CAR RESALE VALUE PREDICTION

Category: Machine Learning

IBM-Project-48405-1660807243

Team ID: PNT2022TMID14329

A PROJECT REPORT

Submitted by

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(AUTONOMOUS)

CHAPTER 1
INTRODUCTION

Given the variety of elements that influence a used car's market pricing, determining if the quoted price is accurate is a difficult undertaking. The goal of this research is to create machine learning models that can precisely forecast a used car's price based on its attributes so that buyers can make educated decisions. Implement and assess various learning techniques using a dataset of sale prices for various brands and models. The cost of the car will be determined based on a number of factors. Regression It is feasible to forecast the actual price of a car rather than just the price by using algorithms because they provide us a continuous value rather than a classified value as an output.

1.1 Project Overview

- Able to understand the problem to classify if it is a regression or a classification kind of problem.
- Able to know how to pre-process/clean the data using different data preprocessing techniques.
- Applying different algorithms according to the dataset.
- Able to know how to evaluate the model.
- Able to build web applications using the Flask framework.

1.2 Purpose

Car resale value prediction system is made with the purpose of predicting the correct valuation of used cars that helps users to sell thecar remotely with perfect valuation and without human intervention inthe process to eliminate biased valuation. Used car resale market in India was marked at 24.2 billion US dollars in 2019. Due to the huge requirement of used cars and lack of experts who can determine the correct valuation, there is an utmost need of bridging this gap betweensellers and buyers. This project focuses on building a system that can accurately predict a resale value of the car based on minimal features like kms driven, year of purchase etc. without manual or human interference and hence it remains unbiased.

CHAPTER 2
LITERATURE SURVEY

2.1 Existing problem

Using various machine learning algorithms we will predict the price. The algorithms involves Random Forest Regression. The best model which predicts the most accurate price is selected. After selection of the best model the predicted price is displayed to the user according to user's inputs. User can give input through website to for used car price prediction to machine learning model.

2.2 References

Book/journal	Author's name	Inference
Predicting the Price of Used Cars using Machine Learning Techniques	Sameerchand Pudaruth	In this paper, we investigate the application of supervised machine learning techniques to predict the price of used cars in Mauritius.The predictions are based on historical data collected from daily newspapers. Different techniques like multiple linear regression analysis, k-nearest neighbour's, naive bayesand decision trees have been used to make the predictions.
Car Price Prediction Using Machine Learning	Enis gegic, Becir Isakovic, Dino Keco, Zerina Masetic, Jasmin Kevric	In this paper, we applied different methods and techniques in order to achieve higher precision of the used car price prediction. This paper is organized in the following manner: Section II contains related work in the field of price prediction of used cars. In section III, the research methodology of our study is explain. Section IV elaborates various machine learning.
Price Evaluation Model In Second Hand Car System Based On BP Neural Network Theory	Ning sun, Hongxi Bai, Yuxia Geng, Huizhu Sh	This paper presents a system that has been implemented to predict a fair price for any pre-owned car. The system works well to anticipate the price of used cars for the Mumbai region. Ensemble techniques in machine learning namely Random Forest Algorithm, extreme Gradient Boost.
Prediction of Prices for Used Car by using Regression Models	Nitis Monburinon, Prajak Chertchom, Thongchai Kaewkiriya, Suwat Rungpheung, Sabir Buya, Pitchayakit Boonpou	In this paper, we look at how supervised machine learning techniques can be used to forecast car prices in India. Data from the online marketplace quikr was used to make the predictions.

Prediction car prices using qualify qualitative data and knowledge-based system	Doan Van Thai, Luong Ngoc Son, Pham Vu Tien, Nguyen Nhat Anh, Nguyen Thi Ngoc Anh	In this paper, we describe a scalable end-to-end tree boosting system called XGBoost, which is used widely by data scientists to achieve state-of-the-art results on many machine learning challenges. We propose anovel sparsity-aware algorithm for sparse data and weighted quantile sketch for approximate tree learning.

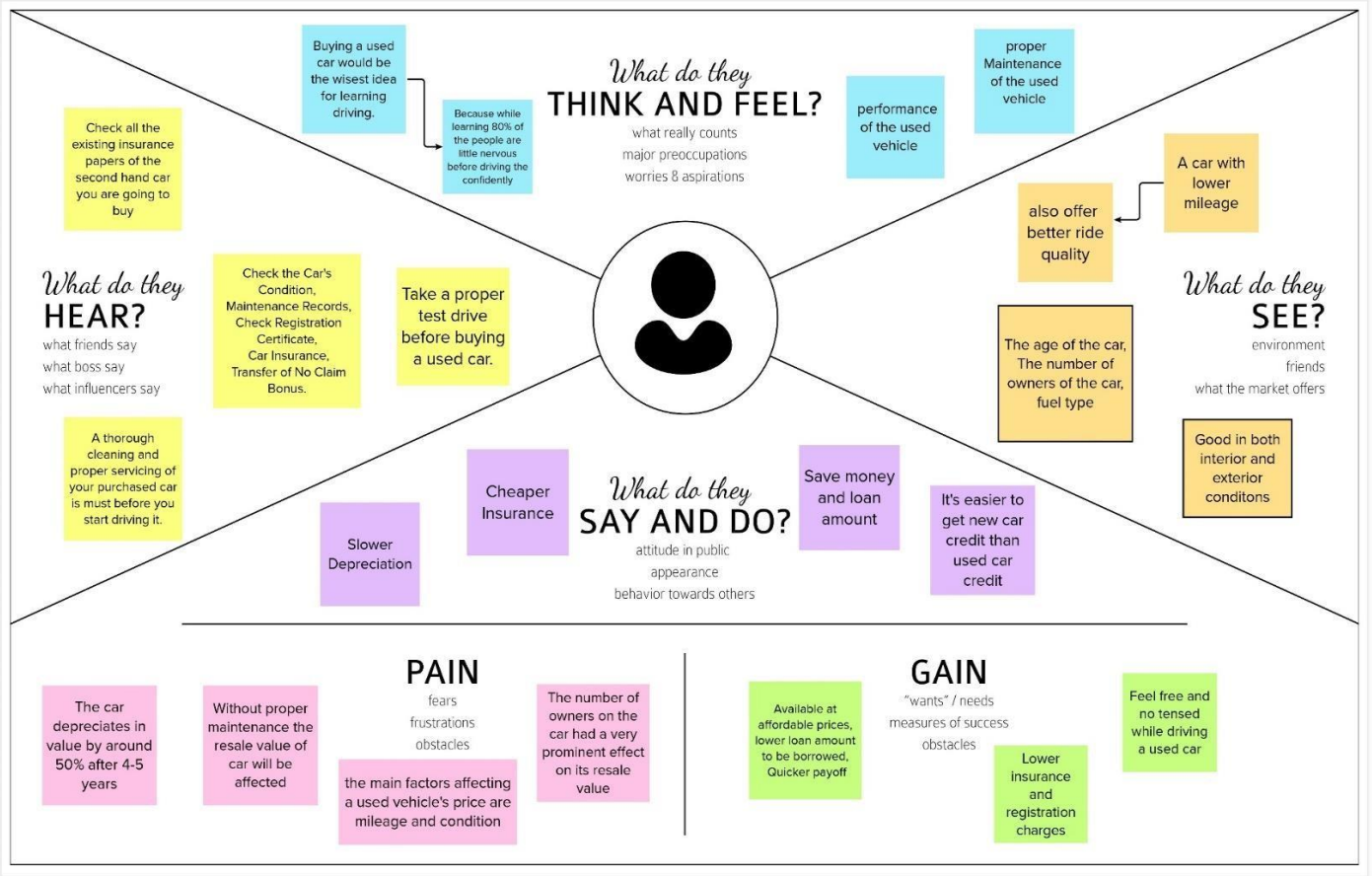
2.3 Problem Statement Definition

The prices of new cars in the industry is fixed by the manufacturer with some additional costs incurred by the Government in the form of taxes. So customers buying a new car can be assured of the money they invest to be worthy. But due to the increased price of new cars and the incapability of customers to buy new cars due to the lack of funds, used cars sales are on a global increase. Predicting the prices of used cars is an interesting and much-needed problem to be addressed. Customers can be widely exploited by fixing unrealistic prices for the used cars and many falls into this trap. Therefore, rises an absolute necessity of a used car price prediction system to effectively determine the worthiness of the car using a variety of features. Due to the adverse pricing of cars and the nomadic nature of people in developed countries, the cars are mostly bought on a lease basis, where there is an agreement between the buyer and seller. These cars upon completion of the agreement are resold. So reselling has become an essential part of today's world.

The main aim of this project is to predict the price of used cars using the various Machine Learning (ML) models. This can enable the customers to make decisions based on different inputs or factors namely Brand or Type of the car one prefers like Ford, Hyundai, Model of the car namely Ford Figo, Hyundai Creta, Year of manufacturing like 2020, 2021, Type of fuel namely Petrol, Diesel, Price range or Budget, Type of transmission which the customer prefers like Automatic or Manual, Mileage to name a few characteristic features required by the customer. This project Car Price Prediction deals with providing the solution to these problems. Different techniques like multiple linear regression analysis, k-nearest neighbours, naïve bayes and decision trees have been used to make the predictions. The predictions are then evaluated and compared in order to find those which provide the best performances.

CHAPTER 3
IDEATION AND PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation and Brainstorming

MEMBER 1:

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

MEMBER2:

- The main objective of this project is to *predict* the *Prices* of *used cars*, compare the ***prices*** and also estimate the *life span* of a particular ***car***.
- Insurance, Company claims,etc

- regression Algorithm is used to predict the value
- Regression model based on k-nearest neighbor machine learning algorithm was used to predict the price of a car.

MEMBER 3:

- Car prediction using engine condition.
- user should Upload engine Sound in the format of audio file.
- By using Convolutional Neural Networks methodology price can be predicted.
- CNNs for Machine Learning on sound data by spectrogram approach that was just converts each song (or song segment) into a spectrogram: a twodimensional matrix

MEMBER 4:

- Economic Conditions.
- Kilometres Covered.
- Its mileage (the number of kilometers it has run) and its horsepower
- Car prediction using XGBoost algorithm accurate result will be monitored.
- XGBoost as a regression model gave the best MSLE and RMSLE values.

3.3 Proposed Solution

S. No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	• The main aim of this project is to predictthe price of used cars using the various Machine Learning (ML) models. • The project should take parameters related to used car as inputs and enablethe customers to make decisions by theirown.
2.	Idea / Solution description	• The model is to be built that would give the nearest resale value of the vehicle. By using these best accuracy value will be taken as a solution and it will be integrated to the web-based application where the user is notified with the status of his product.

3.	Novelty / Uniqueness	• Used car price prediction is effectively used to determine the worthiness of thecar by their own within few minutes by using various features such as year, model, mileage(km), etc.
4.	Social Impact / Customer Satisfaction	• If the user wants to buy or sell a own carit helps users to predict the correct valuation by their own. • A loss function is to be optimized and mainly a weak learner can make predictions for used cars easily.
5.	Business Model (Revenue Model)	• It helps users to predict the correct valuation of the car remotely with perfect valuation and without humanintervention like car dealers in the process to eliminate biased valuation predicted by the dealer.
6.	Scalability of the Solution	• Using Stored data and machine learning approaches, this project proposed a scalable framework for predicting valuesfor different type of used cars present allover India.

3.4 Problem Solution fit

Project Title: Car Resale Value Prediction

Project Design Phase-I - Solution Fit Template

Team ID: PNT2022TMID14329

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) — CS

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

Both used car sellers and buyers

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.

- To etermine the worthiness of the car by their own within few minutes
- A loss function is to be optimized by spending money for dealers,brokers to buy or sell a car.

5. AVAILABLE SOLUTIONS — 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

- In the past User cannot find the value of used car buy their own without prior knowledge about cars.
- A person who don't know much about the car can also make predictions for used cars easily.

Explore AS, differentiate

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.

To build a supervised machine learning model using regression algorithms for forecasting the value of a vehicle based on multiple attributes such as

- Condition of Engine
- Age of the used car
- Kilometers driven
- Number of owners

9. PROBLEM ROOT CAUSE — RC

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.

- The price predicted by the dealers or brokers for used car is not trustful.
- users can predict the correct valuation of the car remotely without human intervention like car dealers.
- User can eliminate biased valuation predicted by the dealer.

7. BEHAVIOUR — BE

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)

- The History of Your Car's condition and documents produced by them will be suspicious.
- The model is to be built that would give the nearest resale value of the vehicle by eliminating anonymous value predicted by the humans.

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

Identify strong TR & EM

3. TRIGGERS — TR

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

users can predict the correct valuation of the car by their own like olx,cars24 and other car resale value prediction websites by using model,year,owner,etc.

4. EMOTIONS: BEFORE / AFTER — 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.

Before:

- User will be in fear about the biased values predicted by the humans based on the condition of the car.

After:

- user can determine the worthiness of the car by their own without human intervention.

10. YOUR SOLUTION — SL

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 behaviour.

- The main aim of this project is to predict the price of used cars using the Machine Learning (ML) algorithms and collection data's about different cars. The project should take parameters related to used car as inputs and enable the customers to make decisions by their own.

8. CHANNELS of BEHAVIOUR — 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 #7 and use them for customer development.

- customer should predict the worth of the car by using different parameters given by the owner.
- User Should confirm the details provided about the vehicle in RTO online.
- user can decide by seeing the exterior and interior condition of the car.
- User can test the performance of the car and to buy it up in a affordable price based on its condition.

Identify strong TR & EM

CHAPTER 4
REQUIREMENT ANALYSIS

4.1 Functional requirement

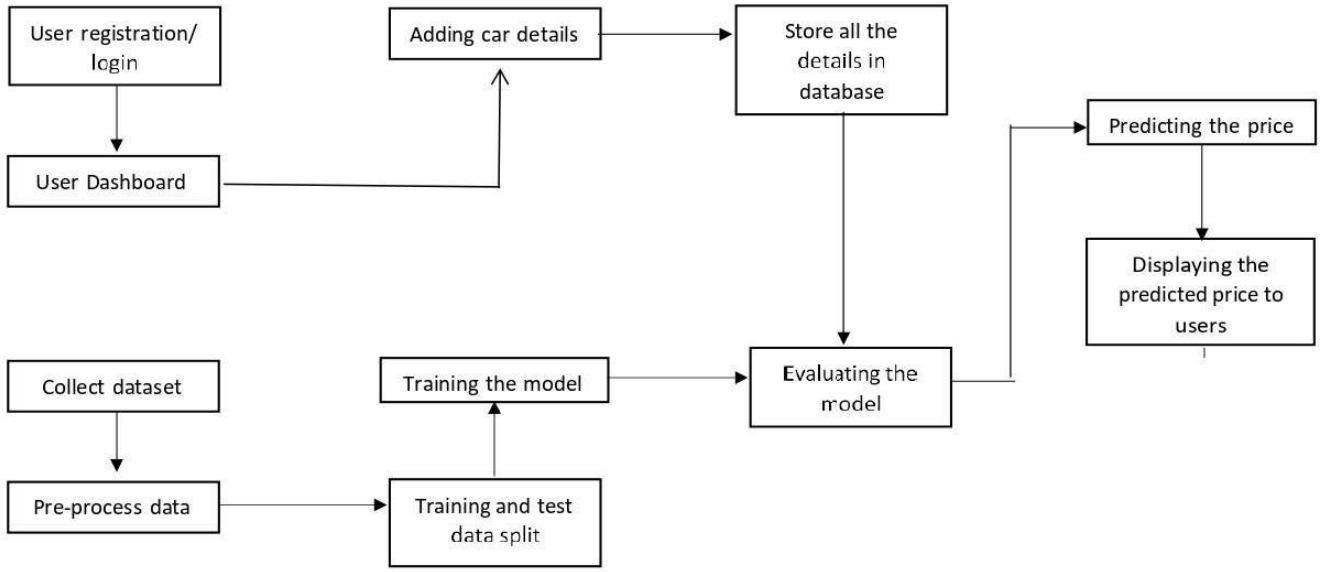
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Gmail.
FR-2	User Confirmation	Confirmation via Email.
FR-3	User Login Window	Login using given credentials.
FR-4	Dashboard	Fill the required data shown in the window.
FR-5	Prediction Value	Predicting the value of the car and displayed in the window.

4.2 Non-Functional requirements

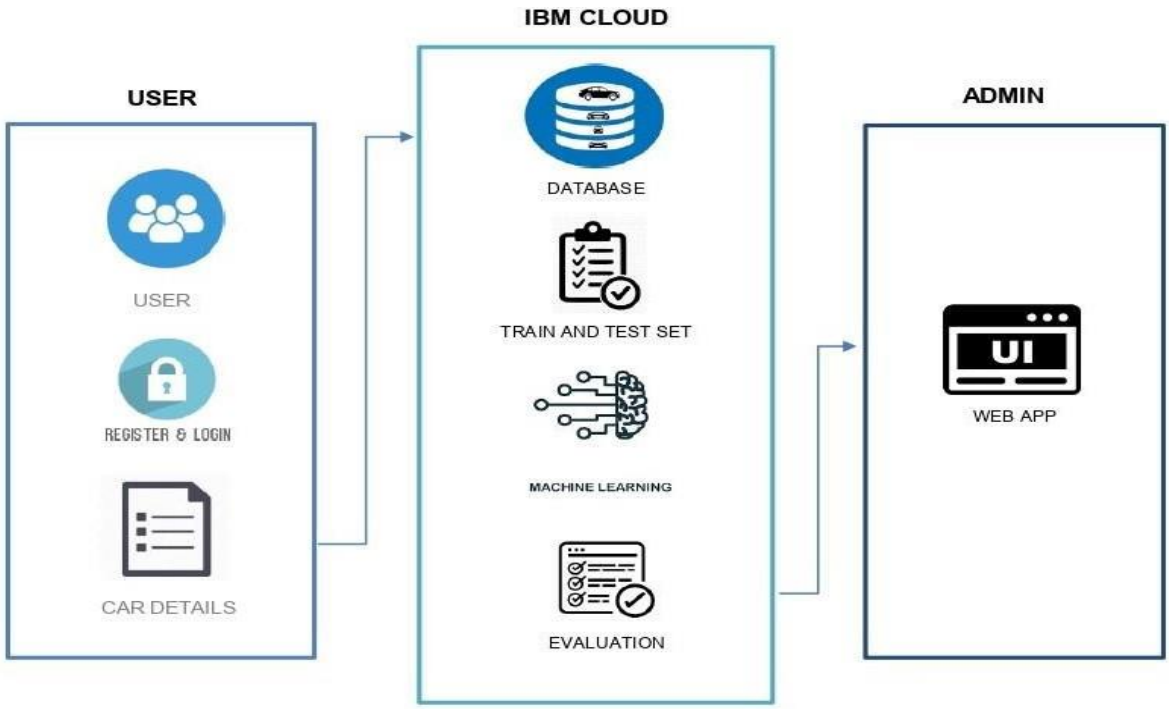
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Predicting the value of used cars.
NFR-2	**Security**	Aware about fraudulent sites the data's given by the user is not exposed in any way.
NFR-3	**Reliability**	It helps user to predict the correct valuation of the car remotely with perfect valuation and without human intervention like car dealers.
NFR-4	**Performance**	Users can determine the worthiness of the car by their own within a few minutes.
NFR-5	**Availability**	It is available for everyone and can be accessed anywhere at anytime.
NFR-6	**Scalability**	This project proposed a scalable framework for predicting values for different types of used cars present all over India.

CHAPTER 5
PROJECT DESIGN

5.1 Data Flow Diagrams



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
Admin	Dataset	USN-1	Gather the information needed to make the car resale prediction.	enough data has beengathered to train the model.	High	Sprint-1
	Data preprocessing	USN-2	Perform data cleaning to optimize the dataset	Clean Dataset enough tomake correct predictions	High	Sprint-1
	Training & Building Model	USN-3	Build the model using regression algorithmsto classify the data	Model should be used forPredicting perfect valuation of the car.	High	Sprint-1
	Deploy the model	USN-4	Deployment of ML model using IBM Cloud	Model should be workingfine from the cloud	High	Sprint-2
	Integrate the web app with the IBM model	USN-5	Use flask for the integration purpose.	The model ought to be simple to use and reliable onthe web application.	High	Sprint-2
Customer	Homepage	USN-6	Information on the application and the process for selling used cars	We can get an idea abouthow to use these model.	Medium	Sprint-2
	Registration	USN-7	User can register the application by entering email, password, and confirming my password.	user can access myaccount /dashboard	High	Sprint-3
		USN-8	user will receive confirmation email.jonce they have registered for the application	user can receive confirmationemail	High	Sprint-3
	Login	USN-9	user can log into the application byentering email & password	user can login to myaccount	High	Sprint-3
	Dashboard	USN-10	User can add new cars and get accessto insert and update their details	user can add new cars	Medium	Sprint-4
	Car Details	USN-11	user should give the required car details like carmodel, kilometer driven,manufactured year, etc...	After filling the car'sdetails and taking them for furtherprocessing.	High	Sprint-4
	Car Price	USN-12	The price of a used car can be displayed and seen by the user.	Car prices must be displayed depending on thedata provided by the user.	High	Sprint-4

CHAPTER 6
PROJECT PLANNING AND SCHEDULING

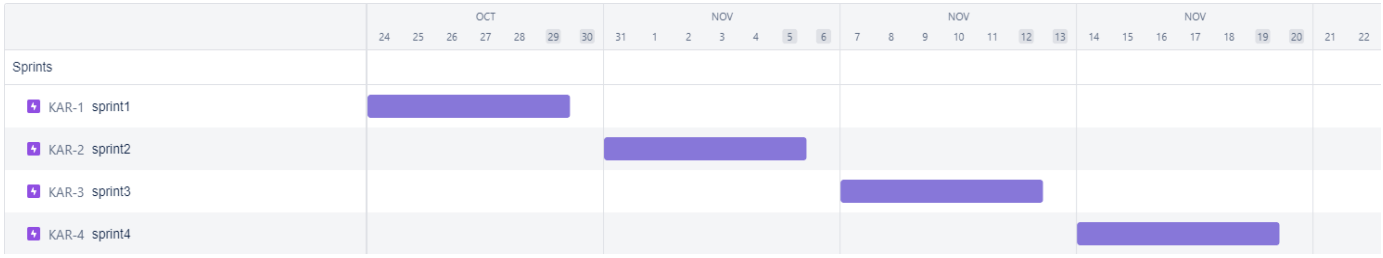
6.1 Sprint Planning and Estimation

User	Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Admin	Sprint 1	Dataset collection	USN-1	Collect the required data for the Car resaleprediction	2	High	Yaswanth M Manigandan J Umesh L Raghuram P LOhith P
	Sprint 1	Data pre-processing	USN-2	Perform data cleaning to optimize the dataset	4	Medium	Yaswanth M Manigandan J
	Sprint 1	Training & Building Model	USN-3	Build the model using regression algorithms toclassify the data	6	High	Umesh L Manigandan J Yaswanth M
	Sprint 2	Deploy the model	USN-4	Deployment of ML model using IBM Cloud	5	High	Yaswanth M Manigandan J
	Sprint 4	Integration	USN-5	Integrate the web app developed using flask with IBM model	5	High	Umesh L Raghuram P
Customer	Sprint 2	Homepage	USN-6	Details about the application and the car resale process	2	Low	Manigandan J Lohith p
	Sprint 2	Registration	USN-7	As a user, I can register for the application by entering confirming.	5	High	Raghuram P Umesh L Lohith P
	Sprint 3	Confirmation	USN-8	As a user, I will receive confirmation email once I have registered for the application	3	Medium	Lohith P Raghuram
	Sprint 3	Login	USN-9	As a user, I can log into the application by entering email & password	4	High	Manigandan J Umesh L
	Sprint 3	Dashboard	USN-10	As a user, I can add new cars and get access toinsert and update their details	5	High	YaswanthM Manigandan j Umesh L
	Sprint 4	Car Details	USN-11	As a user, I should give the car details like car model, engine and fuel type, etc…	2	Medium	Yaswanth M
	Sprint 4	Car Price	USN-12	As a user, I can view the current rate of the usedcar price	5	High	Manigandan J

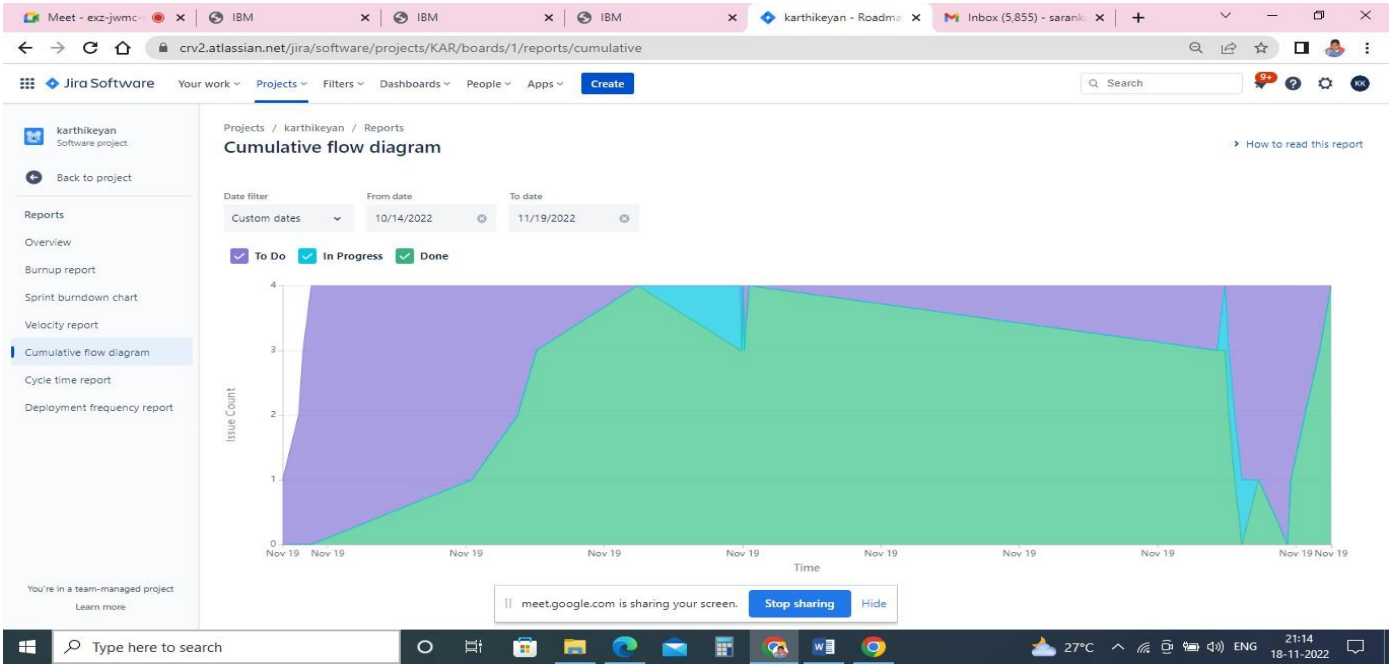
6.2 Sprint Delivery Schedule

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	12	6 Days	24 Oct 2022	29 Oct 2022	12	29 Oct 2022
Sprint-2	12	6 Days	31 Oct 2022	05 Nov 2022	12	05 Nov 2022
Sprint-3	12	6 Days	07 Nov 2022	12 Nov 2022	12	12 Nov 2022
Sprint-4	12	6 Days	14 Nov 2022	19 Nov 2022	12	19 Nov 2022

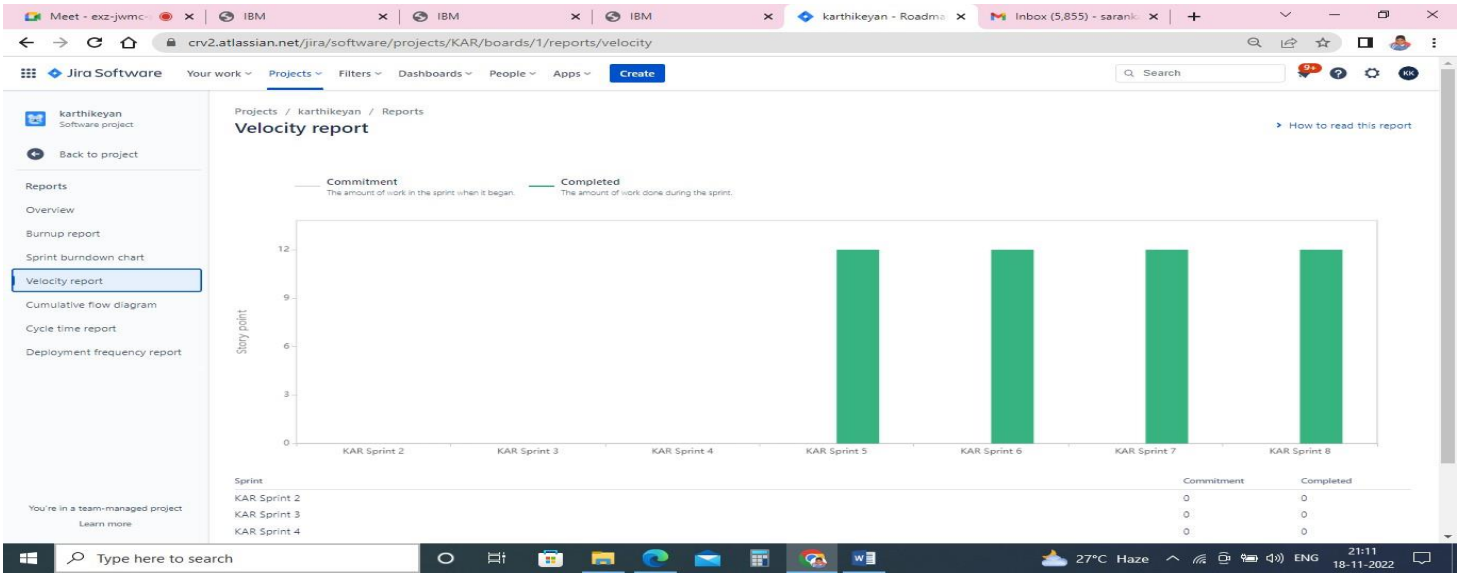
6.3 Reports from JIRA



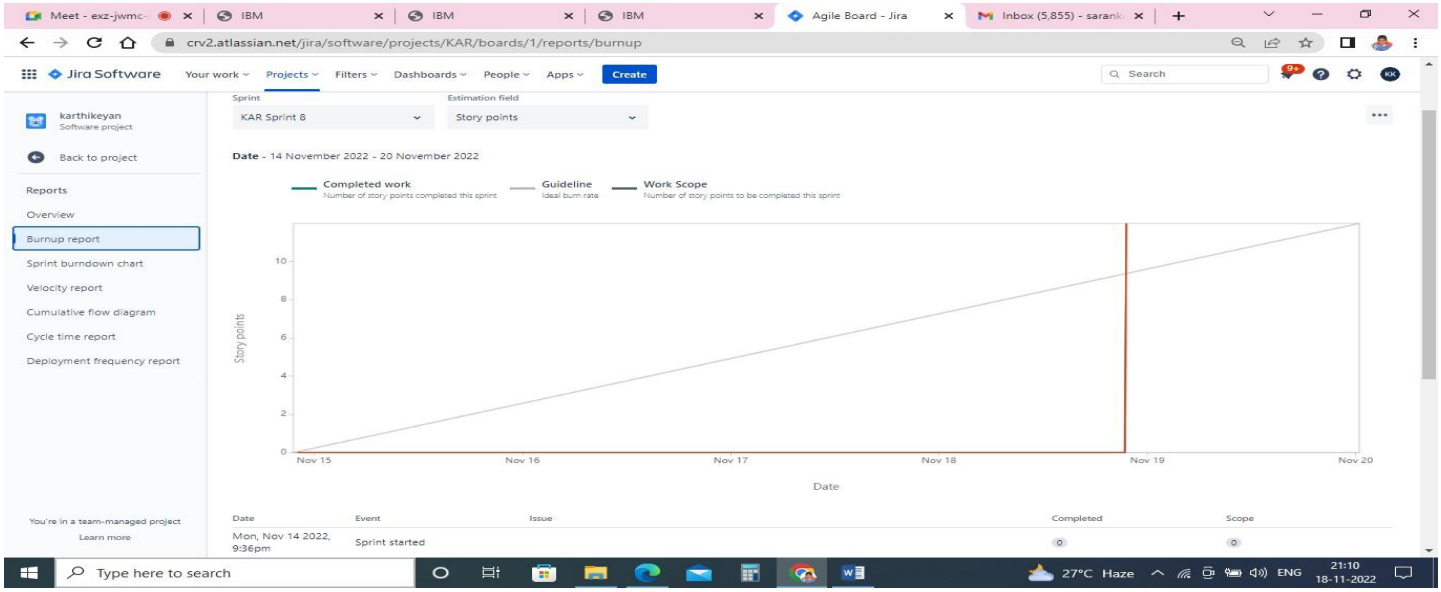
Roadmap



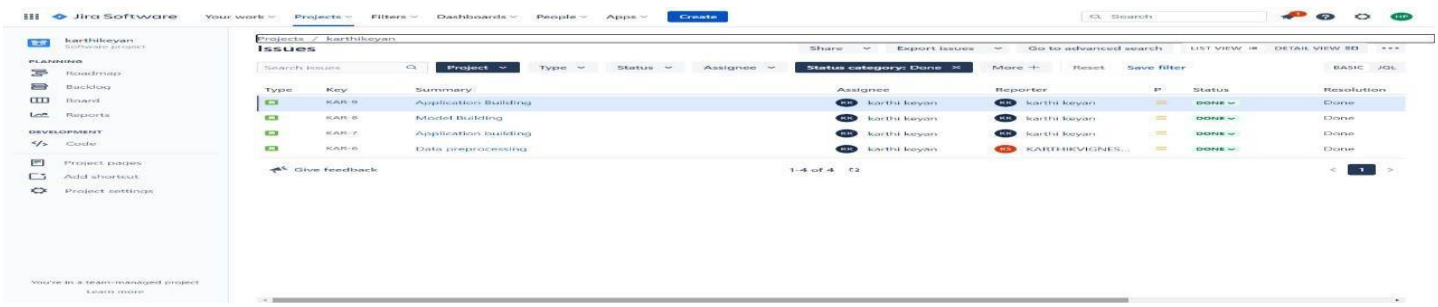
Cumulative flow diagram



Velocity Graph



Burnup Report



Completed report

CHAPTER 7
CODING AND SOLUTIONING

7.1 Feature 1

Regression Model:

Random Forest Regressor

```
In [20]: from sklearn.ensemble import RandomForestRegressor
         from sklearn.metrics import r2_score
         regressor = RandomForestRegressor(n_estimators=1000,max_depth=10,random_state=34)
         regressor.fit(X_train,np.ravel(Y_train,order='C'))
         X_test

Out[20]: array([[  2008,    140, 150000, ...,      1,      1,      4],
                [  2000,     60, 150000, ...,     38,      7,      7],
                [  2004,     54, 125000, ...,     38,      7,      7],
                ...,
                [  2001,    102, 150000, ...,     20,      7,      4],
                [  2003,    146, 150000, ...,      2,      7,      2],
                [  1999,     75, 150000, ...,     24,      7,      7]], dtype=int64)

In [17]: y_pred=regressor.predict(X_test)
         y_pred

Out[17]: array([9937.11993609, 1157.33268937, 2739.06719477, ..., 2124.91777611,
                2955.66758818, 1207.44132337])

In [18]: print(r2_score(Y_test,y_pred))

         0.834527626497731

In [19]: filename='resale_model.sav'
         pickle.dump(regressor,open(filename,'wb'))
```

7.2 Feature 2

Accuracy:

```
In [40]: from sklearn.ensemble import RandomForestRegressor
         from sklearn.metrics import r2_score
         regressor = RandomForestRegressor(n_estimators=1000,max_depth=10,random_state=34)
         regressor.fit(X_train,np.ravel(Y_train,order='C'))

Out[40]: RandomForestRegressor(max_depth=10, n_estimators=1000, random_state=34)

In [41]: y_pred=regressor.predict(X_test)
         print(r2_score(Y_test,y_pred))

         0.834527626497731

In [42]: filename='resale_model.sav'
         pickle.dump(regressor,open(filename,'wb'))
```

CHAPTER 8
TESTING

8.1 Test Cases

				Date	19-Nov-22									
				Team ID	PNT2022TMID02356									
				Project Name	Project - car resale value predict									
				Maximum Marks	4 marks									
Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Commnets	TC for Automation(Y/N)	BUG ID	Executed By	
LoginPage_TC_001	Functional	Home Page	Verify user to click check price button when the user is entered url	Anaconda navigator,visual studio,python libraries	1.Enter URL and click go 2.Click on Enter check price . 3.The user get logged into the vechicle details page.The user should fill the required details shown In the window and click on submit to view the result.	http://127.0.0.1:5000/	Login popup should display,user input window should be displayed.Finally the result window get displayed	Working as expected	Pass	The project is done and executed successfully	y		KARTHIKEYAN.H,KAMESH.P,KARTHIKVIGNESH.S,HARISH.T	

8.2 User Acceptance Testing

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [ProductName] project at the time of the release to User Acceptance Testing (UAT).

2. 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	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

3. 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	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3

CHAPTER 9
RESULTS

9.1 Performance Metrics

S.No.	Parameter	Values	Screenshot
1.	Metrics	**Regression Model:** MAE - , MSE - , RMSE - , R2 score - **Classification Model:** Confusion Matrix - , Accuray Score- & Classification Report – Label Encoder	

CHAPTER 10

ADVANTAGES

- The model is to be built that would give the nearest resale value of the vehicle.
- By using these model best accuracy value will be taken as a solution for the given used car.
- Used car price prediction is effectively used to determine the worthiness of the car by their own within few minutes by giving different parameters as input such as year, model, km driven, etc.
- A loss function is to be optimized and mainly a weak learner can make predictions for used cars easily.
- Using Stored data and machine learning approaches, this project proposed a scalable framework for predicting values for different type of used cars present all over India.
- It helps users to predict the correct valuation of the car remotely with perfect valuation and without human intervention like car dealers in the process to eliminate biased valuation predicted by the dealer

DISADVANTAGES

- Even though predicting the value of a used car by these model Taking a proper test drive before buying a used car will show a perfect condition of the car to predict the value by their own.
- The main limitation of random forest is that a large number of trees can make the algorithm too slow and ineffective for real-time predictions.
- In general, these algorithms are fast to train, but quite slow to create predictions once they are trained.
- They are largely unstable compared to other decision predictors.

CHAPTER 11
CONCLUSION

The increased prices of new cars and the financial incapability of the customers to buy them, Used Car sales are on a global increase. Therefore, there is an urgent need for a Used Car Price Prediction system which effectively determines the worthiness of the car using a variety of features. The proposed system will help to determine the accurate price of used car price prediction.

CHAPTER 12
FUTURE SCOPE

In future this machine learning model may bind with various website which can provide real time data for price prediction. Also we may add large historical data of car price which can help to improve accuracy of the machine learning model. We can build an android app as user interface for interacting with user. 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.

CHAPTER 13
APPENDIX

Source Code

Model building:

```
import pandas as pd
import numpy as np
import matplotlib as plt
from sklearn.preprocessing import LabelEncoder
import  pickle
import os, types
import pandas as pd
from botocore.client import Config
import ibm_boto3

def __iter__(self): return 0

# @hidden_cell
# The following code accesses a file in your IBM Cloud Object Storage. It includes your credentials.
# You might want to remove those credentials before you share the notebook.
cos_client = ibm_boto3.client(service_name='s3',
    ibm_api_key_id='xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx',
    ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
    config=Config(signature_version='oauth'),
    endpoint_url='https://s3.private.us.cloud-object-storage.appdomain.cloud')

bucket = 'carresalevaluepredictiondeploymen-donotdelete-pr-ryosh4pvhxemjh'
object_key = 'autos_preprocessed.csv'

body = cos_client.get_object(Bucket=bucket,Key=object_key)['Body']
# add missing __iter__method, so pandas accepts body as file-like object
if not hasattr(body, "__iter__"): body.__iter__ = types.MethodType( __iter__, body )

df = pd.read_csv(body)
df.head()

# print(df.seller.value_counts())
# df[df.seller!='gewerblich']
# # df=df.drop('seller',1)
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# print(df.offerType.value_counts())
# df[df.offerType!='Gesuch']
# df=df.drop('offerType',1)                                    17

print(df.shape)
df=df[(df.powerPS >50) & (df.powerPS <900)]
df=df[(df.yearOfRegistration >=1950) & (df.yearOfRegistration <2017)]
print(df.shape)
(278578, 12)
(278578, 12)

#  df.drop(['name','abtest','dateCrawled','nrOfPictures','lastSeen','postalCode','dateCreated'],axis='columns',inplace=True)

new_df=df.copy()
new_df=new_df.drop_duplicates(['price','vehicleType','yearOfRegistration','gearbox','powerPS','model','kilometer','monthOfRegistr
ation','fuelType','notRepairedDamage'])

new_df.gearbox.replace(('manuell','automatik'),('manual','automatic'),inplace=True)
new_df.fuelType.replace(('benzin','andere','elektro'),('petrol','others','electric'),inplace=True)
new_df.vehicleType.replace(('kleinwagen','cabrio','kombi','andere'),('small car','convertible','combination','others'),inplace=True)
new_df.notRepairedDamage.replace(('ja','nein'),('Yes','No'),inplace=True)

new_df=new_df[(new_df.price >=100)&(new_df.price <=150000)]
new_df['notRepairedDamage'].fillna(value='not-declared',inplace=True)
new_df['fuelType'].fillna(value='not-declared',inplace=True)
new_df['gearbox'].fillna(value='not-declared',inplace=True)
# new_df['vehicleType'].fillna(value='not-declared',inplace=True)
new_df['model'].fillna(value='not-declared',inplace=True)

# new_df.to_csv("autos_preprocessed.csv")

from sklearn.preprocessing import LabelEncoder
labels=['gearbox','notRepairedDamage','model','brand','fuelType','vehicleType']
mapper={}
for i in labels:
    mapper[i]=LabelEncoder()
    mapper[i].fit(new_df[i])
    tr=mapper[i].transform(new_df[i])
    np.save(str('classes'+i+'.npy'),mapper[i].classes_)
    print(i,":",mapper[i])
    new_df.loc[:,i+'_labels']=pd.Series(tr,index=new_df.index)
labeled = new_df[['price','yearOfRegistration','powerPS','kilometer','monthOfRegistration']+[x+"_labels" for x in labels]]
print(labeled.columns)
gearbox : LabelEncoder()
notRepairedDamage : LabelEncoder()
model : LabelEncoder()
brand : LabelEncoder()
fuelType : LabelEncoder()
vehicleType : LabelEncoder()
Index(['price', 'yearOfRegistration', 'powerPS', 'kilometer',
       'monthOfRegistration', 'gearbox_labels', 'notRepairedDamage_labels',
       'model_labels', 'brand_labels', 'fuelType_labels',
       'vehicleType_labels'],
      dtype='object')

Y=labeled.iloc[:,0].values
X=labeled.iloc[:,1:].values
```

```
Y=Y.reshape(-1,1)
from sklearn.model_selection import cross_val_score,train_test_split
                                                                                    18
X_train,X_test,Y_train,Y_test= train_test_split(X,Y,test_size=0.3,random_state=3)

from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import r2_score
regressor = RandomForestRegressor(n_estimators=1000,max_depth=10,random_state=34)
regressor.fit(X_train,np.ravel(Y_train,order='C'))

RandomForestRegressor(max_depth=10, n_estimators=1000, random_state=34)

y_pred=regressor.predict(X_test)
print(r2_score(Y_test,y_pred))
0.834527626497731

filename='resale_model.sav'
pickle.dump(regressor,open(filename,'wb'))
```