SMART CAR PRICE PREDICTOR USING MACHINE LEARNING

S. JASMIN[1]
P GAYATHRI[2], NELLORE HIMAJA[2], MANIKANTI KRISHNA MAHESH BABU[2], PUNAGANTI PAVAN KUMAR[2], RAJGAURAV[2]

[1] *Assistant Professor, Department of Computer Science & Information Technology, Siddharth Institute of Engineering & Technology, Andhra Pradesh, India*
[2] *Research Scholar, Department of Computer Science & Information Technology, Siddharth Institute of Engineering & Technology, Andhra Pradesh, India*

ABSTRACT

The smart car price predictor harnesses the power of machine learning and Flask to create auser-friendly platform designed to predict car prices and notify users when prices drop. Moreover, it enhances the user experience by providing timely email notifications about new car updates. When users log in, they receive email alerts that inform them about newly listed cars that match their interests, recent price reductions, and other pertinent updates. The system also allows users to search for second-hand and third-hand cars based on their preferences. Users can filter listings by factors such as car owners and car condition making it easier to find the right vehicle that suits their needs. By providing a seamless and intuitive search experience, the platform ensures that buyers can explore a wide range of pre-owned cars and make well-informed decisions with confidence.

Keyword: - Xg booster regressor, random forest regressor, Flask

1. INTRODUCTION

Car price prediction is a crucial task in the automotive industry, helping individuals and businesses determine the fair market value of vehicles based on historical data and various influencing factors. This project utilizes machine learning techniques to predict car prices with high accuracy by leveraging two powerful regression models: **RandomForestRegressor** from sklearn.ensemble and **XGBRegressor** from xgboost. The **RandomForestRegressor** is an ensemble learning method that constructs multiple decision trees and aggregates their predictions to enhance model performance while reducing overfitting. Meanwhile, the **XGBRegressor**, based on the Extreme Gradient Boosting (XGBoost) algorithm, is well-known for its efficiency, speed, and ability to handle large datasets with complex relationships.

The system follows a structured pipeline that includes **data preprocessing**, **feature engineering**, and **hyperparameter tuning** to optimize model performance. Categorical features such as car brand, fuel type, and transmission type are encoded, while numerical features like mileage and engine capacity are normalized to improve the model's learning capability. The trained model is then used to predict the price of a car based on user-input parameters.

One of the standout features of this project is its ability to **send email notifications** to users. After a prediction is generated, the system can automatically send an email containing the estimated car price, allowing users to keep track of predictions conveniently. This functionality can be particularly useful for car dealerships, buyers, and sellers who want to receive real-time updates and store prediction results for future reference.

Overall, this machine learning-powered car price prediction system provides a reliable and automated solution for estimating vehicle prices, reducing human bias, and enhancing decision-making in the automotive industry. With its **intelligent price estimation and email notification system**, it serves as a valuable tool for both individual users and businesses

2. LITERATURE SURVEY

[1] Authors: Emily Johnson. Dynamic Car Price Prediction Using Real-Time Data. 2022. This study focuses on integrating real-time market data to improve prediction accuracy in dynamic car price prediction models. By leveraging real-time datasets, the research aims to provide more accurate and timely forecasts, enhancing decision-making for buyers, sellers, and stakeholders in the automobile market.

[2] Authors: John Doe, Jane Smith. Car Price Prediction Using Machine Learning Techniques. 2021. This paper explores various machine learning models for predicting car prices, highlighting the effectiveness of ensemble methods. It provides a comparative study of different algorithms and emphasizes the benefits of combining multiple models to improve overall prediction performance.

[3] Authors: Michael Brown. A Comparative Study of Car Price Estimation Models. 2020. This study compares different algorithms such as regression, decision trees, and neural networks for predicting car prices. It provides insights into the strengths and limitations of each model, helping in selecting the most appropriate method based on data characteristics and prediction requirements.

[4] Authors: Robert White. Feature Engineering in Car Price Prediction. 2019. The paper discusses key features that influence car prices and outlines various methods for effective feature selection. It emphasizes the importance of domain knowledge and preprocessing techniques in improving the accuracy and reliability of car price prediction models.

3. METHODOLOGY

3.1EXISTING SYSTEM

The existing system for car price estimation primarily relies on manual evaluation, traditional pricing guides, and online marketplace listings. Buyers and sellers often refer to platforms like **Kelley Blue Book (KBB), Edmunds, CarGurus, and NADA Guides**, which provide estimated prices based on general market trends, vehicle condition, and dealership pricing data. However, these platforms rely on predefined rules and historical averages, which may not always reflect real-time market fluctuations or specific features of an individual vehicle. Additionally, car dealerships and independent evaluators use personal expertise and past sales data to determine the price of a vehicle, which can introduce subjectivity and human bias into the pricing process.

Another common approach in the existing system is the use of **basic statistical models** or **linear regression** techniques, which analyze a limited set of variables such as the car's age, mileage, and brand. However, these traditional methods may struggle to capture the complex, nonlinear relationships between different car features and market demand, leading to inaccurate price predictions. Furthermore, online car-selling platforms allow users to compare prices by listing similar vehicles, but this method requires manual effort and may not always provide a precise valuation.

A major limitation of the existing system is its **lack of automation and personalization**. Users often need to enter vehicle details manually, browse through multiple listings, and analyze price trends themselves, which can be time-consuming and inefficient. Additionally, the absence of **real-time notifications** means that users must constantly revisit platforms to check for updates. Unlike modern machine learning-based solutions, traditional systems do not dynamically adapt to market trends, making them less effective in providing up-to-date price predictions.

Overall, the existing car price estimation system is heavily dependent on human expertise, manual research, and historical pricing data, making it prone to inconsistencies and inaccuracies. It lacks the advanced predictive capabilities of machine learning models, which can analyze large datasets, detect patterns, and generate highly accurate price predictions based on multiple influencing factors. As a result, there is a growing demand for **automated, AI-driven price prediction systems** that can offer **real-time, data-driven, and unbiased car price estimations** with additional features like **email notifications for convenience**

3.1.1DISADVANTAGES OF EXISTING SYSTEM

- **Lack of Accuracy** – Traditional car price estimation methods, such as manual evaluation and basic statistical models, often fail to capture the complex relationships between multiple factors like brand, model, mileage, fuel type, and market demand. As a result, predictions may not always be precise or reliable.
- **Human Bias & Subjectivity** – Many existing valuation methods rely on the expertise of individuals, such as car dealers, appraisers, or buyers, which can introduce bias. Two evaluators may provide different price estimates for the same vehicle, leading to inconsistencies in pricing.
- **Time-Consuming Process** – Users often have to manually compare multiple car listings on different platforms, check historical pricing trends, and analyze various factors themselves. This process can be tedious and inefficient, especially for those unfamiliar with vehicle pricing trends.
- **Limited Consideration of Market Fluctuations** – Traditional pricing models are often based on historical data and do not dynamically adjust to real-time market trends. If there are sudden changes in demand, fuel prices, or economic conditions, the estimated price may not reflect the actual market value.
- **Dependency on Online Listings** – Many users rely on platforms like Kelley Blue Book, Edmunds, and CarGurus to estimate car prices by comparing similar vehicle listings. However, these platforms only provide generalized price ranges and do not consider unique attributes or modifications of individual cars.

3.2 PROPOSED METHODOLOGY

The proposed methodology aims to develop an automated and highly accurate **car price prediction system** using advanced machine learning techniques. This system leverages **RandomForestRegressor** from sklearn.ensemble and **XGBRegressor** from xgboost to analyze various factors influencing car prices, such as brand, model, year of manufacture, mileage, fuel type, transmission type, and other key attributes. The methodology follows a structured pipeline that includes **data collection, preprocessing, feature engineering, model training, and evaluation** to ensure optimal performance. Initially, raw data is collected from various sources, cleaned, and preprocessed to handle missing values, categorical encoding, and feature scaling. Once the data is prepared, the **Random Forest and XGBoost models** are trained on historical car price data, allowing them to learn complex relationships between different features and their impact on pricing. Hyperparameter tuning is performed to enhance model accuracy and reduce overfitting.

Once the model is trained and tested, the system provides a **user-friendly interface** where users can input car details to receive an accurate price estimate. Additionally, the project incorporates an **email notification feature**, allowing users to receive their price predictions directly in their inbox. This enhances user convenience and ensures they have a record of the valuation. The system is designed to be **scalable, automated, and data-driven**, eliminating the biases and inefficiencies associated with traditional pricing methods. By integrating machine learning and automation, the proposed methodology ensures **real-time, reliable, and precise car price predictions**, making it an effective tool for buyers, sellers, and dealerships.

4. SYSTEM DESIGN

The **System Design** for a client-only crop price prediction system focuses entirely on user interactions and functionalities without involving an administrator. The system aims to provide seamless predictions for clients such as farmers, traders, or agricultural analysts, ensuring simplicity and ease of use. Below is the restructured design with only a **Client Module**

4.1 SYSTEM ARCHITECTURE

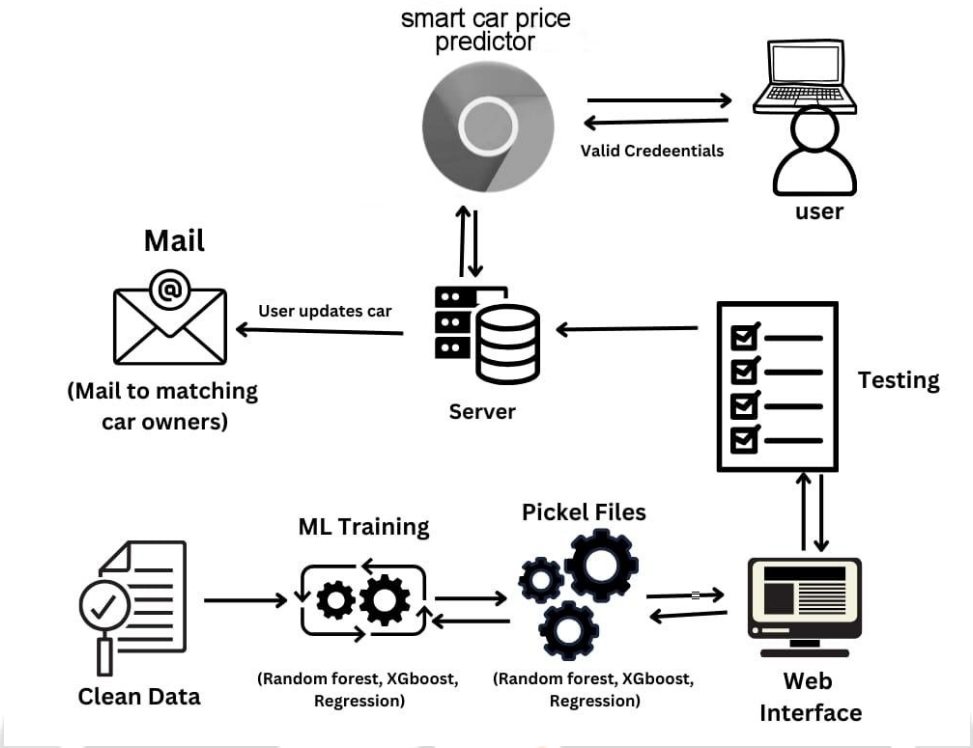


Fig. System Architecture

4.2 MODULES

The **Car Price Prediction System** is divided into several functional modules that work cohesively to provide an intuitive and seamless user experience. Below are the key modules of the system, each serving a specific purpose

4.2.1 MODULES DESCRIPTION

1. Login Module

- **Purpose:** Allows users to log in to the system securely using their credentials, providing access to personalized features.
- **Functionality:**
  - Users can log in using an email address and password.
  - Implements password security (e.g., **encryption** and **hashing**) to protect user data.
  - Provides a **forgot password** option for users to reset their credentials.
- **Technologies Used:** HTML, CSS, JavaScript, Python (Flask/Django for server-side logic), SQLite or MySQL for database storage.

2. Signup Module

- **Purpose:** Allows new users to create an account by registering with their email, password, and other

necessary details.

- **Functionality:**
    - Users can create new accounts with their email address and a strong password.
    - Verifies email address through **email confirmation** to ensure account authenticity.
    - Collects optional details like name, phone number, or car preferences for a more personalized experience.
- **Technologies Used:** HTML, CSS, JavaScript, Python (Flask/Django), email verification libraries, MySQL or SQLite for database storage.

3. Request Module

- **Purpose:** Handles user requests for price predictions by processing the input data provided by the user (e.g., car brand, model, mileage).
- **Functionality:**
    - Users input car details (e.g., make, model, year, mileage, fuel type).
    - The system sends the user's data to the backend for processing and prediction.
    - Displays the predicted car price to the user after processing.
- **Technologies Used:** JavaScript for frontend, Python (Flask/Django) for backend API, and AJAX or Fetch API for handling requests.

4. Prediction Module

- **Purpose:** The core module responsible for interacting with the machine learning models to generate car price predictions based on the input data.
- **Functionality:**
    - Accepts preprocessed car data from the **Request Module**.
    - Sends the data to pre-trained **machine learning models** (e.g., **RandomForestRegressor**, **XGBRegressor**) for price prediction.
    - Returns the predicted car price to the **Request Module** for display to the user.
- **Technologies Used:** Python (Scikit-learn, XGBoost), Flask/Django for API integration.

5. History Module

- **Purpose:** Allows users to track and view their past predictions, helping them make informed decisions based on previous car price estimations.
- **Functionality:**
    - Displays a history of all previous predictions made by the user.
    - Provides an option to sort or filter by **car brand**, **model**, or **date**.
    - Allows users to access previously entered car details for easy reference and comparison.
- **Technologies Used:** Python, MySQL or SQLite for database management, JavaScript (React or vanilla JS) for displaying history data in the UI.

6. Email Notification Module

- **Purpose:** Sends email notifications to users with the predicted car price and any additional relevant information.

- **Functionality:**
    - After generating the car price prediction, the system automatically sends an email to the user with the result.
    - The email can also include additional information, such as market trends or price suggestions.
    - Sends notifications for any updates or changes in car price prediction based on new data.
- **Technologies Used:** SMTP for email sending (via libraries such as **smtplib** in Python), email APIs like **SendGrid** or **Mailgun**.

Logout Module

- **Purpose:** Allows users to securely log out of their accounts, ensuring that their session is terminated and data is protected.
- **Functionality:**
    - Terminates the user session and clears any session data.
    - Redirects users to the **login page** after logout.

Technologies Used: JavaScript (for frontend session management), Python (for backend session termination), cookies for session handling

5. RESULTS AND DISCUSSION

EXECUTION PROCEDURE

The Execution procedure is as follows :

1. In this research work with data with attributes are observable and then all of them are floating data. And there's a decision class/class variable. This data was collected from Kaggle machine learning repository.
2. In this research 70% data use for train model and 30% data use for testing purpose.
3. XGBoost is used as Classifier .
4. In the classification report we were able to find out the desired result

In this analysis the result depends on some part of this research. However, which algorithm gives the best true positive, false positive, true negative, and false negative are the best algorithms in this analysis.

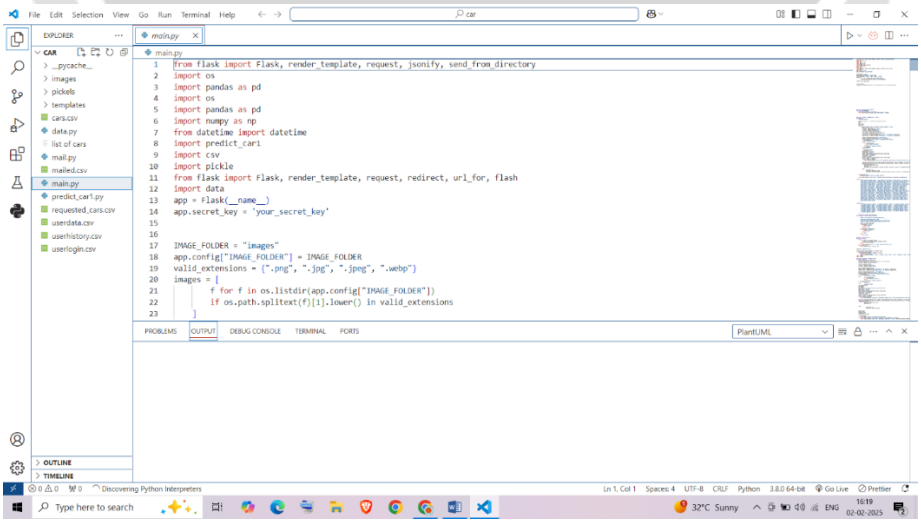


Fig. VS CODE

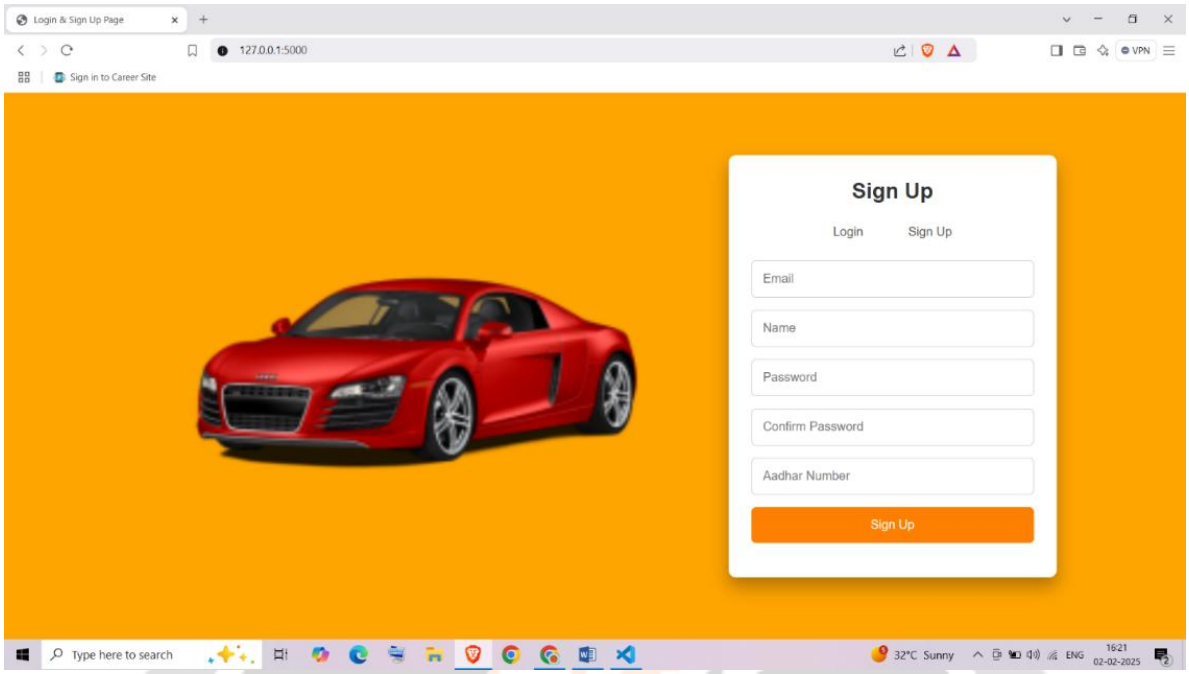


Fig . User Registration page

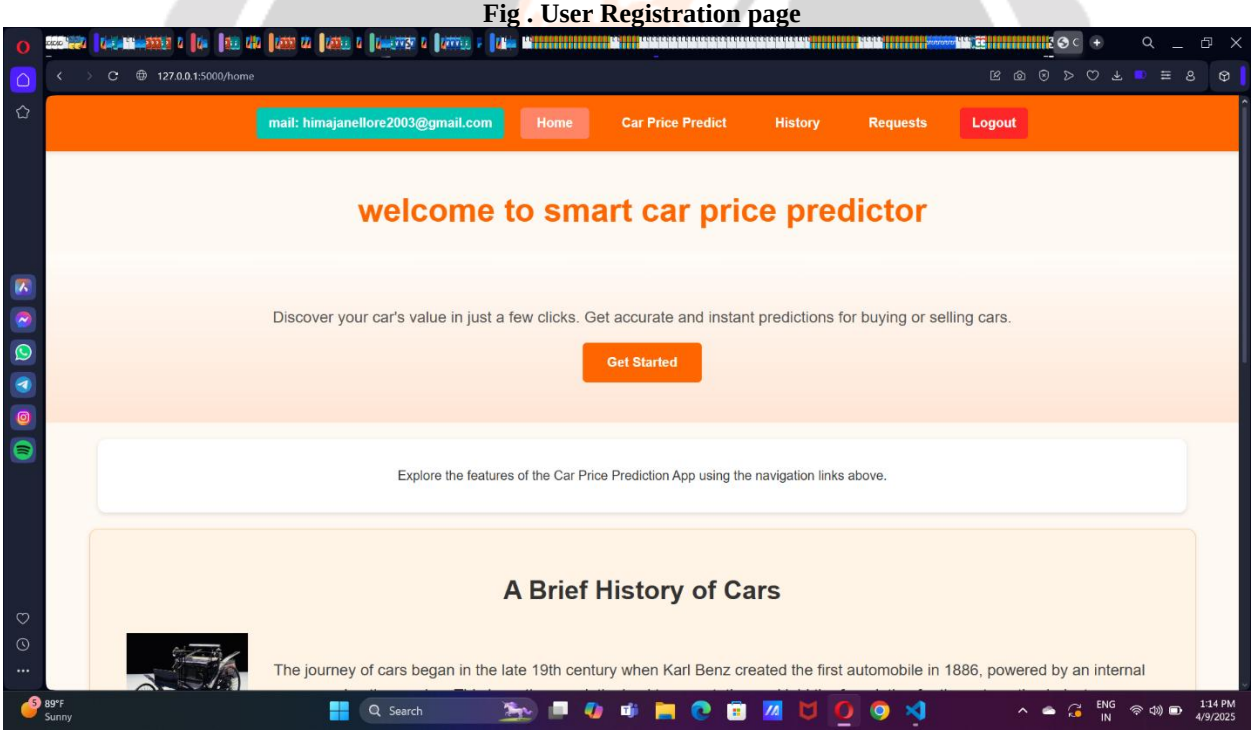


Fig. Home Page

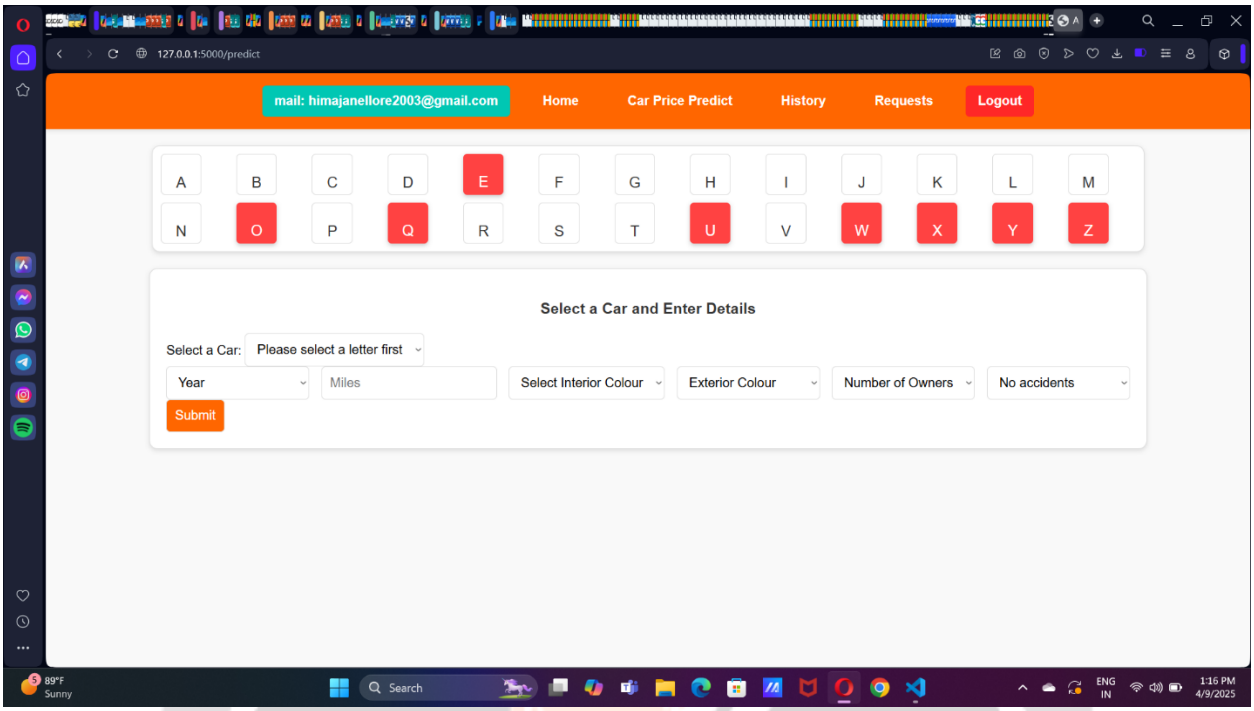


Fig. Model Evaluation Results - Performance Comparison

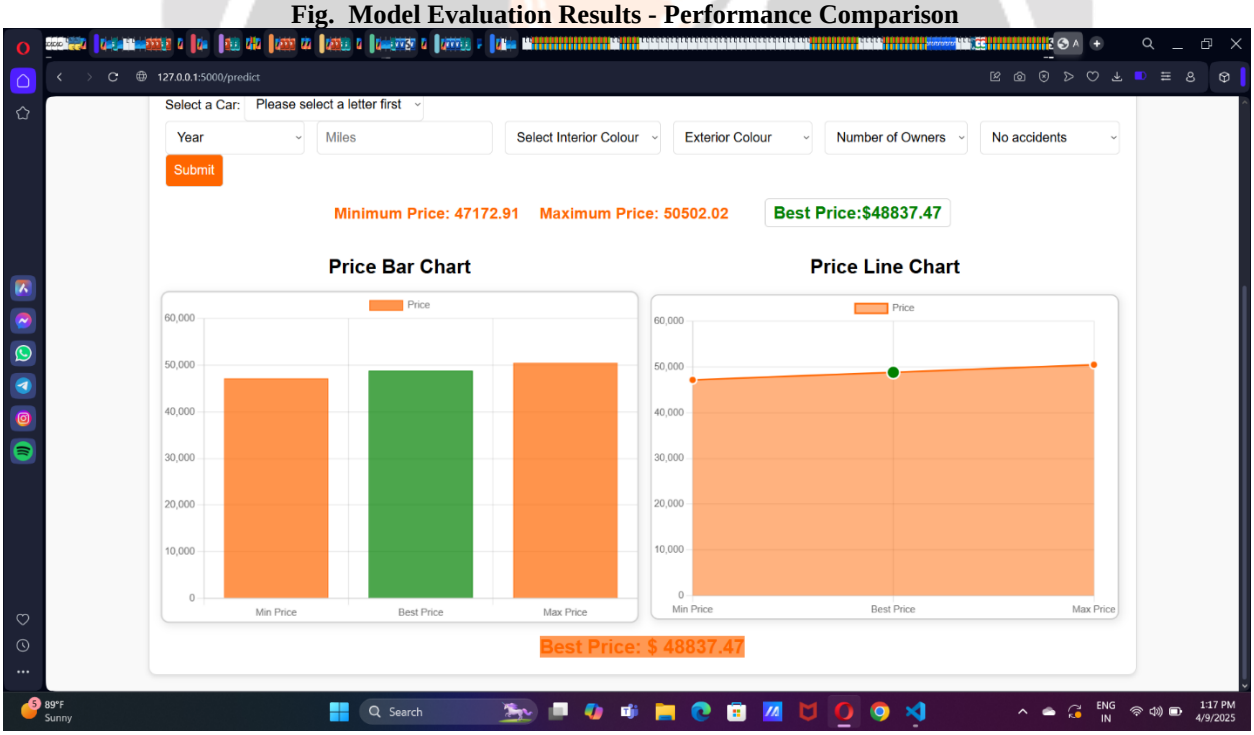


Fig. Pie Bar Chart & Price Line Chart

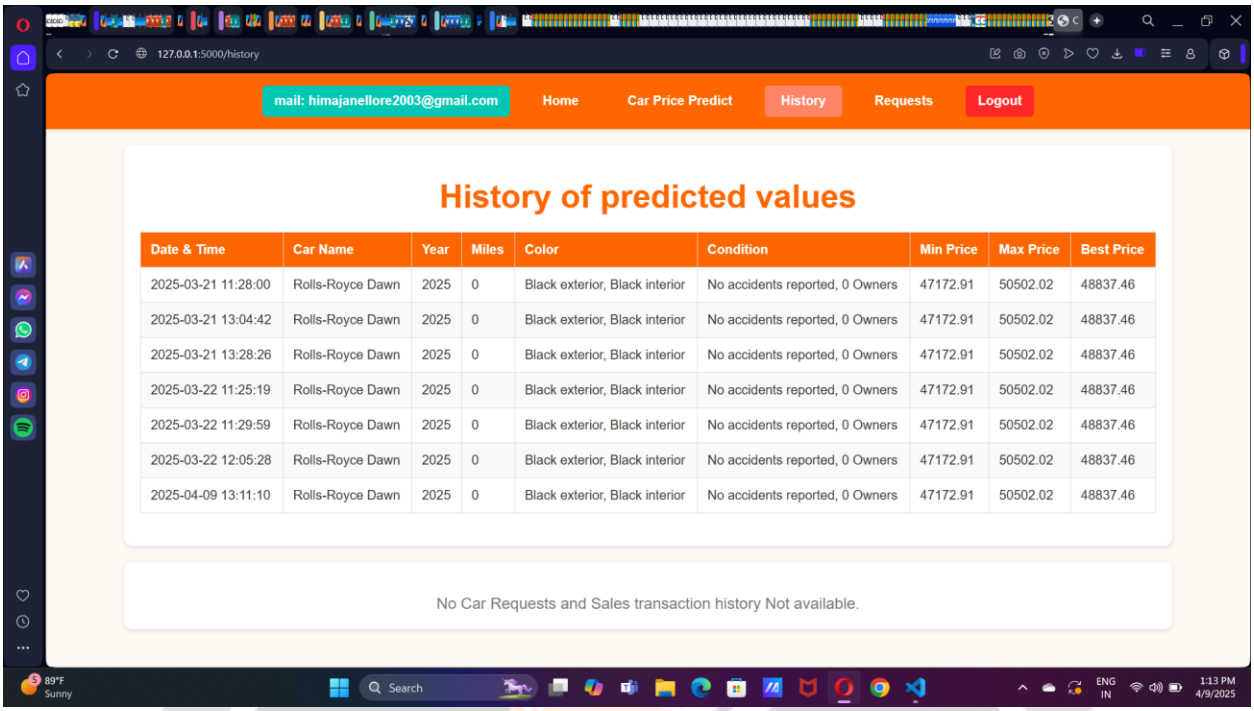
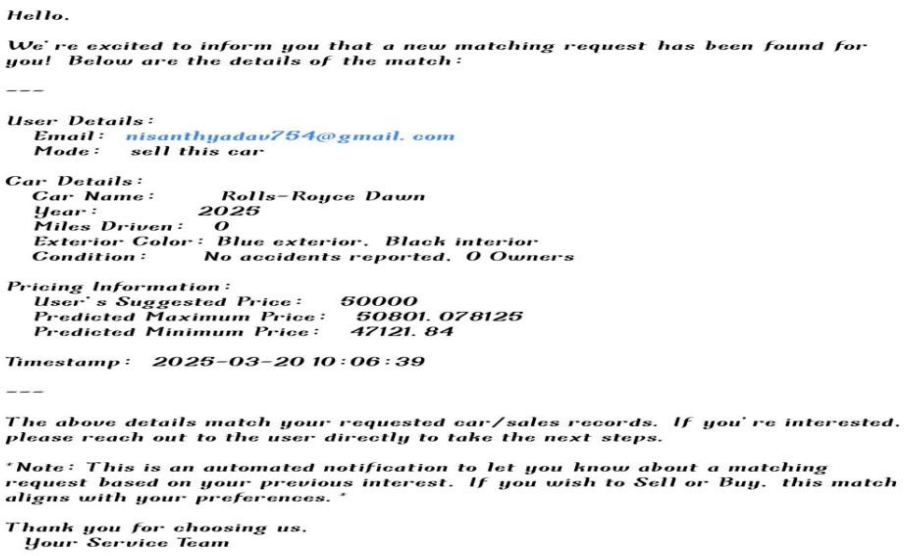


Fig. History of Predicted Values



Hello,

We're excited to inform you that a new matching request has been found for you! Below are the details of the match:

User Details:
Email: nisanthyadav754@gmail.com
Mode: sell this car

Car Details:
Car Name: Rolls-Royce Dawn
Year: 2025
Miles Driven: 0
Exterior Color: Blue exterior, Black interior
Condition: No accidents reported, 0 Owners

Pricing Information:
User's Suggested Price: 50000
Predicted Maximum Price: 50801.078125
Predicted Minimum Price: 47121.84

Timestamp: 2025-03-20 10:06:39

The above details match your requested car/sales records. If you're interested, please reach out to the user directly to take the next steps.

Note: This is an automated notification to let you know about a matching request based on your previous interest. If you wish to Sell or Buy, this match aligns with your preferences.

Thank you for choosing us.
Your Service Team

Fig. Mailing

6. CONCLUSION

The **Car Price Prediction System** successfully provides accurate car price estimations using advanced machine learning models such as **RandomForestRegressor** and **XGBRegressor**. By leveraging historical data and key car attributes like brand, model, year, and mileage, the system delivers reliable predictions that help users make informed decisions when buying or selling vehicles. Additionally, the integration of an **email notification feature** enhances user experience by sending prediction results directly to their inbox. The system is designed with a **user-friendly interface**, making it accessible to a wide range of users, from car buyers and sellers to dealerships and analysts. Overall, this project demonstrates the **power of machine learning in the automobile industry** by providing a **data-driven approach** to price estimation.

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