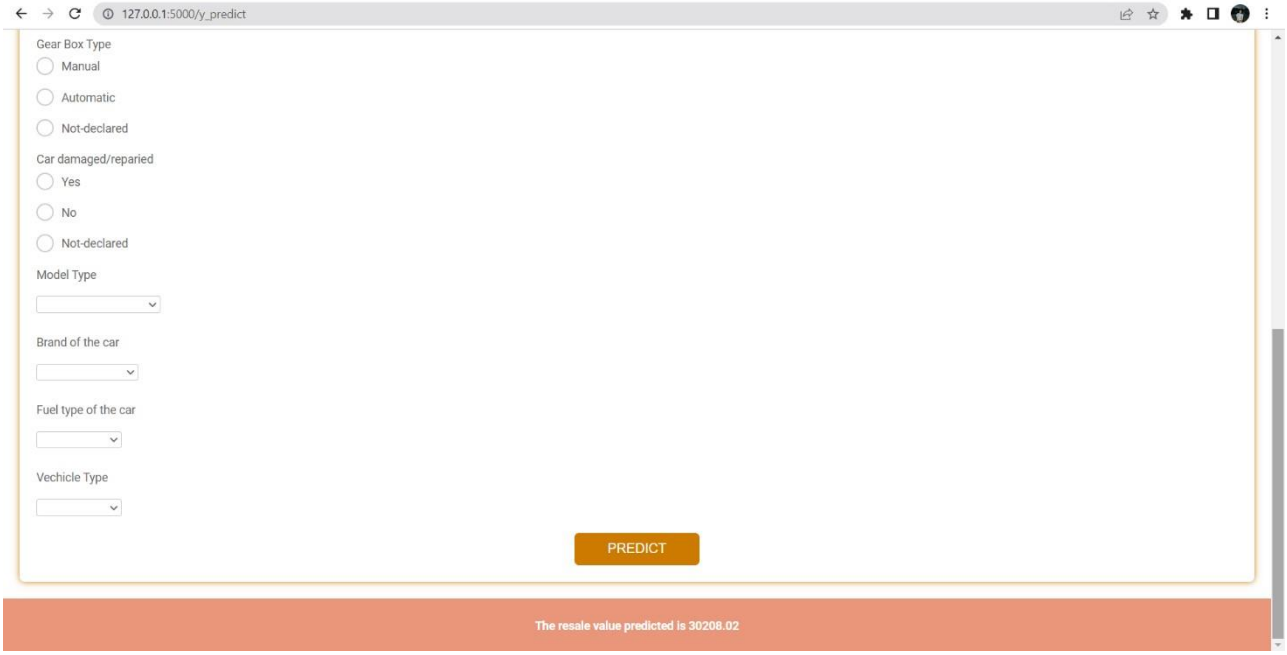


DATA ENTRY PAGE





PREDICT PAGE



10.ADVANTAGES & DISADVANTAGES:

ADVANTAGES

- Accuracy of our model is 90%.
- Prediction runs for different types of cars.

DISADVANTAGES

- Accuracy can be improved.
- Prediction is done using only a few criteria.

11.CONCLUSION:

We started with understanding the use case of machine learning in the Automotive industry and how machine learning has transformed the driving experience. We build a Random Forest Regression model to predict the resale value of a used car. Finally, we evaluated the performance of the model using the R squared score and Residual Plot. We could have also used simpler regression algorithms like Linear Regression and Lasso Regression. Still, we need to make sure there are no outliers in the dataset before implementing them. Pair plots and scatter plots help visualize the outliers. Then we have used a Flask application to display the predicted value to the users based on their corresponding input. This car resale value prediction can be used by the public to estimate the resale value of the car.

12.FUTURE SCOPE:

Currently, only few features are used to predict resale value of the car. This can be extended to more features. One can also implement CNN to determine physical condition of the car from images like identifying dents, scratches etc. and thus predicting more relevant resale value of a car.

For better performance, we plan to judiciously design deep learning network structures, use adaptive learning rates and train on clusters of data rather than the whole dataset. To correct for overfitting inRandom Forest, different selections of features and number of trees will be tested to check for change in performance.

13.APPENDIX:

GITHUB LINK: https://github.com/IBM-EPBL/IBM-Project-24512-1659944123

DEMO_LINK:https://drive.google.com/file/d/1e86GOgVZaDFQnz3pMBpJrSO3HbZsuPTI/view?usp=drivesdk