ISSN No:-2456-2165

Cogni Value: Unveiling the Future-A Journey into used Car Price Forecasting with ANN and ML

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Abstract:- In the rapidly expanding domain of the used car market, accurately forecasting prices present a significant challenge, necessitating innovative solutions. This research paper introduces a ground-breaking methodology that combines the power of Artificial Neural Networks (ANNs) and machine learning algorithms to achieve highly precise predictions of used car prices. A comprehensive dataset is meticulously compiled, encompassing influential attributes such as make, model, year, mileage, condition, location, and additional features. Rigorous pre-processing techniques are applied to address missing values, outliers, and categorical variables, ensuring the dataset is optimized for accurate model performance. An intricate feature selection technique is employed to identify the most significant attributes driving used car prices. The model complexity is reduced by eliminating irrelevant and redundant features, leading to improved prediction accuracy and efficiency. The predictive models integrate ANNs with various machine learning algorithms, including linear regression, decision trees, random forests, and gradient boosting. ANNs play a central role in this framework, adeptly capturing the complex non-linear relationships inherent in the data. The empirical evaluation is conducted on a diverse dataset comprisinga wide range of used car transactions, encompassing different makes, models, and geographical locations. Random partitioning divides the dataset into training and testing subsets, enabling thorough model training and comprehensive evaluation of predictive performance. The empirical findings unequivocally demonstrate the superiority of the proposed approach, with ANNs surpassing traditional machine learning algorithms in accurately predicting used car prices. ANNs excel in unravelling the intricate patterns and nuances within the data. Additionally, the inclusion of multiple machine learning algorithms provides valuable insights, enabling comparative analysis and a deeper understanding of their performances. The implications of this research are significant, benefiting used car dealerships, buyers, and sellers.Accurate price predictions facilitate fair negotiations and empower stakeholders to make well-informed decisions, ultimately enhancing market efficiency and customer satisfaction. As progress continues topropel the field forward, this research represents a pivotal milestone in predicting used car prices, leveragingthe synergy ofANNand machine learning algorithms. The proposed approach hasthe potential to redefine pricing strategies in the industry, introducing reliability and efficiency into the dynamic used car market.

Keywords:- *Artificial Neural Network, Decision Tree Regressor, Linear Regression.*

I. INTRODUCTION

In the ever-evolving landscape of the automotive industry, the market for used cars has become an integral part, driven by its own dynamics and intricacies. As buyers and sellers navigate the complex terrain of pricing used cars, accurately determining their market value has become a paramount challenge. The task is further complicated by the multifaceted nature of factors influencing prices, including the vehicle's age, mileage, condition, and a myriad of other attributes. In this era of data-driven decision-making, the integration of advanced computational techniques offers a promising solution.

This research endeavor sets out on a quest to delve into the realm of predicting used car prices, harnessing the capabilities of Artificial Neural Networks (ANN) and machine learning algorithms. Through the utilization of these advanced models, our objective is to unravel the intricate patterns and connections that exist between a multitude of car attributes and their corresponding values. The potential of such insights is substantial, empowering both buyers and sellers with the understanding necessary to make well-informed decisions and foster equitable transactions.

The primary objective of this study is to develop a robust predictive model capable of estimating used car prices with accuracy and precision. Through the integration of ANN and machine learning algorithms, we seek to overcome the limitations of traditional approaches and unlock new frontiers in the realm of pricing prediction. By capturing the intricate interplay between different attributes, wecan transform a previously complex and subjective process into an objective and data-based framework.

To achieve our research goals, we will utilize a comprehensive dataset comprising an extensive range of used car listings. This dataset will encompass diverse makes, models, years, and conditions, reflecting the rich and

varied landscape of the used car market. By implementing advanced pre-processing techniques, we will extract and engineer relevant features that encapsulate the essence of each vehicle's value proposition. Through rigorous experimentation, we will train and fine-tune the ANN model, optimizing its architecture and parameters to achieve the most accurate price predictions. Furthermore, alongside our investigation of the potential of ANN, we will conduct an extensive comparative analysis of various machine learning algorithms. This comparative assessment aims to shed light on the appropriateness and effectiveness of different models in the prediction of used car prices. Through this analysis, we strive to develop a comprehensive understanding of the distinct advantages and limitations inherent in each approach, contributing to a more informed evaluation of their predictive performance.

The outcomes of this research endeavors hold immense value for all stakeholders involved in the used car market. Buyers will benefit from a transparent and data-driven pricing framework, empowering them to make informed purchasing decisions. Sellers, on the other hand, will be equipped with a competitive edge, armed with insights to set optimal asking prices and negotiate deals effectively. Furthermore, this study can contribute to enhancing market efficiency and establishing fair and mutually beneficial transactions. Through this paper, we strive to bridge the gap between the realm of used car pricing and the potential of ANN and machine learning algorithms. The findings of this study will shed light on the efficacy of these models, enabling industry professionals and researchers to explore new avenues in the field of automotive pricing. The lessons learned and insights gained will pave the way for further advancements and fuel future research endeavors.

In the following sections of this paper, we will conduct a comprehensive examination of the current state-of-the-art approaches and techniques employed in the prediction of used car prices. Subsequently, we will outline our research methodology, providing detailed information about the dataset used, the pre-processing steps undertaken, and the architecture of our ANN model. Next, we will present the experimental results and engage in a thorough discussion of their implications. Finally, we will conclude by summarizing the contributions of this study, identifying potential limitations, and suggesting directions for future research.

Overall, this research seeks to unlock the predictive potential of ANN and machine learning algorithms in the realm of used car pricing, revolutionizing the way prices are estimated and empowering market participants with actionable insights.

II. LITERATURE SURVEY

The study of predicting used car prices has gained considerable importance due to the growing need for precise valuation in the pre-owned vehicle market. Scholars have delved into numerous methodologies and advancements in the implementation of Artificial Neural Networks (ANN) and machine learning algorithms to tackle this task. This literature survey provides a thorough examination of existing research, covering a wide range of approaches, discoveries, and developments pertaining to the prediction of used car prices using ANN and machine learning techniques

Several studies have been conducted on the topic of "Divination of pre-owned car price tags using Artificial Neural Networks and machine learning" to explore and enhance the accuracy of price predictions in the used car market. A study named "Used Car Price Prediction Using Artificial Neural Networks" by Zhang et al [1]. (2017) focuses on predicting used car prices using Artificial Neural Networks (ANN). The main objective of the study is to develop an ANN-based approach for accurately predicting used car prices by considering various car attributes. The authors utilize a dataset comprising historically used car prices. They train and test different ANN architectures to analyze their performance in predicting prices. It investigates the impact of feature selection on the accuracy of price prediction. The authors compare the results of using all available attributes versus using a subset of relevant features. The results of the study demonstrate that ANN models show promising performance in predicting used car prices. The paper concludes that ANN-based approaches have significant potential in accurately predicting used car prices.

Overall, the research paper by Zhang et al. provides insights into the application of ANN for used car price prediction. It emphasizes the importance of model selection and feature engineering in achieving accurate predictions, providing a foundation for further advancements in the field.

Another study named "Improving Used Car Price Prediction with Feature Engineering and Deep Learning" by Li et al [2]. (2020) focuses on enhancing the accuracy of used car price prediction through deep learning algorithms. Here is a summary of the key points and findings of the paper. The primary objective of the study is to improve the prediction accuracy of used car prices by utilizing feature engineering techniques and deep learning models. The authors employ a dataset containing historical data on used car prices along with a wide range of car attributes. They perform feature engineering, which involves transforming and pre-processing the attributes to enhance their representation. The study investigates various feature engineering techniques. These techniques aim to improve the representation of the input data, capturing important patterns and relationships between the car attributes and prices. The results of the study indicate that incorporating feature engineering techniques improves the prediction accuracy of used car prices. The deep learning models, demonstrate the ability to capture temporal dependencies and achieve more accurate predictions compared to traditional machine learning models. The paper concludes that featureengineering and deep learning models contribute to improved used car price prediction. The findings emphasize the importance of pre-processing and transforming the input data and highlight the effectiveness

of deep learning models in capturing complex patterns and temporal relationships.

In summary, the research paper by Li et al. provides insights into enhancing used car price prediction through feature engineering and deep learning. It emphasizes the significance of pre-processing techniques and the utilization ofadvanced models for achieving improvedprediction accuracy in the domain of used car prices.

Therefore, a variety of methodologies and advancements to enhance the accuracy of price predictions. Researchers have delved into different ANN architectures to capture intricate relationships between car attributes and prices. Comparative studies have been conducted to assess the effectiveness of various machine learning algorithms in predicting used car prices. Feature selection techniques have also been investigated to identify influential attributes and enhance prediction performance. The studies underscore the significance of model selection, pre-processing techniques, and ensemble methods in achieving precise and reliable predictions. The findings of the study conducted by Li et al suggest that ANN and machine learning algorithms may be the most suitable algorithms for pre-owned car price prediction.

III. METHODOLOGY

The company that manufactures the vehicle in the automobile sector decides the cost of a new vehicle, with some additional expenses paid by the government in the form of taxes. Customers can be sure that their investment in a new car will be worthwhile as a result. But because new cars are becoming more expensive and consumers can no longer afford to acquire them, used car sales are rising everywhere. Therefore, a system that accurately assesses the value of the car using a range of features is urgently needed for used car price prediction. Leasing a car rather than purchasing one entirely is typical in many affluent nations. A lease is a legally enforceable contract between the purchaser and the seller (or third party; often a bank, insurance firm, or other financial institution), in which the buyer promises to pay the vendor/financier in fixed per-month or yearly instalments.

The buyer has the option to purchase the vehicle at its residual valuethat is, its anticipated market valueafter the lease time is finished.

In the Existing system we are using linear regression.

A. *DRAWBACKS:*

- The presumption that dependent and independent variables are related in a linear manner.
- Noise and overfitting are frequently encountered issues.

B. *Proposed System:*

Predicting used car prices is the most important aspect of the used automobile industry. To achieve this, we require a model that can determine the price at which a used car should be sold at a profit for both the seller and the buyer. Because price typically depends on numerous distinguishing traits and aspects, car price prediction has therefore been a research area with great interest. This is because it demands great understanding in the industry.

There are numerous occasions where con artists defraud buyers. As a result, we cannot rely on price predictions made by individuals because they may be biased. So, in this research, an artificial neural network is applied to develop a model that forecasts the price of used cars without discriminating either the owner or the buyer.

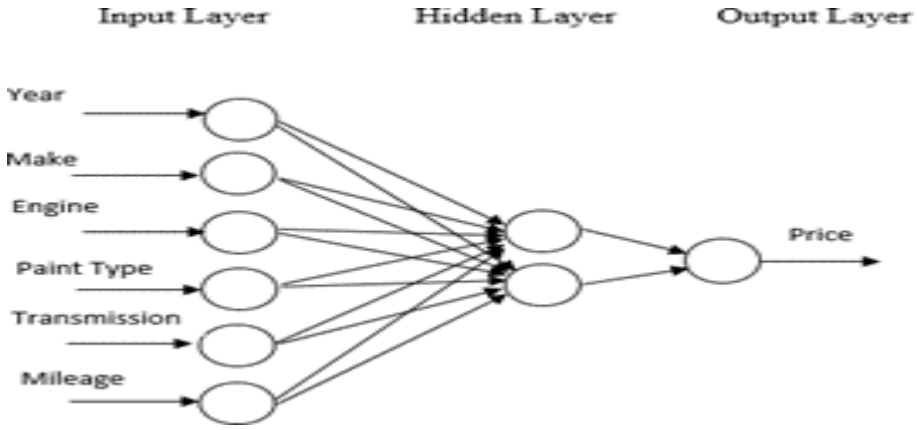

Fig. 1: Neural Network Architecture

A neural network with six inputs and one hidden layer containing two nodes was used to predict the price of second-hand cars.

To implement this project, we have designed following modules

- Data Collection
- Dataset
- Data Preparation
- Model Selection
- Analyze and Prediction

➢ *Data Collection*

We create the Data Collection module in the first module. This marks the beginning of the actual process of building a machine learning model and gathering data. This is a crucial phase since how well the model performs will be influenced by how much more and better data we can collect. Data collection methods include web scraping, manual interventions, and others.

➢ *Dataset*

The dataset consists of 301 individual data. There are 9 columns in the dataset, which are described below.

- **Name-** Company of the car
- **Year-** Year in which it was purchased
- **Selling_Price –** the price at which it is sold after using vehicle
- **Present_price–** the price when the car was purchased
- **Kms_Driven –** the total kilometers that the car was driven
- **Fuel_Type–** sort of fuel (petrol/diesel/CNG)
- **Seller_Type –** if it is being sold by individual or dealer
- **Transmission –** gear transmission of vehicle (whether it is automated/manual)
- **Owner –** Number of owners that used the particular car.

➢ *Data Preparation*

Gather data and get it ready for training. Clean up everything that might need it (remove duplicates, fix errors, handle missing numbers, normalize, convert data types, etc.).

The impacts of the specific order in which we collected and/or otherwise prepared our data are eliminated by randomizing the data.Perform other exploratory analysis, such as visualizing data to identify meaningful correlations between variables or class imbalances (bias alert!). Sets for training and evaluation are separated.

➢ *Model selection*

We employed the machine learning algorithm Decision Tree Regression. A supervised learning method called a decision tree can be used to solve classification and regression problems, but it is typically favored for doing so. It is a tree-structured classifier, where internal nodes stand in for a dataset's features, branches for the decision-making process, and each leaf node for the classification result.

C. Decision Tree Regressor:

Decision Trees are a type of supervised machine learning where the data is continually divided according to a specific parameter (you explain what the input is and what the related output is in the training data).Decision nodes and leaves are the two components that can be used to explain the tree.By constructing a decision tree, it creates the categorization model. A test on an attribute is specified by each node in the tree, and each branch descending from that node represents one of the possible values for that attribute.

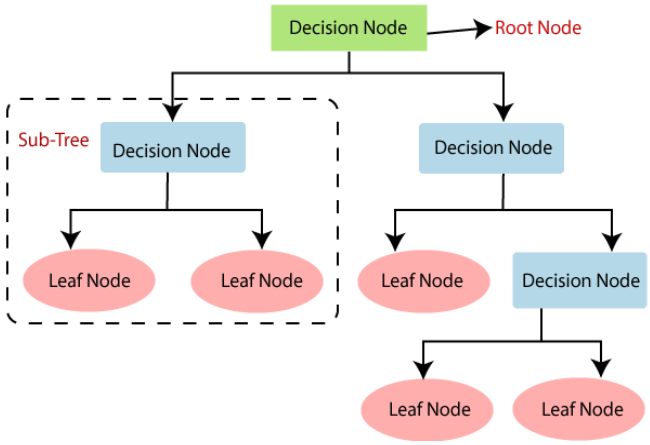

Fig. 2: Decision Tree Representation

D. Advantages:

- Simple to understand and to interpret. ...
- Requires little data preparation. ...
- The cost of using the tree (i.e., predicting data) is logarithmic in the number of data points used to train the tree.
- Able to handle both numerical and categorical data. ...
- Able to handle multi-output problems.

E. Analyze and Prediction:

In the actual dataset, we chose only 7 features:

- Year- Year in Which it was purchased
- Present_price– the price when the car was purchased
- Kms_Driven – the total kilometers that the car was driven
- Fuel_Type– sort of fuel(petrol/diesel/CNG)
- •Seller_Type – if it is being sold by individual or dealer
- Transmission – gear transmission of vehicle (whether it is automated/manual)
- Owner – Number of owners that used the particular car
- Selling_Price – the price at which it is sold after using vehicle (Target)

➢ *Exploratory Data Analysis:*

Using statistical graphics and other methods for data visualization, we present a summary of the key features of the data at this point.To help with understanding, many graphs and charts are plotted.having knowledge of the dataset and the connections between its features.

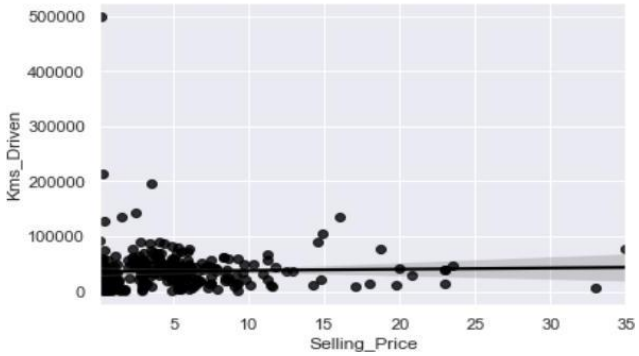

Fig. 3: Initial price v/s Selling price

➢ **Comparison of Initial Price and Selling Price:** The graph below shows the direct proportionality between Initial Price and Selling Price, suggesting that a greater initial price will produce a higher selling price.

Fig. 4: Kilometer'sDrivenv/sSellingPrice

➢ **Comparison of Miles Travelled and Selling Price:** The graph above demonstrates that a car with a high mileage will sell for less money than one with a low mileage.

➢ *One hot encoding:*

The categorical variables in the dataset are handled using the one hot coding method. In addition to establishing a binary column for each category or parameter, it generates a sparse matrix or dense array based on the parameters. Our dataset's three categorical variables were Fuel Type, Seller Type, and Transmission. These variables receive a binary representation after a single hot encoding, meaning that for a car with a fuel type of diesel, Fuel_Type_Diesel's value is a binary 1 and Fuel_Type_Petrol's value is a binary 0. The remaining category variables follow the same process.

IV. USING THE TEMPLATE

After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your

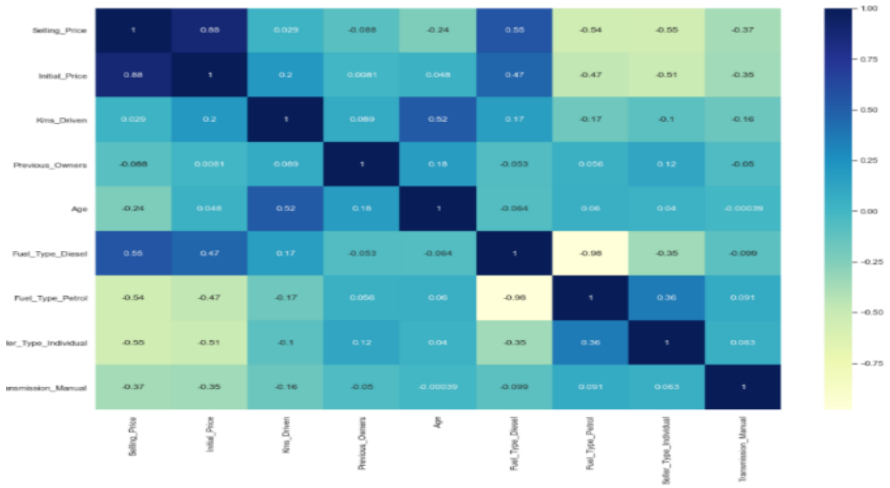

Fig. 5: Correlation Heatmap

ISSN No:-2456-2165

Correlation feature heatmap for the complete dataset: How nearly a linear relationship exists between two variables is indicated by a dataset's correlation characteristics. High correlation features are more linearly dependent and affect the dependent variable in the same way. We can always omit one of the variables if there is a strong association between the two. The correlation heatmap is displayed below, with darker hues signifying higher correlation and lighter hues signifying lower correlation.

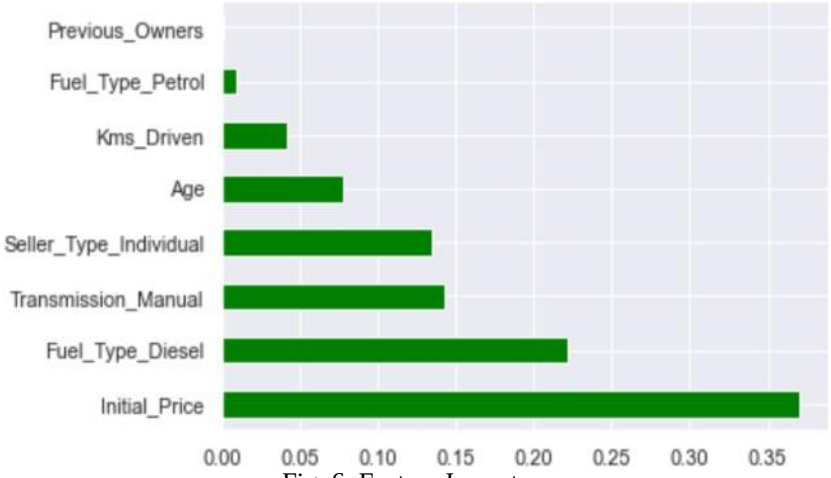

Fig. 6: Feature Importance

The feature significance technique assigns a score to each feature in a feature set depending on how well it can be used to forecast the target variable. The offered dataset's Initial Price characteristic is the most pertinent, whilst preceding Owner is the least significant.

- *Test set accuracy:*
  On the test set, we achieved an accuracy of 91.7%.

- *Output Snapshots:*

- *Protecting the Practiced Model:*
  The first step is to store your trained and tested model into a.h5 or.pkl file using a library like pickle after you are confident enough to use it in a production-ready environment.Verify that Pickle is set up in your environment. Importing the module and dumping the model into a.pkl file is the next step.

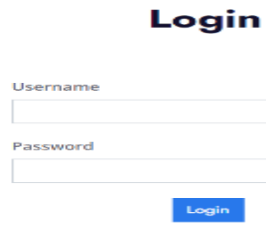

Fig. 7: The login page

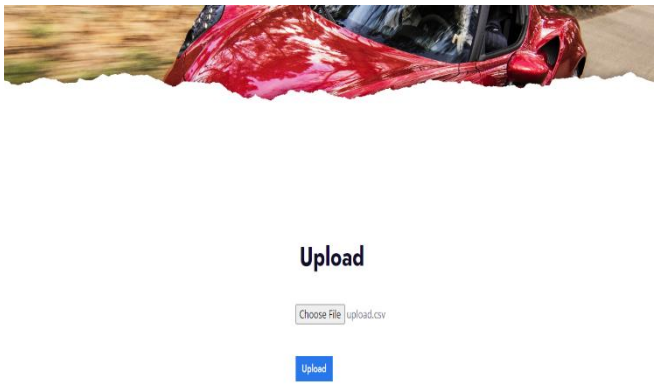

Fig. 8: The Dataset is uploaded in csv format

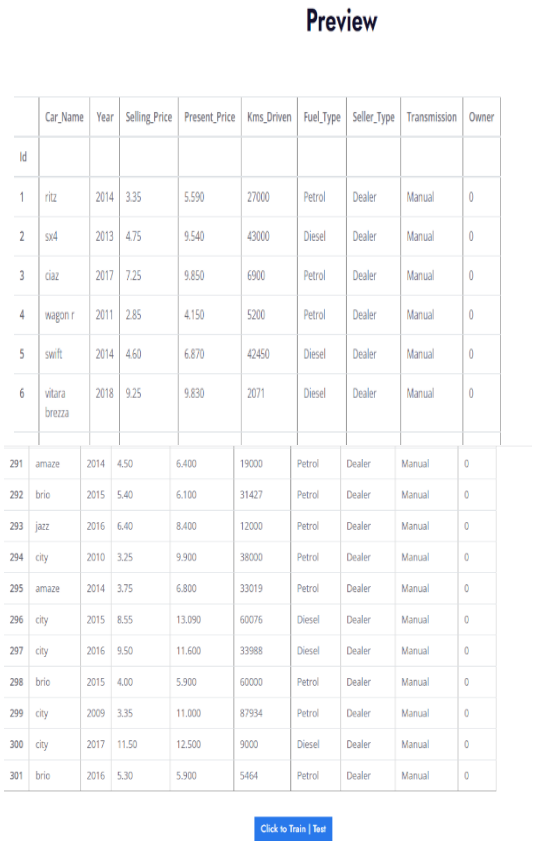

Fig. 9: The dataset

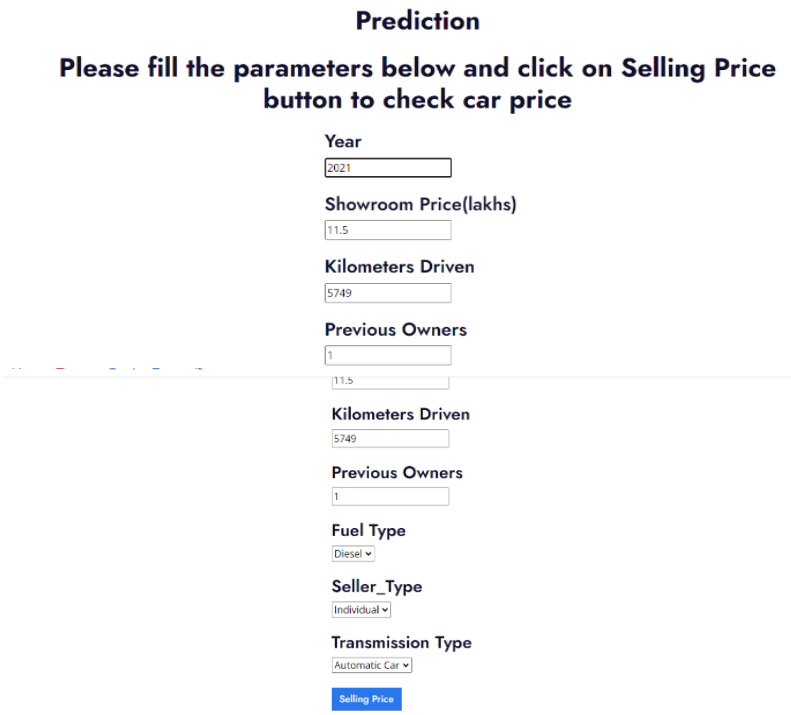

Fig. 10: All the input data is entered

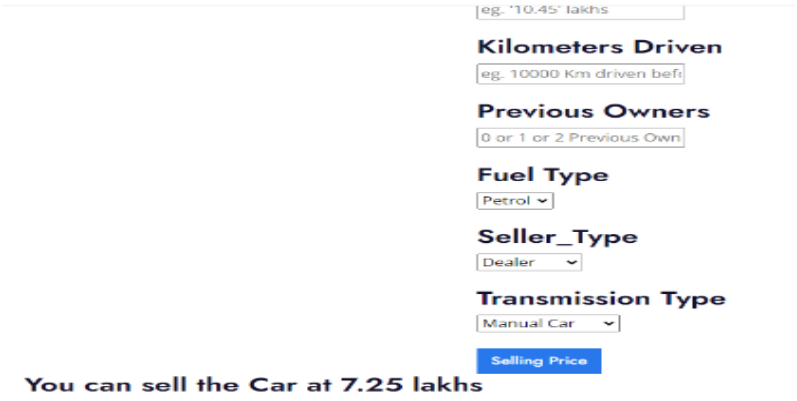

Fig. 11: The final predicted price

V. CONCLUSION

In conclusion, this research paper has embarked on a captivating journey into the realm of predicting used car prices using the powerful tools of machine learning (ML) and Artificial Neural Networks (ANN). The objective of this study wasto explore the vast potential of thesecutting-edge techniques in providing accurate and reliable predictions, facilitating informed decision-making in the dynamic used car market. Through a thorough analysis of existing research, it has become evident that ML algorithms and ANN architectures offer a promising avenue for unravelling the intricate relationships between various car attributes and their corresponding prices. While this research has contributed valuable insights and advanced our understanding of predicting used car prices using ML and ANN, there are still uncharted territories and untapped potentials.

In essence, the prediction of used car prices using ML and ANN stands at the forefront of innovation in the automotive industry. The findings of this research paper open new doors of possibilities, empowering both buyers and sellers with valuable insights and equipping them to navigate the intricate landscape of used car transactions. As technology continues to evolve, this field holds immense promise, revolutionizing the way we perceive, evaluate, and engage in the used car market.

VI. FUTURE ENHANCEMENT

In addition to the significant contributions made by this research paper on the prediction of used car prices using ML and ANN, there are several avenues for future enhancement and exploration. These potential directions can further advance the accuracy, robustness, and applicability of prediction models in the dynamic used car market.

Firstly, incorporating more advanced feature engineering techniques can be a fruitful area of focus. Exploring domain-specific knowledge and domain-adaptive approaches can help uncover additional relevant features that significantly impact the pricing of used cars.

Secondly, the utilization of hybrid models that combine the strengths of different ML algorithms and ANN architectures holds promise. By integrating multiple models, such as ensemble learning techniques, the prediction accuracy can be further improved, and the models can demonstrate enhanced generalization capabilities across different datasets and market conditions.

Lastly, considering the integration of real-time data streams and online learning methodologies can enable continuous model updates and adaptability to evolving market conditions. This can provide more up-to-date and reliable predictions, particularly in a market as dynamic as the used car industry.

Overall, by delving into these future enhancements, researchers can push the boundaries of prediction accuracy, expand the scope of model applicability, and ultimately contribute to the advancement of the field of predicting used car prices using ML and ANN.

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