

MIS 6308.0W2

SYSTEM ANALYSIS AND PROJECT MANAGEMENT

Project Report

on

# **AI and ML Integration in Used Car Marketplace**

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### 1. EXECUTIVE SUMMARY:

The goal of this "AI and ML Integration in Used Car Marketplace" project is to completely transform the online used automobile market. Through the application of Artificial Intelligence (AI) and Machine Learning (ML), this program aims to improve the marketplace's overall efficacy, user experience, and efficiency.

The project's main goal is to incorporate cutting-edge AI and ML technologies into several industry segments. This includes automated chatbots for effective customer service, image recognition for expedited car listings, fraud detection algorithms for platform security, sentiment analysis for customer feedback and improvement, and predictive analytics for the best pricing strategies. AI-driven recommendation engines also play a significant role in providing personalized user experiences.

One of the project's primary objectives is a thorough system overhaul that smoothly incorporates these AI and ML features into the current marketplace architecture. To support the additional capabilities, this calls for the creation of complex algorithms, enhancements to the user interface, and modifications to the backend systems.

There are numerous anticipated results from this study. AI-assisted fraud detection and pricing suggestions will help sellers, resulting in more equitable and safer transactions. The enhanced search functions and recommendation engine will provide customers with a more efficient and customized purchasing experience. It is projected that the industry will become more efficient, safe, and user-friendly overall, which will boost customer satisfaction and give businesses a competitive edge.

An important advancement in the use of AI and ML technology in online marketplaces is this initiative. It not only seeks to improve the used automobile market's present operations but also establishes a standard for upcoming developments. Furthermore, it is projected that the initiative will result in notable enhancements to consumer satisfaction and loyalty. The marketplace will enable faster, more seamless transactions and establish itself as a cutting-edge, customer-focused platform as it grows more sensitive to the requirements and habits of its customers.

In summary, a new industry standard for digital commerce platforms is about to be established by the "AI and ML Integration in Used Car Marketplace" initiative. By emphasizing the revolutionary potential of AI and ML, the market is laying the groundwork for future innovation and expansion while simultaneously seeking to improve its present operations. This project offers a look into the future when technology and business intersect to create unmatched user experiences, demonstrating the ability of artificial intelligence and machine learning to revolutionize entire industries.

## 2. PROBLEM STATEMENT:

Several significant obstacles are hindering the efficiency and user experience of the used car market today. Among these difficulties are:

- **Ineffective Pricing Mechanisms:** Sellers frequently need help to set a fair price for their cars, which can result in either overpricing, which extends the time it takes to sell, or underpricing, which reduces sales and costs money.
- **Limited Personalization:** It can be challenging for buyers to locate cars that precisely fit their requirements and tastes, which makes the search process time-consuming and usually frustrating.
- **Insufficient Fraud Detection:** Buyers and sellers are at risk as the platform does not yet have strong enough safeguards to recognize and stop fake listings and transactions.
- **Limitations on Customer Service:** As the number of users on the platform rises, it is becoming more difficult to provide prompt and efficient customer service, influencing user happiness and platform confidence.
- **Data Utilization Gaps:** Although the marketplace has access to enormous volumes of data, it is not making efficient use of this information to enhance user experiences or boost operational effectiveness.
- **Variations in the Completeness and Quality of Vehicle Listings:** It is challenging for purchasers to make well-informed judgments due to the wide range in the quality and completeness of vehicle listings.

By introducing modern tools and algorithms that improve pricing accuracy, personalize user experiences, strengthen fraud detection, automate customer service interactions, make effective use of marketplace data, and standardize the quality of vehicle listings, the integration of AI and ML technologies seeks to address these issues. By making the marketplace more effective, safe, and user-friendly, this project hopes to make it more competitive and appealing to both consumers and sellers.

This problem statement highlights the need for technological innovation to improve the platform's overall functionality and user experience by outlining the present challenges faced by the used car industry and setting the stage for the proposed AI and ML solutions.

### 2.1 OBJECTIVES:

The following are the goals for the "AI and ML Integration in Used Car Marketplace" project:

- **Boost Pricing Accuracy:** Apply AI-driven predictive analytics to help sellers determine fair and competitive prices for their cars by considering historical sales data, comparable market data, and real-time market data.
- **Customize the User's Experience:** To speed up the car-buying process, create a machine learning-based recommendation system that selects vehicles based on the preferences, search histories, and behavior patterns of specific buyers.

- **Boost the detection of fraud:** By incorporating cutting-edge machine learning algorithms, you can prevent fraudulent listings and transactions in advance, enhancing the marketplace's security and reliability.
- **Enhance Customer Service:** Use chatbots and virtual assistants driven by AI to offer prompt, round-the-clock assistance, answering questions and skillfully assisting users with the purchasing and selling process.
- **Optimize Data Utilization:** Make the most of the data already available in the marketplace to learn about user behavior, industry trends, and operational efficiency. This will help you establish strategies and make well-informed decisions.
- **Standardize the quality of vehicle listings:** By using automated data extraction and picture recognition technology to guarantee consistency and completeness. This will increase the comparability and dependability of the information that potential purchasers may access.
- **Improve Buyers' Decision-Making:** Use AI technologies to give purchasers complete car statistics, such as performance, dependability ratings, and estimated costs of ownership, to help them make wise judgments.
- **Streamline Operations:** By using AI and ML integrations to automate backend tasks like lead tracking, inventory management, and customer relationship management, you may improve operational efficiency.
- **Maintain Competitiveness and Innovate:** To stay competitive and create industry standards, position the automobile e-commerce market at the forefront of technical innovation.
- **Measure and Enhance User Satisfaction:** Make sure the platform changes in response to user demands and preferences by using sentiment analysis and feedback algorithms to continuously monitor and enhance user satisfaction.

With the help of AI and ML technologies, these goals aim to fully address the issues raised in the problem statement and turn the used automobile market into a platform that is safer, more user-friendly, and more efficient.

## 2.b SCOPE:

The depth of the Used Car Marketplace's AI and ML integration includes the creation and application of cutting-edge technology solutions to improve several platform features. This includes developing sophisticated fraud detection algorithms, automated customer support tools, tailored recommendation systems, and predictive pricing models.

To increase operational effectiveness and user experiences while maintaining scalability and adaptability to future technological improvements, the project will concentrate on exploiting current marketplace data. Additionally, by greatly enhancing the purchasing and selling experience for users, it hopes to establish a new benchmark in digital vehicle commerce.

## 3. BPMN DIAGRAM:

The following processes would be shown in a BPMN diagram illustrating the integration of AI and ML in the used automobile market:

**1. Owner Uploads Pictures and Details about the Car:**

- When the owner visits the website, an AI assistant helps him or her upload information and pictures of the car. To verify accuracy and provide advice for taking high-quality pictures, the AI assistant could ask the owner for specific details.

**2. AI Data Enrichment and Image Processing:**

- The AI system analyzes the photos when the owner uploads them to determine the car's condition and identify attributes. Simultaneously, machine learning algorithms examine the data and augment the listing with extra details such as projected market value, comparison with analogous models, and anticipated maintenance expenses.

**3. Buyer Looks for Cars:**

- Buyer searches for cars using the website's search feature, which is now enhanced by machine learning to deliver tailored results. To improve search results and make car recommendations, the system considers the buyer's interactions and preferences.

**4. Views of Buyer's Car Details:**

- The AI provides a comprehensive perspective of the vehicle, together with a report on its dependability, past performance, and prospective future value, when a buyer chooses a listing. Additionally, the technology can provide an augmented reality or virtual tour of the vehicle.

**5. Owner and Buyer Contact with AI Mediation:**

- Using natural language processing to interpret and reply to queries, an AI chat system connects the owner and the prospective buyer via the platform. It can answer routine queries, arrange viewings, and even help with initial negotiations.

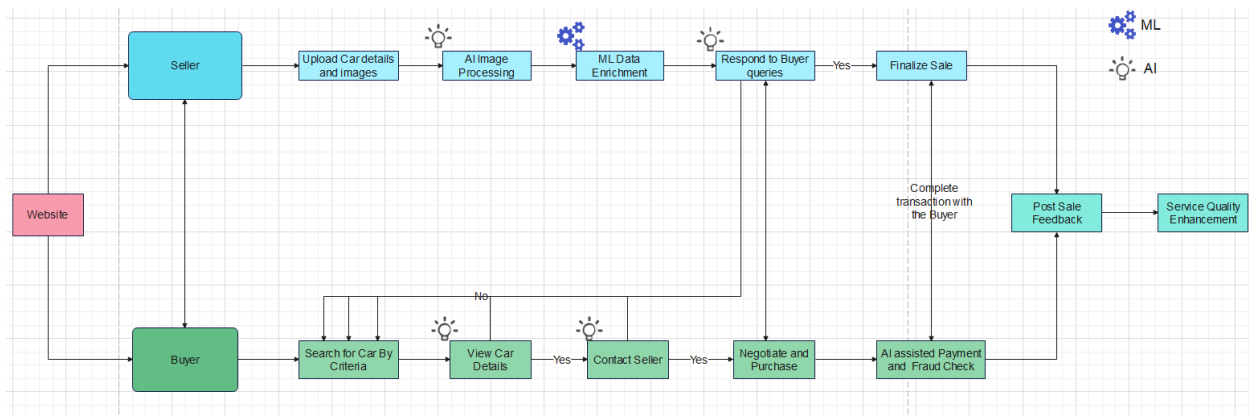
**6. AI-Assisted Purchase and Payment:**

- The transaction proceeds with AI aid if the parties reach a pricing agreement. The system arranges for pickup or delivery, manages documentation online, and provides safe payment choices. ML algorithms keep an eye out for any irregularities or indications of fraud in the transaction.

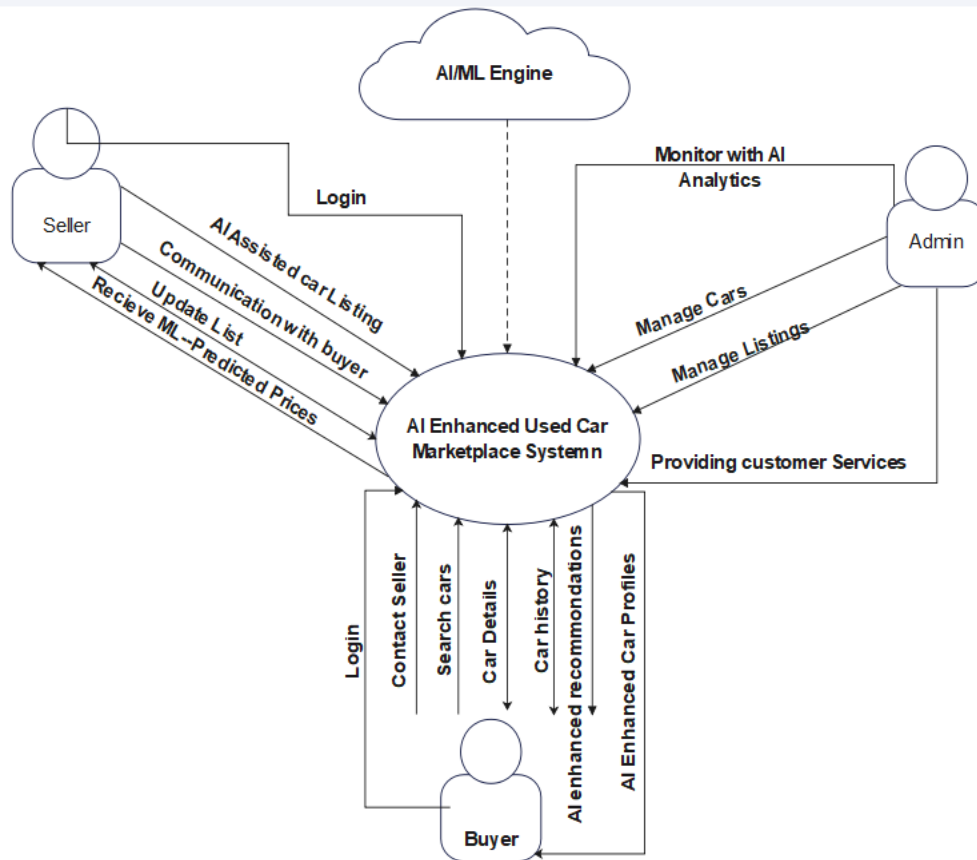
**7. AI Engagement Following Sale and Listing Update:**

- The AI system follows up with both parties after the sale to gather input, which is then utilized to enhance the platform. When the seller identifies the car as sold, the AI system automatically archives the listing.

These phases employ AI and ML to improve user interactions, provide value with enriched data, and expedite the process—all of which contribute to a more effective and user-friendly car purchasing and selling experience. These intelligent systems would be represented by more automated tasks and decision points in the BPMN diagram.

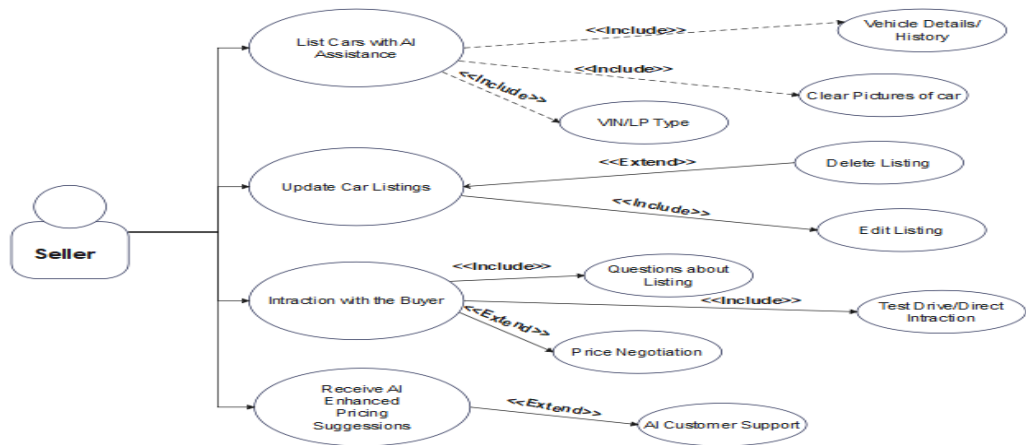
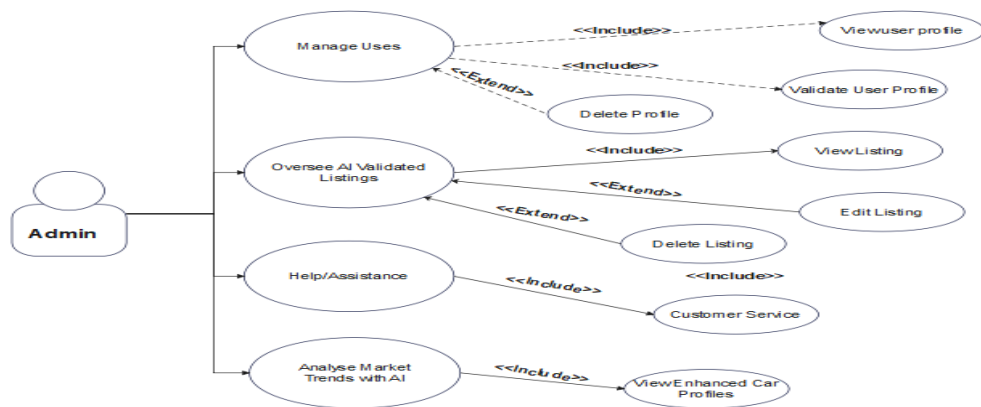


## 4. CONTEXT DESIGN

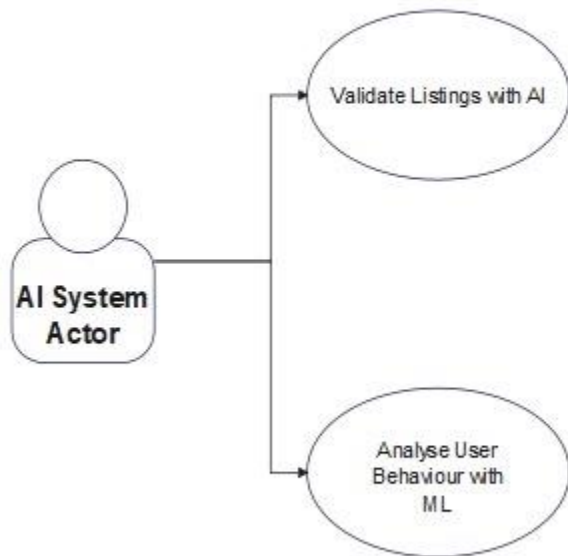
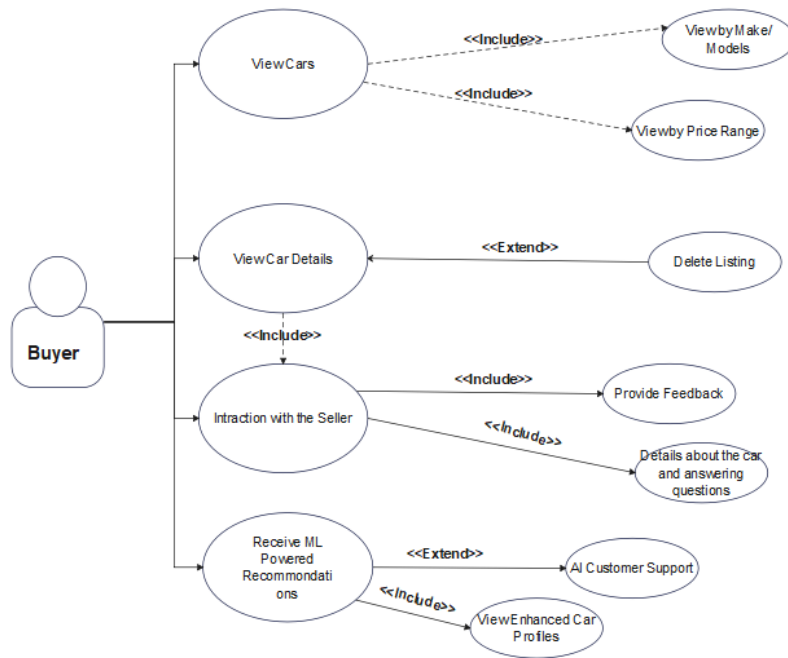


## 5. USE CASE DIAGRAM

### 5.A USE CASE DIAGRAM







## 5.B USE CASE DESCRIPTIONS

### Use Case Description 1:

**Use Case Name:** User Registration with AI Assistance

**Primary Actor:** User

**Brief Description:** User registers on the system with the aid of an AI-powered form that suggests and validates input to ensure accuracy and completeness.

**Trigger:** User chooses to register on the System with enhanced AI features.

**Normal flow of events:**

1. The user opens the browser and enters the address of the AI-enhanced system.
2. User clicks on the registration button, and the AI form assistant activates.
3. User enters details. The AI assistant validates inputs in real-time and suggests corrections.
4. The AI system sends a verification email with a personalized welcome message.
5. User logs onto the Used Car Marketplace with a new account, guided by AI for a personalized onboarding experience.

### Use Case Description 2:

**Use Case Name:** AI-Assisted Car Listing

**Primary Actor:** Seller

**Brief Description:** The seller lists a car for sale with the assistance of AI for pricing recommendations, optimal listing times, and image enhancements.

**Trigger:** Seller decides to use AI features to list their car.

**Normal flow of events:**

1. The seller logs in and is greeted by an AI dashboard with insights and recommendations.
2. The seller inputs car details, and the AI suggests optimal pricing based on ML algorithms.
3. The seller uploads images, which are automatically enhanced and tagged by the AI.
4. The AI system schedules the listing for the most effective times based on buyer activity.
5. Once the listing is live, the AI monitors engagement and suggests adjustments if needed.

### **Use Case Description 3:**

**Use Case Name:** AI-Mediated Communication with Buyer

**Primary Actor:** Seller

**Brief Description:** The seller uses an AI-powered communication tool to negotiate and answer queries, with ML providing real-time insights and responses.

**Trigger:** A buyer expresses interest in the listing.

**Normal flow of events:**

1. The seller receives a notification from the AI system about a buyer's interest.
2. The seller uses AI templates to communicate effectively with the buyer.
3. The AI system facilitates negotiation, offering real-time market-based price suggestions.
4. Upon reaching an agreement, the AI system assists with digital paperwork.
5. The transaction is completed with AI and ML ensuring fraud prevention measures.

### **Use Case Description 4:**

**Use Case Name:** Virtual Test Drive Arrangement

**Primary Actor:** Seller

**Brief Description:** The seller arranges a virtual test drive for the buyer using AI to simulate the driving experience and provide detailed car analytics.

**Trigger:** Buyer requests a test drive.

**Normal flow of events:**

1. The seller offers a virtual test drive option through the platform.
2. The buyer schedules a time, and the AI prepares a virtual simulation.
3. The AI provides the buyer with a virtual reality tour and performance data.
4. The buyer evaluates the car and proceeds with the purchase or further negotiation.

#### **Use Case Description 5:**

**Use Case Name:** Update Car Listing with ML Insights

**Primary Actor:** Seller

**Brief Description:** The seller updates their car listing with insights from ML on market trends and buyer interest patterns.

**Trigger:** The seller decides to refresh their listing with enhanced data.

**Normal flow of events:**

1. The seller logs in and is presented with ML insights on their dashboard.
2. The seller navigates to their listing and selects 'Update with AI Insights'.
3. The seller adjusts the listing details, with AI suggesting changes for better engagement.
4. The updated listing is reviewed by AI for quality before going live.

#### **Use Case Description 6:**

**Use Case Name:** ML-Powered Buyer Matchmaking

**Primary Actor:** Buyer

**Brief Description:** The buyer utilizes the ML-driven matchmaking system to find the most suitable car listings based on their preferences and past behavior.

**Trigger:** Buyer initiates a car search on the platform.

**Normal Flow of Events:**

1. The buyer logs in, and the ML system analyzes their profile and past activity.
2. The buyer inputs search criteria, which the ML system uses to curate a personalized list.
3. The ML system presents the buyer with the best matches and explains why each is suitable.
4. The buyer reviews the suggested listings and saves or contacts sellers from the curated list.

#### **Use Case Description 7:**

**Use Case Name:** Automated Image Analysis for Listings

**Primary Actor:** Seller

**Brief Description:** The seller uploads car images, which are then automatically analyzed by AI for quality, features identification, and descriptive tagging.

**Trigger:** The seller decides to upload images for the car listing.

**Normal Flow of Events:**

1. The seller selects images for upload, and the AI system begins analysis.
2. The AI identifies key features and conditions from the images and suggests tags.
3. The seller reviews and approves the AI-generated tags and descriptions.
4. The AI system optimizes and uploads the images to the listing with enhanced visuals.

**Use Case Description 8:**

**Use Case Name:** AI-Enhanced Fraud Detection for Listings

**Primary Actor:** Admin

**Brief Description:** The admin uses an AI-enhanced system to detect and manage fraudulent listings or user activities.

**Trigger:** A new car listing is submitted, or unusual activity is detected.

**Normal Flow of Events:**

1. The admin is alerted by the AI system of a potential fraudulent listing.
2. The AI presents evidence and a risk assessment score based on behavior patterns.
3. The admin reviews the AI findings and decides on further actions.
4. If confirmed as fraud, the admin removes the listing and takes appropriate measures.

**Use Case Description 9:**

**Use Case Name:** AI-Assisted Financing Options

**Primary Actor:** Buyer

**Brief Description:** The buyer receives AI-powered financing and insurance options tailored to their credit score and purchase history.

**Trigger:** The buyer selects a car and expresses interest in financing options.

**Normal Flow of Events:**

1. The buyer inputs their financial details into the AI system.
2. The AI evaluates the buyer's credit and presents personalized financing options.
3. The buyer selects a financing plan, and the AI facilitates the pre-approval process.
4. The buyer completes the transaction with an AI-generated financing agreement.

### Use Case Description 10:

**Use Case Name:** Post-Sale AI Engagement for Feedback Collection

**Primary Actor:** Seller

**Brief Description:** After a sale, the seller is engaged by the AI system to provide feedback on the transaction, which is used to improve the marketplace.

**Trigger:** A car sale is completed.

#### Normal Flow of Events:

1. The AI system prompts the seller for feedback post-sale.
2. The seller submits feedback through an AI-powered survey that adapts based on responses.
3. The AI analyzes the feedback and integrates insights into the marketplace for improvements.
4. The seller receives personalized tips and insights for future listings based on their feedback.

## 6. Data Model:

### 6.A Data Dictionary

#### 1. Account Creation:

- **First Name:** The given name of the user; text string.
- **Middle Name:** Additional given name of the user; text string (optional).
- **Last Name:** The family name of the user; text string.
- **Suffix:** Any generational or professional suffix following the last name; text string (optional).
- **Address:** Full postal address of the user; text string.
- **Phone:** Primary contact number; numeric string.

#### 2. Login:

- **Username:** Unique identifier chosen by the user for logging in; alphanumeric string.
- **Email:** Email address used for logging in or account recovery; string in email format.
- **Password:** Encrypted password for account security; alphanumeric string with potential special characters.

#### 3. User Information:

- **Username:** Unique identifier chosen by the user for logging in; alphanumeric string.
- **Email:** Email address used for logging in or account recovery; string in email format.

#### 4. Used Car Marketplace:

### 1. Search Details:

- **Model Name:** The model of the car being searched for; string (optional).
- **Color:** The color filter used in the search; string(optional)

### 2. Car Details:

- **VIN:** Vehicle Identification Number, a unique code for each vehicle; alphanumeric string.
- **Make:** Manufacturer of the vehicle; string.
- **Model:** Specific model of the vehicle; string.
- **Year:** Year of vehicle manufacture; four-digit integer.
- **Price:** Current asking price of the vehicle; numeric float.
- **Mileage:** Total distance traveled by the vehicle; numeric integer.
- **Color:** Color of the vehicle; string.
- **Car History:** Comprehensive record of the vehicle's past; text string.
- **Images:** Visual representations of the vehicle; array of ImageID references.

## 5. Transaction:

### 1. Transaction Details:

- **TransactionID:** Unique identifier for the transaction; numeric integer.
- **SellerID:** Reference to the seller's User Profile; numeric integer.
- **BuyerID:** Reference to the buyer's User Profile; numeric integer.
- **Transaction Amount:** Total price agreed upon for the vehicle; numeric float.
- **Payment Method:** Method by which payment was made; string.
- **Delivery Status:** Current status of the vehicle's delivery; string.

## 6. Car History:

- **CarID:** Reference to the Car Details; numeric integer.
- **Event Date:** Date of the recorded event; date format.
- **Event Type:** Type of event recorded (e.g., service, accident); string.
- **Event History:** Description of the event; text string.
- **Owner:** Previous and current owner information; text string.
- **Service Records:** Documented history of vehicle service; text string.

## 7. Buyer:

- **BuyerID:** Unique identifier for the buyer; numeric integer.
- **Favorite Cars:** List of cars marked as favorite by the buyer; array of CarID references.
- **Negotiate Price:** Record of price negotiations made by the buyer; text string.
- **Payment Info:** Financial information for transaction processing; text string.
- **Car Preference:** Attributes of preferred cars; text string.

## 8. Seller:

- **SellerID:** Unique identifier for the seller; numeric integer.
- **List Car for Sale:** Record of cars listed by the seller; array of ListingID references.
- **Type of Communication:** Preferred communication method with buyers; string.
- **Car Records:** Historical records of cars sold; text string.

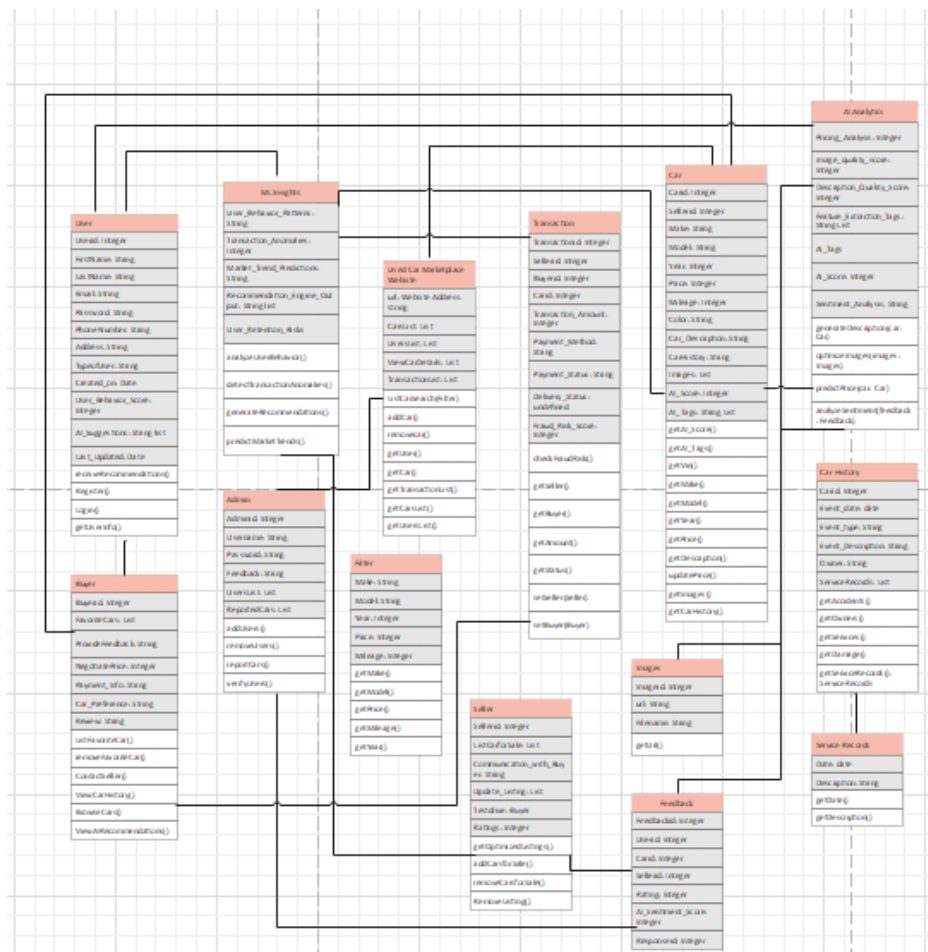
## 9. Images:

- **ImageID:** Unique identifier for the image; numeric integer.
- **URL:** Web location where the image is hosted; string.
- **File Name:** Name of the image file; string.

## 10. Admin:

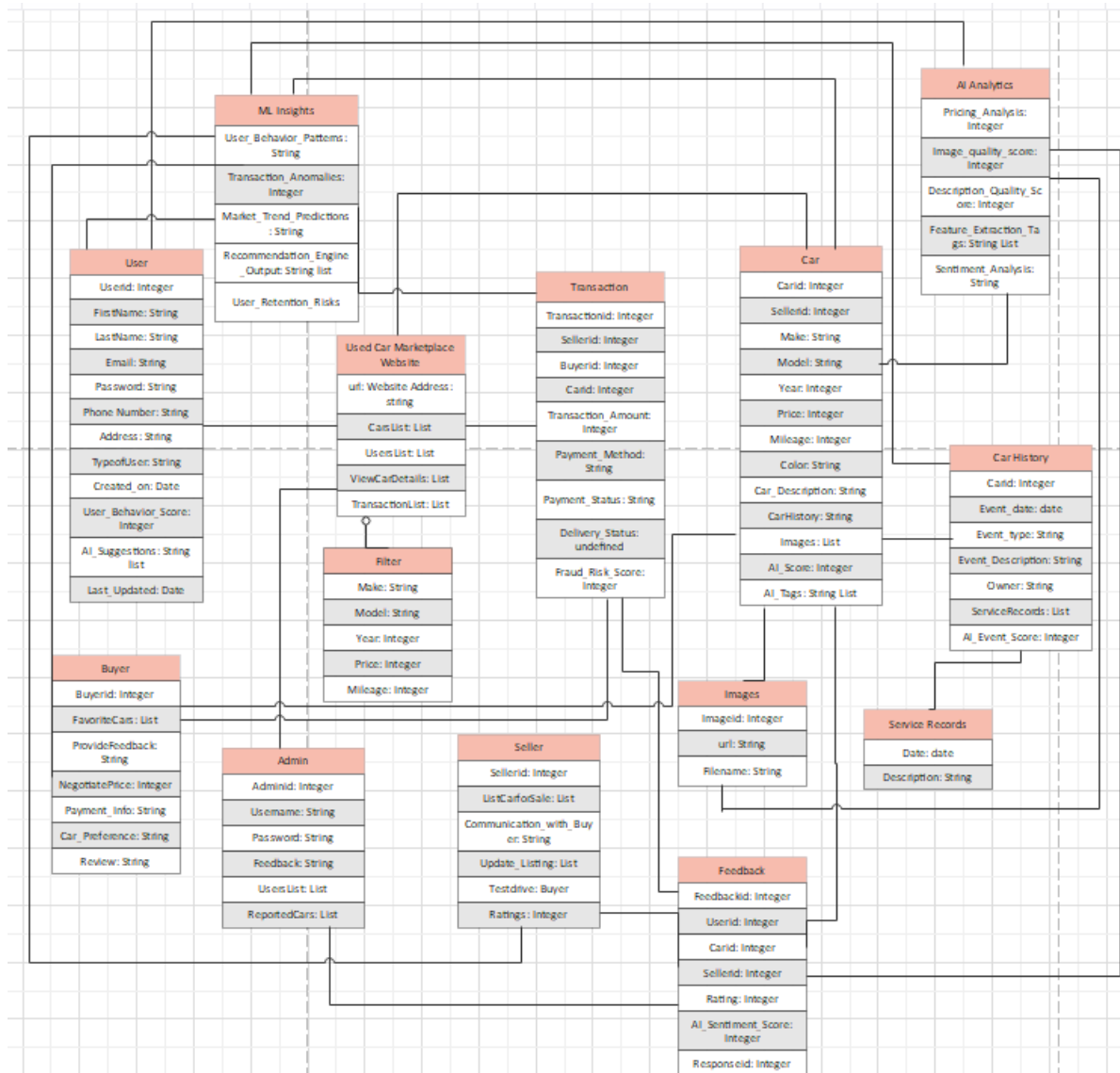
- **AdminID:** Unique identifier for the admin; numeric integer.
- **Username:** Admin username for system access; alphanumeric string.
- **Password:** Encrypted password for the admin account; alphanumeric string with potential special characters.
- **Userlist:** List of users managed by the admin; array of UserID references.

### 6.B CLASS DIAGRAM (With Methods)



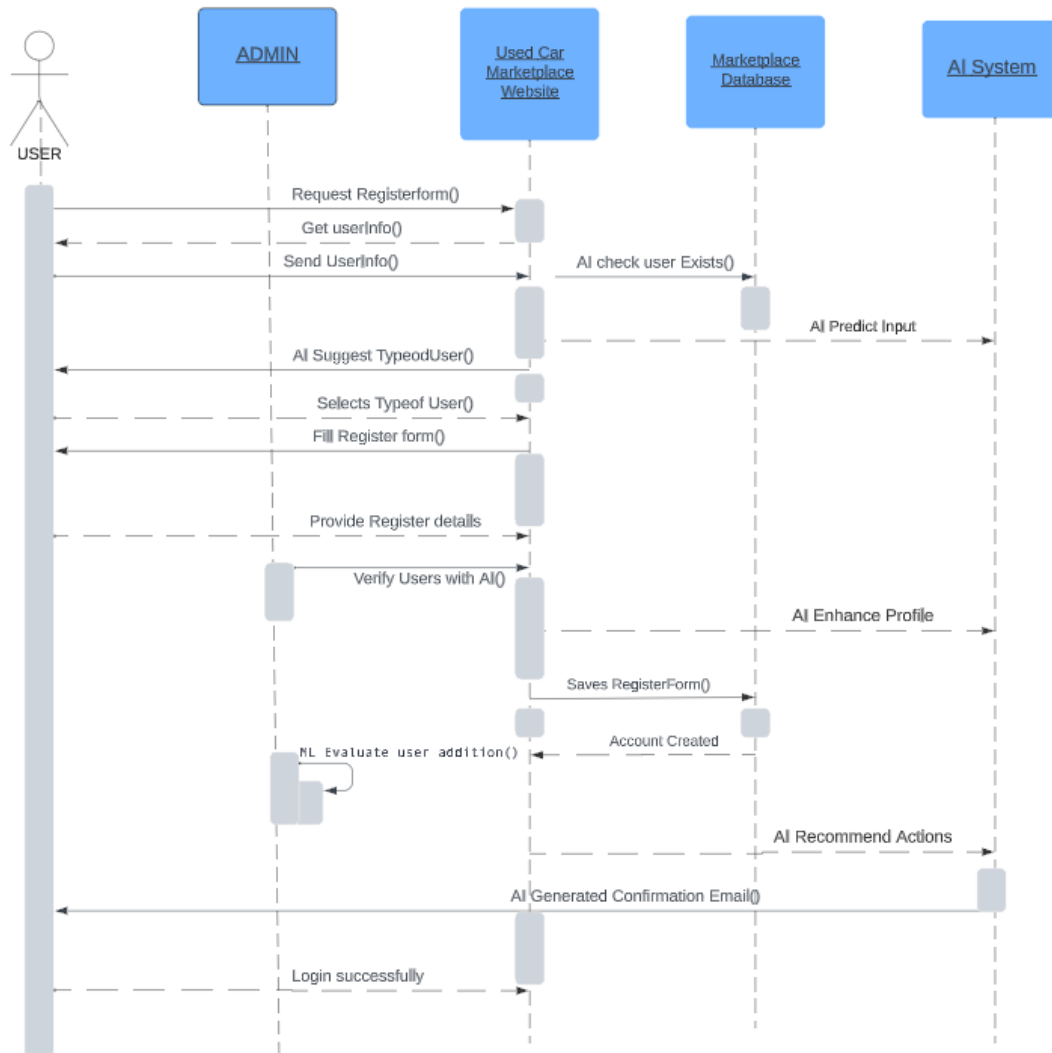


## 6.C CLASS DIAGRAM (Without Methods)

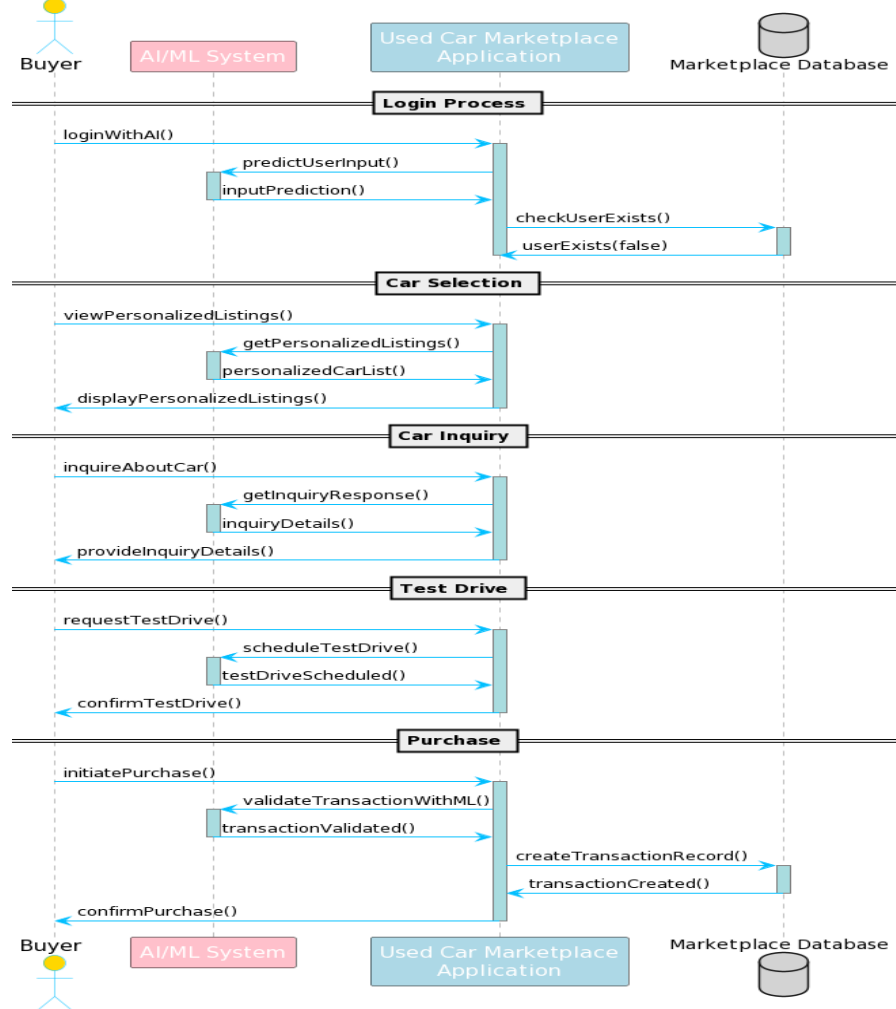


## 7. Object Behavior Model: A Sequence Diagram

Sequence diagram for User Registration:



## Sequence diagram for Buyer:



## 8. FUNCTIONAL SPECIFICATION:

Functional specifications are crucial for integrating AI and ML in used vehicle marketplaces because they spell out how these technologies will improve system efficiency and user experience, give explicit guidelines for development, and guarantee that the final product will meet user needs and the project's goals.

### 1. User Registration with AI Verification:

- **Functionality:** Visitors register by providing their personal details. AI algorithms verify the authenticity of the information to prevent fraudulent accounts.
- **Inputs:** Name, email address, password.

- **Process:** AI-enhanced form processing and validation.
- **Outputs:** Confirmation of registration, user profile creation.

## 2. AI-Enhanced Car Listings:

- **Functionality:** Sellers list their vehicles with assistance from AI for optimal pricing, description generation, and image enhancement.
- **Inputs:** Car make, model, year, cost, location, maintenance history, images.
- **Process:** AI algorithms analyze the market for pricing, process images, and suggest comprehensive descriptions.
- **Outputs:** Car listing posted on the website with enhanced details and visuals.

## 3. ML-Driven Car Search:

- **Functionality:** Consumers use an intelligent search that learns from user preferences and behavior to provide personalized results.
- **Inputs:** Make, model, year, price range, location, and other preferences.
- **Process:** Machine learning algorithms refine search results based on user data and interactions.
- **Outputs:** Customized list of cars that match the user's search criteria.

## 4. Comprehensive Car Information with AI Analysis:

- **Functionality:** Detailed car profiles with AI-generated reports on reliability, projected maintenance costs, and valuation.
- **Inputs:** VIN, car details.
- **Process:** AI systems analyze car history and generate comprehensive reports.
- **Outputs:** In-depth car profiles accessible to prospective buyers.

## 5. AI-Mediated Owner and Buyer Contact:

- **Functionality:** Communication platform facilitated by AI for efficient and secure interactions between buyers and sellers.
- **Inputs:** Buyer contact details, seller responses.
- **Process:** AI chatbots mediate initial conversations and schedule viewings or negotiations.
- **Outputs:** Scheduled appointments, negotiation transcripts.

## 6. Secure Payment Transactions with Fraud Detection:

- **Functionality:** Secure payment gateway with integrated ML algorithms to detect and prevent fraudulent transactions.
- **Inputs:** Agreed price, buyer and seller payment details.
- **Process:** Secure payment processing with real-time fraud detection.
- **Outputs:** Transaction receipts, fraud alerts.

## 7. Automated Sold Status Update:

- **Functionality:** Listings are automatically marked as sold and removed from active search results once the transaction is confirmed.
- **Inputs:** Seller confirmation of sale.
- **Process:** Automated system update upon sale confirmation.
- **Outputs:** Listing status updated to 'Sold', removal from active listings.

## 8. User Review System with Sentiment Analysis:

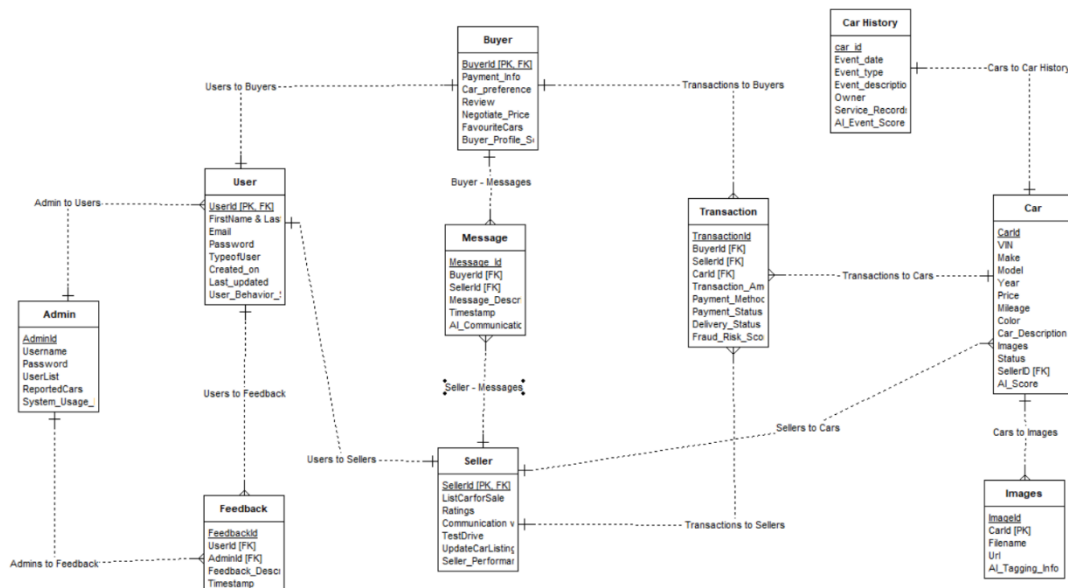
- **Functionality:** AI-driven sentiment analysis on user reviews to gauge customer satisfaction and provide insights.
- **Inputs:** User reviews and ratings post-transaction.
- **Process:** Sentiment analysis algorithms evaluate feedback.
- **Outputs:** Sentiment scores summarized insights for service improvement.

## 9. AI-Enabled Admin Panel for Enhanced Management:

- **Functionality:** An admin panel equipped with AI tools for managing user accounts, listings, and overall site analytics.
- **Inputs:** Admin commands, user and listing data.
- **Process:** AI algorithms assist in user management and site monitoring.
- **Outputs:** Reports on user activity, listing performance, and system health.

The integration of AI and ML technologies into the fundamental operations of a used automobile marketplace is outlined in these functional standards, with a focus on data-driven decision-making, efficiency, user engagement, and security.

## 9. DATABASE TABLES



## 1. Cars Table

- **CarId:** Unique identifier for each car. (Primary Key)
- **VIN:** Vehicle Identification Number.
- **Make:** Car make or brand.
- **Model:** Car model.
- **Year:** Year of manufacture.
- **Price:** AI-suggested price based on market analysis.
- **Mileage:** Car mileage.
- **Color:** Exterior and interior color.
- **Car\_Description:** AI-generated detailed description.
- **Images:** Enhanced and tagged images.
- **Status:** Availability status.
- **SellerID:** ID of the seller.
- **AI\_Score:** An AI-generated score indicating the car's condition or appeal.

## 2. Users Table

- **UserId:** Unique identifier. (Primary Key)
- **FirstName & LastName:** User's name.
- **Email:** User's email address.
- **Password:** Encrypted password.
- **TypeofUser:** Role (Buyer or Seller).
- **Created\_on:** Account creation date and time.
- **Last\_updated:** Last update timestamp.
- **User\_Behavior\_Score:** ML-generated score based on user activity and preferences.

## 3. Buyers Table

- **BuyerId:** Unique identifier. (Primary Key)
- **Payment\_Info:** Payment method information.
- **Car\_preference:** AI-analyzed car preferences.
- **Review:** Reviews left by the buyer.
- **Negotiate\_Price:** Record of price negotiations.
- **FavouriteCars:** List of favorite cars marked by the buyer.
- **Buyer\_Profile\_Score:** ML-generated score assessing buyer's reliability or preference patterns.

## 4. Sellers Table

- **SellerId:** Unique identifier. (Primary Key)
- **ListCarforSale:** Cars listed for sale.
- **Ratings:** Aggregate rating based on buyer feedback.
- **Communication with buyer:** Record of communications, analyzed by AI for insights.

- **TestDrive:** Record of test drives offered.
- **UpdateCarListing:** Updated car listings.
- **Seller\_Performance\_Score:** AI-generated score evaluating seller's performance and reliability.

## 5. Admin Table

- **AdminId:** Unique identifier. (Primary Key)
- **Username:** Admin's username.
- **Password:** Admin's password.
- **UserList:** List of users with AI-generated insights.
- **ReportedCars:** List of reported cars with ML analysis results.
- **System\_Usage\_Insights:** AI-generated insights on overall system usage and performance.

## 6. Transaction Table

- **TransactionId:** Unique transaction identifier. (Primary Key)
- **BuyerId:** ID of the buyer.
- **SellerId:** ID of the seller.
- **CarId:** ID of the car.
- **Transaction\_Amount:** Amount involved.
- **Payment\_Method:** Payment method.
- **Payment\_Status:** Status of the payment.
- **Delivery\_Status:** Delivery status.
- **Fraud\_Risk\_Score:** ML-determined risk score for the transaction.

## 7. Images Table

- **ImageId:** Unique image identifier. (Primary Key)
- **CarId:** Associated car ID.
- **Filename:** Original filename.
- **Url:** Access URL.
- **AI\_Tagging\_Info:** AI-generated tags and descriptions.

## 8. Car History Table

- **car\_id:** Car ID. (Primary Key)
- **Event\_date:** Date of event.
- **Event\_type:** Type of event (e.g., accident, repair).
- **Event\_description:** Description of the event.
- **Owner:** Owner details.
- **Service\_Records:** Service history.
- **AI\_Event\_Score:** AI analysis score for significant events.

## 9. Message Table

- **Message\_Id:** Unique message ID. (Primary Key)
- **BuyerId:** Buyer's ID.
- **SellerId:** Seller's ID.

- **Message\_Description:** Message content, analyzed by AI.
- **Timestamp:** Date and time of the message.
- **AI\_Communication\_Efficiency:** AI score indicating the effectiveness of communication.

## 10. Feedback Table

- FeedbackId: Unique feedback ID. (Primary Key)
- UserId: User ID.
- AdminId: Admin ID for response.
- Feedback\_Description: Description of the feedback.
- Timestamp: Feedback timestamp.

Here's a detailed description of the primary keys and foreign keys for each table in the database:

### 1. Cars Table

- **Primary Key:** CarId
- **Foreign Key:** SellerId (references SellerId in Sellers Table)

### 2. Users Table

- **Primary Key:** UserId
- **No direct foreign key**, but UserId could be used as a foreign key in other tables.

### 3. Buyers Table

- **Primary Key:** BuyerId
- **Foreign Key:** UserId (references UserId in Users Table)

### 4. Sellers Table

- **Primary Key:** SellerId
- **Foreign Key:** UserId (references UserId in Users Table)

### 5. Admin Table

- **Primary Key:** AdminId
- **No direct foreign key**, but AdminId could be used as a foreign key in other tables for administrative actions.

### 6. Transaction Table

- **Primary Key:** TransactionId
- **Foreign Keys:**
  - BuyerId (references BuyerId in Buyers Table)
  - SellerId (references SellerId in Sellers Table)
  - CarId (references CarId in Cars Table)



## 7. Images Table

- **Primary Key:** ImageId
- **Foreign Key:** CarId (references CarId in Cars Table)

## 8. Car History Table

- **Primary Key:** A composite key consisting of car\_id and Event\_date could be used.
- **Foreign Key:** car\_id (references CarId in Cars Table)

## 9. Message Table

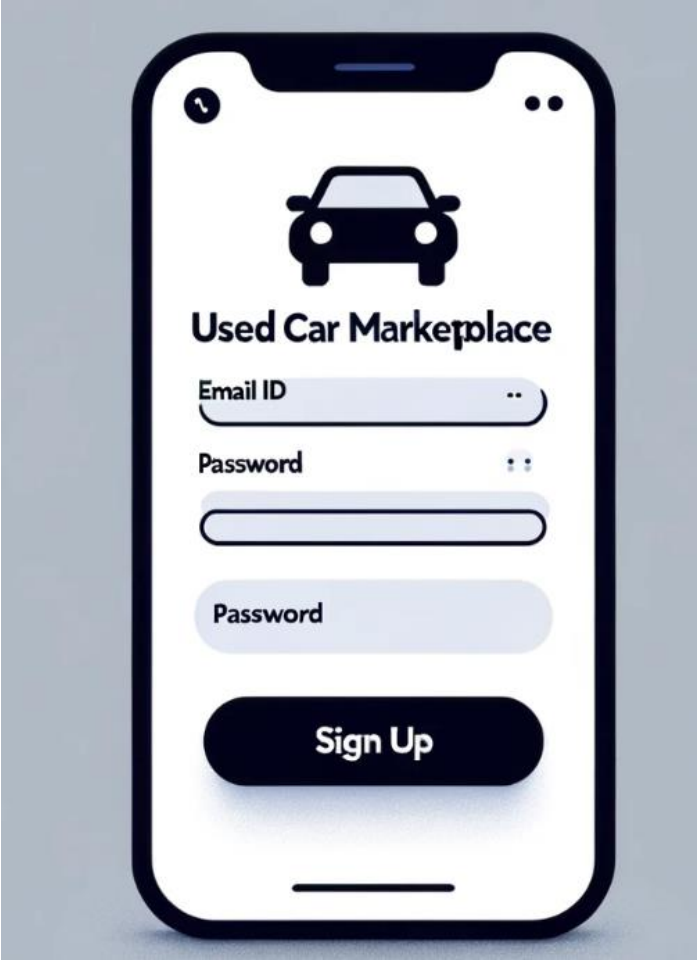
- **Primary Key:** Message\_Id
- **Foreign Keys:**
  - BuyerId (references BuyerId in Buyers Table)
  - SellerId (references SellerId in Sellers Table)

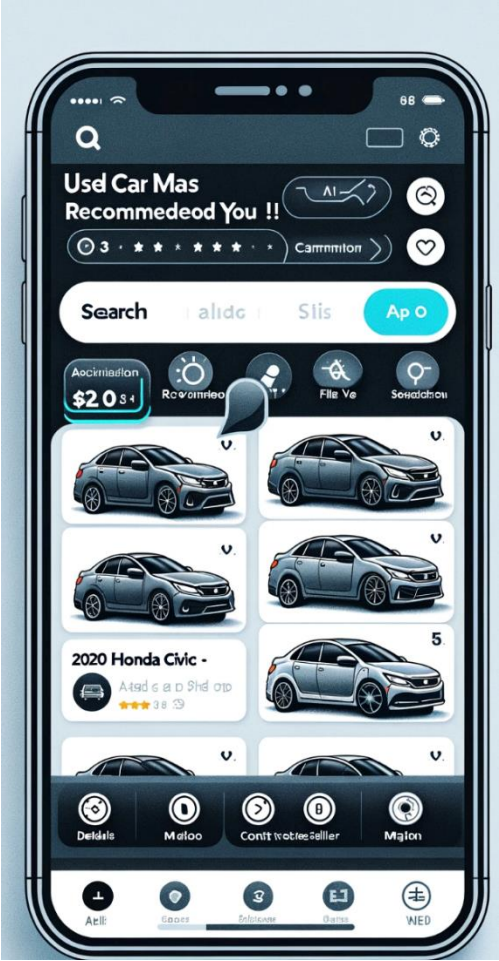
## 10. Feedback Table

- **Primary Key:** FeedbackId
- **Foreign Keys:**
  - UserId (references UserId in Users Table)
  - AdminId (references AdminId in Admin Table)

While foreign keys establish associations between databases and enable complicated queries spanning many tables, each primary key uniquely identifies a record in its corresponding table. This ensures referential integrity is maintained within the database. In the context of the used automobile market that has been boosted by AI and ML, these keys are essential for effective database operations and data administration.

## 10. INTERFACE DESIGN





## 11. SOFTWARE DESIGN

**Method Name:** LoginWithAI()

**Class Name:** CustomerAI

**ID:** 2

**Associated Use Cases:** AI-Assisted Customer Login

**Action Statement:** User attempts to log in with AI support to enhance credential verification.

**Description of Responsibilities:** Validates username and password using AI for pattern recognition and error prediction.

**Pre-Conditions:** User must enter their credentials.

**Post-Conditions:** AI assists with login, providing predictive text and error checking.

**Method Name:** RegisterWithAI()

**Class Name:** UserAISignup

**ID:** 2

**Associated Use Cases:** AI-Enhanced Sign-Up

**Action Statement:** Registers a new account with AI guidance for data validation and predictive input.

**Description of Responsibilities:** AI suggests username options, predicts input for fields, and ensures password strength.

**Pre-Conditions:** User must provide registration details.

**Post-Conditions:** User account is created with AI-validated credentials.

**Method Name:** verifyUsersWithML()

**Class Name:** UserMLList

**ID:** 2

**Associated Use Cases:** ML-Driven User Verification

**Action Statement:** ML algorithms verify new User accounts and suggest verification methods.

**Description of Responsibilities:** ML system optimizes verification code delivery and handles input errors intelligently.

**Pre-Conditions:** User awaits account verification.

**Post-Conditions:** Account is verified using ML-enhanced processes.

**Method Name:** SearchCarWithML()

**Class Name:** PreferencesML

**ID:** 2

**Associated Use Cases:** ML-Based Find Car

**Action Statement:** Users input preferences which are processed by ML to enhance search results.

**Description of Responsibilities:** ML validates inputs and uses predictive analytics to display cars matching user behavior.

**Pre-Conditions:** User inputs search criteria.

**Post-Conditions:** Customized car results are displayed based on ML analysis.

**Method Name:** ContactSellerWithAI()

**Class Name:** NegotiatePriceAI

**ID:** 2

**Associated Use Cases:** AI-Negotiated Contact with Seller

**Action Statement:** Buyer contacts seller with AI tools that aid in negotiation and communication.

**Description of Responsibilities:** AI assists in formulating messages, predicting acceptable price ranges, and facilitating communication.

**Pre-Conditions:** Buyer decides to contact the seller.

**Post-Conditions:** Contact is made with the seller, with AI assisting in negotiation.

## 12. REFERENCES

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3. Price Prediction of Used Cars Using Machine Learning <https://ieeexplore.ieee.org/document/9696839>
4. Car Sales Prediction Using Machine Learning Algorithms [https://www.researchgate.net/publication/332072545\\_Car\\_Sales\\_Prediction\\_Using\\_Machine\\_Learning\\_Algorithms#:~:text=Abstract%20and%20Figures,future%20goals%20for%20it](https://www.researchgate.net/publication/332072545_Car_Sales_Prediction_Using_Machine_Learning_Algorithms#:~:text=Abstract%20and%20Figures,future%20goals%20for%20it)

## **13. PROJECT MANAGEMENT DELIVERABLES**

### **13.1 Project Activities**

- Executive Summary
- Problem Statement
- Objective
- Scope
- BPMN Diagram
- Context Diagram
- Use Case Diagram
- Use Case Descriptions
- Data Dictionary
- Class Diagram (With & Without Methods)
- Sequence Diagram
- Functional Specification
- Interface Design
- Database Design
- Software Design
- References
- Project Management Deliverables