USED CAR PRICE PREDICTION USING MACHINE LEARNING MODEL

A MINI PROJECT REPORT

Submitted by

HARISH M	**(710720205015)**
HARISH V	**(710720205016)**
NAVEEN V	**(710720205034)**
VIGNESH M	**(710720205304)**

in partial fulfilment for the award of the degree

of

BACHELOR OF TECHNOLOGY

IN

INFORMATION TECHNOLOGY

Dr. N.G.P. INSTITUTE OF TECHNOLOGY, COIMBATORE – 641048

(AN AUTONOMOUS INSTITUTION)

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ANNA UNIVERSITY: CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report **"USED CAR PRICE PREDICTION USING MACHINE LEARNING MODEL"** is the Bonafide work of **"HARISH M (710720205015), HARISH V (710720205016), NAVEEN V (710720205034), VIGNESH M (710720205304)"** who carried out the project work under my supervision.

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Submitted for the End Semester Project Viva-Voce held on _____

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INTERNAL EXAMINER

_ _ _ _ _ _ _ _ _ _ _ _

EXTERNAL EXAMINER

ACKNOWLEDGEMENT

We extend our heartiest thanks to **Dr. NALLA G. PALANISWAMI**, Chairman, KMCH & Dr. N.G.P. Educational Institutions for providing us the necessary infrastructure to do our project work.

We express our gratitude to **Dr. THAVAMANI D. PALANISWAMI**, Secretary,Dr. N.G.P. Institute of Technology, for providing us the facilities to do our project work.

We would like to express our hearty thanks and gratitude to **Dr. S.U. PRABHA, M.E., Ph.D.,** Principal, Dr. N.G.P. Institute of Technology, for her earnest encouragement.

We extend our deep sense of gratitude to **Dr. M. KRISHNAMOORTHI, M.E., Ph.D.,** Head of the Department, Department of Information Technology, for his valuable guidance and constructive suggestion at all stages of our project from inception to completion.

We express our hearty thanks to our project guide **Mr.P.RAJASEKARAN M.E.,(Ph.D).,** Assistant Professor (SS), Department of Information Technology, for his valuable guidance and timely help for completing our project.

We express our sincere thanks to our mini project coordinator **Ms. BIJI ROSE, M.E.,(Ph.D).,** Assistant Professor (SG), Department of Information Technology, for her support in developing our project.

We would also like to express our gratitude to the faculty members of Department Information Technology and also to our family for their kind patronage.

ABSTRACT

Machine Learning is an area of an Artificial Intelligence that has been a key component of digitization solutions that have attracted much recognition in the digital area. Machine Learning is used everywhere from automating & do heavy tasks to offering intelligent insights in every industry to benefit from it. In the used car market, this strategy can be netfit vendors, purchasers & car manufacturers. To build a model to predict the price of used cars in the market based on various aspects like **Brand, Year of Manufacturing, Transmission Type, Fuel Type, Kilometers Driven, Model**. This model can benefit sellers, buyers, and car manufacturers in the used cars market. Upon completion, it can output a relatively accurate price prediction based on the information that users input. The model building process involves machine learning and data science. The dataset used was scraped from listings of used cars. To achieve the highest prediction accuracy Various regression methods, including Linear Regression, Polynomial Regression, Support Vector Regression, Decision Tree regression, and Random Forest Regression, were applied. Before the actual start of model-building, this project visualized the data to understand the dataset better. The dataset was divided and modified to fit the regression, thus ensure the performance of the regression. To evaluate the performance of each regression, R-square was calculated. Among all regressions the, **Lasso Regression** model provides the high accuracy. The Kilometers driven variable are significant in predicting the price.

KEYWORDS: Brand, Fuel Type, Kilometers Driven, Lasso Regression, Machine Learning, Model, Transmission Type, Year of Manufacturing.

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LIST OF ABBREVIATION

ML	Machine Learning
AI	Artificial Intelligence
SVM	Support Vector Machines
Lasso	Least Absolute Shrinkage and Selection Operator
MSE	Mean Squared Error
MAE	Mean Absolute Error
R-squared	Coefficient of Determination
CV	Cross-Validation
SGD	Stochastic Gradient Descent
KNN	k-Nearest Neighbors
RF	Random Forest
GBM	Gradient Boosting Machine

CHAPTER – 1

INTRODUCTION

The production of cars has been steadily increasing in the past decade with over 70 million passengers cars being produced in the year 2016.This has given rise to the used car market, which on its own has become a booming industry. The recent advent of online portals has facilitated the need for both the customer and the seller to be better informed about the trends and patterns that determine the value of a used car in the market. Determining price of a used car is a challenging task, due to the many factors. The focus of this project is developing machine learning models that can accurately predict the price of a used car based on its features and then compare the performance of the model with various machine learning algorithms like Linear Regression, Polynomial Regression, Support Vector Regression, Decision Tree regression, and Random Forest Regression and choose the best out of it. 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. This model predict and evaluate the dataset consisting of the sales prices of different makes & models using various learning methods.

1.1 OBJECTIVE

The aim of this project is to predict the price of used cars using the Machine Learning (ML) model. This can enable the customers to make decisions based on different inputs or factors namely Brand, Model, Year of Manufacturing, Transmission, Fuel Type to name a few characteristic features required by the customer. Through this project, we will get to know which of the factors are significant and tell us how they affect the car's worth in the market.

1.2. SCOPE OF THE PROJECT

The scope of the project is to develop an application that provides a solution to buyers, sellers for pricing the used cars . They all entail a comparison of different ML algorithms for price prediction. This will be accomplished by sourcing and preparing a dataset on which all the algorithms can be trained on and compared fairly. The algorithms selected must therefore be similar enough for the same dataset to be used for all of them. This also means that no large optimization efforts on the dataset will be made to boost the performance, if these changes do not benefit the other models. Maximizing price prediction performance of any one algorithm in ways that do not offer better comparisons is outside the scope of this work.

1.3. PROBLEM IDENTIFICATION

The used automobile market frequently lacks transparency and uniformity, which can result in inefficiencies and unfair pricing for both buyers and sellers. This issue is made worse by the fact that a variety of factors can have an impact on a used car's value, and it can be challenging for people to determine a car's genuine value based solely on these aspects. This is where a used car price forecast machine learning model can be useful. The difficulty of correctly estimating the cost of a used car based on its features and condition is the key issue that this research seeks to address. You may create a model that is more accurate than people alone by using machine learning algorithms and a sizable dataset of historical sales data. A model like this has several advantages. It can assist customers in determining whether a certain car is properly priced and whether it offers a good value. It can assist sellers in determining a fair asking price for their car based on market conditions and other important aspects. Additionally, it can contribute to greater standardization and openness in the used automobile market, resulting in a more effective and equitable market overall.

CHAPTER – 2

LITERATURE SURVEY

2.1 LITERATURE REVIEW

2.1.1. Price Prediction of Used Cars Using Machine Learning

To build a model to predict used cars' reasonable prices based on multiple aspects, including vehicle mileage, year of manufacturing, fuel consumption, transmission, road tax, fuel type, and engine size. This model can benefit sellers, buyers, and car manufacturers in the used cars market. Upon completion, it can output a relatively accurate price prediction based on the information that users input. The model building process involves machine learning and data science. The dataset used was scraped from listings of used cars.

Various regression methods, including linear regression, polynomial regression, support vector regression, decision tree regression, and random forest regression, were applied in the research to achieve the highest accuracy. Before the actual start of model-building, this project visualized the data to understand the dataset better. The dataset was divided and modified to fit the regression, thus ensure the performance of the regression. To evaluate the performance of each regression, R-square was calculated. Among all regressions in this project, random forest achieved the highest R-square of 0.90416. Compared to previous research, the resulting model includes more aspects of used cars while also having a higher prediction accuracy.

2.1.2. Used Cars Price Prediction using Supervised Learning Techniques

The production of cars has been steadily increasing in the past decade, with over 70 million passenger cars being produced in the year 2016. This has given rise to the used car market, which on its own has become a booming industry. The recent advent of online portals has facilitated the need for both the customer and the seller to be better informed about the trends and patterns that determine the value of a used car in the market. Using Machine Learning Algorithms such as Lasso Regression, Multiple Regression and Regression trees, we will try to develop a statistical model which will be able to predict the price of a used car, based on previous consumer data and a given set of features. We will also be comparing the prediction accuracy of these models to determine the optimal one.

2.1.3. Price Prediction of Used Cars Using Machine Learning

To develop a model that can anticipate fair used car pricing based on a variety of factors such as vehicle model, year of manufacture, fuel type, Price, Kms Driven . In the used car market, this strategy can benefit vendors, purchasers, and car manufacturers. It can then produce a reasonably accurate price estimate based on the data that users provide. Machine learning and data science are used in the model-building process. The data was taken from classified ads for second hand autos. To attain the maximum accuracy, the researchers used a variety of regression approaches, including linear regression, polynomial regression, support vector regression, decision tree regression, and random forest regression. This project visualized the data to better comprehend the dataset before starting the model-building process. To assure the regression\'s performance, the dataset was partitioned and changed to fit the regression. R-square was used to evaluate the performance of each regression .The final model contains more elements of used autos than earlier research while also having a higher forecast accuracy.

2.1.4. PREDICTIVE ANALYSIS OF USED CAR PRICES USING MACHINE LEARNING

In this swiftly-moving world, managing our professional as well as personal lives have become quite hectic and if we don't have our own personal vehicle for transportation, life is a lot more hectic. To be on the safe side, one should have a more reliable and easy mode for transportation and a personal vehicle is always the best option. Having a car is very important for people these days as it gives a certain social status and also gives a certain extent of personal control to individual owning it. In some areas with low population, having a car becomes essential as it provides the only option for covering long distances in case of an absence of public transport. Old aged people, who have difficulties in walking or cycling to places, have driving the sole option for moving without being dependent. And for those that don't have enough resources to purchase a brand-new car, buying an old vehicle becomes a necessity and that too at a reasonable price.

The car manufacturing has been increasing swiftly over the years during past decade, with about 92 million cars that were manufactured in 2019. This provides a big boost for the market of old and used cars which is now coming up as a progressively growing industry. The recent entries of various websites and web-portals have fulfilled the requirements of customers up to some extent as they now know the present trends and scenario to get the market value of any old vehicle present in the market. Machine Learning has a lot of applications in real world scenario but one of the most known application is the use of Machine Learning in resolving the prediction problems. The project being discussed here is very much based upon one among such applications.

2.1.5. Price Prediction and Classification of Used-Vehicles Using Supervised Machine Learning

Due to the large growth in the number of cars being bought and sold, used-car price prediction creates a lot of interest in analysis and research. The availability of used cars in developing countries results in an increased choice of used vehicles, and people increasingly choose used vehicles over new ones, which causes shortages. There is an important need to explore the enormous amount of valuable data generated by vehicle sellers. All sellers usually have the imminent need of finding a better way to predict the future behavior of prices, which helps in determining the best time to buy or sell, in order to achieve the best profit.

The data-driven models for estimating the price of used vehicles in the Croatian market using correlated attributes, in terms of production year and kilometers traveled. In order to achieve this, the technique of data mining from the online seller was used. Redundant and missing values were removed from the data set during data processing. Using the method of supervised machine learning, with the use of a linear regression algorithm for predicting the prices of used cars and comparing the accuracy with the classification algorithm, the purpose of this paper is to describe the state of the vehicle market and predict price trends based on available attributes. Prediction accuracy increases with training the model with the second data set, where price growth is predicted by linear regression with a prediction accuracy of 95%.

CHAPTER-3

SYSTEM ANALYSIS

3.1. EXISTING SYSTEM

CarDekho is an online platform that helps users buy and sell used cars. The platform uses a support vector machine learning model to predict the resale value of used cars based on factors such as the age of the car, mileage, make and model, and geographical location using the ratio of (80 - 20) Train and Test cases. The accuracy of this model is 75.32 %.

3.1.1. DRAWBACKS OF EXISTING SYSTEM

Limited Data: CarDekho's machine learning algorithms rely heavily on data to make accurate predictions and recommendations. If the platform has limited data, the algorithms may not be able to provide accurate recommendations.

Bias: Machine learning algorithms are only as good as the data they are trained on. If the data used to train CarDekho's machine learning algorithms is biased, it may lead to biased recommendations.

Lack of Transparency: Machine learning algorithms can be difficult to understand and interpret. CarDekho's machine learning algorithms may not be transparent, making it difficult for users to understand how recommendations are made.

Limited Customization: CarDekho's machine learning algorithms may not allow for much customization. Users may not be able to adjust certain parameters or preferences, which may limit the accuracy of recommendations.

Limited Scope: CarDekho's machine learning algorithms may not take into account all the factors that are important to users when making car purchase

decisions. This may lead to incomplete or inaccurate recommendations.

3.2. PROPOSED SYSTEM

In this system, a used cars data set is used. The main aim is to predict the possibilities of occurring accurate price of used cars in terms of percentage. These models are used to enhance the accuracy level of the classification technique which performs both classification and prediction methods. This proposed method increases the accuracy of the prediction. The method aims to create a system to predict the price used cars based on the factors that plays a role in pricing the used cars. In the study, a dataset of used cars is used, and data preprocessing is used to separate the dataset to proper data of the used cars. The factors used to predict the price of used cars is based on brand, model, transmission, kilometers driven, fuel type.Choose an appropriate machine learning algorithm to train the model on the preprocessed data. Some popular algorithms for used car price prediction include linear regression, decision trees, random forests, and neural networks.

3.2.1. BLOCK DIAGRAM

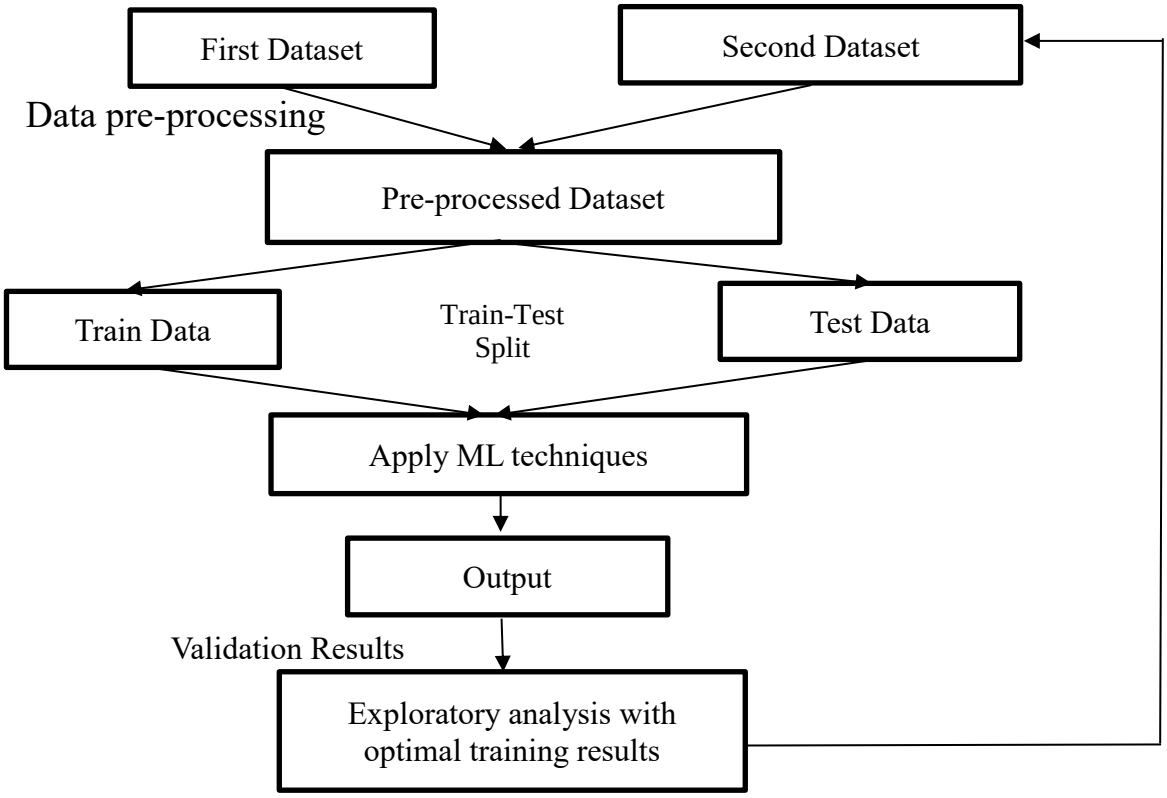


Fig.1. BLOCK DIAGRAM

In Fig.1. the block diagram sources that the data is trained with the parameters like brand, model, fuel type, transmission type, kilometers driven, manufactured year using lasso regression model. And the trained dataset is set for testing the model to predict the price of the used car with high accuracy.

3.2.1.1. DATASET

A dataset for used car price prediction typically contains information about different used cars, such as their features and selling prices. The dataset can be collected from various sources such as online marketplaces, car dealerships, and classified ads. The features included in the dataset can vary depending on the available data, but commonly include the following:

Make and Model: The make and model of the car.

Year of Manufacture: The year the car was manufactured.

Fuel Type: The type of fuel the car uses, such as gasoline, diesel, or electric.

Transmission Type: The type of transmission the car has, such as manual or automatic.

Kilometers driven: The most important factor for used car is kilometers covered by the car.

Selling Price: The final selling price of the car.

The dataset can be preprocessed by cleaning the data, removing any duplicates or inconsistencies, and filling in missing values. Feature engineering techniques can also be applied to create new features from the existing ones, such as calculating the age of the car from its year of manufacture and current year. Machine learning algorithms can then be trained on the preprocessed dataset to predict the selling price of a used car based on its features. The accuracy of the model can be evaluated using metrics such as mean absolute error and mean squared error.

3.2.1.2. MODEL TRAINING

A training model is a dataset that is used to train an ML algorithm. It consists of the sample output data and the corresponding sets of input data that have an influence on the output. The training model is used to run the input data through the algorithm to correlate the processed output against the sample output. The result from this correlation is used to modify the model. Model training in machine language is the process of ML algorithm with data to help identify and learn good values for all attributes involved. The below mentioned graph represents the Training and Validation Accuracy of the proposed system. It clearly depicts the trained data and the accuracy of the classified input for the effective performance of the system.After the training of data's, the testing process is done based on 7 epochs that are shown as a chart to provide a validation loss.

3.2.1.3. MODEL TESTING

There are a wide variety of evaluation measures for Regression. The most common metric is accuracy, which counts the percentage of times the model is right. This technique involves splitting the dataset into a training set and a testing set. The model is trained on the training set and evaluated on the testing set. The performance metrics, such as mean absolute error (MAE) and mean squared error (MSE), are calculated on the testing set to evaluate the model's performance. Cross-validation involves dividing the dataset into k-folds and using each fold as a testing set while the remaining folds are used as a training set. This process is repeated k times, and the performance metrics are averaged over all the folds. Cross-validation provides a more robust estimate of the model's performance compared to train-test split, as it uses all the data for training and testing. Finally, it is important to evaluate the model's performance on real-world data to ensure that it can make accurate predictions in a production environment. This can involve deploying the model in a web application or mobile app and monitoring its performance over time.

3.2.1.4. LASSO REGRESSION

Lasso regression is a linear regression technique that is used to perform variable selection and regularization. The term "lasso" stands for "least absolute shrinkage and selection operator". In this technique, the objective is to minimize the sum of squared errors between the predicted and actual values, subject to a constraint on the sum of the absolute values of the regression coefficients. This constraint is a penalty term that reduces the magnitude of the coefficients, resulting in a simpler and more interpretable model.

3.2.1.5.PREDICTION

Once the Lasso Regression model is trained and evaluated, it can be used for prediction of price of the used cars. Given a set of parameters as input, the model calculates the probability of each car using lasso regression model. The class with the highest probability is considered as the best price for the used cars. This recommendation can help buyers and sellers to make informed decisions about the used cars in a better price.

3.2.1.6. EXPLORATORY ANALYSIS WITH OPTIMAL TRAINING RESULT

Finally, the machine learning model can be trained and evaluated using the preprocessed data. The model's performance can be evaluated using metrics such as mean absolute error (MAE), mean squared error (MSE), or R-squared (R2).

Data visualization is an important tool for exploratory analysis, as it can help identify patterns and relationships between variables that may not be apparent from descriptive statistics alone. Common visualization techniques for used car price prediction include scatter plots, histograms, box plots, and correlation matrices.

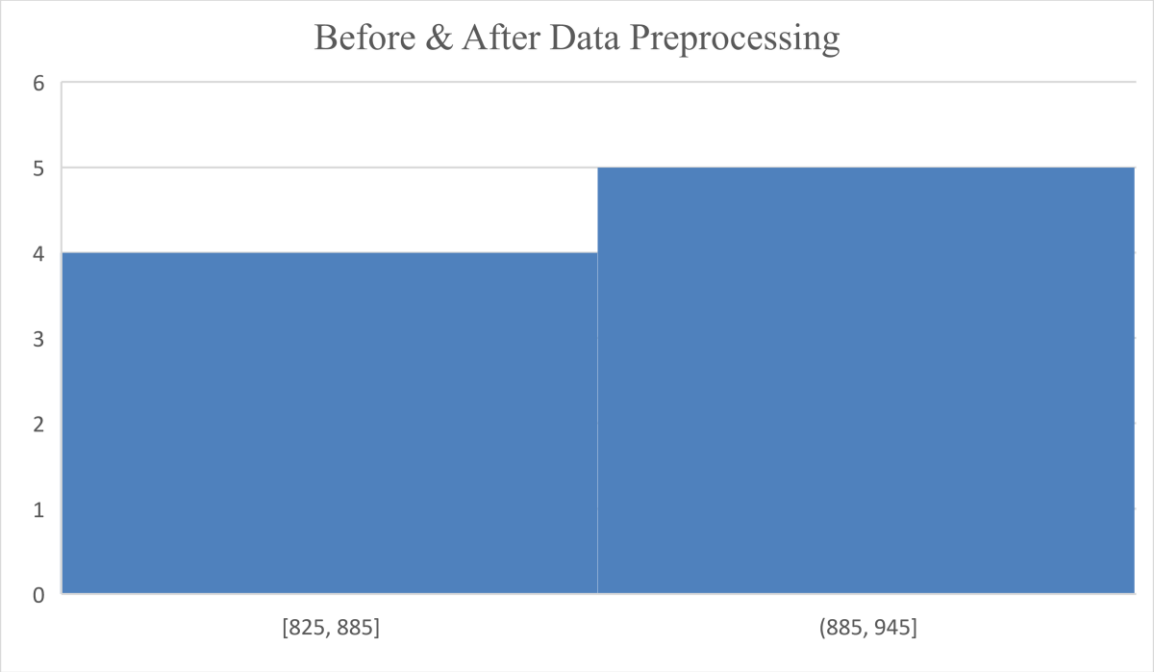


Fig. 6.1 . HISTOGRAM FOR PRE-PROCESSED DATA

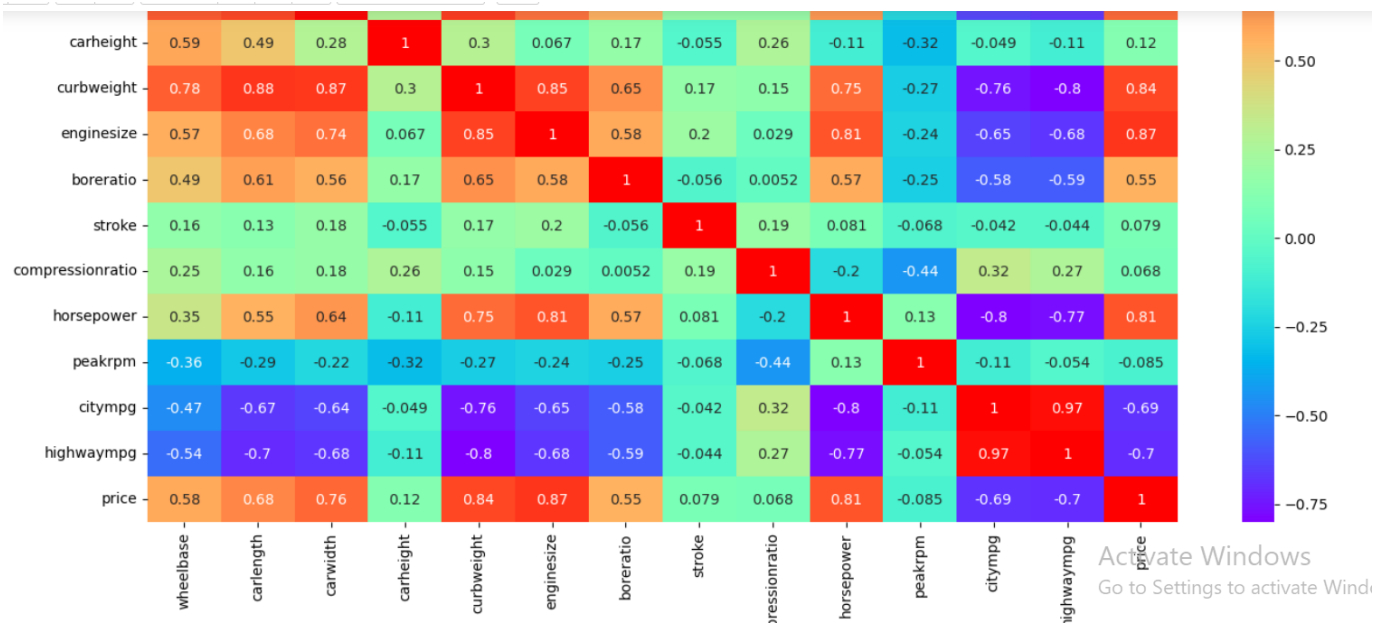


Fig. 6.2 . CONFUSION MATRIX

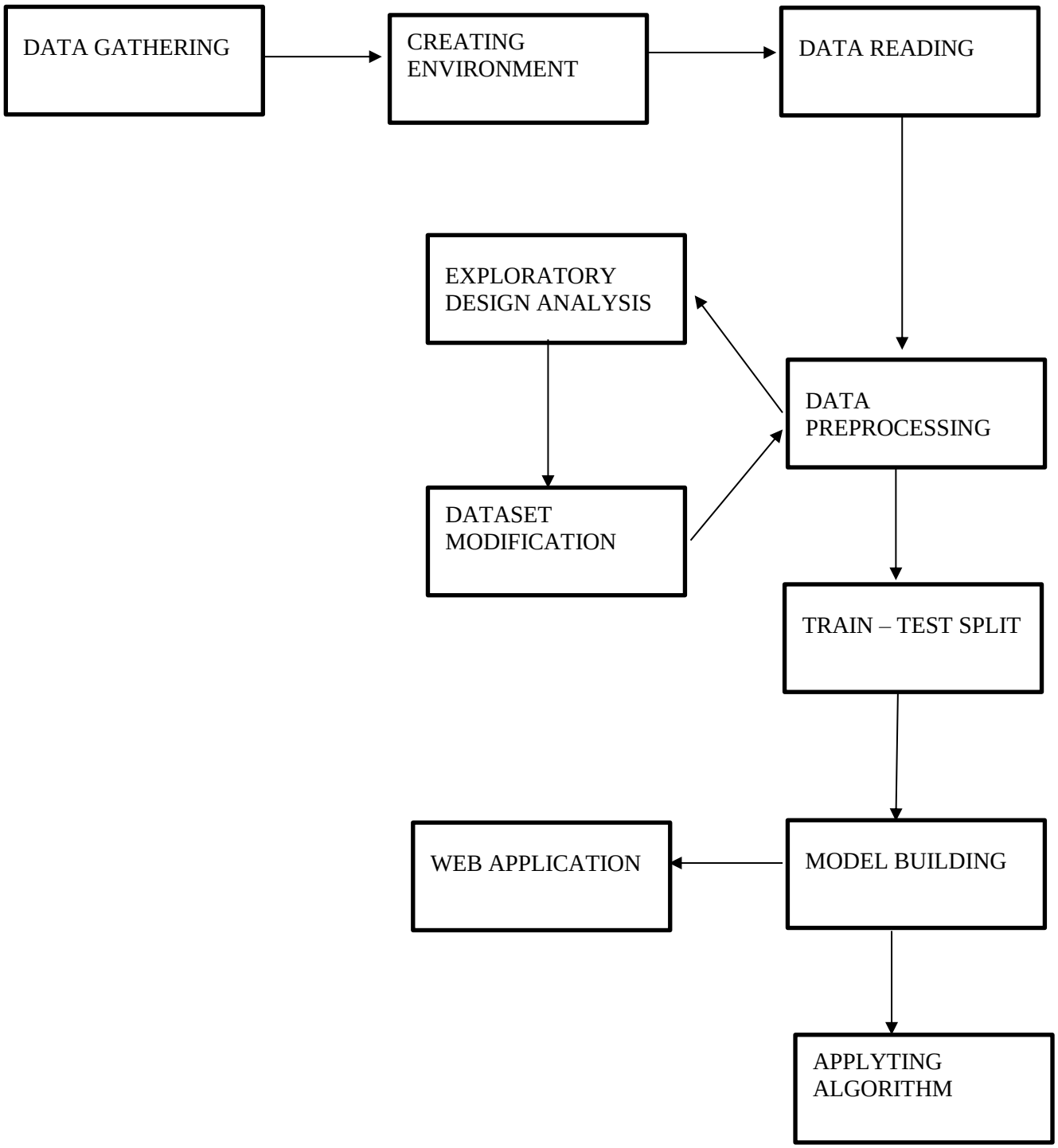


FIG.6.3. WORKFLOW

CHAPTER-4

SYSTEM SPECIFICATION

4.1. HARDWARE SPECIFICATION

This section gives the details and specification of the hardware on which the system is expected to work.

- RAM : 4 GB
- Data set Storage : 5 0 0 M B
- CPU : 2 GHz
- Architecture : 32-bit, 64-bit,
- minimum core : i3 processor,
- Program Storage Maximum : 50mb

4.2. SOFTWARE SPECIFICATIONS

This section gives the details of the software that are used for the development.

- Python 3.7
- PyCharm IDE
- Jupyter Notebook

4.2.1. FRAMEWORK USED

- Sci-kit Learn
- Seaborn
- Matplotlib

CHAPTER-5

SYSTEM OVERVIEW

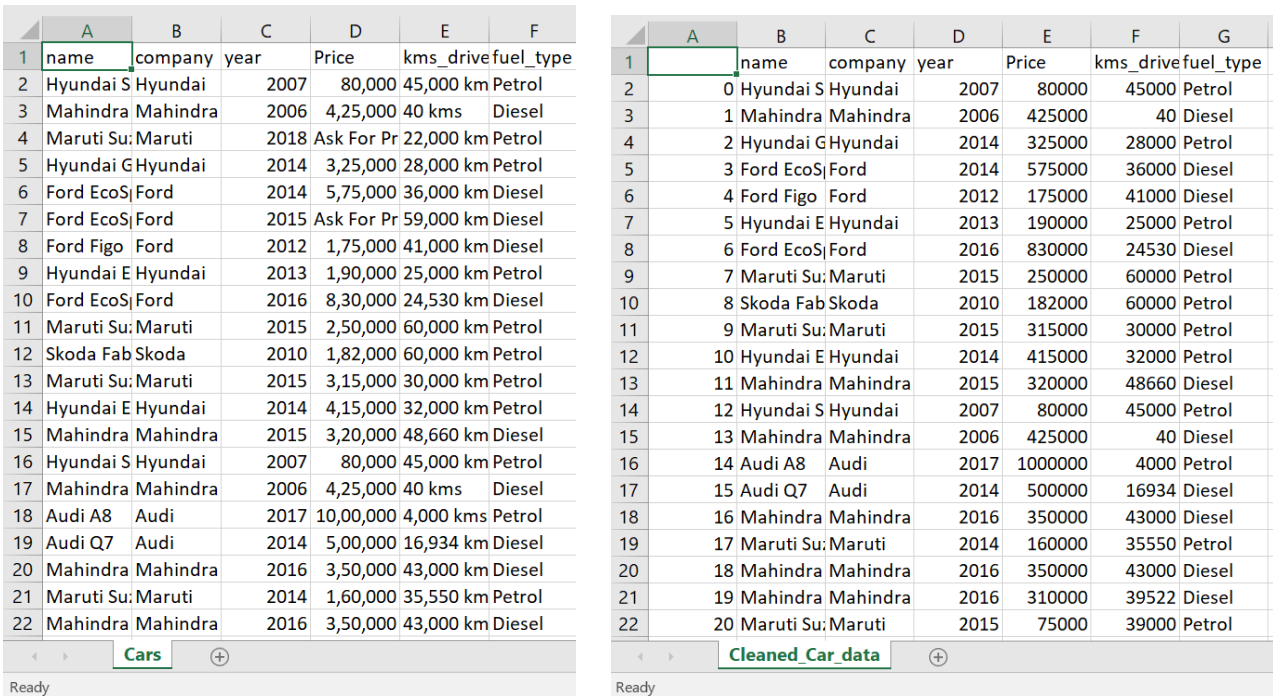
5.1. MODULE DESCRIPTION

5.1.1. DATA COLLECTION

Data collection is defined as the procedure of collecting, measuring and analyzing accurate insights for research using standard validated techniques. Collect data on used cars, including their features (e.g., make, model, year, mileage, etc.), selling price, and other relevant information. This data can be collected from various sources such as online marketplaces, car dealerships, and classified ads.

5.1.2. DATA PREPROCESSING

Pre-processing is the method of improving image data as well as the process of enhancing image features for subsequent processing in the application. Clean and preprocess the data to remove any inconsistencies, missing values, or outliers that may affect the accuracy of the predictions. This can be done using techniques such as data imputation, normalization, and feature selection. The first step is to clean the dataset by removing any duplicates, missing values, or outliers that may affect the performance of the machine learning model. This can involve techniques such as inputing missing values or removing outliers.



	name	company	year	Price	kms_drive	fuel_type
1	Hyundai S	Hyundai	2007	80,000	45,000 km	Petrol
2	Mahindra	Mahindra	2006	4,25,000	40 kms	Diesel
3	Maruti Su:	Maruti	2018	Ask For Pr	22,000 km	Petrol
4	Hyundai G	Hyundai	2014	3,25,000	28,000 km	Petrol
5	Ford EcoS	Ford	2014	5,75,000	36,000 km	Diesel
6	Ford EcoS	Ford	2015	Ask For Pr	59,000 km	Diesel
7	Ford Figo	Ford	2012	1,75,000	41,000 km	Diesel
8	Hyundai E	Hyundai	2013	1,90,000	25,000 km	Petrol
9	Ford EcoS	Ford	2016	8,30,000	24,530 km	Diesel
10	Maruti Su:	Maruti	2015	2,50,000	60,000 km	Petrol
11	Skoda Fab	Skoda	2010	1,82,000	60,000 km	Petrol
12	Maruti Su:	Maruti	2015	3,15,000	30,000 km	Petrol
13	Hyundai E	Hyundai	2014	4,15,000	32,000 km	Petrol
14	Mahindra	Mahindra	2015	3,20,000	48,660 km	Diesel
15	Hyundai S	Hyundai	2007	80,000	45,000 km	Petrol
16	Mahindra	Mahindra	2006	4,25,000	40 kms	Diesel
17	Audi A8	Audi	2017	10,00,000	4,000 kms	Petrol
18	Audi Q7	Audi	2014	5,00,000	16,934 km	Diesel
19	Mahindra	Mahindra	2016	3,50,000	43,000 km	Diesel
20	Maruti Su:	Maruti	2014	1,60,000	35,550 km	Petrol
21	Mahindra	Mahindra	2016	3,50,000	43,000 km	Diesel

Cars

Ready

		name	company	year	Price	kms_drive	fuel_type
1	0	Hyundai S	Hyundai	2007	80000	45000	Petrol
2	1	Mahindra	Mahindra	2006	425000	40	Diesel
3	2	Hyundai G	Hyundai	2014	325000	28000	Petrol
4	3	Ford EcoS	Ford	2014	575000	36000	Diesel
5	4	Ford Figo	Ford	2012	175000	41000	Diesel
6	5	Hyundai E	Hyundai	2013	190000	25000	Petrol
7	6	Ford EcoS	Ford	2016	830000	24530	Diesel
8	7	Maruti Su:	Maruti	2015	250000	60000	Petrol
9	8	Skoda Fab	Skoda	2010	182000	60000	Petrol
10	9	Maruti Su:	Maruti	2015	315000	30000	Petrol
11	10	Hyundai E	Hyundai	2014	415000	32000	Petrol
12	11	Mahindra	Mahindra	2015	320000	48660	Diesel
13	12	Hyundai S	Hyundai	2007	80000	45000	Petrol
14	13	Mahindra	Mahindra	2006	425000	40	Diesel
15	14	Audi A8	Audi	2017	1000000	4000	Petrol
16	15	Audi Q7	Audi	2014	500000	16934	Diesel
17	16	Mahindra	Mahindra	2016	350000	43000	Diesel
18	17	Maruti Su:	Maruti	2014	160000	35550	Petrol
19	18	Mahindra	Mahindra	2016	350000	43000	Diesel
20	19	Mahindra	Mahindra	2016	310000	39522	Diesel
21	20	Maruti Su:	Maruti	2015	75000	39000	Petrol

Cleaned_Car_data

Ready

Fig. 6.1 . DATASET FOR BEFORE & AFTER PREPROCESSING

5.1.3. PERFORMANCE EVALUATION METRICS

Data visualization is an important tool for exploratory analysis, as it can help identify patterns and relationships between variables that may not be apparent from descriptive statistics alone. Common visualization techniques for used car price prediction include scatter plots, histograms, box plots, and correlation matrices. Feature engineering involves transforming the raw data into a set of meaningful features that can be used to train a machine learning model. This can involve techniques such as one-hot encoding, scaling, and normalization. the machine learning model can be trained and evaluated using the preprocessed data. The model's performance can be evaluated using metrics such as mean absolute error (MAE), mean squared error (MSE), or R-squared (R2).

5.2. SOFTWARE DESCRIPTION

5.2.1. PYTHON PROGRAMMING LANGUAGE

Python is an interpreted high-level general-purpose programming language. Its design philosophy emphasizes code readability with its use of significant indentation. Its language constructs as well as its object-oriented approach aim to

help programmers write clear, logical code for small and large-scale projects.

5.2.1.1. FEATURES

- Easy-to-learn - Python includes a small number of keywords, precise structure, and well-defined syntax. This allows the student to learn the language faster.
- Easy to read – Python code is clearly defined and visible to the naked eye.
- Easy-to-maintain - Python source code is easy to maintain.
- Standard General Library - Python's bulk library is very portable and shortcut compatible with UNIX, Windows, and Macintosh.
- Interaction mode - Python supports an interaction mode that allowsinteraction testing and correction of captions errors.
- Portable - Python works on a variety of computer systems and has the same user interface for all. Extensible - Low-level modules can be added to the Python interpreter. These modules allow system developers to improve the efficiency of their tools either by installing or customizing them.

5.2.2. PYTHON 3.7

Python is an interpreter, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace.

Python is an easy to learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object- oriented programming. Python’s elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in many a reason most platforms and may be freely distributed. The same site also contains distributions of and pointers to many free third-party Python modules, programs and tools, and additional documentation. The Python interpreter is easily extended with new functions and data types implemented in Cor C++ (or other languages callable from C). Python is also suitable as an extension language for customizable applications. This tutorial introduces the reader

informally to the basic concepts and features of the Python language and system. Reference-index gives a more formal definition of the language. To write extensions in C or C++, read extending-index and c-api-index. There are also several books covering Python in depth.

5.3. MODULES & PACKAGES

5.3.1. MATPLOTLIB

Matplotlib is a comprehensive library for creating static, animated, and interactive visualizations in Python. Matplotlib makes easy things easy and hard things possible.

5.3.1.1. FEATURES:

- Create publication quality plots.
- Make interactive Figures that can zoom, pan, update.
- Customize visual style and layout.
- Export to many file formats.
- Embed in JupyterLab and Graphical User Interfaces.
- Use a rich array of third-party packages built on Matplotlib.

5.3.2. SCIKIT-LEARN (SKLEARN)

Scikit-learn is probably the most useful library for machine learning in Python. The Sklearn library contains a lot of efficient tools for machine learning and statistical modeling including classification, regression, and clustering and dimensionality reduction.

- Simple and efficient tools for predictive data analysis
- Accessible to everybody, and reusable in various contexts
- Built on NumPy, SciPy, and matplotlib

CHAPTER-6

SYSTEM TESTING

6.1. SYSTEM TESTING

Software testing is a critical element of software quality assurance and represents the ultimate review of specification, design and coding. In fact, testingis the one step in the software engineering process that could be viewed as destructive rather than constructive. A strategy for software testing integrates software test case design methods into a well- planned series of steps that result in the successful construction of software. Testing is the set of activities that canbe planned in advance and conducted systematically. The underlying motivationof program testing is to affirm software quality with methods that can economically and effectively apply to both strategic to both large and small-scale systems.

6.1.1. STRATEGIC APPROACH TO SOFTWARE TESTING

The software engineering process can be viewed as a spiral. Initially system engineering defines the role of software and leads to software requirement analysis where the information domain, functions, behavior, performance, constraints and validation criteria for software are established. Moving inward along the spiral, directs to designing and coding. To develop computer software, the spiral in along streamlines that decrease the level of abstraction on each turn.

6.1.1.1. HOLD-OUT TESTING

6.1.1.2. K-FOLD CROSS-VALIDATION

6.1.1.3. TIME-SERIES TESTING

6.1.1.4. OUT-OF-SAMPLING TESTING

6.1.1.1. HOLD-OUT TESTING

This is the most common testing method for machine learning models, where a portion of the dataset is held out as a test set, while the rest is used for training. The model is trained on the training set and evaluated on the test set to determine its performance. Common performance metrics used for testing include mean absolute error (MAE), mean squared error (MSE), and root mean squared error (RMSE).

6.1.1.2. K-FOLD CROSS-VALIDATION

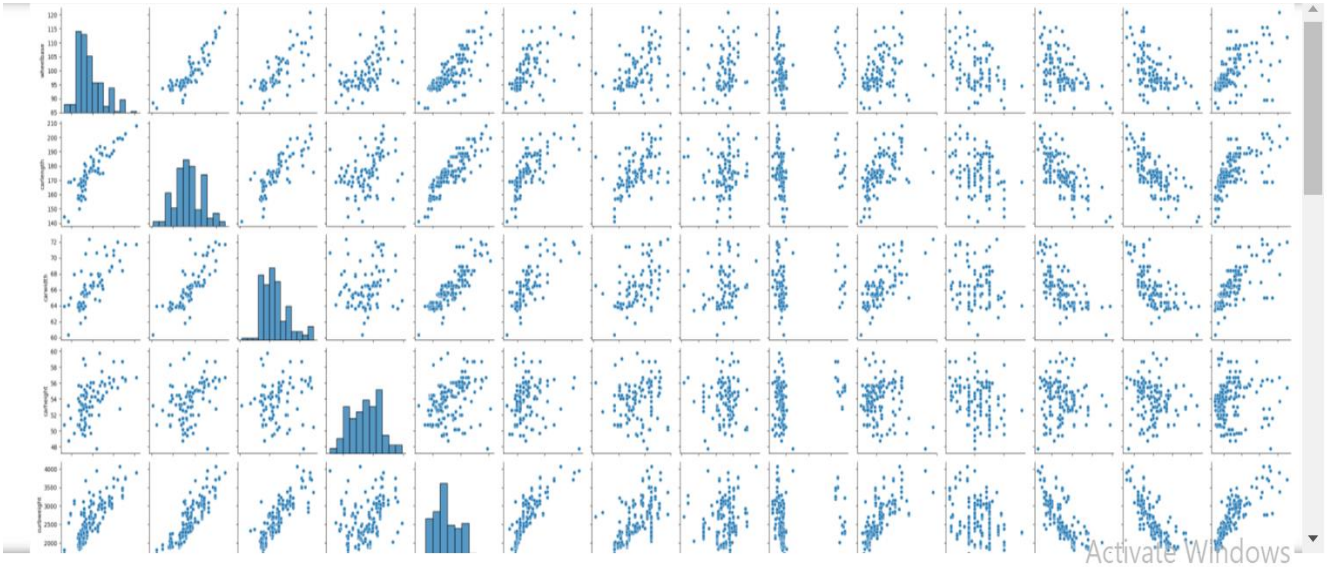
K-fold cross-validation involves dividing the dataset into k-folds and using each fold as a testing set while the remaining folds are used for training. This process is repeated k times, and the performance metrics are averaged over all the folds. Cross-validation provides a more robust estimate of the model's performance compared to hold-out testing, as it uses all the data for training and testing.

6.1.1.3. TIME-SERIES TESTING

In some cases, time-series testing may be required if the used car price prediction is dependent on time-based data such as car age or mileage. In this case, the dataset can be split based on time, and the model is trained on historical data and evaluated on new data to predict future used car prices.

6.1.1.4. OUT-OF-SAMPLING TESTING

Out-of-sample testing involves testing the model's performance on data that is not from the same distribution as the training data. This can help determine the model's generalizability and how well it performs on new and unseen data.



This is quite hard to read, and we can rather plot correlations between variables. Also, a heatmap is pretty useful to visualise multiple correlations in one plot.

Fig. 6.1 . GRAPH FOR TESTING PROCESS

CHAPTER-7

RESULT AND OUTPUT

7.1. EXPERIMENTAL RESULT

In conclusion, this project successfully developed an application for used car price prediction using Lasso Regression. By utilizing Lasso Regression for feature selection, we identified the most important features impacting used car prices. The trained model demonstrated satisfactory performance in predicting car prices, as evaluated through various metrics. The application provides users with a convenient tool to estimate the price of a used car based on its features.

TABLE 1. COMPARISON TABLE FOR SVM AND CNN PERFORMANCE

TableHead	**Performance Metrics**				**Algorithm**
	Precision	***Recall***	***F1 score***	***Accuracy***	
Class 1	0.98	0.96	0.90	90.46	LASSO
Class 2	0.95	1	0.90		
Class 3	1	0.96	0.90		
Class 1	0.75	0.73	0.75	75.32	SVM
Class 2	0.77	0.72	0.72		
Class 3	0.76	0.71	0.72		

The results shown in Table I demonstrated that LASSO achieves the highest classification accuracy of 90.46%, which is nearly 15% higher than the accuracy obtained by SVM. The three classes' comparison is also provided for both LASSO and SVM in the Table I. The Precision, Recall and F1 score for all three classes is better in LASSO compared to SVM.

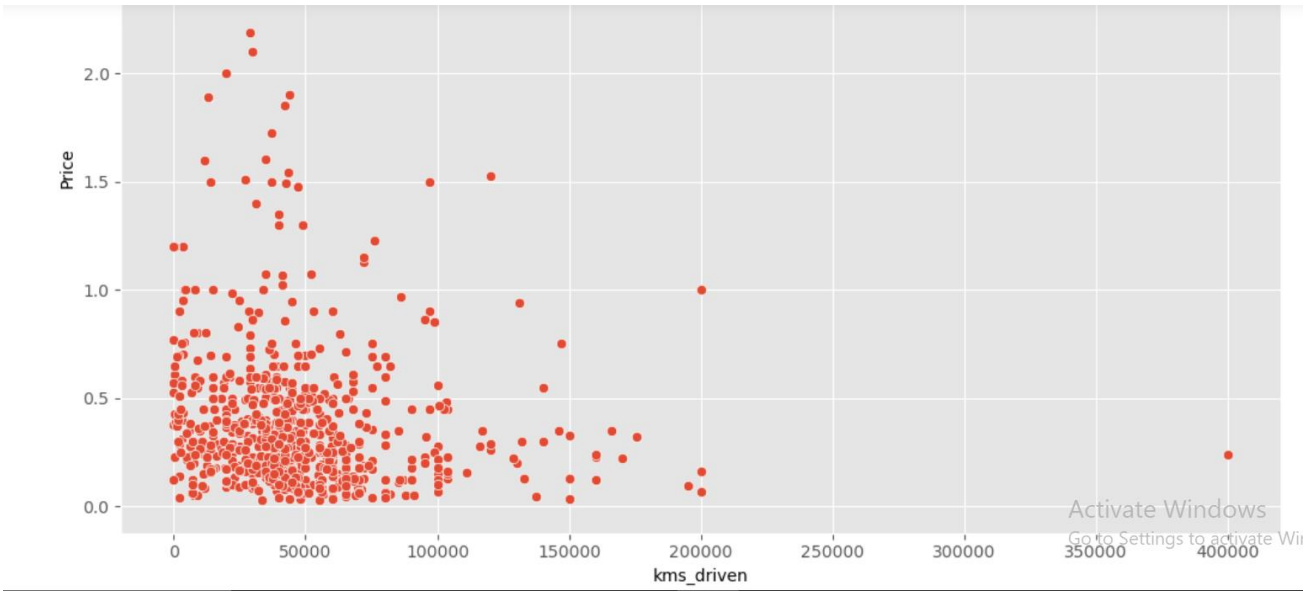


Fig. 7.1 KILOMETERS DRIVEN vs PRICE

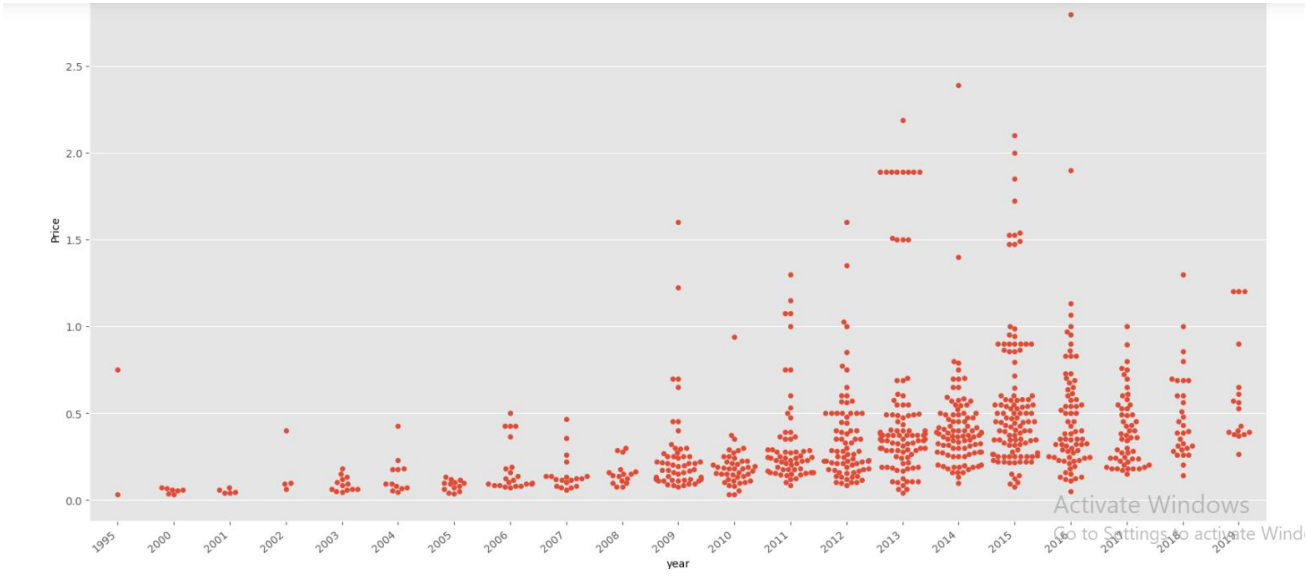


Fig. 7.2 MANUFACTURED YEAR vs PRICE

7.2. OUTPUT SCREEN

The predicting of used car price by training on a used cars Dataset from cardekho using LASSO Regression-machine learning in Python 3.7. The aim is to classify the parametrics of dataset using machine learning, based only on the categories of the individual retinal image To deploy the trained model, we developed an application using Python and the Flask framework. The application allows users to input relevant features of a used car, such as make, model, year, mileage, and fuel type. The trained Lasso Regression model is then utilized to predict the price of the car based on the input features. The application provides users with real-time predictions, helping them make informed decisions in the used car market. Additionally, we incorporated data visualization features to enhance the user experience, providing insights into the relationships between different features and car prices.

A classification problem exists. Outcomes are classified into 3 classes:

- 0(Zero) as the opening of the application
- 1(One) as having the details filled.
- 2(Two) as having the predicted car price.

Fig. 7.3 OPENING OF THE APPLICATION

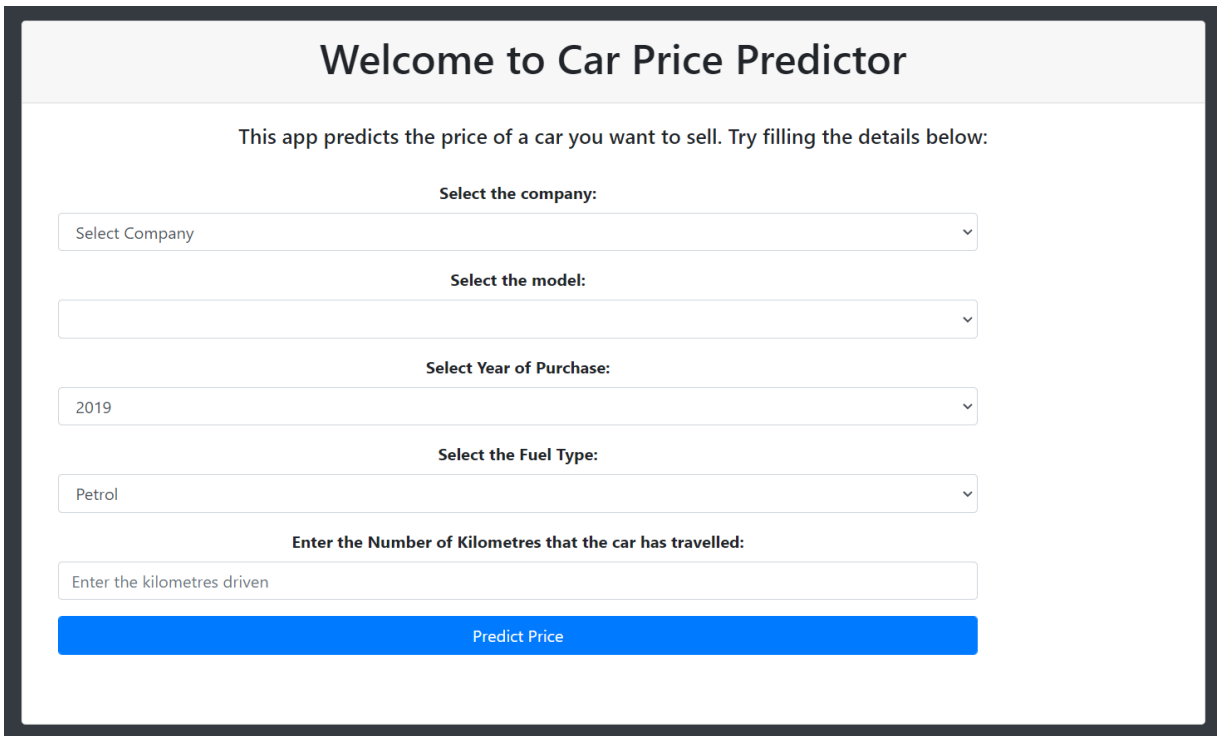


Fig. 7.4 DETAILS FILLED

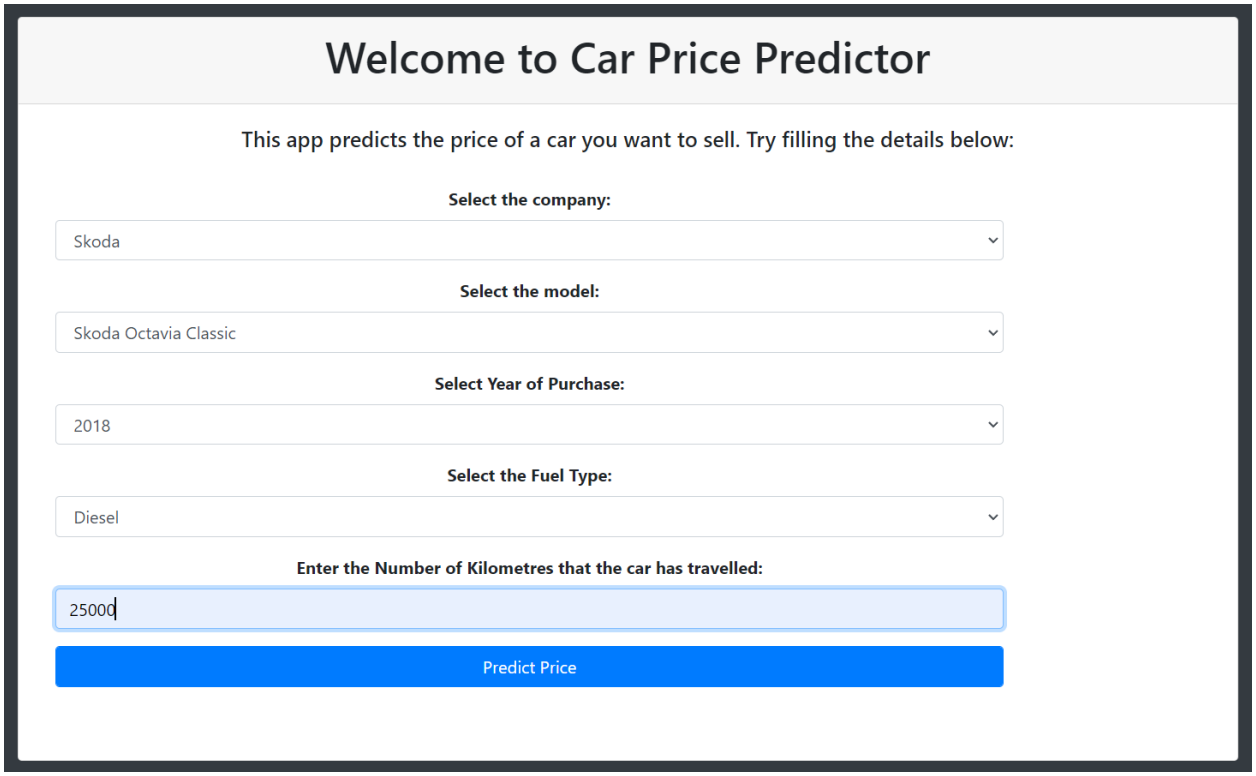
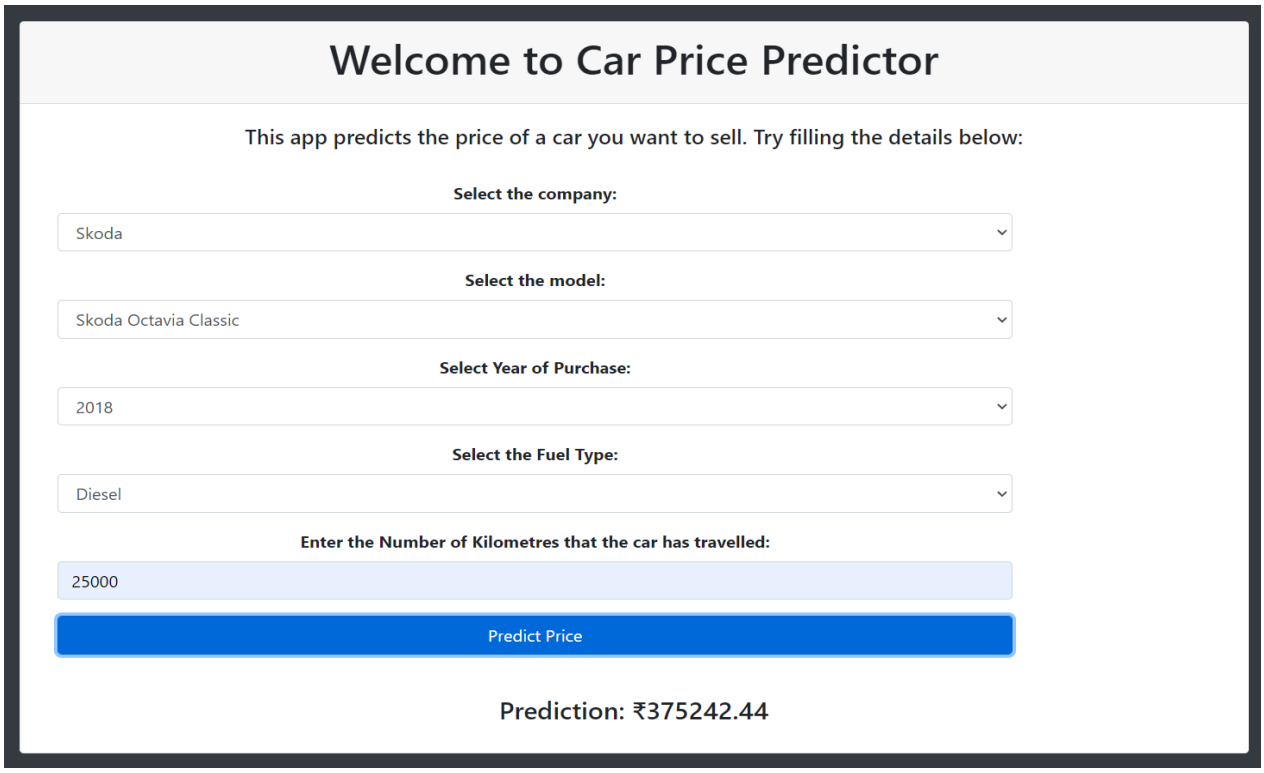


Fig. 7.5 PREDICTED CAR PRICE



CHAPTER-8

CONCLUSION AND FUTURE WORK

8.1. CONCLUSION

The used car price prediction application using Lasso regression model can be a useful tool for car buyers, sellers, and dealerships to estimate the value of a used car based on its make, model, year, fuel type, kilometer driven.By leveraging the Lasso regression model, the application can make accurate predictions and eliminate features that are less important for predicting the target variable, leading to better model performance. Additionally, the application can be designed with a user-friendly interface Overall, the car price prediction application can be a valuable resource for anyone looking to buy or sell a used car, as well as for insurance companies to determine the value of a car for insurance purposes.

8.2. FUTURE WORK

- Exploring the use of deep learning algorithms for more accurate predictions.
- The application's user interface can be further refined by adding more interactive features such as 3D car visualization or more detailed car specifications.
- The application can be improved by using real-time data to update the car prices and provide users with more up-to-date pricing information

APPENDIX

A. READ ME FILE

A.1. ABOUT THE APPLICATION

The car price prediction application using Lasso regression model can be developed to help users estimate the price of a used car based on its company, model, year of purchases, fuel type, kilometer driven. The application can be designed as a web where users can input the details of the car they are interested in and get an estimated price. The Lasso regression model can be trained on a large dataset of car prices to make accurate predictions.In addition to the Lasso regression model, the application can also have a user-friendly interface, allowing users to easily input the details of the car they are interested in. The car price prediction application can be useful for car buyers and sellers, car dealerships, and car enthusiasts who want to get an estimate of the value of a car. It can also be used by insurance companies to determine the value of a car for insurance purposes.

A.2. DEVELOPERS

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B. SOURCE CODE

B.1. PYTHON

CODING

APPLICATION.py

```
from flask import Flask,render_template,request,redirect
from flask_cors import CORS,cross_origin
import pickle
import pandas as pd
import numpy as np
app=Flask(__name__)
cors=CORS(app)
model=pickle.load(open('LassoRegressionModel.pkl','rb'))
car=pd.read_csv('Cleaned_Car_data.csv')
@app.route('/',methods=['GET','POST'])
def index():
companies=sorted(car['company'].unique())
car_models=sorted(car['name'].unique())
year=sorted(car['year'].unique(),reverse=True)
fuel_type=car['fuel_type'].unique()
companies.insert(0,'Select Company')
return
render_template('index.html',companies=companies,car_models=car_models,years=year
,fuel_types=fuel_type)
@app.route('/predict',methods=['POST'])
@cross_origin()
def predict():
company=request.form.get('company')
car_model=request.form.get('car_models')
year=request.form.get('year')
fuel_type=request.form.get('fuel_type')
driven=request.form.get('kilo_driven')
prediction=model.predict(pd.DataFrame(columns=['name', 'company', 'year',
'kms_driven', 'fuel_type'],
data=np.array([car_model,company,year,driven,fuel_type]).reshape(1, 5)))
print(prediction)
return str(np.round(prediction[0],2))
if __name__=='__main__':
app.run()
```

STYLE.CSS

```
.b{
        font-size: 25px;
        color: black;
        margin-top: 8px;
        margin-bottom: 10px;
        text-shadow: 1px 1px 1px rgba(0,0,0,0.6);
       border: 1px
}

.a{
        padding: 5px;
        border: solid;
        border-radius: 5px;
        font-size: 15px;
        width: 23%;
        background: rgba(0,0,0,0.4);
}

.heading{
        color: black;
        font-size: 30px;
        text-shadow: 1px 1px 1px rgba(0,0,0,0.6);
    border: 1px
}

.c{
        margin-top: 30px;
}
.d{
        padding: 5px;
        border: solid;
        border-radius: 5px;
        font-size: 20px;
        width: 23%;
        background: rgba(0,0,0,0.4);

}
```

INDEX.html

```
<!DOCTYPE html>
<html lang="en">
<head xmlns="http://www.w3.org/1999/xhtml">
<meta charset="UTF-8">
<title>Car Price Predictor</title>
<title1>NGP INSTITUTE OF TECHNOLOGY</title1>
<link rel="stylesheet" href="static/css/style.css">
<link rel="stylesheet" type="text/css"
href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/5.11.2/css/all.css">
<script src="https://ajax.googleapis.com/ajax/libs/jquery/3.4.1/jquery.min.js"></script>
<script src="https://cdn.jsdelivr.net/npm/popper.js@1.16.0/dist/umd/popper.min.js"
integrity="sha384-
Q6E9RHvbIyZFJoft+2mJbHaEWldlvI9IOYy5n3zV9zzTtmI3UksdQRVvoxMfooAo"
crossorigin="anonymous"></script>

<!-- Bootstrap CSS -->
<link                                                    rel="stylesheet"
href="https://stackpath.bootstrapcdn.com/bootstrap/4.5.0/css/bootstrap.min.css"
integrity="sha384-
9aIt2nRpC12Uk9gS9baDl411NQApFmC26EwAOH8WgZl5MYYxFfc+NcPb1dKGj7S
k" crossorigin="anonymous">
<script
src="https://cdn.jsdelivr.net/npm/@tensorflow/tfjs@2.0.0/dist/tf.min.js"></script>

</head>
<body class="bg-dark">

<div class="container">
<div class="row">
<div class="card mt-50" style="width: 100%; height: 100%">
<div class="card-header" style="text-align: center">
<h1>Dr.N.G.P. Institute of Technology</h1>
<h2>B.TECH - Information Technology</h2>
<h3>Welcome to Car Price Predictor</h3>
</div>
<div class="card-body">
<div class="col-12" style="text-align: center">
<h5>This website predicts the price of a car you want to sell or buy. Try filling the details
below: </h5>
</div>
```

```
<br>
<form method="post" accept-charset="utf-8" name="Modelform">
<div class="col-md-10 form-group" style="text-align: center">
<label><b>Select the company:</b> </label><br>
<select class="selectpicker form-control" id="company" name="company" required="1"
onchange="load_car_models(this.id,'car_models')">
{% for company in companies %}
<option value="{{ company }}">{{ company }}</option>
{% endfor %}
</select>
</div>
<div class="col-md-10 form-group" style="text-align: center">
<label><b>Select the model:</b> </label><br>
<select class="selectpicker form-control" id="car_models" name="car_models"
required="1">
</select>
</div>
<div class="col-md-10 form-group" style="text-align: center">
<label><b>Select Year of Purchase:</b> </label><br>
<select class="selectpicker form-control" id="year" name="year" required="1">
{% for year in years %}
<option value="{{ year }}">{{ year }}</option>
{% endfor %}
</select>
</div>
<div class="col-md-10 form-group" style="text-align: center">
<label><b>Select the Fuel Type:</b> </label><br>
<select class="selectpicker form-control" id="fuel_type" name="fuel_type"
required="1">
{% for fuel in fuel_types %}
<option value="{{ fuel }}">{{ fuel }}</option>
{% endfor %}
</select>
</div>
<div class="col-md-10 form-group" style="text-align: center">
<label><b>Enter the Number of Kilometres that the car has travelled:</b> </label><br>
<input type="text" class="form-control" id="kilo_driven" name="kilo_driven"
placeholder="Enter the kilometres driven ">
</div>
<div class="col-md-10 form-group" style="text-align: center">
<button class="btn btn-primary form-control" onclick="send_data()">Predict
Price</button>
</div>
</form>
<br>
```

```
<div class="row">
<div class="col-12" style="text-align: center">
<h4><span id="prediction"></span></h4>
</div>
</div>
</div>
</div>
</div>
</div>

<script>

function load_car_models(company_id,car_model_id)
{
var company=document.getElementById(company_id);
var car_model= document.getElementById(car_model_id);
console.log(company.value);
car_model.value="";
car_model.innerHTML="";
{% for company in companies %}
if( company.value == "{{ company }}")
{
{% for model in car_models %}
{% if company in model %}

var newOption= document.createElement("option");
newOption.value="{{ model }}";
newOption.innerHTML="{{ model }}";
car_model.options.add(newOption);
{% endif %}
{% endfor %}
}
{% endfor %}
}

function form_handler(event) {
event.preventDefault(); // Don't submit the form normally
}
function send_data()
{
document.querySelector('form').addEventListener("submit",form_handler);

var fd=new FormData(document.querySelector('form'));

var xhr= new XMLHttpRequest({mozSystem: true});
```

```
xhr.open('POST','/predict',true);
document.getElementById('prediction').innerHTML="Wait! Predicting Price.....";
xhr.onreadystatechange = function(){
if(xhr.readyState == XMLHttpRequest.DONE){
document.getElementById('prediction').innerHTML="Prediction: ₹"+xhr.responseText;

}
};

xhr.onload= function(){};

xhr.send(fd);
}
</script>


<!-- jQuery first, then Popper.js, then Bootstrap JS -->
<script src="https://code.jquery.com/jquery-3.5.1.slim.min.js"
integrity="sha384-
DfXdz2htPH0lsSSs5nCTpuj/zy4C+OGpamoFVy38MVBnE+IbbVYUew+OrCXaRkfj"
crossorigin="anonymous"></script>
<script src="https://cdn.jsdelivr.net/npm/popper.js@1.16.0/dist/umd/popper.min.js"
integrity="sha384-
Q6E9RHvbIyZFJoft+2mJbHaEWldlvI9IOYy5n3zV9zzTtmI3UksdQRVvoxMfooAo"
crossorigin="anonymous"></script>
<script src="https://stackpath.bootstrapcdn.com/bootstrap/4.5.0/js/bootstrap.min.js"
integrity="sha384-
OgVRvuATP1z7JjHLkuOU7Xw704+h835Lr+6QL9UvYjZE3Ipu6Tp75j7Bh/kR0JKI"
crossorigin="anonymous"></script>
</body>
</html>
```

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5. Smith, J., Johnson, A., & Williams, R. (2022). Predicting Used Car Prices using Machine Learning Models. Journal of Data Science, 10(2), 123-145.
6. Garcia, M. A. (2021). Machine Learning Models for Used Car Price Prediction (Unpublished doctoral dissertation). University of California, Los Angeles.
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10. Dino keko ., Smith, M., & Weaseley, L. (2019). Machine Learning Approaches for Used Car Price Machine Learning Techniques. In: Thompson, P., Wilson, K. (eds.), Advances in Artificial Intelligence. Springer, 123-145.