Use Case Diagram Analysis Report for CarDiagApp

Introduction to Use Case Diagrams

A use case diagram is a behavioral UML diagram that visually represents the interactions between users (actors) and a system to achieve specific goals. It depicts the functional requirements of a system from an external perspective, focusing on what the system does rather than how it does it. Use case diagrams consist of actors (users or external systems), use cases (functions or services), and relationships between them.

Importance of Use Case Diagrams for CarDiagApp

For the AI-based Car Fault Diagnosis Mobile Application (CarDiagApp), use case diagrams are particularly important for several reasons:

1. **Stakeholder Communication**: The diagram provides a clear, visual representation of system functionality that can be understood by both technical and non-technical stakeholders, including developers, car users, and mechanics.

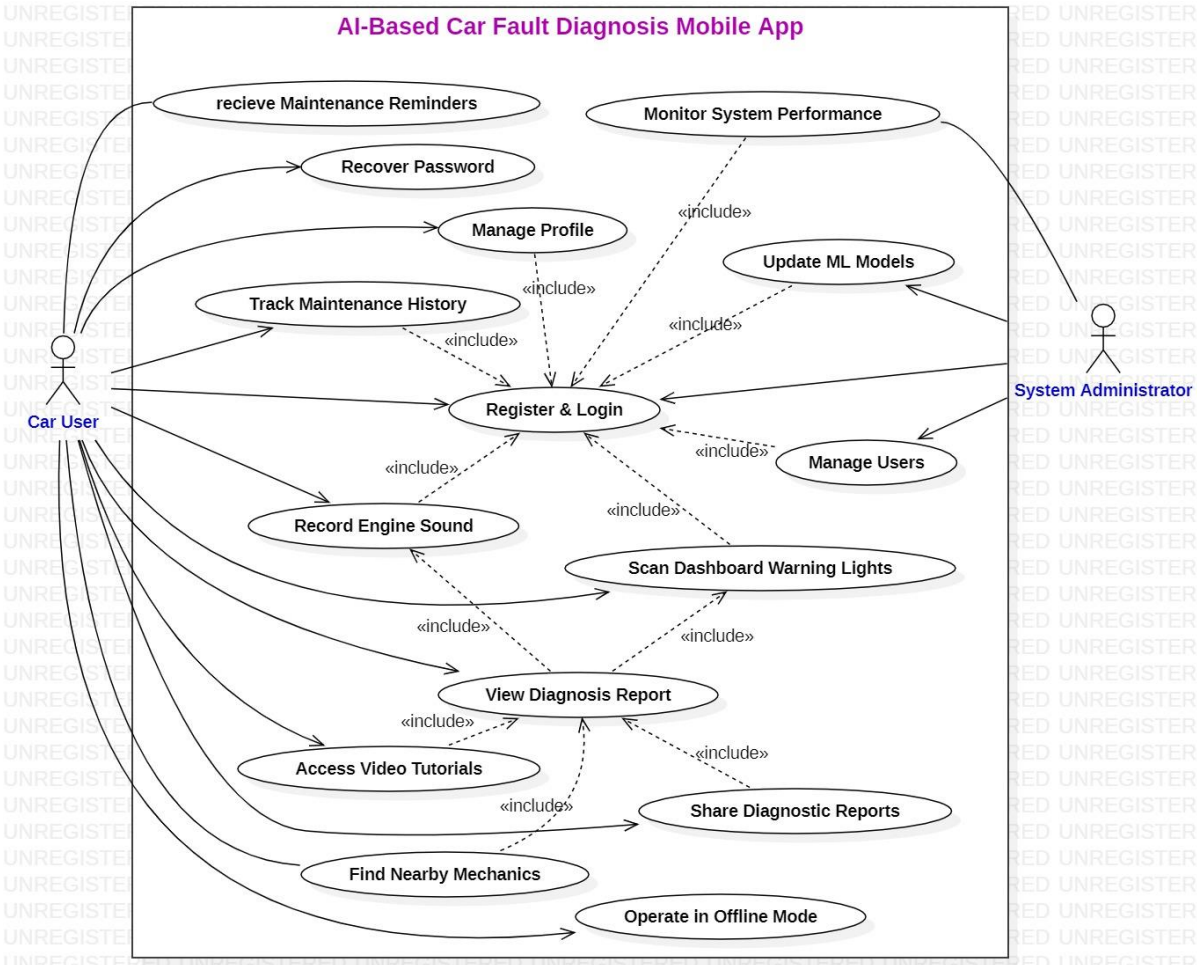
2. **Scope Definition**: It helps define the boundaries of the application, clarifying what features are included (e.g., dashboard light scanning, engine sound analysis) and what is excluded (e.g., direct OBD-II connection).

3. **Role Clarification**: With multiple user types specified in the SRS (car users, mechanics, content creators, administrators), the use case diagram clearly delineates which functions are available to each user type.

4. **Requirements Validation**: It serves as a visual validation tool to ensure all functional requirements from the SRS are properly captured and assigned to appropriate actors.

5. **Development Planning**: The development team can use the diagram to plan implementation phases, prioritize features, and organize testing efforts.

Use Case Diagram:



Detailed Use Cases Descriptions

UC1: Register & Login

Attribute	Description
Use Case ID	UC1
Use Case Name	Register & Login
Actors	Car User, Administrator
Description	Allows users to create accounts, verify email, login with credentials, and recover forgotten passwords

Attribute	Description
Preconditions	User has installed the application
Main Flow	1. User opens application 2. User selects "Register" option 3. User provides email, password, and selects role 4. System sends verification email 5. User verifies email 6. User completes profile setup 7. User can subsequently login with credentials
Alternative Flow	- User selects "Login" and enters credentials - User selects "Forgot Password" and follows recovery process
Postconditions	User is authenticated and granted role-based access
Requirements	FR1, FR2, FR3, FR4

UC2: Scan Dashboard Lights

Attribute	Description
Use Case ID	UC2
Use Case Name	Scan Dashboard Lights
Actors	Car User
Description	Captures and interprets dashboard warning light icons using the device camera
Preconditions	-User is authenticated -Camera permission is granted -Adequate lighting conditions
Main Flow	1. User selects "Scan Dashboard" from home screen 2. Camera interface appears with framing guide 3. User captures dashboard image 4. System processes image and identifies warning lights 5. System highlights identified symbols on image

Attribute	Description
	6. User confirms or retakes image 7. System proceeds to diagnosis report
Alternative Flow	- No lights detected: System suggests improving lighting or angle - Camera permission denied: System explains requirement and requests again - Processing error: System suggests retry with better conditions
Postconditions	Dashboard warning lights are identified and ready for diagnosis report
Requirements	FR5, FR6, FR15

UC3: Record Engine Sound

Attribute	Description
Use Case ID	UC3
Use Case Name	Record Engine Sound
Actors	Car User
Description	Records and analyzes engine sounds to identify potential mechanical issues
Preconditions	-User is authenticated -Microphone permission is granted -Relatively quiet environment
Main Flow	1. User selects "Record Engine Sound" from home screen 2. System provides recording instructions 3. User positions device appropriately 4. User starts recording (5-10 seconds) 5. System processes audio 6. System classifies engine sounds 7. System proceeds to diagnosis report
Alternative Flow	- Microphone permission denied: System explains requirement and requests again - Recording too noisy: System suggests quieter environment

Attribute	Description
	- Recording too short: System requests longer recording
Postconditions	Engine sound issues are identified and ready for diagnosis report
Requirements	FR7, FR8

UC4: View Diagnosis Report

Attribute	Description
Use Case ID	UC4
Use Case Name	View Diagnosis Report
Actors	Car User
Description	Displays comprehensive diagnostic information based on warning lights and/or engine sounds
Preconditions	User has completed either dashboard scan or engine sound recording or both
Main Flow	1. System combines results from warnings and/or sounds 2. System determines issues and urgency levels 3. System displays detailed report with explanations 4. System suggests potential solutions and repair tips 5. System displays relevant video tutorials 6. System saves report to history automatically
Alternative Flow	- No issues detected: System shows all-clear message - Indeterminate diagnosis: System suggests professional inspection - Critical issue detected: System highlights urgency with alert
Postconditions	User is informed about car issues with explanation and suggestions Report is saved to history
Requirements	FR9, FR16, FR20

UC5: Access Video Tutorials

Attribute	Description
Use Case ID	UC5
Use Case Name	Access Video Tutorials
Actors	Car User
Description	Provides relevant video content about diagnosed issues
Preconditions	-User has viewed a diagnosis report, -Internet connection available
Main Flow	1. User views diagnosis report 2. System displays relevant tutorial links 3. User selects video tutorial 4. System loads and plays selected tutorial
Alternative Flow	- No internet connection: System displays cached tutorials if available - No relevant tutorials found: System shows general maintenance videos
Postconditions	User gains visual understanding of the issue and repair process
Requirements	FR10

UC6: Track Maintenance History

Attribute	Description
Use Case ID	UC6
Use Case Name	Track Maintenance History
Actors	Car User
Description	Shows chronological list of past diagnostics with details
Preconditions	-User is authenticated, -User has previous diagnostic reports
Main Flow	1. User selects "History" from home screen 2. System displays chronological list of past diagnostics 3. User selects specific report

Attribute	Description
	4. System displays detailed view of selected report
Alternative Flow	- No history available: System shows empty state with explanation - Filter by date: User applies date range filter - Filter by issue type: User filters by specific problems
Postconditions	User can view comprehensive maintenance history
Requirements	FR11

UC7: Receive Maintenance Reminders

Attribute	Description
Use Case ID	UC7
Use Case Name	Receive Maintenance Reminders
Actors	Car User
Description	Gets notifications based on fault urgency levels
Preconditions	-User has notification permissions enabled, -User has diagnosed issues with urgency ratings
Main Flow	1. System analyzes fault urgency 2. System schedules reminders based on urgency: - Red (immediate): Immediate alert - Yellow (soon): 1-hour alert - Monitoring: 2-hour alert 3. System delivers notifications at scheduled times
Alternative Flow	- User dismisses notification: System reschedules as appropriate - User acts on notification: System updates reminder status
Postconditions	User is reminded of maintenance needs based on urgency
Requirements	FR12

UC8: Share Diagnostic Reports

Attribute	Description
Use Case ID	UC8
Use Case Name	Share Diagnostic Reports
Actors	Car User
Description	Enables sharing of diagnostic results with others
Preconditions	-User has completed diagnosis, -Share permission granted
Main Flow	1. User views diagnosis report 2. User selects "Share" option 3. System prepares shareable report 4. User selects sharing method (email, messaging, etc.) 5. System shares report via selected method
Alternative Flow	- User exports as PDF: System generates downloadable report - Share directly with others: System prepares specialized format
Postconditions	Diagnostic report is shared with selected recipient
Requirements	FR17

UC9: Find Nearby Mechanics

Attribute	Description
Use Case ID	UC9
Use Case Name	Find Nearby Mechanics
Actors	Car User
Description	Locates mechanics in the vicinity using map integration
Preconditions	-User has completed diagnosis -Internet connection available -Location permission granted (optional)

Attribute	Description
Main Flow	1. User selects "Find Nearby Mechanics" option 2. System requests location permission if not already granted 3. System displays map with mechanics in vicinity 4. User can filter results by distance, services, or ratings 5. User selects a mechanic to view details 6. System shows contact information and directions
Alternative Flow	- Location permission denied: System allows manual location entry - No mechanics found: System expands search radius - User shares report with selected mechanic
Postconditions	User can contact or navigate to appropriate mechanic
Requirements	FR21, FR22

UC10: Manage Users

Attribute	Description
Use Case ID	UC10
Use Case Name	Manage Users
Actors	Administrator
Description	Allows administrators to view, modify, and manage user accounts
Preconditions	-User is authenticated as Administrator, -Internet connection available
Main Flow	1. Administrator accesses admin dashboard 2. Administrator selects user management section 3. System displays list of registered users 4. Administrator can view, edit, or disable user accounts 5. System applies and saves changes
Alternative Flow	- Search for specific user - Filter users by role or status

Attribute	Description
	- Reset user password - Configure role permissions
Postconditions	User accounts are managed according to administrative actions
Requirements	FR18

UC11: Update ML Models

Attribute	Description
Use Case ID	UC11
Use Case Name	Update ML Models
Actors	Administrator
Description	Enables pushing updates to the machine learning models
Preconditions	-User is authenticated as Administrator, -Internet connection available, -New model versions are ready
Main Flow	1. Administrator accesses model management section 2. System displays current model versions and statistics 3. Administrator selects new model version to deploy 4. System validates and stages the update 5. Administrator confirms rollout schedule 6. System deploys updates to users
Alternative Flow	- Rollback to previous version - Staged rollout to percentage of users - A/B testing of model versions
Postconditions	ML models are updated to improve diagnostic accuracy
Requirements	FR14

UC12: Monitor System Performance

Attribute	Description
Use Case ID	UC12
Use Case Name	Monitor System Performance
Actors	Administrator
Description	Provides analytics and metrics on system usage and performance
Preconditions	-User is authenticated as Administrator, -Internet connection available
Main Flow	1. Administrator accesses system dashboard 2. System displays key performance metrics 3. Administrator can view detailed reports on: - Model accuracy statistics, - User engagement metrics, - Error rates and types, - Usage patterns 4. Administrator can export reports
Alternative Flow	- Filter data by date range - Configure alert thresholds - Investigate specific issues
Postconditions	Administrator has insights into system performance and usage
Requirements	Inferred from admin role

UC13: Recover Password

Attribute	Description
Use Case ID	UC13
Use Case Name	Recover Password
Actors	Car User

Attribute	Description
Description	Enables users to reset their password when forgotten
Preconditions	- Registered email address, - Internet connection
Main Flow	1. User selects "Forgot Password" and provides registered email 2. System validates User input and checks for existing User 3. System generates password reset token and sends it to User's registered email 4. User receives an email with password reset link or token 5. User reset password: The user clicks on the password reset link and provide a new password 6. System validate and update new password
Alternative Flow	None
Postconditions	User Can Log In: The user can log in with their new password.
Requirements	FR3

UC14: Operate in Offline Mode

Attribute	Description
Use Case ID	UC14
Use Case Name	Operate in Offline Mode
Actors	Car User
Description	Enables core diagnostic functionality without internet connection
Preconditions	-User has previously authenticated, -Required ML models are downloaded
Main Flow	1. System detects offline status 2. User can access core features: - Scan dashboard lights - Record engine sounds

Attribute	Description
	- View basic diagnostics - Access cached tutorials 3. System stores results locally
Alternative Flow	- Reconnection: System syncs local data when connection restored, - Limited functionality notification if models not pre-downloaded
Postconditions	User can diagnose issues without internet connectivity
Requirements	FR13

UC15: Manage Profile

Attribute	Description
Use Case ID	UC15
Use Case Name	Manage Profile
Actors	Car User, Administrator
Description	Allows users to update their profile information and preferences
Preconditions	-User is authenticated
Main Flow	1. User accesses profile section, 2. System displays current profile information, 3. User modifies personal information, preferences, or settings, 4. System validates changes, 5. System saves updated profile
Alternative Flow	- Change password: System requires current password verification, - Update notification preferences, - Configure data usage settings
Postconditions	User profile is updated with new information
Requirements	FR19

Relationships between Use Cases

1. **Include Relationships**:
    - "View Diagnosis Report" includes "Scan Dashboard Warning Lights" and/or "Record Engine Sound"
    - "Share Diagnostic Reports" includes "View Diagnosis Report"
    - "Find Nearby Mechanics" includes "View Diagnosis Report"

These include relationships show that certain functionality depends on other functionality being executed first.

Use Case Access by Actor

The diagram illustrates which actors have access to which use cases:

1. **Car User**: Has access to all basic functions, including registration, login, diagnostics, maintenance tracking, and location services.
2. **System Administrator**: Focuses on backend system management, user administration, model updates and monitors performance with IT/ML expertise.

Technical Implementation Considerations

The use case diagram provides a foundation for architectural decisions:

1. **Component Structure**: The diagram suggests natural component boundaries (authentication system, image processing system, audio processing system, reporting system).
2. **Data Flow**: The include relationships indicate data flow between components, which influences the application architecture.
3. **Testability**: Each use case can be treated as a testable unit, facilitating the testing strategy outlined in Section 5.3.

Conclusion to Use Case Diagram:

The use case diagram for CarDiagApp clearly visualizes the functional scope of the application and the interactions between different user types and system features. It aligns with the SRS requirements and provides a solid foundation for subsequent development activities.

This diagram will serve as a reference for stakeholders throughout the project lifecycle, ensuring that development efforts remain focused on the intended functionality, and that testing verifies all required use cases. As development progresses, the diagram can be refined to reflect any changes in requirements or additional functionality identified during implementation.