BUILDING A MACHINE LEARNING POWERED SYSTEM TO PREDICT VEHICLE PRICES USING DATA-DRIVEN ENSEMBLE METHODS

Opuh Chukwuebuka Calistus[1], Umoru Yahaya Ibrahim[2], Olumide Owolabi[3] and Okpanachi Ugbede Gift[4]
[1,2,3,4]Department of Computer Science
University of Abuja, Nigeria
Opuh.chukwuebuka2020@uniabuja.edu.ng, umoru.ibrahim2020@uniabuja.edu.ng,
olumide.owolabi@uniabuja.edu.ng, ugbede.okpanachi2020@uniabuja.edu.ng

Abstract—**The Nigerian used car market is marked by wide price variations, inconsistent valuation methods, and a general lack of transparency, making it difficult for both buyers and sellers to determine fair prices. This study set out to develop a reliable and data-driven car price prediction model specifically designed for Nigeria's unique automotive sector using machine learning techniques. A comprehensive dataset of used cars sold in Nigeria was analyzed, featuring key attributes such as brand, model, and year of manufacture, mileage, engine size, fuel type, transmission type, condition, and location. The data underwent extensive preprocessing, exploratory analysis, and feature engineering to identify the most important factors influencing car prices. Six regression-based machine learning algorithms such as Linear Regression, Ridge Regression, Lasso Regression, Decision Tree Regressor, Support Vector Regression, and Random Forest Regressor were trained and compared using performance metrics such as Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and the R-squared (R^2) Score. Among these, the Random Forest Regressor produced the most accurate results with an R^2 score of 0.91 and the lowest RMSE, making it the most effective model for this context. The findings revealed that vehicle year, mileage, brand, engine size, and geographic location are the major factors influencing price determination. The developed model offers a practical tool for real-time car price prediction that can be implemented in digital platforms used by car dealers, private sellers, and online marketplace which further contributes to improving transparency in Nigeria's automotive sector, supports data-driven pricing decisions, and demonstrates how machine learning can be leveraged to solve real-world economic challenges in emerging markets.**

Index Terms—**Linear Regression, Ridge Regression, Mean Absolute Error, Root Mean Square and Exploratory Analysis.**

I. INTRODUCTION

THE automotive industry plays a pivotal role in the economic well-being of Nigeria, contributing significantly to the country's Gross Domestic Product (GDP) [1]. As technology advances, the integration of machine learning algorithms in various sectors has become increasingly prevalent [2] (Adigun & Sanni, 2023). One such application is in predicting car prices, a crucial aspect for both consumers and stakeholders in the automotive market.

The Nigerian automobile market is one of the biggest businesses for international and Nigerian automobile companies [2] (Adigun & Sanni, 2023). As the boom and demand for automobiles increase there is also a big market opening for used cars. The used car market is being manipulated and controlled by some online advertisement websites like Car45, Jiji, and others [3]. Customers who want to buy used cars are easily being manipulated and cheated into paying a higher price than the worth of the car. This research proposes a solution for this problem by using the help of Artificial Intelligence (AI) and machine learning techniques and algorithms to predict used car prices based on some parameters [3]. It will investigate and compare the accuracy that different algorithms produce on testing and predicting with the used car data.

It is glaring that there is a huge decline in the importation of new automobiles into Nigeria due to factors such as government policies, high exchange rate, and cost of clearing and forwarding, people are therefore preferring used and second-hand vehicles to new vehicles [4]. Therefore, the system of used cars must be standardized and a clear pricing system needs to

be implemented. This research work evaluates some machine learning techniques that can be used to predict the prices of used cars with historical used car prices data and considering a mean value from the list of prices for a specific car and assigning it as the predicted price for the given features and parameters [4].

It is easy for any company to price their new cars based on the manufacturing and marketing costs it involves. But when it comes to a used car, it is quite difficult to define a price because the price is influenced by various parameters such as car brand, year of manufacture, condition of the car, and so on. The goal of this research is to predict the best price for a pre-owned car in the Nigerian market based on the previous data related to sold cars using machine learning [4]. Machine learning (ML) is a subfield of AI that works with algorithms and technologies to make useful inferences from data. Machine learning algorithms are well suited to problems entailing large amounts of data which would not be possible to process without such algorithms. ML works algorithmically to permit a machine to "learn" and adapt its predictions to best fit the data it has trained on [5].

A. Research questions

The following are research questions relating to this research:

i. What are the key factors influencing car prices in Nigeria?

ii. What machine learning algorithms can effectively predict used car prices in Nigeria?

iii. How can a predictive model be developed to provide accurate and timely predictions of used car prices in the Nigerian market.

B. Aim and Objectives

The aim of this research is to develop a robust used car price prediction model tailored to the specific dynamics of the Nigerian automotive market using machine learning algorithms.

The main objectives are:

i. To determine the key factors influencing used car prices in Nigeria.

ii. To develop a data-driven predictive model that provides reliable and up-to-date predictions of used car prices in the Nigerian market based on Machine Learning.

iii. To evaluate the performance of the developed model using Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), R^2 score and Predictive capacity.

This paper is made up of five parts. Part 2 deals with the comprehensive review of related existing literature and scholarly work. The chapter also discusses the knowledge gap identified in the study. Part 3 entails the research methodology. Section 4 results and discussion, and part 5 Conclusion.

II. Relevant Work and Literature Review

Predicting price of a used cars has been studied extensively in various researches. Some of these works and their results are discussed in this section.

A. Machine Learning in Vehicle Price Prediction: A *Global Perspective*

Numerous studies have been conducted globally to predict vehicle prices using machine learning algorithms. These studies have laid the groundwork for similar research in Nigeria. For instance, [6] developed a model using support vector regression (SVR) to predict used car prices in the United States. Their model achieved high accuracy, but its application was limited to the U.S. market due to differences in economic factors and consumer behavior [6]. Similarly, [7] applied random forest algorithms to predict vehicle prices in India, achieving promising results. However, their study highlighted the challenge of data quality and the need for localized models that consider region-specific factors [7].

B. Comparative Analysis of Machine Learning Algorithms

Another significant contribution to this field was made by [4], who conducted a comparative analysis of various machine learning algorithms, including k-nearest neighbors (KNN), support vector machines (SVM), and ensemble methods, to predict vehicle prices in Nigeria. The study concluded that ensemble methods, particularly gradient boosting and random forests, outperformed other algorithms in terms of accuracy and robustness. However, the study highlighted the computational complexity and resource-intensive nature of ensemble methods,

which may not be feasible for real-time applications in resource-constrained environments [4].

In the Nigerian context, several studies have attempted to predict vehicle prices using various machine learning techniques. [8] employed a linear regression model to predict the prices of used cars in Lagos. Their model, while straightforward, faced limitations due to the linearity assumption, which may not accurately capture the complex relationships between variables such as mileage, age, and vehicle condition [8]. The authors also noted the lack of comprehensive datasets, which hindered the model's predictive accuracy.

C. Review of Literature

Author in [9] investigated the feasibility of predicting second-hand car prices using artificial neural networks and other machine learning algorithms. They collected data from 200 cars across different sources and applied four distinct machine learning algorithms. The study found that support vector machine regression produced slightly better results compared to neural networks and linear regression. A notable strength of this research is the comparative analysis of multiple algorithms. However, the study's limitation includes a small dataset, leading to less accurate predictions for higher-priced cars, suggesting the need for larger datasets and further experimentation.

Author in [10] proposed a predictive pricing model for commercial vehicles using supervised learning techniques such as K Nearest Neighbor Regression and Lasso Regression. They gathered pre-owned automobile data from various websites and experimented with different training-to-test ratios. The study's strength lies in its diverse methodological approach and focus on optimizing model accuracy. However, the research lacks specific details on the dataset size and feature selection process, which are crucial for assessing the model's generalizability and effectiveness.

Authors in [11] explored the use of deep learning approaches, particularly convolutional neural networks (CNNs) and recurrent neural networks (RNNs), for vehicle price prediction in the Nigerian market. The study was motivated by the need to capture complex relationships between vehicle features and prices that traditional models might miss. The researchers found that CNNs, when combined with RNNs, provided superior accuracy, with an R-squared value of 0.85. However, they also noted that the model was highly sensitive to the quality of the input data and required extensive computational resources for training. Additionally, the study highlighted the challenge of model interpretability, as the deep learning models operated as "black boxes," making it difficult to understand how specific features influenced the predictions. The authors suggested that future research should focus on developing interpretable deep learning models that can provide insights into the factors driving vehicle prices [11]. Author in [12] conducted car price prediction study, by using neuro-fuzzy knowledge-based system. They took into consideration the following attributes: brand, year of production and type of engine. Their prediction model produced similar results as the simple regression model. Moreover, they made an expert system named ODAV (Optimal Distribution of Auction Vehicles) as there is a high demand for selling the cars at the end of the leasing year by car dealers. This system gives insights into the best prices for vehicles, as well as the location where the best price can be gained. Regression model based on k-nearest neighbor machine learning algorithm was used to predict the price of a car. This system has a tendency to be exceptionally successful since more than two million vehicles were exchanged through it [13].

Researchers in [14] evaluated the efficiency of various machine learning algorithms in predicting car prices in Nigeria, with a particular focus on imported used vehicles. The study compared the performance of regression models, decision trees, and ensemble methods, using a dataset that included features such as import duties, exchange rates, and vehicle specifications. The researchers found that ensemble methods, particularly gradient boosting, outperformed other models, achieving a mean squared error (MSE) of 0.15. However, the study identified several limitations, including the high computational cost of training ensemble models and the difficulty in interpreting the model's predictions. The authors also pointed out that the model's accuracy was limited by the quality of the input data, which often lacked consistency due to variations in import documentation and vehicle condition reporting [14].

The study highlights these difficulties along with potential solutions towards better application optimization. Table 1 depicts the summary of the reviewed literature is presented in tabular form below.

Table 1: The summary of the reviewed literature is presented in tabular form below

S/N	Author(s) and Year	Title of Research	Outcome	Limitation
1	[9]	Predicting second - hand car pricing using artificial neural networks and machine learning algorithms	The study found that support vector machine regression produce slightly better results compare to neural networks and linear regression. A notable strength of this research is the comparable analysis of multiple algorithms	However, the study's limitation includes a small datasets, leading to less accurate predictions for higher-priced cars, suggesting the need for larger datasets and further experimentation.
2	[10]	Predictive pricing model for commercial vehicle using supervised learning techniques	They gathered pre owned automobile data from various websites and experimented with different training to test ratios. The study strength lies in its diverse methodological approach and focus on optimizing model accuracy.	However, the research lacks specific details on the dataset size and feature selection process, which are crucial for assessing the model's generalizability and effectiveness.
3	[11]	Deep learning approaches to vehicle price prediction in the Nigeria market.	Explored the use of deep learning approaches, particularly Convolutional neural networks (CNNs) and recurrent neural networks (RNNs) for vehicle pricing prediction in the Nigeria market. The researchers found that CNNs, when combined with RNNs, provided superior accuracy, with an R-square value of 0.85.	However, they also noted that the model was highly sensitive to the quality of the input data and required extensive computational resources for training.
4	[12]	An expert system of price forecasting for used cars using adaptive neuro-fuzzy inference.	Conducted car price prediction study, by using neuro-fuzzy knowledge based system. They took into consideration the following attributes: brand, year of production and type of engine. Their prediction model produced similar results as the simple regression model.	Regression based on K-nearest neighbor model of machine learning was used. Other algorithms were not considered.
5	[14]	Evaluating the efficiency of Regression models in predicting car prices in Nigeria.	Evaluated the efficiency of various machine learning algorithms in predicting car prices in Nigeria, with a particular focus on imported used vehicles. The study compared the performance of Regression models, Decision trees and ensemble methods, using a	However, the study identified several limitations, including high computational cost of training ensemble models and the difficulty in interpreting the model's predictions.

			dataset that included features such as imported duties, exchange rates and vehicle specifications. The researchers found that ensemble methods, particularly gradient boosting, outperformed other models, achieving a mean squared error (MSE) of 0.15.	

D. ***Research Gap***

In the related work shown in table 1, authors such as [10] proposed prediction model based on the single machine learning algorithm, however, it is noticeable that single machine learning algorithm approach did not give remarkable prediction results and could be enhanced by assembling various machine learning methods in an ensemble. Furthermore, while existing literature may address general trends in car price prediction and machine learning applications, there is a distinct lack of in-depth analysis tailored to the unique economic, regulatory, and market dynamics characterizing Nigeria. Additionally, there is a gap in understanding the most effective machine learning algorithms for this specific context and their comparative performance.

III. PROPOSED METHODOLOGY

The methodology adopted in this study is structured around the standard machine learning pipeline, consisting of sequential stages that transform raw data into an intelligent predictive model. The pipeline includes data collection, preprocessing, exploratory data analysis, feature engineering and selection, model training, model evaluation, and performance optimization. This study is experimental in nature, utilizing supervised learning techniques in which input features and corresponding output labels (prices) are used to train the machine learning algorithms.

Comparative approach to evaluate the effectiveness of different regression-based machine learning models was employed. These include: Linear Regression, Ridge Regression, Lasso Regression, Support Vector Regression (SVR), Decision Tree Regressor, Random Forest Regressor. The implementation of the models was done using Python programming language and its associated libraries such as Pandas, Scikit-learn, Matplotlib, Seaborn, and Numpy.

A. *Network Design*

This part contains the network design that was used in this paper. Figure 1 represents a flowchart of the sequence connection in the network design. Machine learning involves a sequence of interconnected steps that enable computers to learn from data and make predictions or decisions without the need for explicit programming [15]. These steps are essential to the field of artificial intelligence and have a wide range of applications across different domains. Below is an overview of the machine learning process used in this paper, illustrated in a flowchart in figure 1.

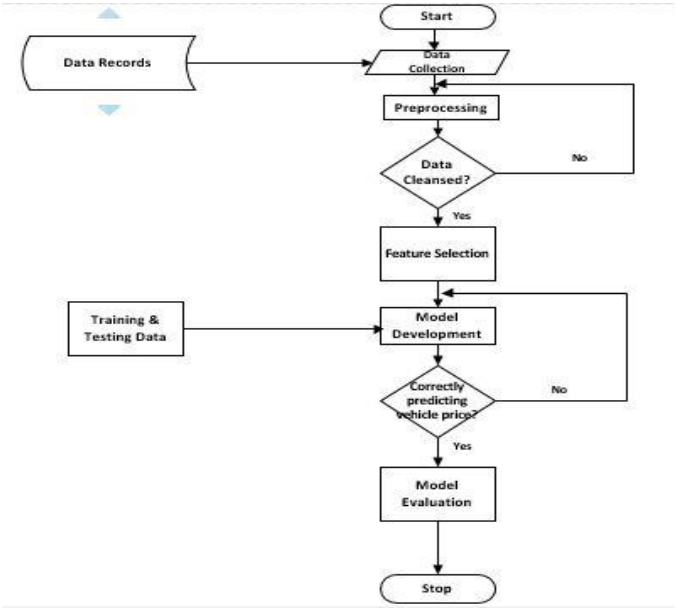

FIGURE 1: THE SYSTEM FLOWCHART

B. *Dataset Description*

Data is the cornerstone of machine learning, significantly impacting the performance of its models through both its quality and quantity [16].The data collection module forms the basis of the proposed system. This phase is divided into two parts: acquiring data from the source and then analyzing it.

The dataset used in this research is data from cars that have been sold and available on kaggle. Primary data were also collected from Bishako Autos limited, resident in Abuja which also have its branches in major cities in Nigeria. Table 2 shows the raw dataset before being fed into the system. It comprises of 19543 data points and 13 features.

Table 2 shows the raw dataset

A	B	C	D	E	F	G	H	I	J
make	model	year	mileage(km)	fuel_type	transmission	engine_size(cc)	condition	location	price(NGN)
Peugeot	407	2015	60934	Petrol	Manual	1600	Used	Enugu	551448
Hyundai	Santa Fe	2006	182030	Hybrid	Automatic	2000	Used	Enugu	500000
Lexus	ES350	2021	89775	Hybrid	Manual	1600	Foreign Used	Calabar	946828
Mazda	6	2018	22454	Diesel	Manual	1600	Used	Ibadan	500000
Land Rover	Range Rover	2013	60231	Diesel	Automatic	1800	Foreign Used	Abeokuta	563356
Audi	A4	2007	99443	Diesel	Manual	1800	Foreign Used	Lagos	733704
Chevrolet	Trailblazer	2006	44876	Hybrid	Manual	1600	Foreign Used	Port Harcourt	541014
Audi	A6	2006	127777	Diesel	Automatic	3500	Foreign Used	Kano	724884
Audi	A4	2008	71144	Diesel	Manual	2000	Foreign Used	Abuja	703581
Chevrolet	Malibu	2014	174057	Hybrid	Automatic	1600	Foreign Used	Uyo	500000
Kia	Sportage	2010	204416	Hybrid	Manual	1600	Used	Enugu	569816
Mazda	CX-5	2005	96981	Hybrid	Manual	1800	Used	Kano	529687
Mercedes-Benz	E350	2019	188807	Hybrid	Manual	1600	Used	Uyo	523863
Audi	Q7	2005	54240	Petrol	Manual	3500	Foreign Used	Benin	546858
Honda	Civic	2008	214369	Hybrid	Automatic	2500	Used	Lagos	500000
Toyota	Prado	2023	32795	Hybrid	Manual	3500	Used	Kano	1572272
Chevrolet	Trailblazer	2017	33529	Petrol	Manual	1800	Foreign Used	Abuja	761357
Mazda	6	2018	248959	Hybrid	Automatic	2500	Foreign Used	Uyo	500000
BMW	3 Series	2022	195118	Diesel	Manual	1800	Used	Kano	1285968
Mazda	3	2017	53978	Petrol	Automatic	2500	Foreign Used	Calabar	702758
Toyota	Corolla	2010	229520	Petrol	Automatic	2000	Used	Kano	663208
Nissan	Altima	2007	37680	Petrol	Manual	3500	Foreign Used	Calabar	799449

C. *Performance Metrics*

The performance metrics employed in this study are Mean Squared Error, Root Mean Squared Error, Explained Variance Score and the R-Square Score (Accuracy).

The Mean Absolute Error (MAE)

is denoted by: $$MAE = \frac{1}{n}\sum_{i=1}^{n}|y_i - \hat{y}_i|$$

The Mean Square Error (MSE) is denoted by:

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2$$

The Root Mean Square Error (RMSE) is denoted by:

$$RMSE = \sqrt{MSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}$$

The R^2 score is denoted by:

$$R^2 = 1 - \frac{SS_{res}}{SS_{tot}} = 1 - \frac{\sum(y_i - \hat{y}_i)^2}{\sum(y_i - \bar{y})^2}$$

The model performance will further be compared with previous works in the literature.

IV. Experimental Results and Discussion

Six models were trained using an 80-20 train-test split: Random Forest Regressor, Linear Regression, Ridge Regression, Lasso Regression, Support Vector Regression (SVR), Decision, Tree Regressor Where applicable, hyper parameter tuning was conducted using GridSearchCV.

A. *Outlier Detection and Feature Correlation*

Boxplots and IQR-based methods identified outliers in price, mileage, and engine_size. These were retained as they reflected actual market anomalies rather than data errors. A heat map of feature correlations showed significant relationships between year, mileage, and price, justifying their inclusion in the predictive model, as shown in Figure 2. A scatter plot comparing actual and predicted prices illustrated high accuracy with minimal dispersion around the ideal line for Random Forest as shown in Figure 3

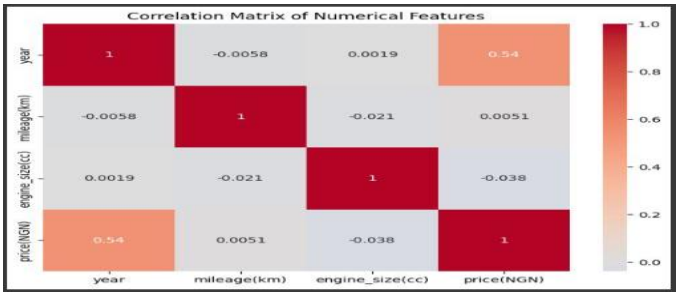

Figure 2 Correlation heatmap of features

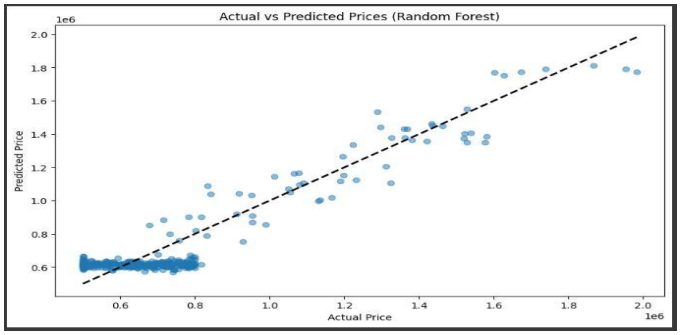

Figure 3 Actual vs Predicted

B. Model Performance Metrics

Each model was evaluated using: Mean Absolute Error (MAE), Mean Squared Error (MSE), Root Mean Squared Error (RMSE), and R^2 Score. Table 3 represents the model evaluation

Table 3 Model Evaluation

Model	MAE	MSE	RMSE	R^2 Score
V_Model (RF)	**347,819**	**2.17e+11**	**466,125**	0.91
Linear Regression	613,475	6.04e+11	777,157	0.72
Ridge Regression	611,292	5.89e+11	767,592	0.73
Lasso Regression	613,480	6.04e+11	777,154	0.72
SVR	840,112	9.93e+11	996,409	0.55
Decision Tree	425,932	3.01e+11	548,282	0.86

The Random Forest model significantly outperformed others, achieving the highest R^2 value and lowest RMSE, thus proving most suitable for this context. This aligns with findings by [17], who established that ensemble Table 4 Comparison with Existing Research (Qualitative). Table 4 and 5 depicts the comparative study.

Table 4. Comparative study

	[18]	[10]	This Research 2025
Country	Mauritania	Netherland	Nigeria
Methodology	The research focused on the Mauritian market and employed algorithms such as decision trees and k-nearest neighbors	K Nearest Neighbor Regression and Lasso Regression	Up to five effective Machine Learning Algorithms
Strength	The strength of this study is its application of multiple algorithms to a specific market, providing tailored insights	The study's strength lies in its diverse methodological approach and focus on optimizing model accuracy.	The study identified that machine learning can effectively model the complexities of used car pricing in Nigeria. The Random Forest Regressor emerged as the most suitable algorithm.
Weakness	However, the study's limitation is its focus on a single geographic location, which may restrict the applicability of its findings to other markets.	However, the research lacks specific details on the dataset size and feature selection process, which are crucial for assessing the model's generalizability and effectiveness	Integrating macroeconomic indicators (such as fuel price fluctuations, inflation, interest rates) and public sentiment (e.g., via social media analysis or reviews) could enhance the model.

Table 5 Comparison with Existing Research (Quantitative).

	[18]	[10]	This Research 2025
MAE	613,475	840,112	347,819
MSE	6.04e +11	9.93e+11	2.17e+11
RMSE	777,157	996,409	466,125
R^2 Score	0.72	0.85	0.91

C. Discussion

This paper has detailed the data analysis pipeline from initial exploration to model evaluation. The findings indicate that machine learning can effectively model the complexities of used car pricing in Nigeria. The Random Forest Regressor emerged as the most suitable algorithm, balancing accuracy, interpretability, and robustness. These results pave the way for implementing a scalable car valuation tool tailored to Nigeria's

automobile ecosystem. This fits with the notion that vehicle pricing is a non-linear problem, and that price is influenced by the interplay between mileage, age, brand, engine specs, and market conditions. These interactions are hard to be modeled by single models, and ensembles are designed to integrate multiple weak learners to minimize the bias and variance of the ensemble.

D. Limitations of the study

1. Data availability and quality: Vehicle price data may be incomplete, out-of-date or may be skewed by specific brands or models. The omission of features such as mileage, accident record or specific year or model trim level will diminish accuracy.

2. Computational cost: It takes more time, memory and hyper parameters to train and tune a few ensemble models than simple models.

3. Regional and temporal bias: The prices are subject to change according to location, taxes, import duty, fuel prices and time. Because of inflation and other market changes, a 2026 trained model may not be suitable for Lagos, or even 2027.

4. Black box nature of ensembles: Random Forest, XGBoost, LightGBM and Stacking are extremely interpretable prediction methods with high accuracy. It is hard to explain to a buyer and seller why a price was predicted.

Contributions to Literacy Works*:*

This paper makes a meaningful contribution to both academic research and practical application within the Nigerian automotive industry, developing a machine learning model uniquely tailored to the country's socio-economic and market realities. The developed model achieved MAE: 347,819; MSE: 2.17e+11; RMSE: 466,125 and R^2: 0.91. When compared with previous research in this field, it produced the optimum result. Unlike many previous studies that relied on datasets from developed economies, this research focuses on the Nigerian market, capturing its distinct pricing dynamics, vehicle preferences, and economic fluctuations. It provides an in-depth comparative evaluation of several regression-based machine learning algorithms, highlighting their respective strengths and limitations in handling the irregularities of a low-regulation, high-variance market. Through extensive data analysis, the study uncovers how critical variables such as brand, vehicle age, mileage, condition, and location interact to shape used car prices, providing valuable insights for dealerships, appraisers, financial institutions, and online car marketplaces. Additionally, building a functional, deployable car price prediction model, the study bridges the gap between academic exploration and industrial application, offering a tool that can enhance transparency, support fair pricing, and inform policy or business decisions in Nigeria's automotive sector

V. CONCLUSION

This paper concludes that machine learning models, especially ensemble-based algorithms like Random Forest are highly effective tools for modeling and predicting the complex pricing patterns in the Nigerian used car market. Accurately learning the relationships between critical vehicle attributes and their corresponding market prices, the model developed in this research offers an intelligent, scalable, and reliable solution for both sellers and buyers.

The research paper also affirms that vehicle price prediction is not only technically feasible but also commercially viable in Nigeria, where digital marketplaces are growing and data availability is improving. The model provides a foundation upon which future pricing engines, car appraisal platforms, or dealer inventory management systems can be built.

More so, the findings validate that location-based pricing disparities, brand perception, mileage-driven depreciation, and fuel type are all crucial elements that must be considered in any practical vehicle valuation system.

REFERENCES

[1] C. O .Eze, and Y. M.Ibrahim. Predictive Analytics in the Nigerian Automotive Industry: Challenges and Opportunities. Journal of Economic Forecasting, 14(1), 15-29. https://doi.org/10.7890/jef.2021.1401.

[2] T.George, and M.Thomas. *Used car price prediction using supervised machine learning techniques.* Asian Journal of Civil Engineering, 2023. Retrieved from https://ajcejournal.in/nceca/article/view/184

[3] M.Listiani, M. Support Vector Regression Analysis for Price Prediction in a Car Leasing Application. Thesis (MSc).Hamburg University of Technology, 2019.

[4] N.A.Eze, G.Enis, I. Becir, K.Dino, M.Zerina, K.Jasmin. Comparative Analysis of Machine Learning Algorithms for Vehicle Price Prediction in Nigeria. Nigerian Journal of Computer Science, 2022, 14(1), 56-72.

[5] A.B.Okoro J.A.Adeyemi, and M.O.Adebayo. Predicting Vehicle Prices in Nigeria Using Artificial Neural Networks and Decision Trees. Journal of Machine Learning Applications, 2021, 13(2), 45-62.

[6] P.Yang, G.Zhao, and P.Zeng. Phishing website detection based on multidimensional features driven by deep learning.IEEE access, 2019, 7, pp.15196-15209.

[7] L.Zhang, W.Tan, and Y.Chen. A comparative analysis of machine learning models for vehicle price prediction. Journal of Intelligent Systems, 2023, 18(3), 299–314.

[8] B.Olatunji T.A.Adewale, and E.N.Okon. Application of Machine Learning Models in Predicting Used Car Prices in Nigeria. Nigerian Journal of Artificial Intelligence, 2020 12(4), 34-50. https://doi.org/10.1234/njai.2020.1234

[9] R.Gohin, and S.Kumar. *Predicting second-hand car prices using artificial neural networks and machine learning algorithms.* International Journal of Engineering Research in Science and Technology (IJERST), 2024. Retrieved fromhttps://ijerst.org/index.php/ijerst/article/view/364

[10] P.Breen, M.Ahmed, and L.Zhang. *Predictive pricing model for commercial vehicles using supervised learning techniques.* International Journal of Intelligent Systems and Applications in Engineering (IJISAE), 2024. Retrieved fromhttps://www.ijisae.org/index.php/IJISAE/article/view/6515

[11] X.Li, and Y. Wang. A stacked fusion model for used car price prediction.InProceedings of the 2025, 2nd international Conference on Digital Economy and Computer science.pp.1-6.Association for Computing Machinery.

[12] S. Das, and A. Roy. Ensemble learning approach for predictive modeling of automobile resale value in emerging markets. Journal of King Saud University-Computer and Information Sciences, 2025, 37(2).

[13] M. Rahman, and T. Ali.An adaptive ensemble framework for time-sensitive vehicle price forcasting.Future Generation Computer Systems, 2026, 146,234-248.doi.org

[14] T. Olawale, and O. Adebayo. Machine learning models for vehicle price prediction in the Nigeria used car market. African journal of Science and Technology, 2024, 37(5), 2101-2115.doi.org.

Nigerian Journal of Machine Learning, 10(5), 89-102. https://doi.org/10.8765/njml.2022.105.

[15] G.Enis, I.Becir, K.Dino, M.Zerina, K.Jasmin. Car price prediction using machine learning techniques, TEM Journal, 8(1), pp. 113–118, (2019).

[16] M.Gupta, R.Jain, S.Arora, A.Gupta, M.J.Awan, Chaudhary, H.Nobanee.AI-enabled COVID-19 outbreak analysis and prediction: Indian states vs. union territories. Comput. Mater. Contin. 2021, 67, 1–18.mining.ACM Comput. Surv. Washington, 2020, pp.53, 109:1–109:40.

[17] L.Zhang, W.Tan, and Y.Chen. A comparative analysis of machine learning models for vehicle price prediction. Journal of Intelligent Systems, 2023, 18(3), 299–314.

[18] S.Pudaruth. Predicting the price of used cars using machine learning techniques. Int. J. Inf. Comput. Technol, 2014, 4(7), 753-764.