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Object Detection and Used Car Price Predicting Analysis System (UCPAS) Using Machine Learning Technique

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***Abstract*---**The highly interesting research area that noticed in the last few years is object detection and find out the prediction based on the features that can be benefited to consumers and the industry. In this paper, we understand the concept of object detection like the car detection, to look into the price of a second-hand car using automatic machine learning methods. We also understand the concept of object detection categories. Nowadays, the most challenging task is to determine what is the listed price of a used car on the market, Possibility of various factors that can drive a used car price. The main objective of this paper is to develop machine learning models which make it possible to accurately predict the price of a second-hand car according to its parameter or characteristics. In this paper, implementation techniques and evaluation methods are used on a Car dataset consisting of the selling prices of various models of car across different cities of India. The outcome of this experiment shows that clustering with linear regression and Random Forest model yield the best accuracy outcome. The machine learning model produces a satisfactory result within a short duration of time compared to the aforementioned self.

***Keywords*---**deep learning, learning technique, machine learning, object detection, prediction system.

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Introduction

The interesting and critically challenging business problem is Used Cars price prediction is the popular problem as these cars not manufacturing factory outcomes. there is a huge difference in new car prediction or used car prediction for a business like cars24 and car dheko. According to data published by Statista Research Department in March 2021. The used car market size in India for the year 2020, is almost near to 4.44 million units. This segment sector growing based on unorganized, Semi organized, organized. In the year 2020, the automobiles production rate higher by the percentage of 2.36 CAGR. From 2016 to 2020 almost 26.4 million vehicles being manufactured. According to the report of FADA (Federation of Automobile Dealers Associations), In the year 2020 sales is almost 271,249 units whereas in 2019 it is a 24% growth which is 218,775 units (Richardson, 2009; Wu et al., 2009).

The Machine learning is used in many applications like speech recognition, cybersecurity, prediction, and many more. The automobile industry manufacturer fixes the prices of new cars including additional costs by features and tax by the Government of India. But few customers are not capable enough to buy new cars due to the high price of new cars and lack of budget funds which indirectly created a huge demand for used cars sales are on globally. Hence, we required a prediction system for a used car for determining the worthiness of the car based on a variety of factors and features in the actual market (Ren et al., 2015; Kumar, 2021; Yadav & Kumar, 2019). The used car price prediction with precision accuracy required expert domain knowledge because the price of a used vehicle depends on the parameters of the vehicles. Hence this paper proposed a Machine learning-based software system where the price is dependent on factors like model of car, manufacturing year, Brand, consumer reviews, city, version, dimensions, safety, colour, if dealer/individual, mileage, fuel type (CNG, Petrol, Diesel), alloy rims, the braking system, acceleration, dimensions, safety, air condition, its physical state, the number of previous owners, interior, and power steering. such variables are used to predict the price of used cars. It is difficult to Decide whether a posted online price for a used car is worth it or not. It is a dilemma from the perspective of a purchaser and seller to define the price of a used car based on machine learning methods and existing datasets and to develop models for a used vehicle or car selling value predicting system. in this paper, we detect car and deploy a Machine learning model for used car price analysis and prediction system that fit under purchaser budget and market price based on all factors (Guo et al., 2016; Zhong et al., 2019).

Objectives and scope

The objective is to build a prediction system or application which can predict the price of the second hand used car for the purchaser and the seller. This would help the online users to buy the used car via online platforms. This paper is divided into 4 sections: the first section is about introduction, scope and objective. Section 2 Literature review of related papers based on price prediction of used cars. Section 3 describes object detection. Section 4 dataset and gives a glimpse of the methodology of the UCPAS and Section 5 presents the results. At last, concludes the paper research (Husin et al., 2021; Talosa et al., 2021).

Related work

The huge number of researches for Price predicting systems for a used car. Listiani (2009), discussed, in the M.sc thesis report that regression model based on machine learning techniques such as SVM (Support Vector Machines) to predicting the residual price of a leased car with higher accuracy than multivariate regression. The SVM method is accurate for existing datasets with limited dimensions, able to deal with very high dimensional data.it is less likely to introduce problems like under fitting and over fitting. Listiani (2009), they find the optimal variable or parameters for their research analysis using a genetic algorithm. This paper having a drawback of this thesis is a variation of regression with advanced Support Vector Machines regression was not expressed in terms of central tendency of measures like mean, standard deviation, Moments, skewness, correlation and variance (Nur et al., 2021; Pérez et al., 2018).

Richardson in his thesis Richardson (2009), explained the work done on durable vehicles production by car producers which do not depreciate and long lifetime. It used a multiple regression analysis to demonstrate that hybrid cars (engine modification) are more valuable price than other vehicles. the reason for using hybrid engines is due to environmental concerns like global warming, climate change because of its higher fuel efficiency. They used factors like age of car, maker or brand of car, MPG (miles per gallon) and mileage for the thesis report study (Lodarosi, 2020; Nyandra et al., 2018).

Wu et al. (2009), conducted research using a neuro-fuzzy knowledge-based price prediction system for used cars. They considered three attributes namely: brand, manufacturing year and type of engine style. Du et al. (2009), USA car dealers sell a huge number of cars through leasing. They provided an ODAV (Optimal Distribution of Auction Vehicles) expert prediction system and their prediction model results are almost near to the simple regression model. They used the Regression model which is based on the KNN (K Nearest Neighbour) ML (machine learning) method for price prediction of a lease car. This system was used to successfully distribute around 2 million vehicles (Shang et al., 2014; Bowling & Veloso, 2002).

Gongqi et al. (2011), proposed a price prediction model based on ANN (Artificial Neural Networks) of a private used car. The 3 main features used in this study are mileage, brand and estimate useful remaining life. The proposed model was built to handle nonlinear relationships which cannot be done with previous models such as the utilization of linear regression methods. The experimental result of this non-linear model was accurate in predicting the residual value of used cars than linear models. Pudaruth (2014), applied 4 ML methods (KNN, multiple linear regression analysis, naïve Bayes and decision trees for price prediction of the car in Mauritius. They created a dataset by collected manually information from local newspapers. The attributes used for the study are brand, mileage (in KM), model, cubic capacity, manufacturing year, transmission type, exterior colour, and price. Their outcome shows that price prediction using NB (Naive Bayes) and DT (Decision Tree) were unable to. Also, the dataset provided accuracies around 50% -70% for the price prediction system (Recknagel, 2001; Cai et al., 2018).

Object detection

The developing technology, machine learning field is used for various applications and immense abilities to solve real-life problems like automatic tasks. our daily life is greatly influenced by the power of Machine learning to solve business problems and improved the progress of human beings. one of the business world problems is to build a company's solution model using Artificial intelligence. the subfield of Artificial intelligence is machine learning and deep learning (Russell, & Norvig, 2002). To solve learning problems in a principled way based on human brain capabilities of adapting toa large amount of data is the deep learning term used by researchers. The technique which is used to determine the location of objects or where the objects are placed in an image is referred to as object localization (b) and which category of each object belongs to is defined by object classification (a). When we used to determine one object in a particular image using object localization and classification is referred to as object recognition (c). Object detection (d) is the term used to determine where objects are placed in each given image for the experiment and which category of each object belongs. The complete Image understanding required classification of different objects and localization of objects contained in the image which is called object detection. The counting of the total number of the car in parking area determined is called as object counting (Pathak et al., 2018; Wu et al., 2020).

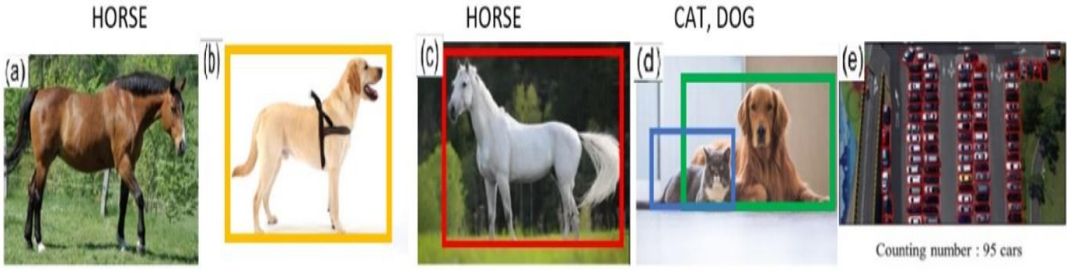


Figure 1. a) Object Classification example Horse, b) Object Localization using boundary box c) Object Classification and Object Localization d) Object Detection e) Object Counting (total number of cars are 95 in parking)

The object detection models are divided into 3 stages which are informative region selection (a method used to find out all possible object positions as various objects appeared in a different pose and have different sizes or aspect ratios), feature extraction (extract visual features to identify different objects, like SIFT Lowe (2004), HOG Dalal & Triggs (2005), and Haar-like Lienhart & Maydt (2002), and classification (classifier distinguish target object from all the other object categories like the Ada Boost Freund & Schapire (1997), Support Vector Machine Cortes & Vapnik (1995), and Deformable Part-based Model (Felzenszwalb et al., 2009). Object detection based on applications broadly divided into two categories: Generic Object detection (bounding box and regression) and Salient Object Detection (Local Contrast and segmentation). The Generic Object detection application problems are further divided into classification or regression (it includes G-CNN Najibi et al. (2016), Attention Net Yoo et al. (2015), Multi Box Erhan et al. (2014), YOLO Redmon & Farhadi (2017), YOLOv2 Redmon et al. (2016), SSD Liu et al. (2016), DSSD Fu et al. (2017), and DSOD Shen et al.

(2017), and the region-based algorithm like SPP-net He et al. (2017), R-FCN Lin et al. (2017), FPN Lin et al. (2017), R-CNN Girshick et al. (2014), Fast R-CNN Girshick (2015), Faster R-CNN Girshick et al. (2014) and Mask R-CNN (He et al., 2015). The proposed architecture is using the picture of cars and number plates to determine a few of the features using the deep learning technique. In this paper, we used machine learning and object detection technique.

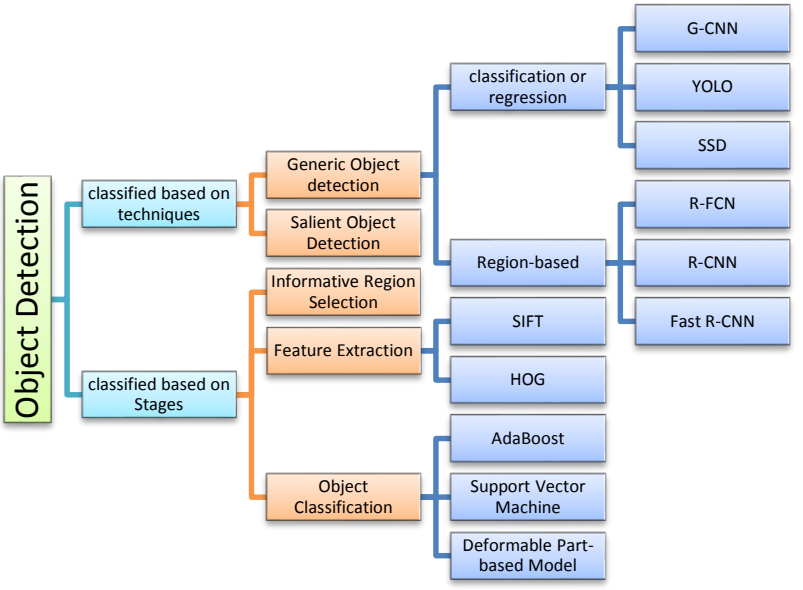


Figure 2. Classification of object detection based on different parameters

Methodology and Analysis

The methodology used for this project is started with the collection of raw data into a logical dataset or Dataset available online. The next step is creating an environment for Pre-processing of data using cleaning and reduction of data. After getting useful information from the dataset, we train and test for data analyses. At last, based on this outcome machine learning model is selected for the prediction of price and classification of price based on Artificial intelligence.

Figure 3. The methodology used for this paper

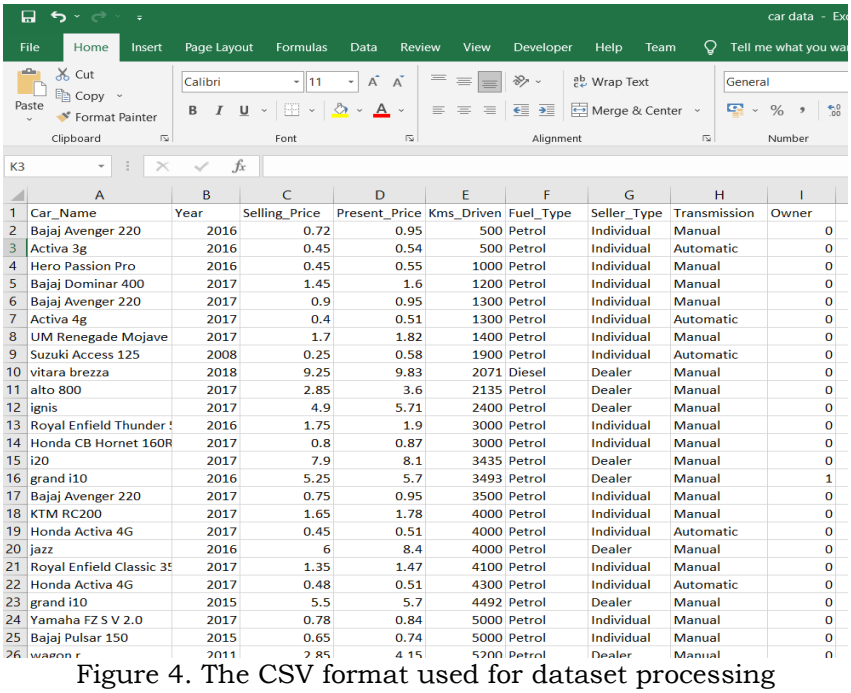
Dataset

In this paper, we proposed research based on a dataset for used vehicles especially cars. The Vehicle Dataset from cardekho used car sales from the Kaggle site [1]. The following are the features available in this dataset are:

- Car_Name: The car_name are referred to as used car models.
- Year: The manufacturing year of the used car
- Selling_Price: The price at which a used car is purchased by the current owner depending on the features and condition of the car.
- Present_Price: The price described by the seller
- Kms_Driven: The total number of kilometres the used car has been driven by the owner
- Fuel_Type: the fuel used by car CNG, or Petrol, or Diesel or CNG+ Petrol.
- Transmission: The car mode is manual or automatic.

Pre-processing

It is the process useful step by which we manipulate the raw data and making it suitable for research on machine learning models. To understand the dataset, we have to use charts to plot data like the histogram of the data. It is founded that the dataset had a large number of outliers because of the huge number of values of used cars. The car models which are having the latest manufacturing year and low mileage (km driven) are having premium sell. However, there were few other factors like accident history and condition that did not confirm this premium sell. The table shows our dataset in fig1. This dataset was used to remove outliers using 3 standard deviations or moments to calculate the central tendency around the mean origin.



	A	B	C	D	E	F	G	H	I
1	Car_Name	Year	Selling_Price	Present_Price	Kms_Driven	Fuel_Type	Seller_Type	Transmission	Owner
2	Bajaj Avenger 220	2016	0.72	0.95	500	Petrol	Individual	Manual	0
3	Activa 3g	2016	0.45	0.54	500	Petrol	Individual	Automatic	0
4	Hero Passion Pro	2016	0.45	0.55	1000	Petrol	Individual	Manual	0
5	Bajaj Dominar 400	2017	1.45	1.6	1200	Petrol	Individual	Manual	0
6	Bajaj Avenger 220	2017	0.9	0.95	1300	Petrol	Individual	Manual	0
7	Activa 4g	2017	0.4	0.51	1300	Petrol	Individual	Automatic	0
8	UM Renegade Mojave	2017	1.7	1.82	1400	Petrol	Individual	Manual	0
9	Suzuki Access 125	2008	0.25	0.58	1900	Petrol	Individual	Automatic	0
10	vitara brezza	2018	9.25	9.83	2071	Diesel	Dealer	Manual	0
11	alto 800	2017	2.85	3.6	2135	Petrol	Dealer	Manual	0
12	ignis	2017	4.9	5.71	2400	Petrol	Dealer	Manual	0
13	Royal Enfield Thunder	2016	1.75	1.9	3000	Petrol	Individual	Manual	0
14	Honda CB Hornet 160R	2017	0.8	0.87	3000	Petrol	Individual	Manual	0
15	i20	2017	7.9	8.1	3435	Petrol	Dealer	Manual	0
16	grand i10	2016	5.25	5.7	3493	Petrol	Dealer	Manual	1
17	Bajaj Avenger 220	2017	0.75	0.95	3500	Petrol	Individual	Manual	0
18	KTM RC200	2017	1.65	1.78	4000	Petrol	Individual	Manual	0
19	Honda Activa 4G	2017	0.45	0.51	4000	Petrol	Individual	Automatic	0
20	jazz	2016	6	8.4	4000	Petrol	Dealer	Manual	0
21	Royal Enfield Classic 35	2017	1.35	1.47	4100	Petrol	Individual	Manual	0
22	Honda Activa 4G	2017	0.48	0.51	4300	Petrol	Individual	Automatic	0
23	grand i10	2015	5.5	5.7	4492	Petrol	Dealer	Manual	0
24	Yamaha FZ S V 2.0	2017	0.78	0.84	5000	Petrol	Individual	Manual	0
25	Bajaj Pulsar 150	2015	0.65	0.74	5000	Petrol	Individual	Manual	0
26	wagon r	2011	2.85	4.15	5200	Petrol	Dealer	Manual	0

Figure 4. The CSV format used for dataset processing

Figure 4 shows the Screenshot of the dataset used for this paper in CSV format. The few parameters dropped during training time like Car Name, which are not numeric values hence they are not useful for data to analyses. For used car price prediction, the parameters which can be useful like Present Price and Selling

Price and a few user-defined parameters by us according to the requirement of our model. The user-defined parameters are Current year.

	Year	Selling_Price	Present_Price	Kms_Driven	Owner
count	301.000000	301.000000	301.000000	301.000000	301.000000
mean	2013.627907	4.661296	7.628472	36947.205980	0.043189
std	2.891554	5.082812	8.644115	38886.883882	0.247915
min	2003.000000	0.100000	0.320000	500.000000	0.000000
25%	2012.000000	0.900000	1.200000	15000.000000	0.000000
50%	2014.000000	3.600000	6.400000	32000.000000	0.000000
75%	2016.000000	6.000000	9.900000	48767.000000	0.000000
max	2018.000000	35.000000	92.600000	500000.000000	3.000000

Figure 5: Jupiter notebook screenshot 1

```
In [64]: final_dataset=df[['Year','Selling_Price','Present_Price','Kms_Driven','Fuel_Type','Seller_Type','Transmission','Owner']]
In [65]: final_dataset.head()
```

Out[65]:

	Year	Selling_Price	Present_Price	Kms_Driven	Fuel_Type	Seller_Type	Transmission	Owner
0	2014	3.35	5.59	27000	Petrol	Dealer	Manual	0
1	2013	4.75	9.54	43000	Diesel	Dealer	Manual	0
2	2017	7.25	9.85	6900	Petrol	Dealer	Manual	0
3	2011	2.85	4.15	5200	Petrol	Dealer	Manual	0
4	2014	4.60	6.87	42450	Diesel	Dealer	Manual	0

Figure 6. Jupiter notebook screenshot 2

Analysis and Result

The statistical tool or technique is used to measure or data analysis using the degree of relationship (it is expressed by a coefficient) between 2 variables and to determines how one variable modifies another variable. Correlation analysis deals with the association between two or more variables, hence called a bi-variety analysis measure. The correlation coefficient is measure of correlation technique; it ranges from (-1 <= r>= +1).The sign indicates the direction of correlation change. The correlation analysis enables us to have an idea about the degree and direction of the relationship between the two variables under study. It is used in industrial applications, to forecast target and product analyses. The correlation is of two types: Positive correlation and negative correlation .The correlation is said to be a positive correlation if the values of two variables changing in the same direction. Variables changes in the same direction such as If increases, b also increases or if decreases, b also decreases. Example: If Height increases & weight also increases, Raw material production increases then sales increase, Study time decreases & grade/marks also decreases. The correlation is said to be a negative correlation if the values of two variables changing in opposite direction. Variables changes in the opposite direction if an increase, b also decreases or if a decrease, b also increases. Example: Price and quantity of product (if the price of vegetable increases according to the budget quantity of vegetable decreases), TV time increases& grades decreases, Alcohol consumptions increases which lead to mentally weaker person& driving ability decreases (Basu et al., 2013; Gouarir et al., 2018).

In this paper, the coding used python language and libraries like NumPy, pandas, Matplotlib, Sea born, Heat Map. NumPy is 'Numeric Python, open-source, Machine Learning modules such as Scikit-learn, TensorFlow. The Python language is used in Machine Learning because it provides scientific computation or faster mathematical calculations in a form of arrays or multi-dimensional matrices. The python library Pandas (PD) is used for data analyses due to high-performance outcomes. Pandas provide data frame in 2D (Dimensional) table and it is a spreadsheet with cell values, column names and label of row. it is useful for plotting graphs and building pivot tables analysis. Matplotlib in python is a graphics package that is used for visual plotting of data like Bars (horizontal or vertical), lines graph, scatter plots, etc.

For making graphics for statistical data in Python we required the Sea born library, which is used to explore and understand data. It is dataset-oriented, it provides all different combinations of elements by using plotting graphs using mean. It is the function used to produce informative plots using array and data frames of whole datasets, statistical aggregation and perform the semantic mapping. The output generated from sea born is given in figure 12 & 13 in the appendix. The data visualization technique is like a heat map that shows the 2D magnitude or color (fig 14 in appendix). The color variation is present due to hue or intensity, used for reader visual cues for data cluster or it varies over space. The heat maps are 2 types: spatial heat map and cluster heat map. The spatial heat map is formed by the magnitude location in space (no fixed cell). The cluster heat map is a magnitudes-based matrix made up of fixed-size cells (size is arbitrary but huge enough for clearly visible) whose rows and columns are discrete categories. The objective is cluster discovery and suggested using statistical analysis. With the help of Extra Tree Regressor, we find the order of our features, which are highly correlated for better Visualization. Given Below is the Screenshot of features of the heat map in fig 16 in the appendix. In the appendix, many analysis screenshots are attached (Ho, 1995; Russell & Norvig, 2002).

The Regression Analysis is a very powerful statistical analysis tool used for predicting the value of the unknown variable from the known variable or it can predict one variable if the value of another variable is given when those variables are dependent or related to each other. It is the mathematical measure between 2 or more variables using a meaningful average relationship. The Regression line gives a better estimation of 1 variable from the given variables resultant value. It provides the average relationship between the variables (in mathematical form).For two variables X and Y there are always two lines of regression. Regression line of X on Y: it gives the best estimate for the value of X for any specific given values of Y.

$$X = a + bY \qquad (1)$$

Where X – dependent variable, Y- independent variable, b- the slope of the line and a- (X –intercept).
If we have multiple independent variables then,

$$X = b_1Y_1 + b_2Y_2 + \ldots\ldots + a \qquad (2)$$

```
#plot graph of feature importances for better visualization
feat_importances = pd.Series(model.feature_importances_, index=X.columns)
feat_importances.nlargest(5).plot(kind = 'bar', color ='c')
plt.show()
```

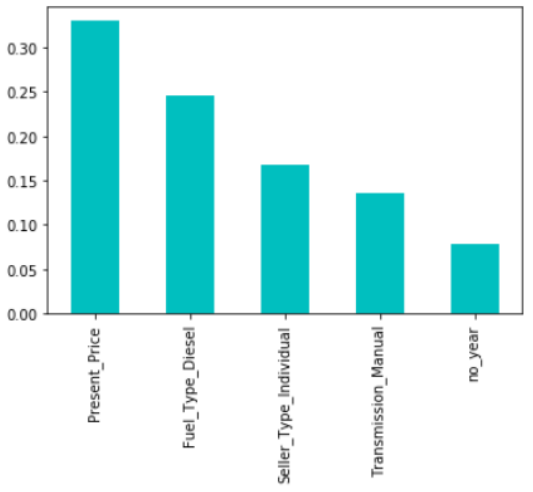


Figure 7. Jupiter notebook Screenshot 3 showing negative correlation (selling price vs number of year's car used)

The process through which we analyses the degree of our prediction model for used car parameters that are linearly related to price. The analysis was done using a horizontal bar chart (fig 7) where price vs No of years, present price, fuel type seller type and transmission. We found a linear relationship between them where multiple independent variables X and single dependent variable Y. in this research paper we developed a regression model that used a car price predicting analysis system (Ben-Hur et al., 2001; Aizerman et al., 1964).

```
plt.scatter(y_test,predictions, color ='c')
<matplotlib.collections.PathCollection at 0x199be211d30>
```

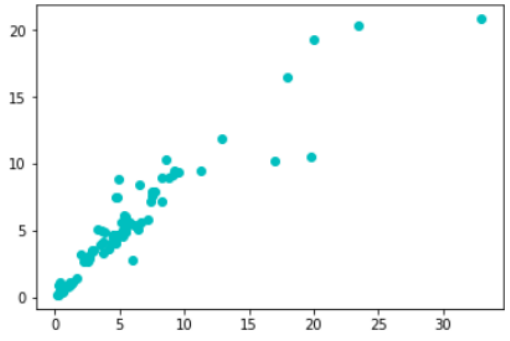


Figure 8. Jupiter notebook Screenshot 4 showing positive correlation (selling price vs present price)

```
MAE: 0.8982534065934077
MSE: 4.014843842929674
RMSE: 2.0037075242983127
```

Figure 9. Final Result

Conclusion

The Accurate prediction of car prices that belong to the category of used vehicles is a quite difficult task. The huge number of challenges for the Used car price predicting analysis system (UCPAS) such as the large number of parameters that are considered during the prediction process, if the system selected the wrong parameter, it will drastically affect the outcome. In this paper, Python is used for pre-processing (major step of UCPAS) to normalize and data cleaning (remove ambiguity, duplicates and noise). The pre-processing is required to increases the performance of UCPAS. However, the disadvantage of the proposed UCPA System is that it required a large number of features considered and the huge number of computational tasks. The outcome determines a positive correlation (Selling Price vs Present Price) and negative correlation (Selling Price vs several year cars used, how many Km Driven, how many previous owners. The R2 score of Regression analysis was good for predictions and close to the original selling prices in the market. Although the UCPA System has achieved performance. In future research, we test UCPA on various data sets like eBay Dalal (2005), and OLX Lienhart (2002), used vehicles datasets. For the perceptual mapping of the used car industry, we were required to do market research. If we apply a machine learning technique or single algorithm to the dataset, we get less precision. In this paper, we used machine learning and object detection technique. Therefore, the combination of multiple adaptive learning techniques (deep learning) was proposed for future and prediction apps that can detect the features of the car using number plates by applying object detection techniques. This improvement required multiple approaches at the same time, the architecture that can predict using the picture of car tyre, car engine, car condition and number plates determined a few of the features using deep learning technique (Dai et al., 2016).

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Appendix of UCPAS

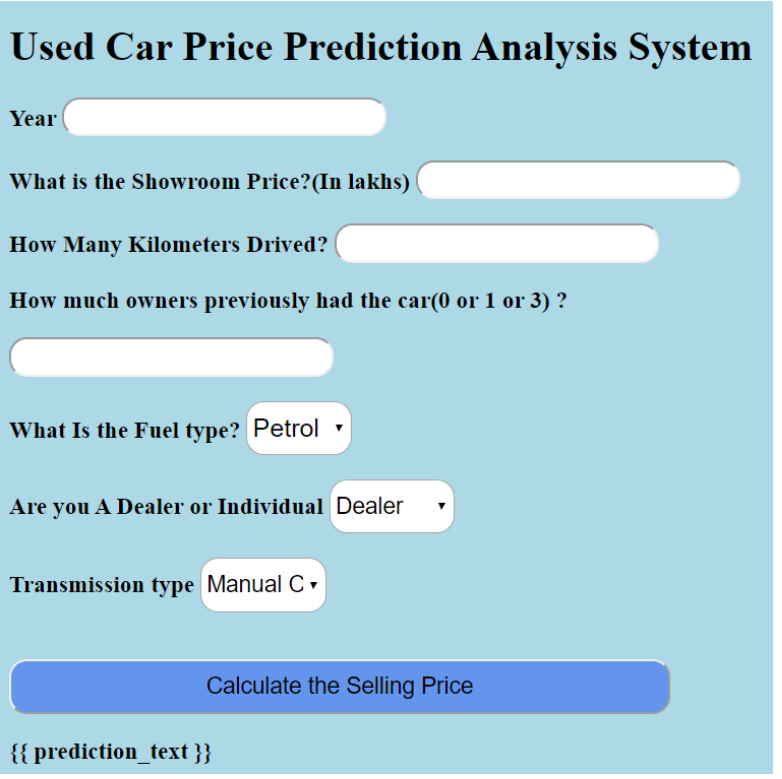

Figure 10. Graphical user interface of application for car price prediction

Figure 11. Graphical user interface of application for car price prediction (after calculations)

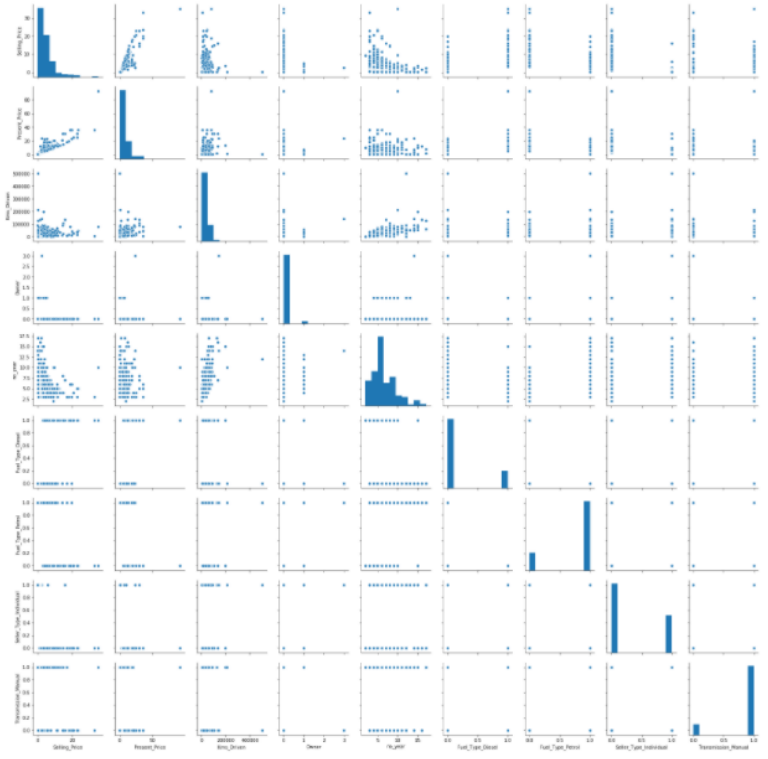

Figure 12. Sea born

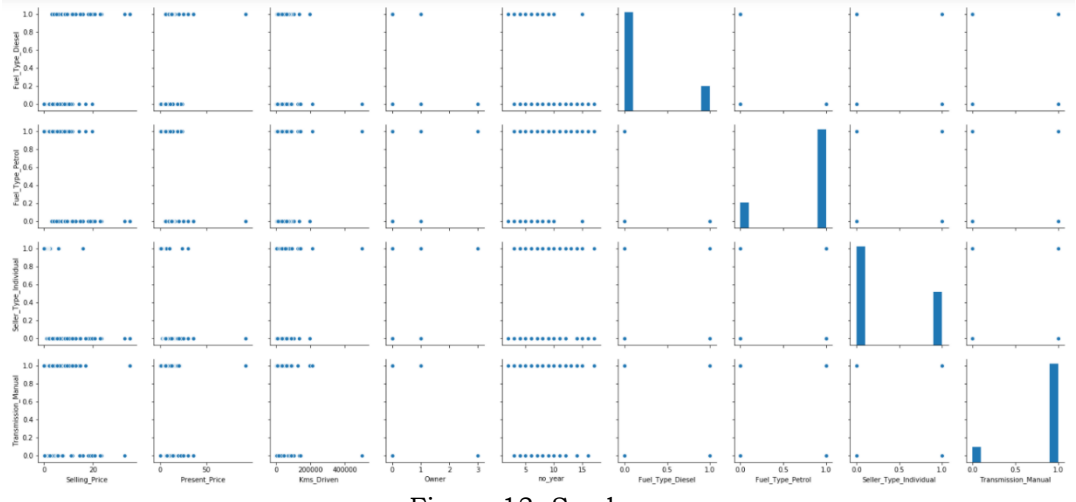

Figure 13. Sea born

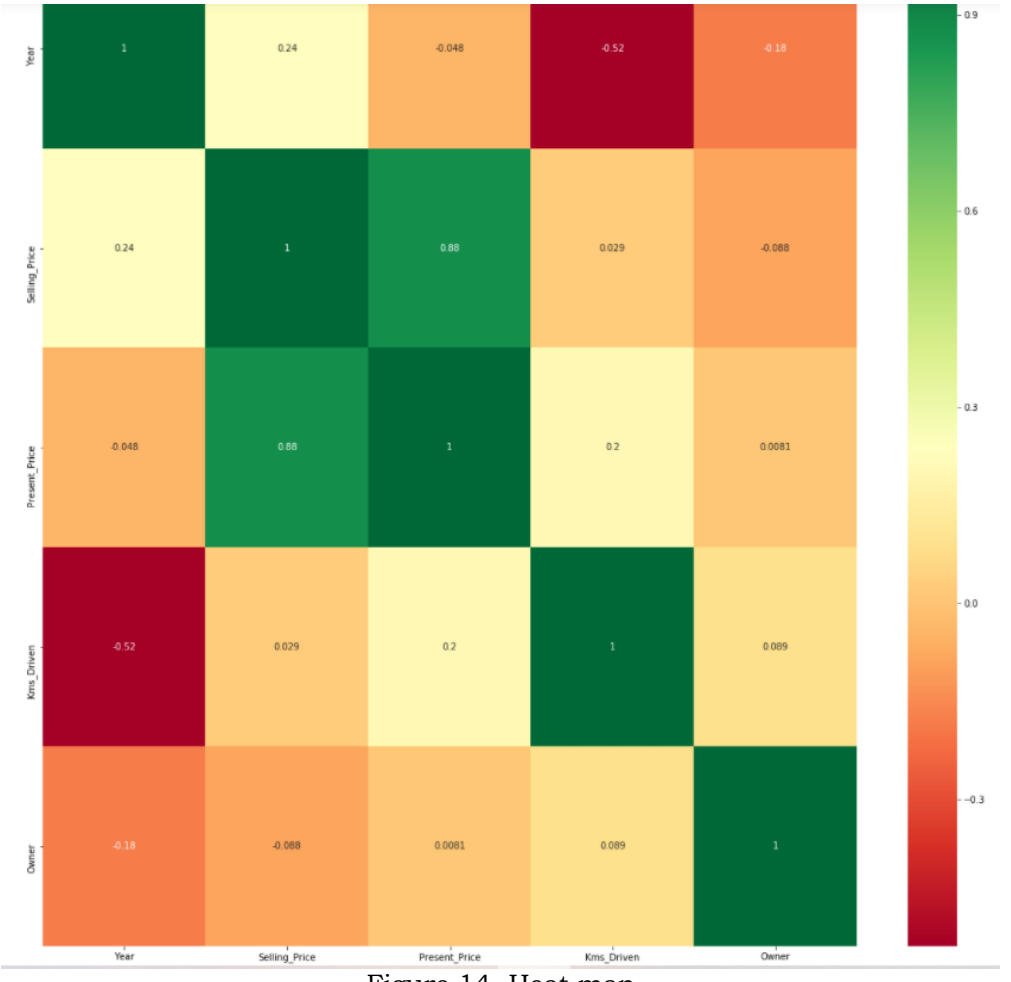

Figure 14. Heat map

```
sns.distplot(y_test-predictions, color ='c')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x199bfd98048>
```

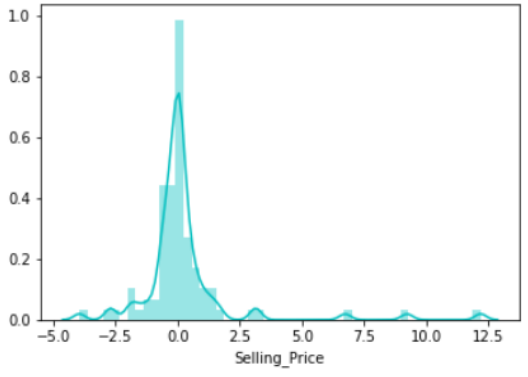

Figure 15. Jupiter notebook Screenshot 5 showing selling price

```
X.head()
```

	Present_Price	Kms_Driven	Owner	no_year	Fuel_Type_Diesel	Fuel_Type_Petrol	Seller_Type_Individual	Transmission_Manual
0	5.59	27000	0	6	0	1	0	1
1	9.54	43000	0	7	1	0	0	1
2	9.85	6900	0	3	0	1	0	1
3	4.15	5200	0	9	0	1	0	1
4	6.87	42450	0	6	1	0	0	1

```
y.head()
```

```
0    3.35
1    4.75
2    7.25
3    2.85
4    4.60
Name: Selling_Price, dtype: float64
```

Figure 16. Jupiter notebook Screenshot 5 showing selling price concerning other parameters like kms driven, transmission