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1. EXECUTIVE SUMMARY

1.1 Project Overview

This project is a **Car Rental Management System** that allows Admins, Owners, and Managers to manage vehicles, reservations, clients, services, and branches through a centralized web platform.

1.2 Purpose and Scope of This Specification

This document defines the functional specifications, user interactions, data structures, and system diagrams necessary for implementing the platform. It also outlines behavioral and structural models used during the design phase.

2. PRODUCT/SERVICE DESCRIPTION

2.1 Product Context

The system is a multi-role SaaS platform for car rental businesses, supporting multi-branch structures with clearly defined user roles and responsibilities.

2.2 User Characteristics

- **Admin**: Creates branches, monitors reports, and manages system-wide data.
- **Owner**: Manages branch-specific users, cars, and reservations.
- **Manager**: Creates and updates reservations and interacts with clients.
- **Public User**: Views public info on the homepage.

2.3 Assumptions

- Only authorized users can access restricted functionalities.
- Cars are tied to a single business/branch.
- Internet access is required to use the platform.

2.4 Constraints

- One reservation per car per time slot.
- A manager is assigned to only one branch.
- Users must operate within their role’s permission boundaries.

2.5 Dependencies

- **Frontend**
    - Laravel Blade Templating Engine (for server-rendered views)
    - Tailwind CSS and optional Alpine.js for interactivity

- **Backend**
  - Laravel (PHP framework) handling routing, business logic, and API endpoints
  - Laravel Sanctum or Passport for authentication (token-based or session-based)

- **Database Management System (DBMS)**
  - MySQL or PostgreSQL for storing application data (users, reservations, payments, logs)

- **PDF Library**
  - dompdf (via Barryvdh/laravel-dompdf) for generating receipts and invoices in PDF format

- **Authentication & Session Management**
  - Laravel's built-in session middleware
  - JWT (via `tymon/jwt-auth`) if using token-based API authentication

2. PRODUCT/SERVICE DESCRIPTION

2.1 Product Context

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- **Admin**: Creates branches, monitors reports, and manages system-wide data.
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2.3 Assumptions

- Only authorized users can access restricted functionalities.
- Cars are tied to a single business/branch.
- Internet access is required to use the platform.

2.4 Constraints

- One reservation per car per time slot.

- A manager is assigned to only one branch.
- Users must operate within their role's permission boundaries.

2.5 Dependencies

- Frontend: Laravel Blade
- Backend: Laravel
- DBMS: MySQL
- PDF library: For generating receipts/invoices
- JWT: Authentication and session management

3. SOFTWARE DESIGN / DIAGRAMS

3.1 REQUIREMENTS ANALYSIS

3.1.1.1 User Scenarios List

#	Name	Description
US_01	User logs in	Users: Admin, Owner, and Manager enter their credentials (email and password) to access their personalized dashboard.
US_02	Create a reservation for a new client	Manager creates a reservation for a new client who visits the branch, entering their details and selecting an available car.
US_03	Create a reservation for an existing client	Manager creates a reservation for an existing client already registered in the branch's database.
US_04	View reservations	Users: Owner and Manager view a list of pending reservations for their branch.
US_05	View calendar	Users: Owner and Manager view each car on a calendar reservation for their branch.
US_06	Clients' list	Users: Owner and Manager view all clients registered at their branch.
US_07	Filter car in Calendar by date and availability	Users: Owner and Manager filter the cars by date and availability for easily finding cars available on those dates.
US_08	Managers list	Owner views all Managers assigned to their branch.

US_09	Search a client	Users: Owner and Manager search for a specific client by name, email, or phone number.
US_10	Search a manager	Owner searches for a specific Manager by name or email within their branch.
US_11	View own profile	Users: Owner and Manager view their profile details (e.g., full name, role, branch).
US_12	Add a new Manager or Owner	Owner adds a new Manager to their branch, assigning a username, email, and password.
US_13	Edit a reservation	Owner or Manager edit a reservation for a specific client, updating the start/end dates in the pending list.
US_14	Remove a reservation	Owner can remove a reservation from the list.
US_15	View client’s rental history	Owner views a specific client’s rental history. Admin can view aggregated rental data across branches.
US_16	Download rental receipt	Owner or Manager downloads a PDF receipt of a client’s rental details for record-keeping or client use.
US_17	View reports	Owner views branch-specific reports (e.g., rental stats, revenue). Admin views platform-wide reports.
US_18	User logs out	Users: Admin, Owner, and Manager log out from their accounts.
US_19	Add new car	Owner or Manager adds a new car to the branch’s inventory, provided it’s within the subscription limit.
US_20	View car inventory	Users: Owner and Manager view the full list of cars in the branch, including statuses (e.g., available, rented).
US_21	Add new branch	Admin adds a new branch to the platform, assigning an Owner and setting the time and subscription.
US_22	View activity logs	Owner views a log of all actions within their branch (e.g., car added, reservation updated).
US_23	View Manager activity report	Owner views a report detailing reservations and actions performed by Managers in their branch.
US_24	Mark a reservation as returned	Owner or Manager marks a reservation as returned when the client brings back the car, updating its

		status to available.
US_25	Adding days to a reservation	Owner or Manager extends the reservation by adding how many days the client keeps or wants to keep the car longer.
US_26	View main page before logging in	Users access the main page before logging in to read general information about the car rental platform.
US_27	View Overview (Dashboard Home)	Users: Owner and Manager view a dashboard with key metrics upon logging in. Admin sees platform-wide overview.
US_28	View Upcoming Returns	Users: Owner and Manager view a list of cars scheduled to be returned today or tomorrow for their branch.
US_29	Search car with license plate	Users: Owner and Manager search for a specific car by its license plate number to view its status and rental history.
US_30	Filter reservations	Users: Owner and Manager filter reservations by car, client, or status (e.g., show only pending reservations for a specific car).
US_31	Attach return notes & additional fees	Owner or Manager attaches notes (e.g., “minor scratch on door”) and additional fees (e.g., $20 late fee) when marking a car as returned.
US_32	Generate final invoice after return	Owner or Manager generates a final invoice (e.g., PDF) including rental cost, additional fees, and notes after a car is returned.
US_33	Add services and maintenance for cars	Owner adds car service/maintenance (e.g., oil change, cost, date) and updates car status (e.g., in service).
US_34	View car services and maintenance history	Users: Owner and Manager view a car’s service history (e.g., type, date, cost, status) in a table.
US_35	Check payment page	Admin expands to show all payments, with method details.
US_36	Generate invoice from payment page	Allows Owners to create an invoice from the payment page, consolidating client payments (online/cash) and rental details.

3.1.1.2 User Scenarios Composite Flows

Composite Flow	User Goal	Actions	Outcome
Set up a new operational branch	Admin needs to onboard a new franchise branch	Log in to the platform (UC_01)	Admin dashboard is accessed
		Add a new Owner for the branch (UC_12)	Owner account is created and notified
		Create a new branch with subscription (UC_21)	Branch is added to the system and linked to a subscription plan
		View reports for platform-wide metrics (UC_17)	Admin sees new branch stats
Process a car reservation	Manager needs to book a car for a customer	Log in to the platform (UC_01)	Manager dashboard is accessed
		Enter client details (UC_05)	Client details saved
		Check car availability (UC_06)	System checks car availability
		Save reservation (UC_07)	Reservation is saved
		Mark car as rented (UC_08)	Car is assigned and marked as rented
		Notify Owner if no cars (UC_19)	Owner is alerted about unavailability (conditional)
Register new client and rent car	Manager needs to onboard a new	Log in to the platform (UC_01)	Manager dashboard is accessed

	customer and assign a car		
		Register new client (UC_04)	Client is created in the system
		Check car availability (UC_06)	System verifies availability
		Save reservation (UC_07)	Reservation is saved
		Mark car as rented (UC_08)	Car is assigned and marked as rented
Process payment and close rental	Manager finalizes a rental transaction	View ongoing rentals (UC_09)	Ongoing rental is selected
		Process payment (UC_10)	Payment is recorded
		Mark rental as complete (UC_11)	Rental is closed
		View reports (UC_17)	Reports updated with completed rental
Manage car inventory	Owner/Manager maintains vehicle availability	Add new car (UC_13)	New vehicle registered
		View/update car list (UC_14)	Car list reviewed or updated
		Mark car under maintenance (UC_15)	Vehicle marked unavailable for rental
		Return car to inventory (UC_16)	Vehicle marked available again
Onboard new users and assign roles	Admin adds staff and assigns responsibilities	Log in to the platform (UC_01)	Admin dashboard is accessed

		Register new user (UC_02)	New user account is created
		Assign role and branch (UC_03)	Role and permissions assigned

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3.1.1.3 User Scenarios Action Table

User Goal	Context	Actions	Outcome
Log in	User visits login page	Enter email and password	Access granted to personalized dashboard
Log in	Credentials invalid	Submit login form	Error message shown, user asked to retry
Create new client reservation	Manager logged in, new client arrives	Enter client details and select car	Reservation created, car status updated to "rented"
Create existing client reservation	Manager logged in, client registered	Select client and car, enter rental dates	Reservation created, car status updated to "rented"
View reservations	Owner or Manager logged in	Navigate to reservations page	List of pending reservations displayed
View calendar	Owner or Manager logged in	Navigate to calendar page	Calendar shows reservations by date and car
Filter calendar by date & availability	Owner or Manager logged in	Apply date and availability filters	Filtered cars displayed in calendar
View clients list	Owner or Manager logged in	Navigate to clients page	List of registered clients displayed
View managers list	Owner logged in	Navigate to managers page	List of branch managers

			displayed
Search client	Owner or Manager logged in	Search client by name/email/phone	Matching clients displayed
Search manager	Owner logged in	Search manager by name/email	Matching managers displayed
View own profile	Owner or Manager logged in	Navigate to profile page	User profile details shown
Add new Manager or Owner	Owner logged in	Enter new user details and assign role	New user added and notified
Edit a reservation	Owner or Manager logged in	Select reservation and edit details	Reservation updated
Remove a reservation	Owner logged in	Select reservation and confirm removal	Reservation removed, car marked available
View client rental history	Owner logged in	Select client and view rental history	Client’s past rentals displayed
Download rental receipt	Owner or Manager logged in	Select reservation and download receipt	Rental receipt PDF generated and downloaded
View reports	Owner or Admin logged in	Select report type and date range	Reports displayed with metrics
User logs out	User logged in	Click logout	Session ended, redirected to login
Add new car	Owner or Manager logged in	Enter car details and save	Car added to inventory
View car inventory	Owner or Manager	Navigate to cars page	List of cars with statuses

	logged in		displayed
Add new branch	Admin logged in	Enter branch and owner details, save	Branch created and owner notified
View activity logs	Owner logged in	Navigate to activity logs	Branch activity logs displayed
View Manager activity report	Owner logged in	Select manager and date range	Manager activity report displayed
Mark reservation as returned	Owner or Manager logged in	Mark reservation as returned	Reservation status updated, car marked available
Add days to a reservation	Owner or Manager logged in	Enter extension days and confirm	Reservation extended
View main page before login	Guest visits site	Browse main page	General platform info displayed
View dashboard overview	Owner, Manager, Admin logged in	Access dashboard	Key metrics displayed
View upcoming returns	Owner or Manager logged in	Access upcoming returns page	List of upcoming returns displayed
Search car by license plate	Owner or Manager logged in	Enter license plate and search	Car details displayed
Filter reservations	Owner or Manager logged in	Apply filters on reservations list	Filtered reservations displayed
Attach return notes & fees	Owner or Manager logged in	Add notes and fees on returned car	Notes and fees saved
Generate final invoice	Owner or Manager	Generate invoice after return	PDF invoice generated

	logged in		
Add services/maintenance	Owner or Manager logged in	Enter service details and update status	Service recorded and status updated
View service history	Owner or Manager logged in	View car’s service records	Service history displayed
Check payment page	Admin logged in	View payment records	Payments data displayed
Generate invoice from payment	Owner logged in	Generate invoice from payment page	Invoice PDF created

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User Personas

Persona Name	Role	Goals	Characteristics	Typical Actions
Admin	System Admin	Manage branches, oversee platform-wide reports and payments	Oversees multiple branches, controls subscriptions, users	Add branches, manage Owners, view platform-wide reports
Owner	Branch Owner	Manage branch resources, users, reports	Responsible for branch operations, user & car management	Add Managers, view reservations, add cars, generate invoices
Manager	Branch Manager	Manage client reservations and rentals	Frontline operator interacting with clients	Create reservations, download receipts, update rentals
Client/User	End User	Rent vehicles, view rental info	Accesses dashboard for	Log in, view dashboard,

			personal rental data	request rentals via Manager
Guest	Visitor	Learn about platform services	No login required	View main page, browse info, choose to log in

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3.1.2 User Cases

Use case tables have been created for **US_01 to US_36**, each with:

- Actor(s)
- Preconditions
- Postconditions
- Main Flow
- Alternative Flows

US_01 – User Logs In

Field	**Description**
Use Case ID	US_01
Name	User Logs In
Actor(s)	Admin, Owner, Manager
Description	Allows users to log in using their credentials and access their dashboard.
Preconditions	User must be registered.
Postconditions	User is authenticated and redirected to dashboard.
Main Flow	1. User enters email and password. 2. System verifies credentials. 3. User is redirected to dashboard.
Alternative Flows	Invalid credentials → System shows an error message.

US_02 – Create a Reservation for a New Client

Field	**Description**
Use Case ID	US_02

Name	Create a Reservation for a New Client
Actor(s)	Manager
Description	Manager creates a reservation by adding a new client.
Preconditions	Client is not in the system.
Postconditions	New client and reservation are saved.
Main Flow	1. Manager inputs client details. 2. System saves client. 3. Manager selects car and reservation dates. 4. System saves reservation.
Alternative Flows	Client info missing → System prompts to complete required fields.

US_03 – Create a Reservation for an Existing Client

Field	**Description**
Use Case ID	US_03
Name	Create a Reservation for an Existing Client
Actor(s)	Manager
Description	Manager books a car for an existing client.
Preconditions	Client exists in the system.
Postconditions	Reservation is created for selected client.
Main Flow	1. Manager searches for client. 2. Selects client. 3. Selects car and reservation dates. 4. System saves reservation.
Alternative Flows	Client not found → Manager retries search.

See section 3.2.1 for the full Use Case Diagram.

3.1.3 Functional Requirements (FR)

1. The system shall allow Admins, Owners, and Managers to log in and log out.
2. Managers shall be able to create reservations for new or existing clients.
3. Owners and Managers shall be able to view and filter reservations.
4. The system shall allow Owners and Managers to manage a calendar view of car availability.

5. The system shall support client and manager search functionality.
6. Owners shall be able to add, edit, and delete Managers.
7. Owners and Managers shall be able to add, edit, and remove reservations.
8. The system shall generate and download invoices and receipts.
9. Admins shall be able to create and manage branches and subscriptions.
10. Owners and Managers shall manage car inventory, services, and maintenance.
11. The system shall send notifications and maintain logs of all critical actions.
12. The system shall allow owners to view reports and usage statistics.
13. Cars can be marked as returned and reservation duration can be extended.
14. Damage reports and return notes can be attached to each reservation.
15. Admins shall view all payments and generate consolidated invoices.

3.1.4 Non-Functional Requirements (NFR)

1. **Performance**: The system should respond to user actions within 2 seconds under normal load.
2. **Availability**: The application must be available 99.5% of the time during business hours.
3. **Security**:
    - Passwords must be hashed using bcrypt.
    - All sensitive data must be transmitted over HTTPS.
    - JWT-based authentication must be used.
4. **Scalability**: The system should scale to support multiple branches and up to 5000 users.
5. **Maintainability**: Codebase should be modular and documented using industry-standard practices.
6. **Portability**: The application must be containerized using Docker.
7. **Data Integrity**: Transactions involving payments, returns, or updates must be ACID-compliant.
8. **Auditability**: Logs of user actions must be recorded and available for export.
9. **Localization**: The system must support multilingual interfaces in future versions.
10. **Compliance**: Must comply with GDPR for handling customer data in the EU.

3.2 BEHAVIORAL DIAGRAMS

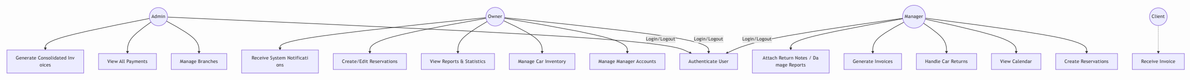
3.2.1 Use Case Diagrams

This section provides visual representations of the core functionalities of the Car Rental Management System from the perspectives of different user roles: **Admin**, **Owner**, and

Manager. Each use case diagram highlights the key interactions between system actors and the system itself, helping to identify role-specific responsibilities and system boundaries.

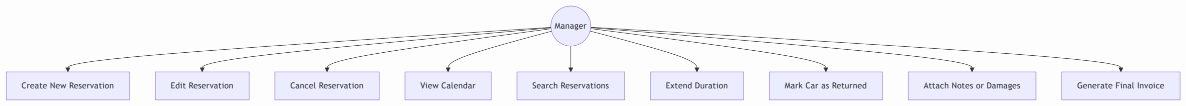
3.2.1.1 System-Wide Use Case Diagram

The following diagram gives a holistic overview of the entire system, showing how all major actors interact with the system and its key functionalities.



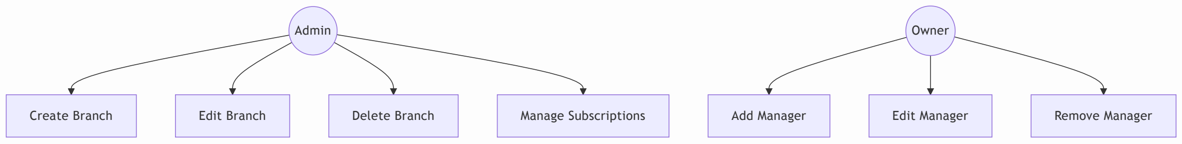
3.2.1.2 Reservation Management Use Cases

This diagram focuses on actions related to managing client reservations, handled primarily by **Managers** and **Owners**.



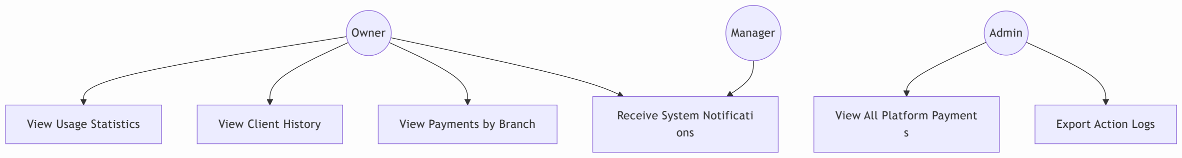
3.2.1.3 User & Branch Management Use Cases

This diagram shows how **Admins** and **Owners** manage users and operational branches.



3.2.1.4 Reporting & Notifications Use Cases

This diagram highlights reporting, notifications, and audit-related actions for **Admins** and **Owners**.

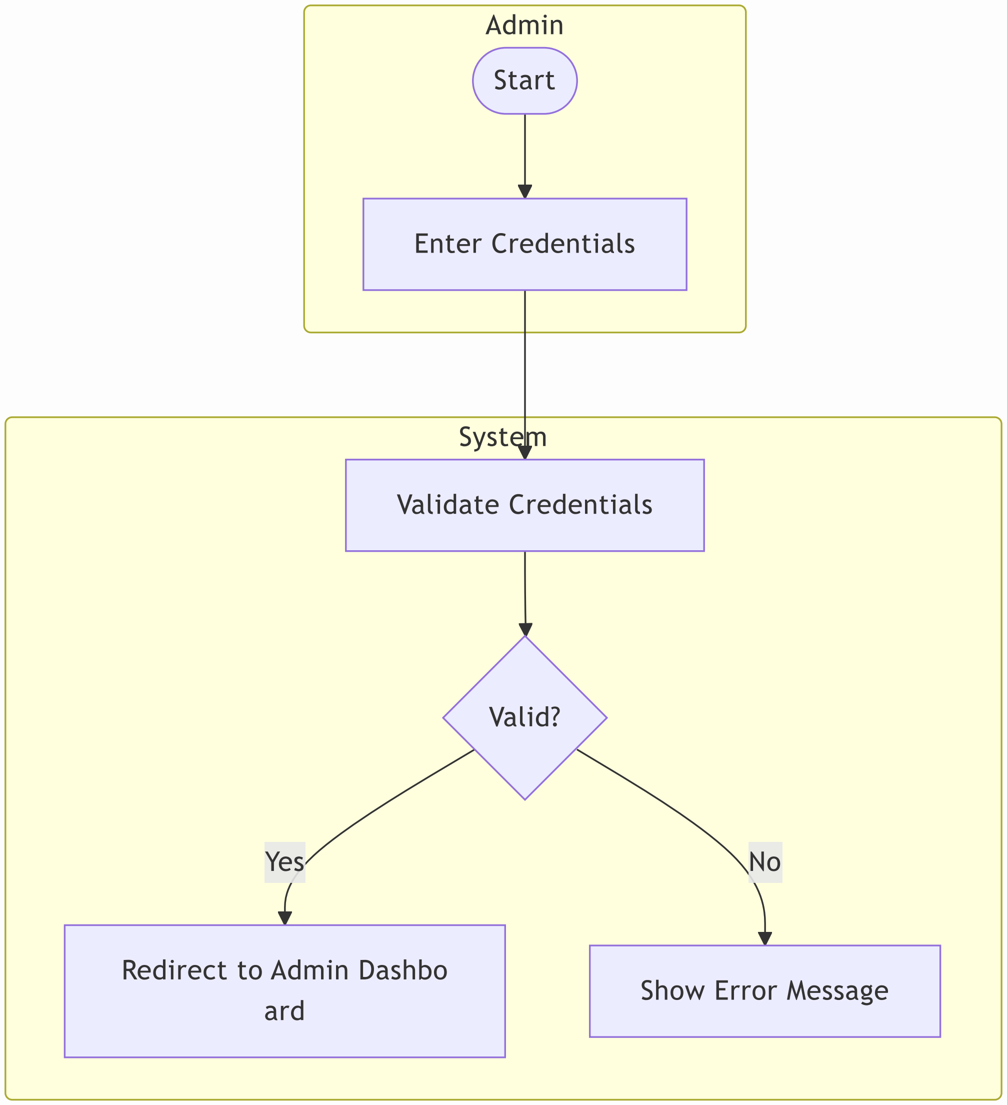


3.2.2 Activity Diagrams

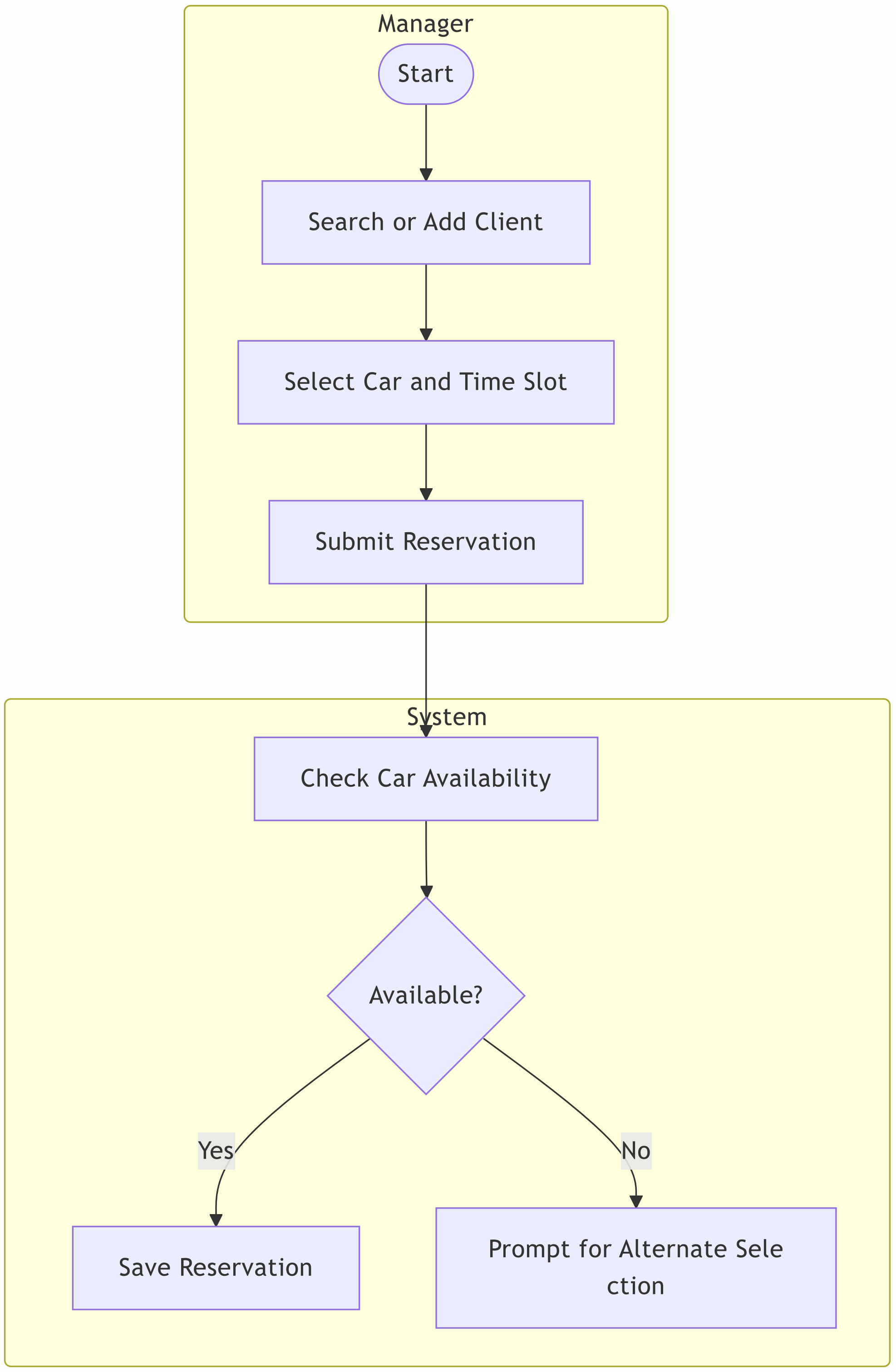
This section presents **activity diagrams** for key use cases in the Car Rental Management System. Activity diagrams illustrate the flow of control between system actions and user interactions across multiple actors, organized using **vertical swimlanes** for clarity.

Each diagram is structured to show decision points, parallel processes, and the sequence of activities from start to end. Actors involved include **Admin**, **Owner**, and **Manager**.

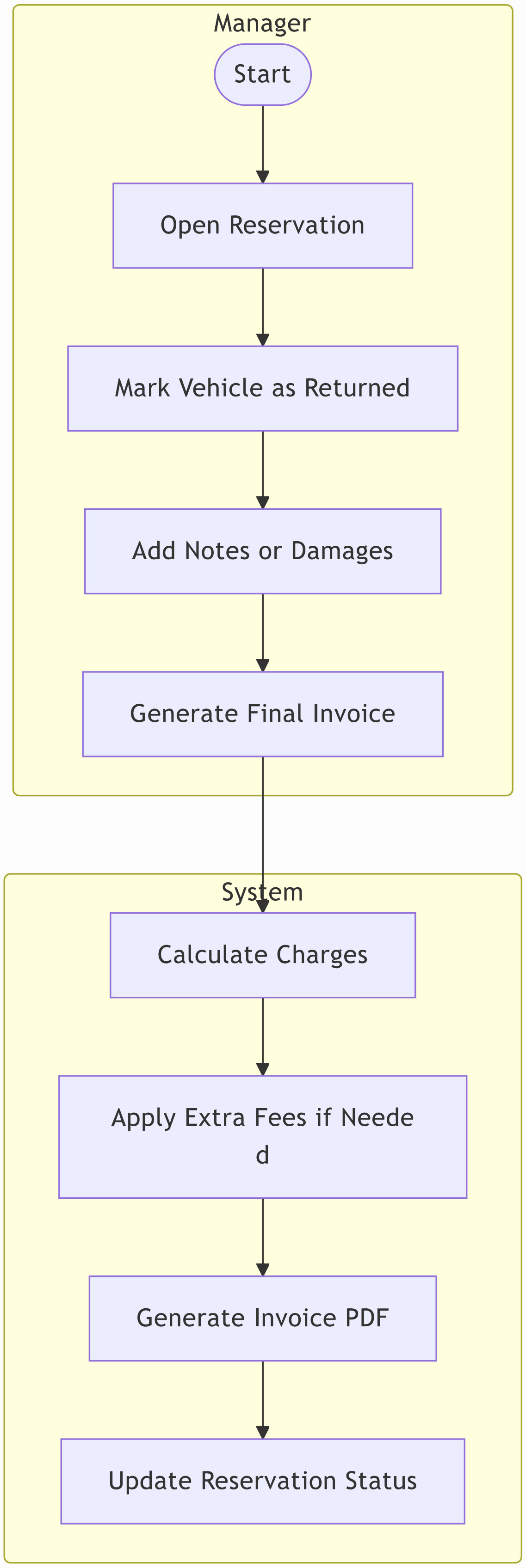
3.2.2.1 Login Flow



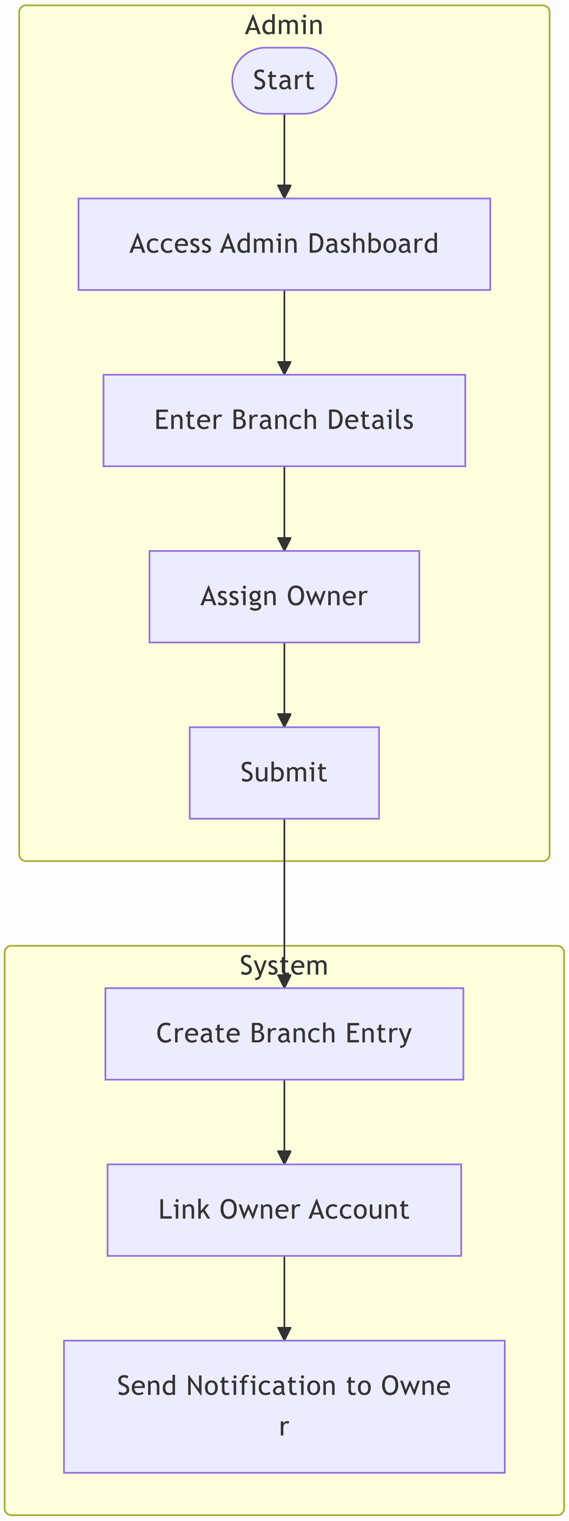
3.2.2.2 Create New Reservation



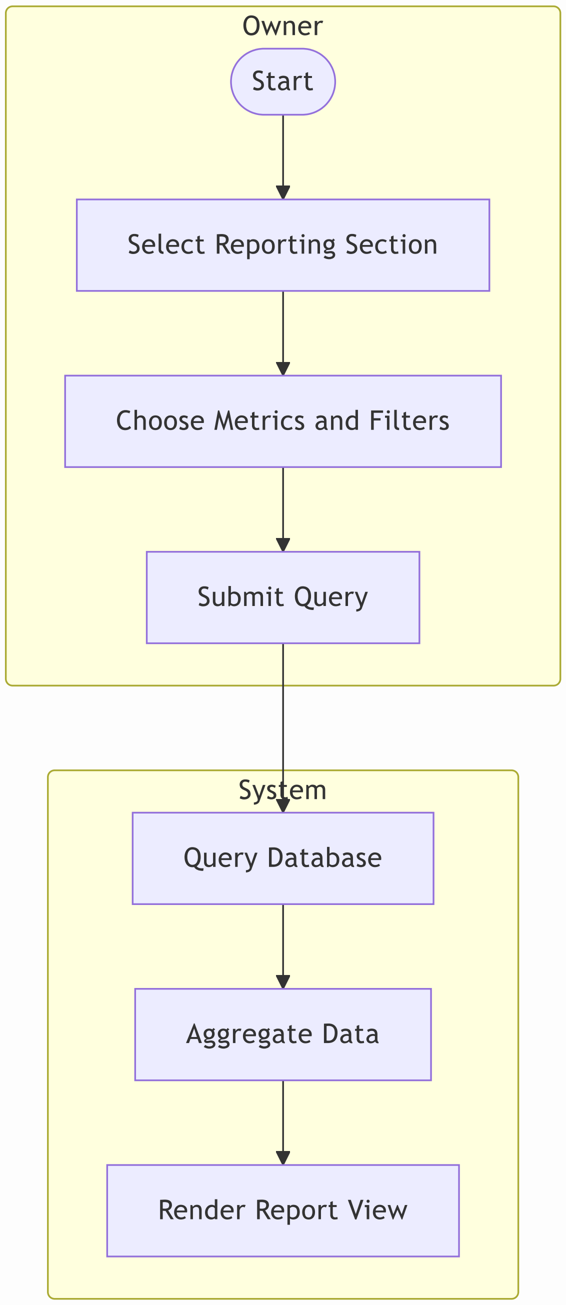
3.2.2.3 Handle Return and Generate Invoice



3.2.2.4 Admin: Add New Branch



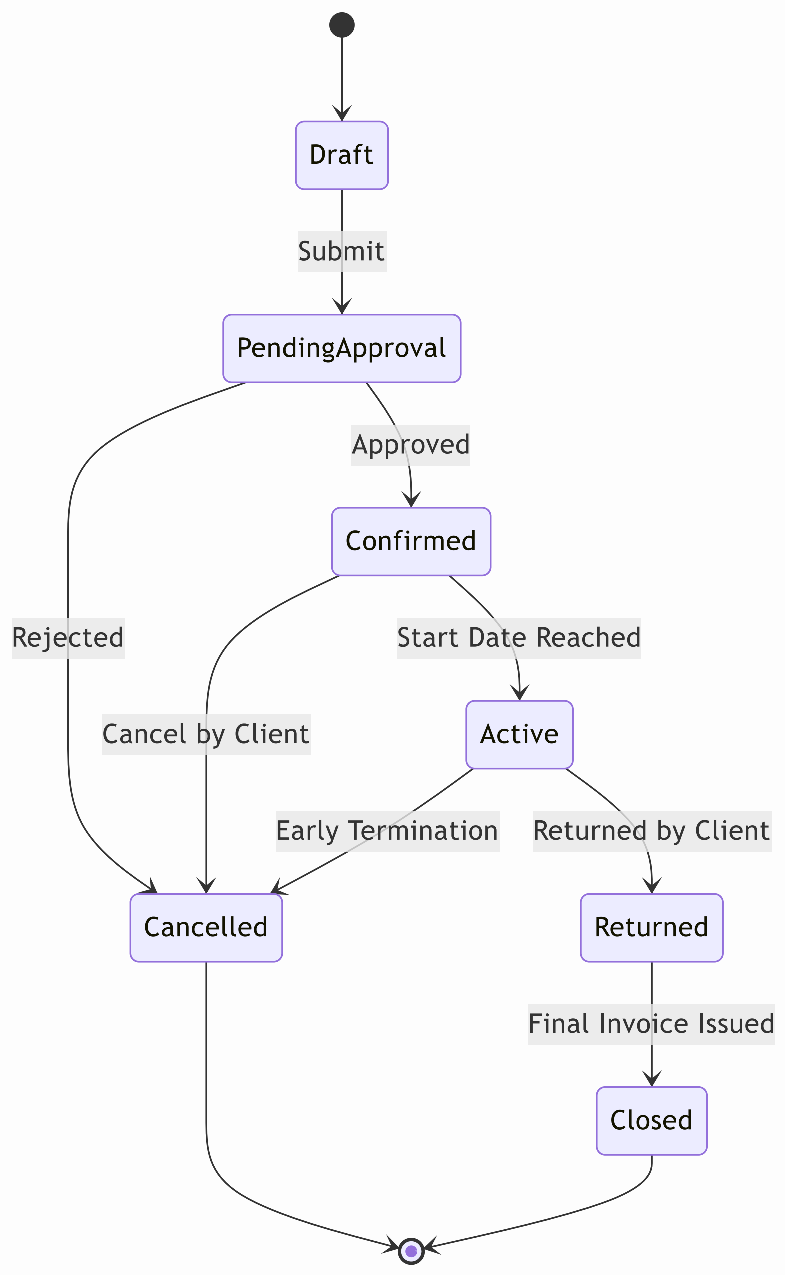
3.2.2.5 View Reports and Analytics



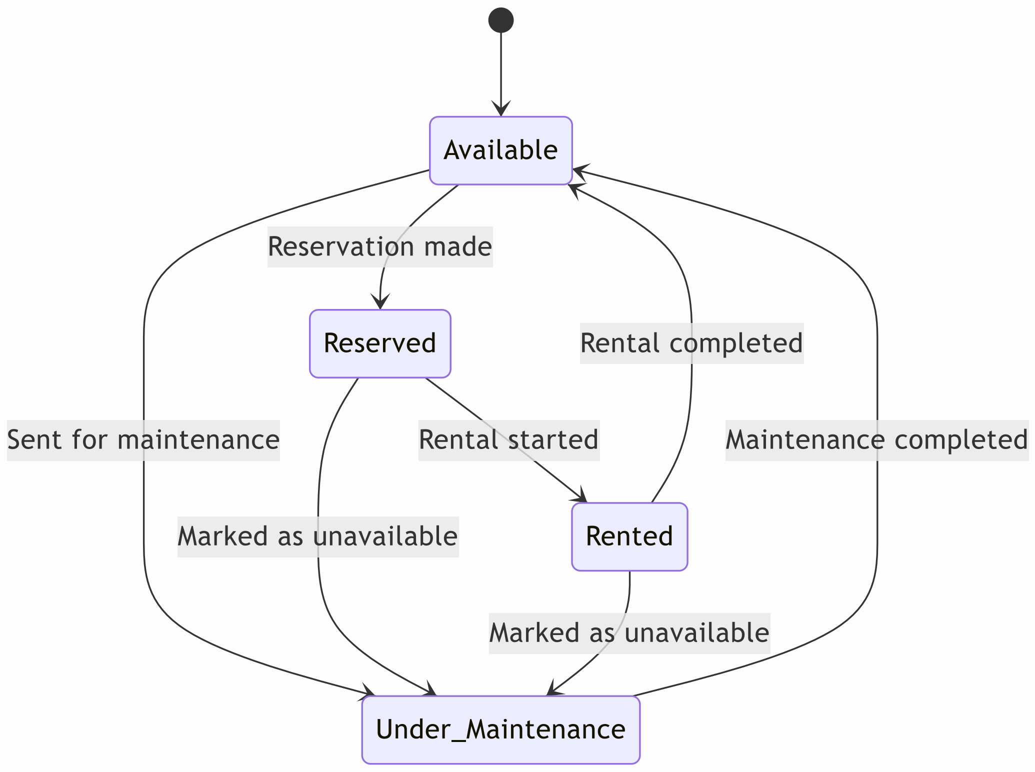
3.2.3 State Diagrams

This section presents **state diagrams** to illustrate how key entities (such as reservations and cars) change states throughout their lifecycle in the Car Rental Management System. State diagrams are useful for understanding object behavior, especially for time-dependent transitions or status-based workflows.

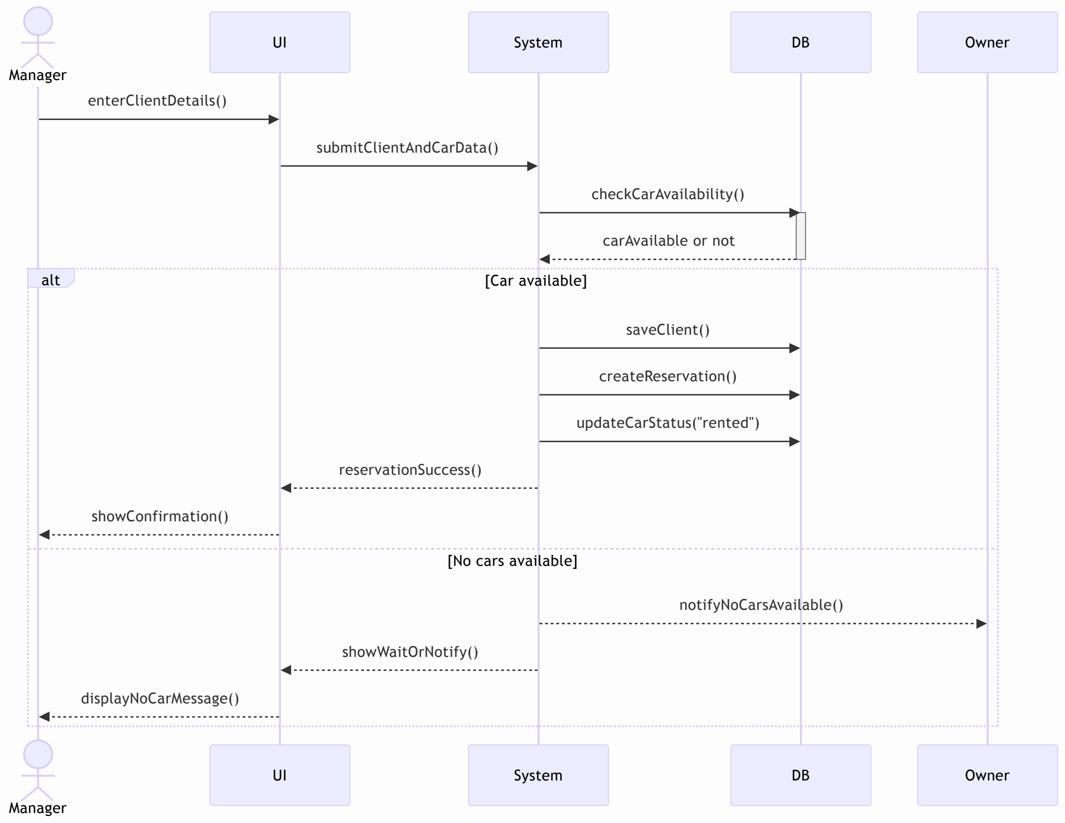
3.2.3.1 Reservation State Diagram



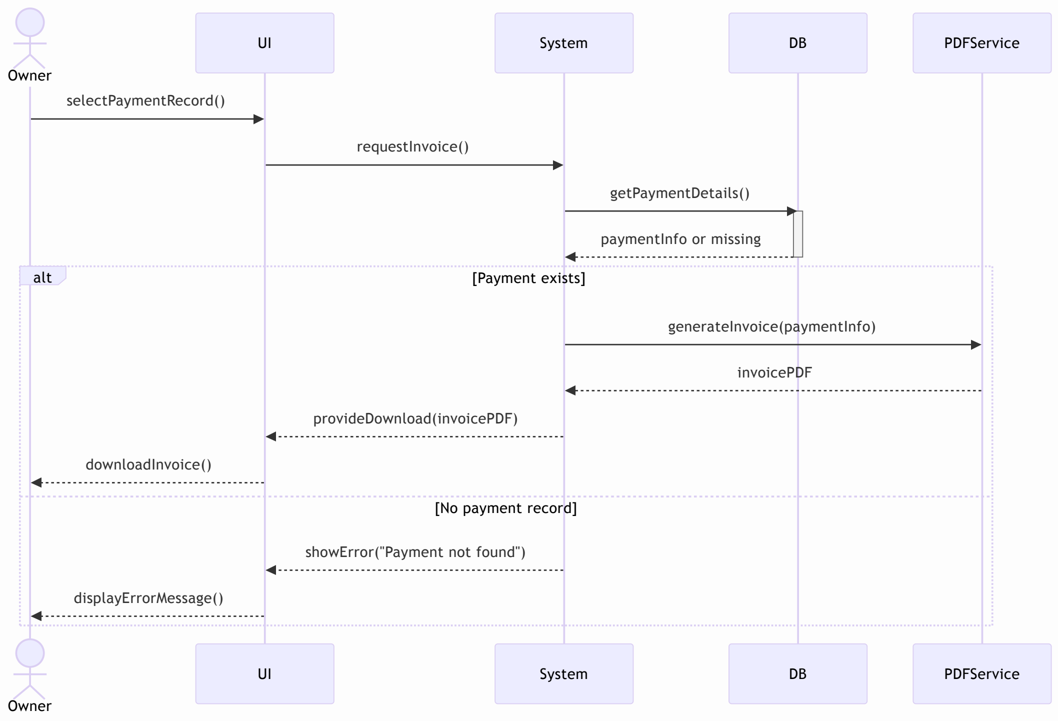
3.2.3.2 Car State Diagram



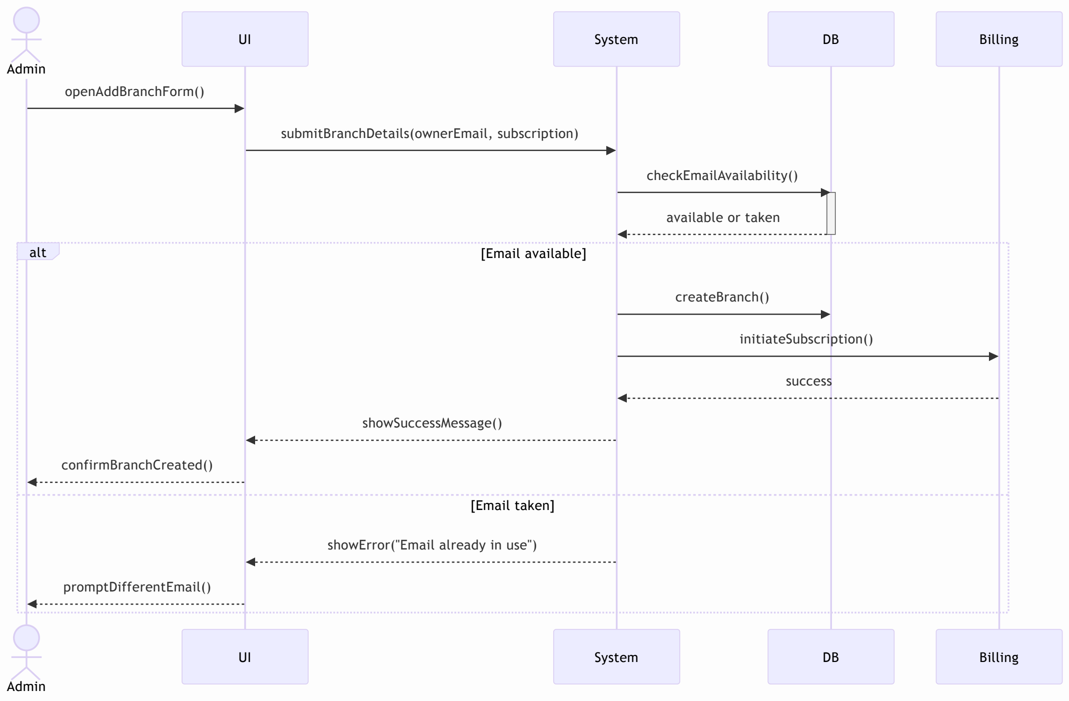
3.2.4.2 Create New Reservation



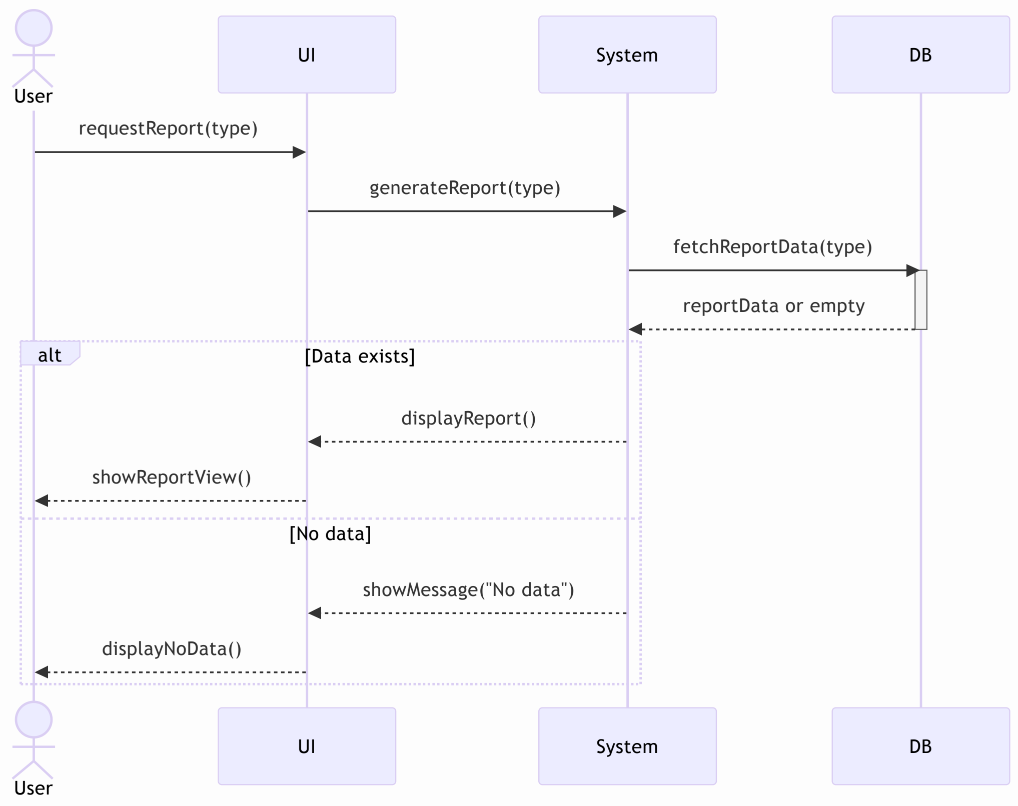
3.2.4.3 Handle Car Return and Invoice Generation



3.2.4.4 Admin Creates a New Branch



3.2.4.5 View Reports and Analytics

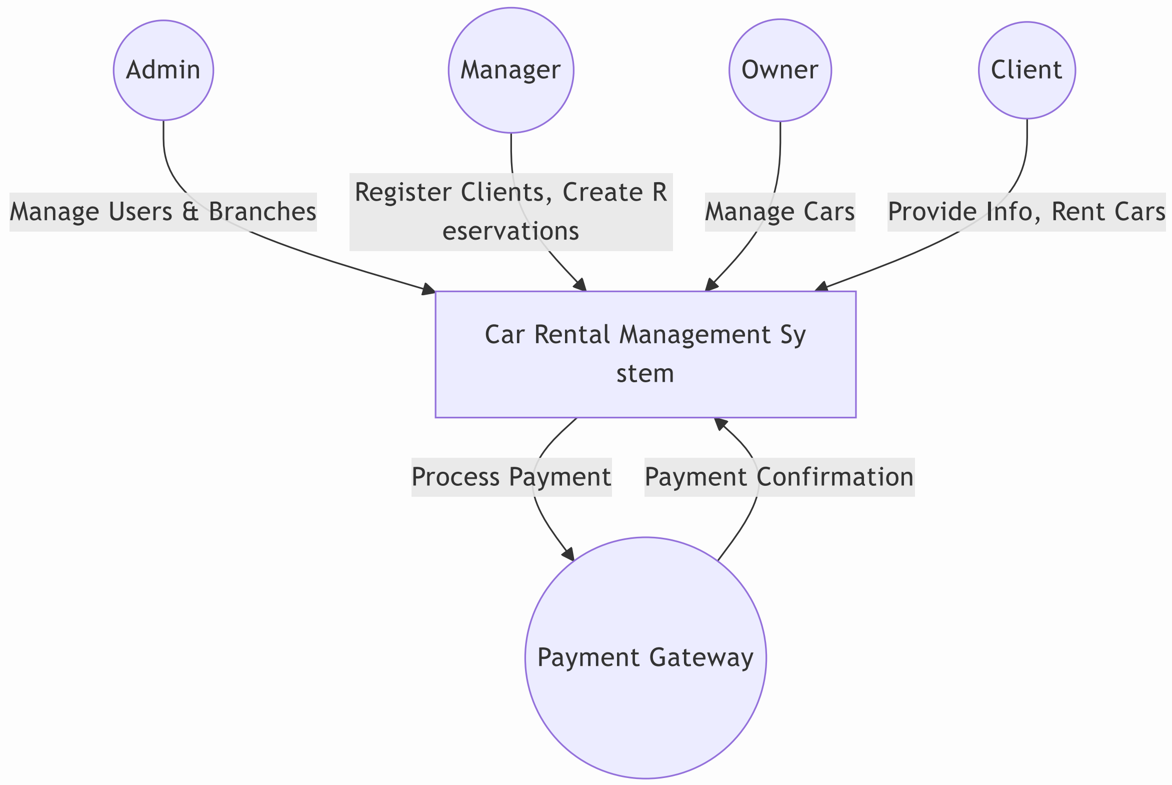


3.3 Data Flow Diagrams

This section presents **Data Flow Diagrams (DFDs)** that depict how data moves through the app. DFDs help visualize system boundaries, inputs/outputs, data storage, and the flow between system processes and external actors.

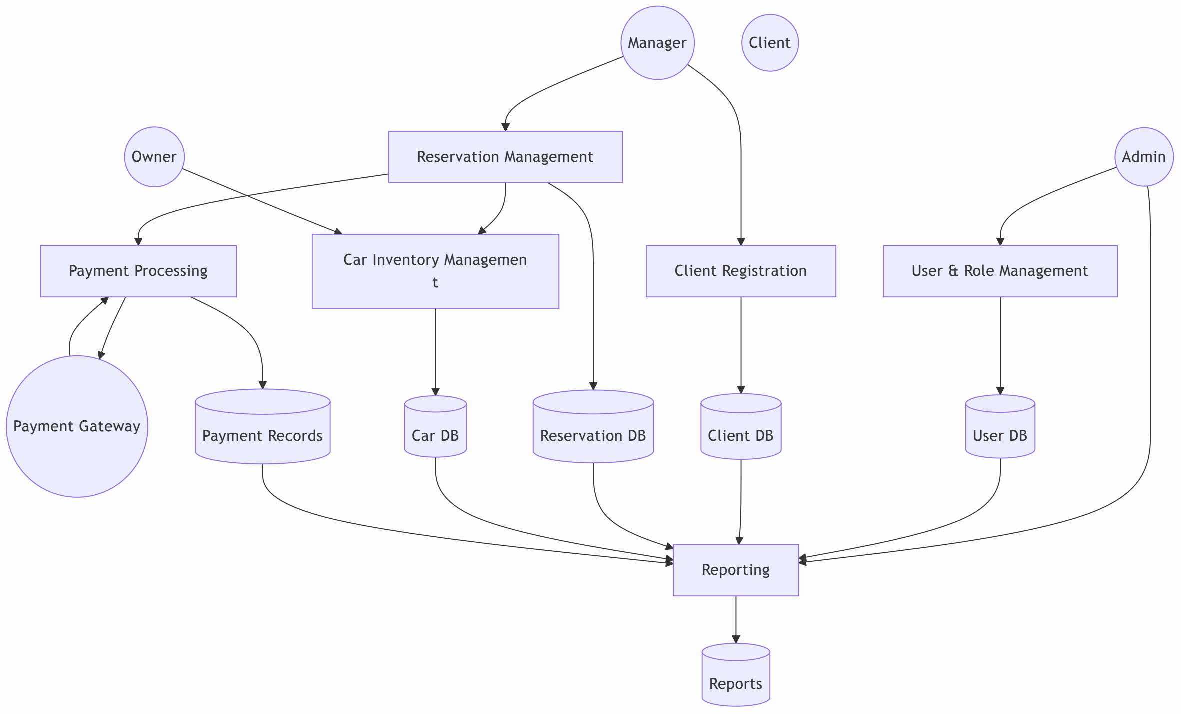
3.3.1 Level 0 – Context Diagram

The context diagram shows the system as a single high-level process with its external entities.



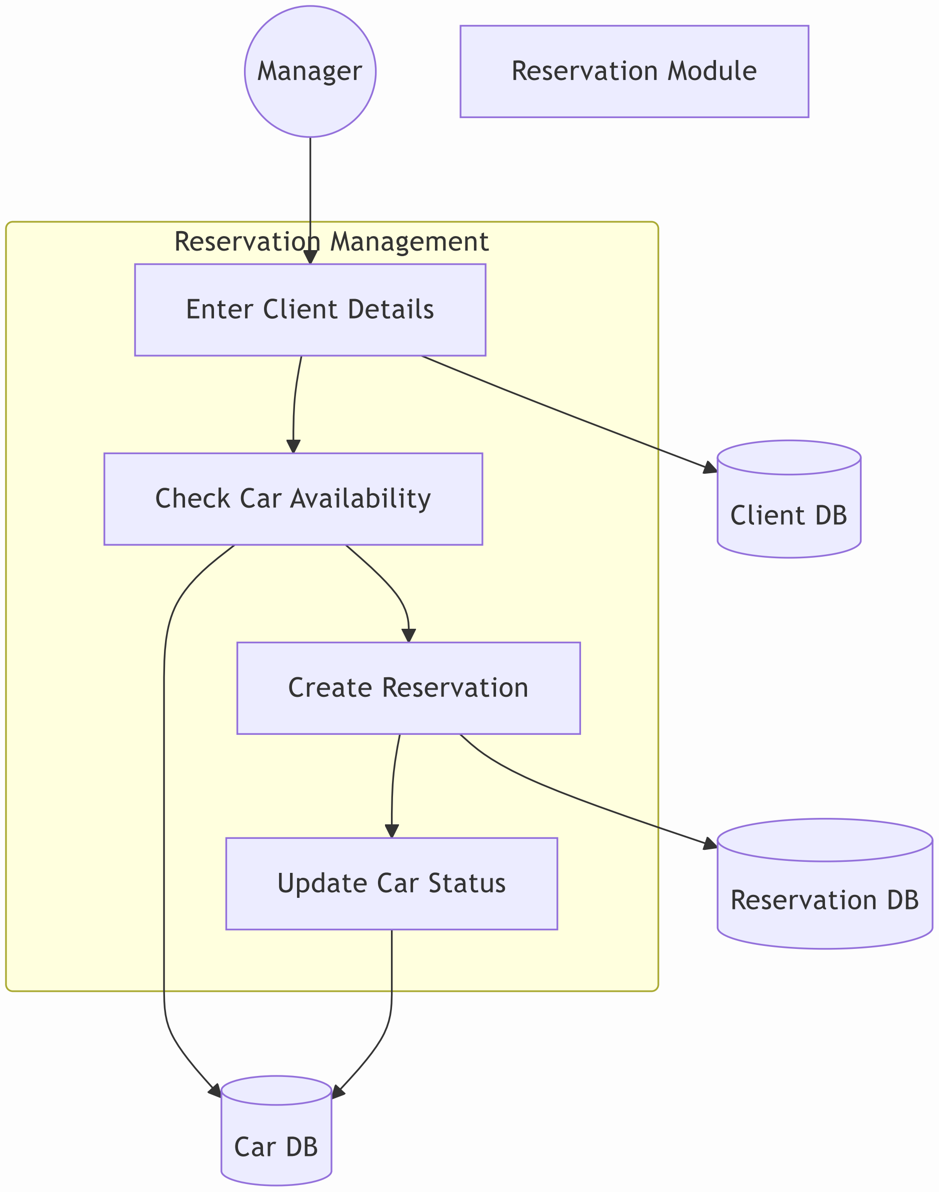
3.3.2 Level 1 – Main System Processes

The Level 1 DFD breaks the system into major functional modules.



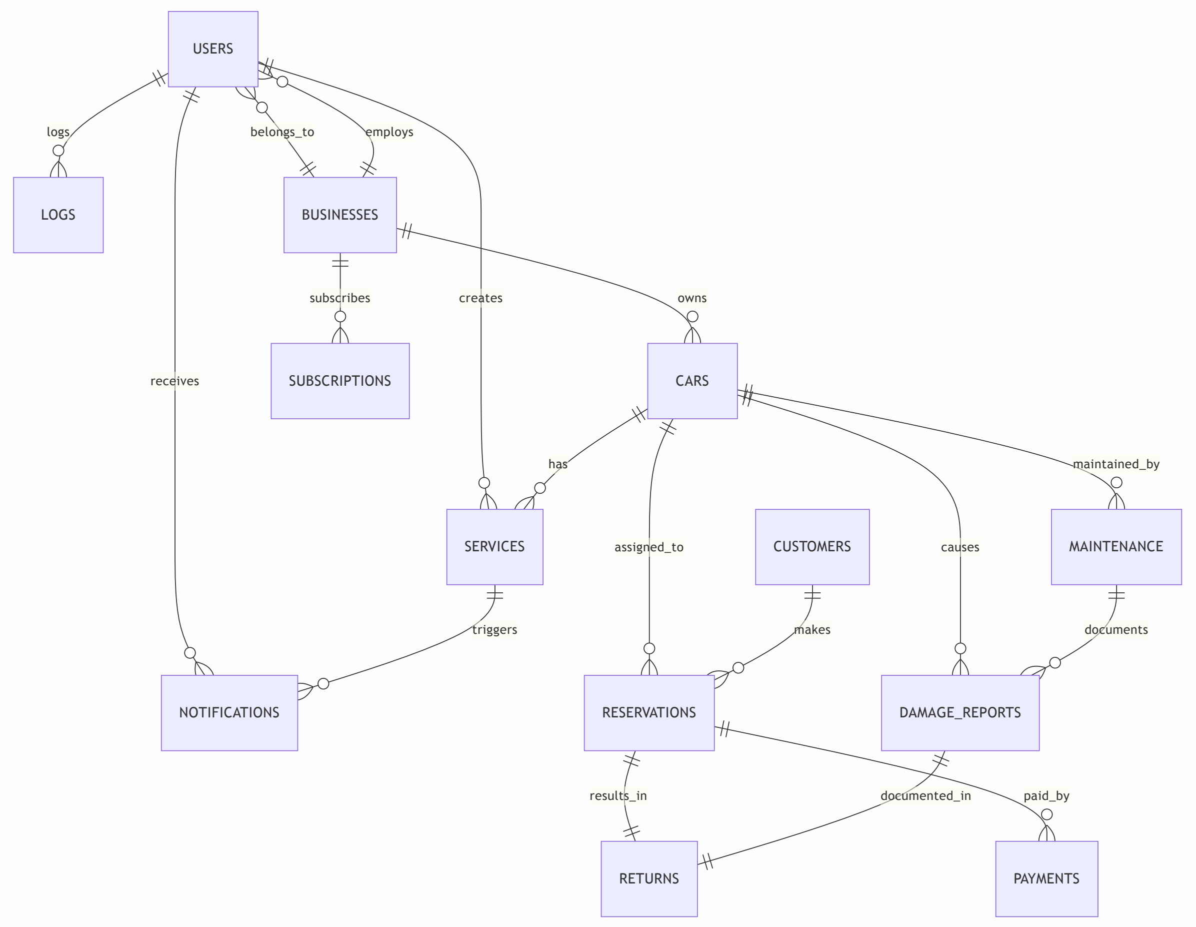
3.3.3 Level 2 – Reservation Management

This diagram breaks down the `Reservation Management` process in more detail, showing how data flows internally when creating a reservation.



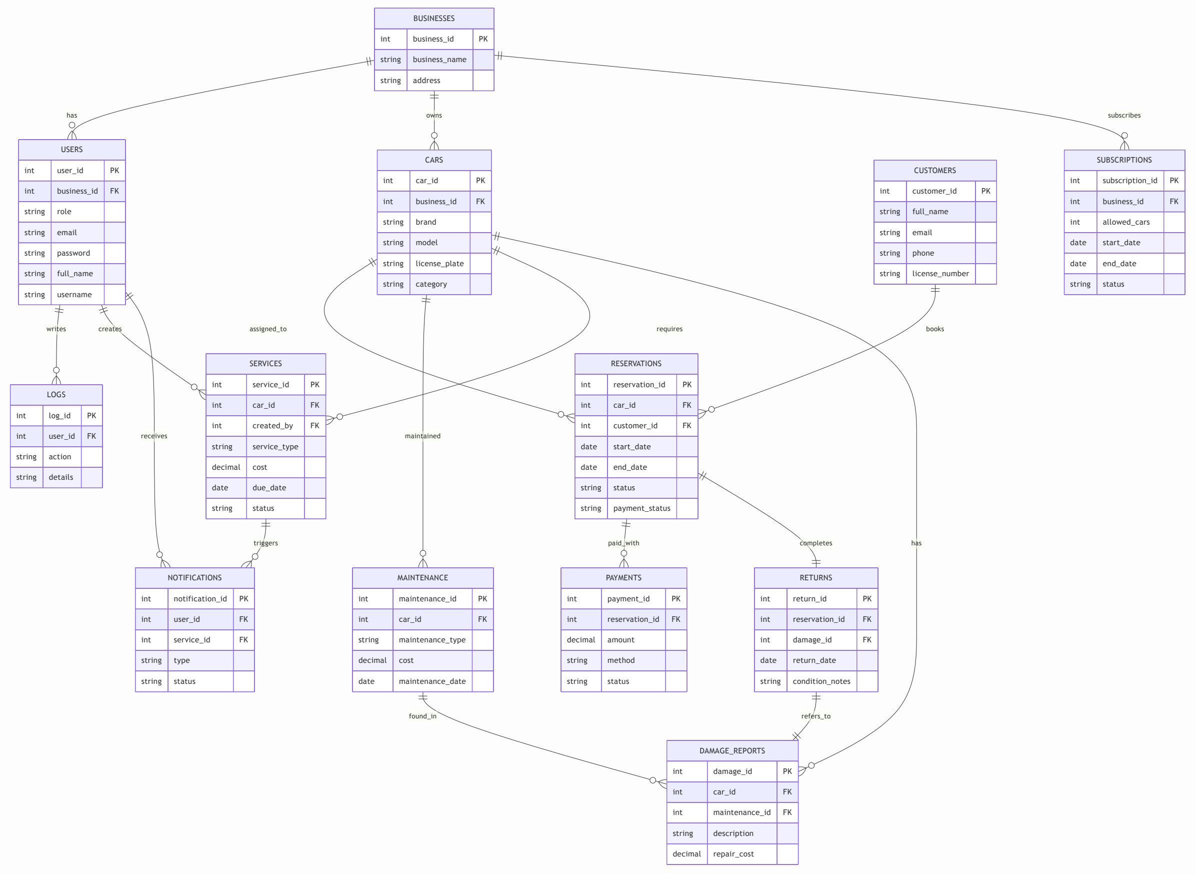
3.4 ENTITY RELATION DIAGRAM

This ERD defines the relational structure of the Car Rental Management System, based on the database schema.



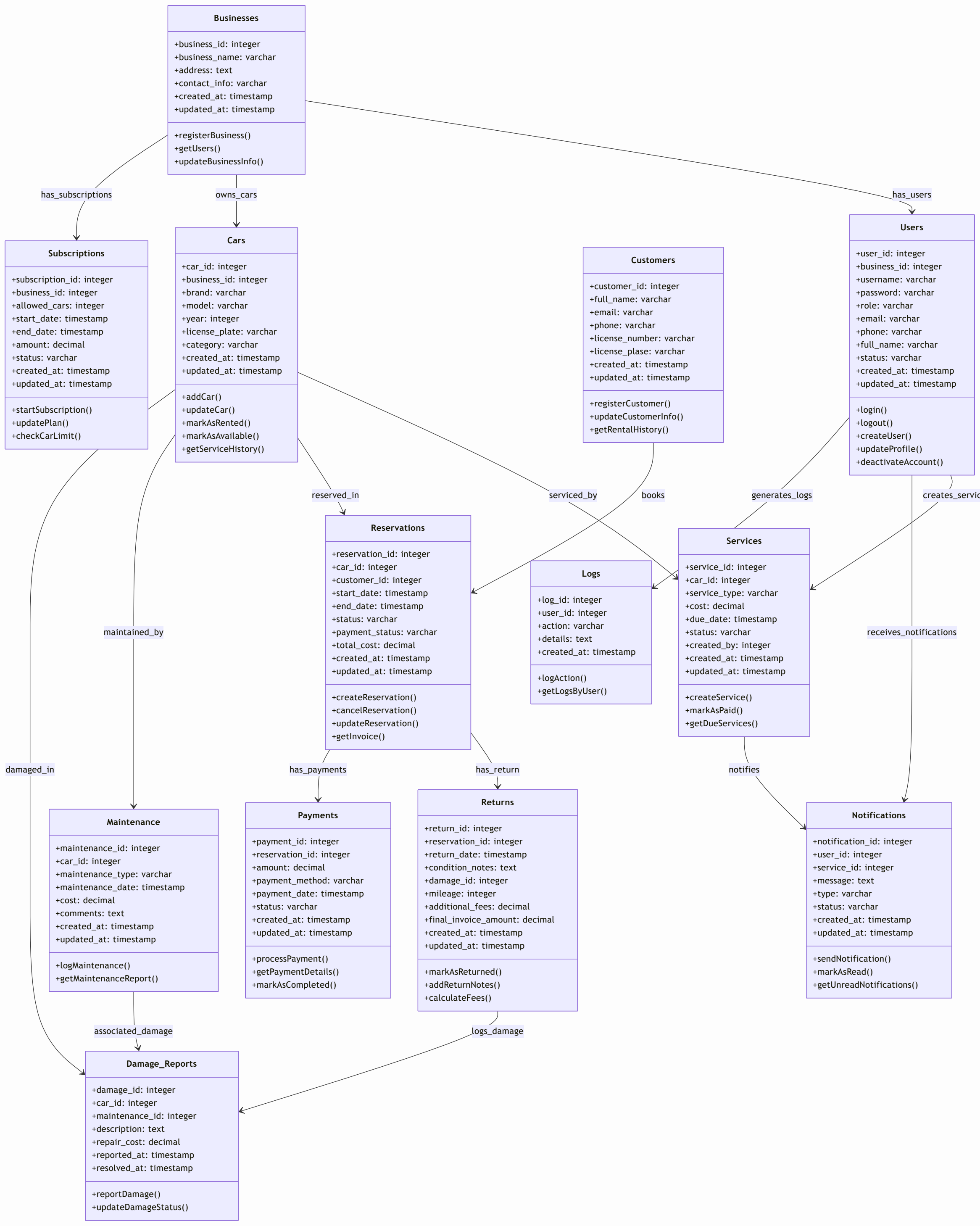
Entities such as `USERS`, `CARS`, `RESERVATIONS`, and `PAYMENTS` are connected by logical foreign key relationships. The schema supports role-based data partitioning and service operations.

3.5 RELATIONAL SCHEMA (Mermaid ER Diagram)



3.6 STRUCTURAL DIAGRAMS

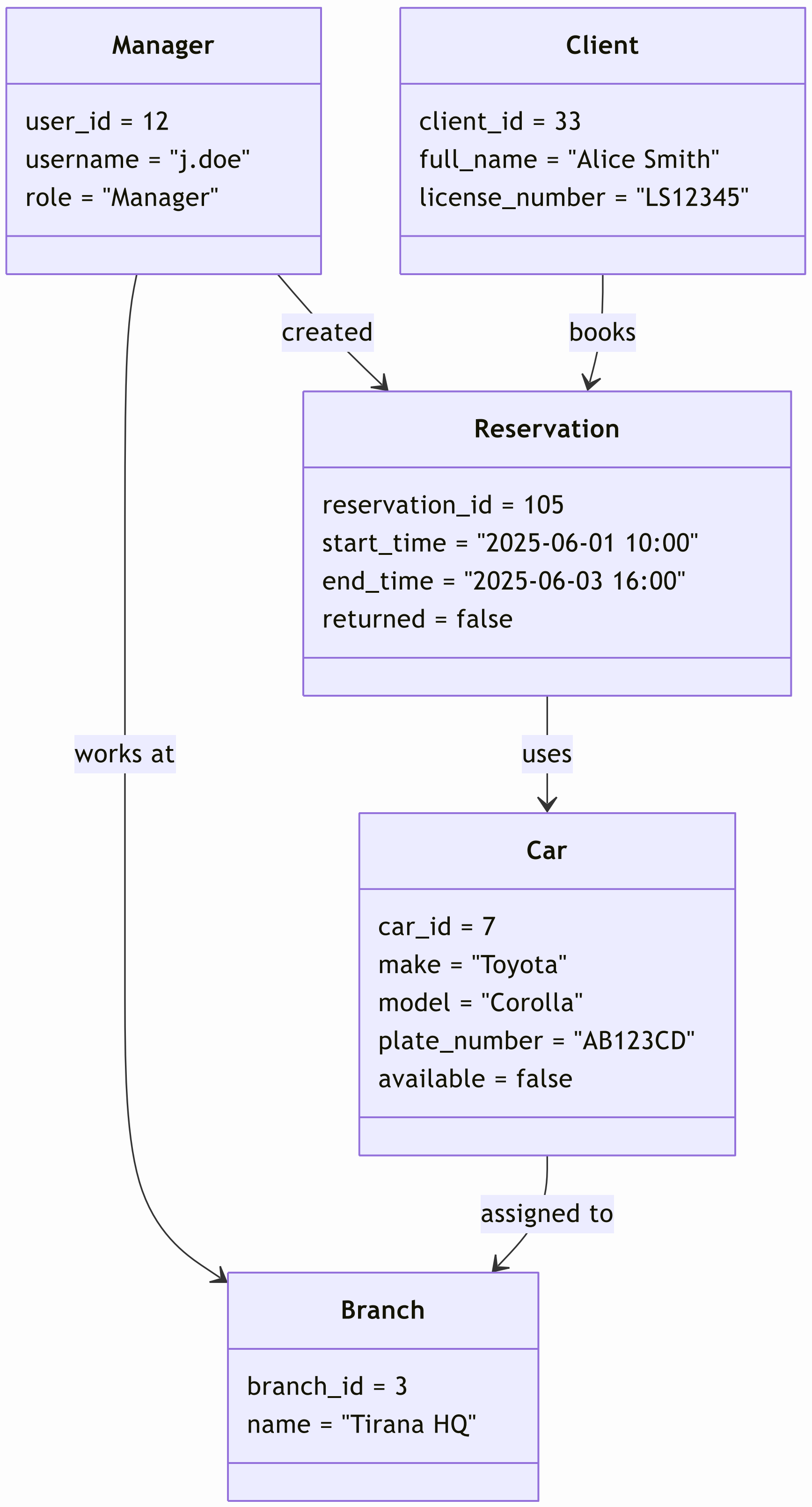
3.6.1 Class Diagram



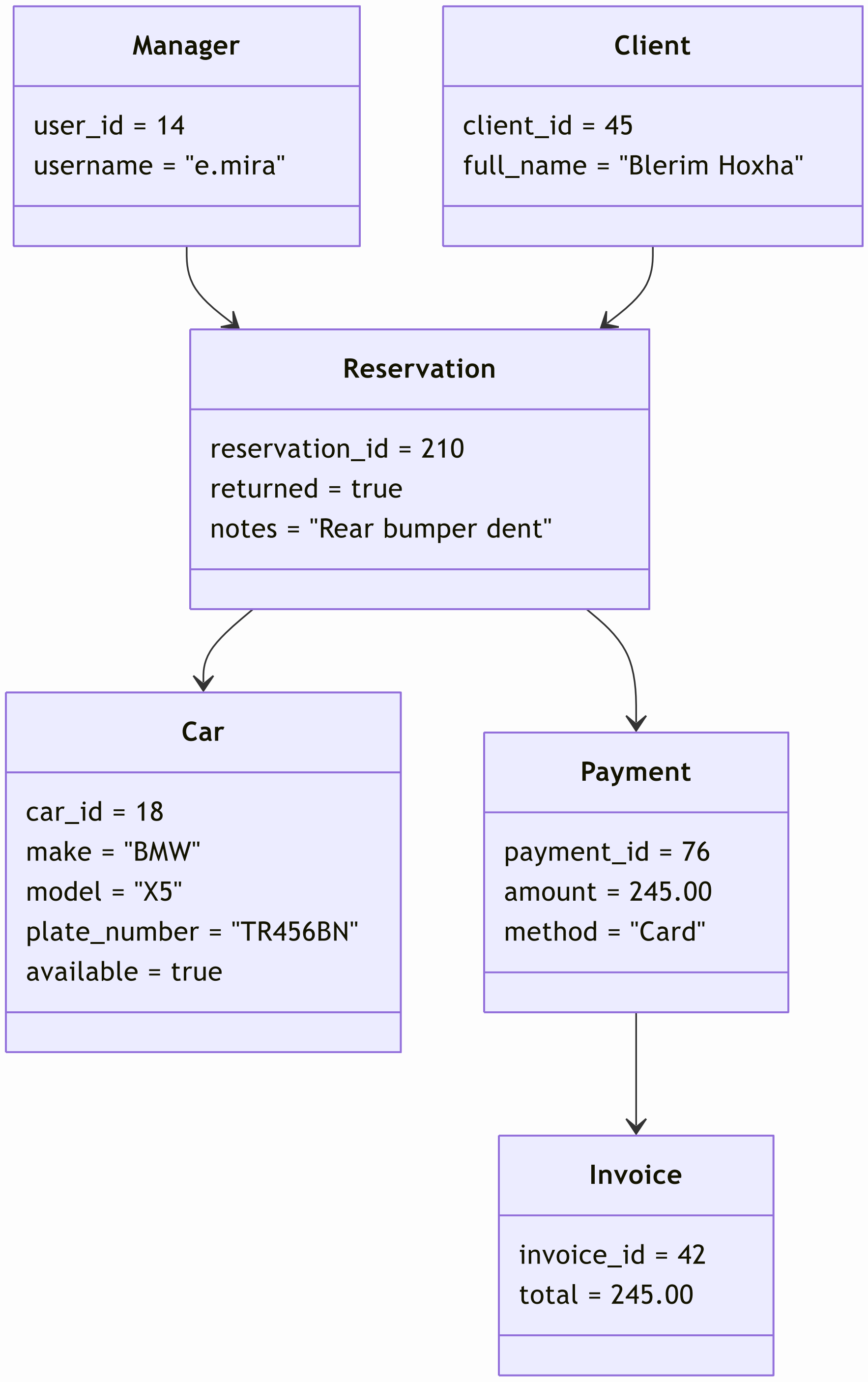
3.6.2 Object Diagrams

This section provides **Object Diagrams** that represent specific runtime instances of classes and their relationships at a particular moment. While class diagrams describe the static structure, object diagrams illustrate **real data examples** (i.e., objects and links) in action.

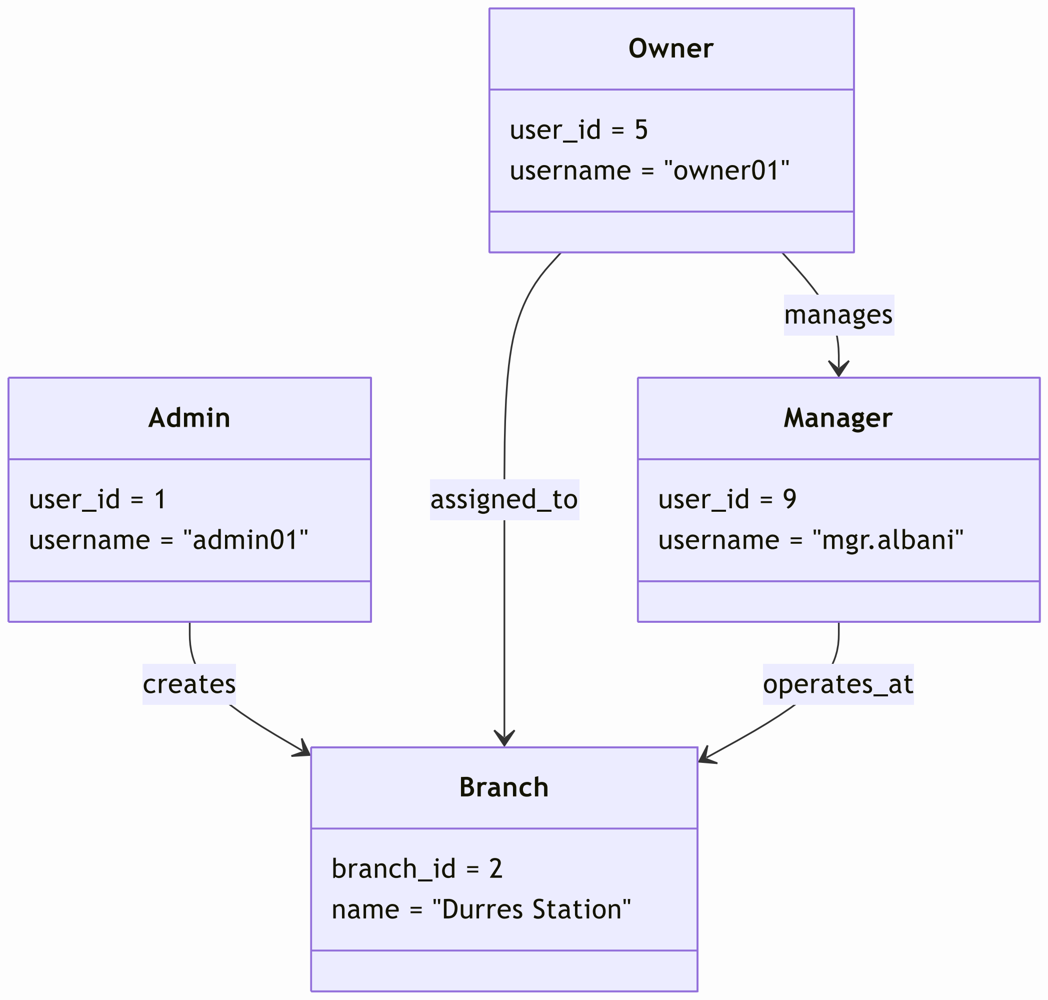
3.6.2.1 Object Diagram: Active Reservation Scenario



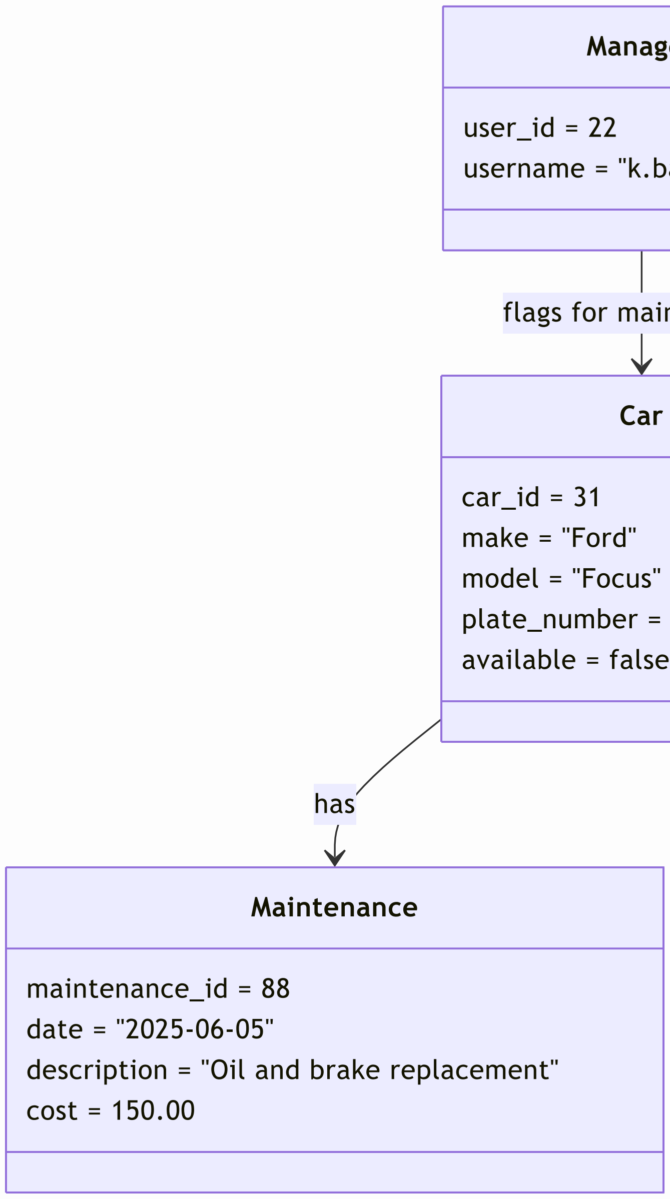
3.6.2.2 Returned Car with Payment and Damage Report



3.6.2.3 Branch and User Management Snapshot

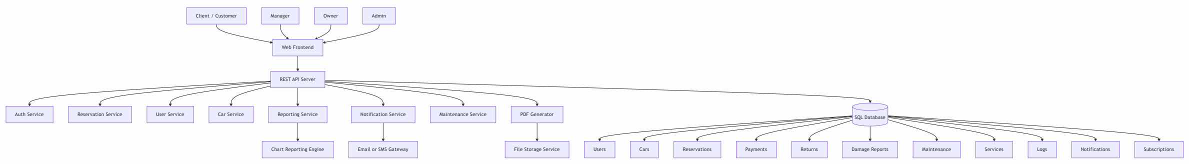


3.6.2.4 Maintenance Workflow Snapshot



3.6.3 Component Diagram

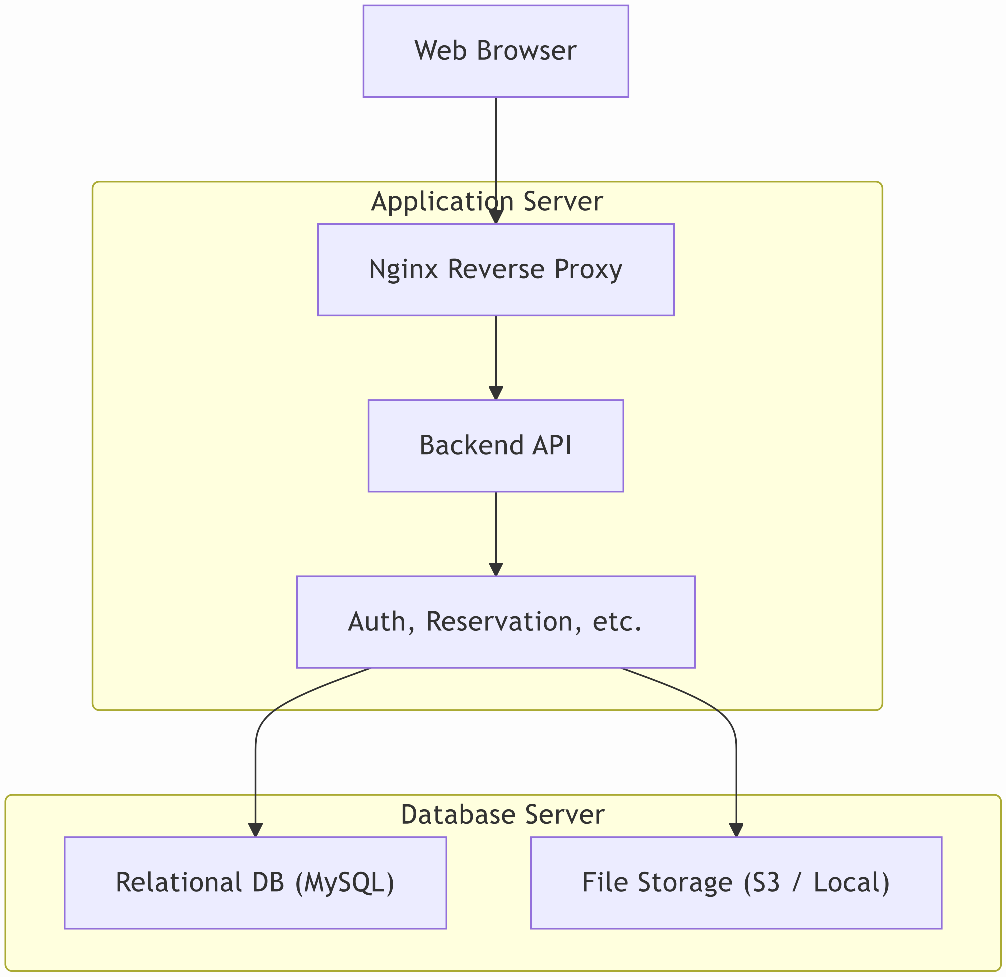
This section presents the **Component Diagram** of the Car Rental Management System. A component diagram shows how the system is decomposed into logical, replaceable modules and how these modules interact through interfaces and data exchange. It helps visualize the **high-level architecture** and is useful for deployment planning and system scalability.



3.6.4 Deployment Diagram

The **Deployment Diagram** describes the physical architecture of the Car Rental Management System, showing how software components are distributed across hardware nodes (servers, databases, client devices). It helps clarify system topology, hosting environments, and inter-component communication.

3.6.4.1 Deployment Architecture



3.6.4.2 Deployment Environment

- **Client Layer**:
  Users access the application through a web browser. The frontend is rendered server-side using **Laravel Blade templates**, styled with **Tailwind CSS**, and enhanced with **JavaScript** for interactivity. All pages are routed via Laravel's `web.php`.

- **Application Server**:

  - Handles HTTP requests using the **Laravel** PHP framework.
  - Business logic is organized using Laravel controllers, services, and middleware.
  - Routing is handled by Laravel's built-in routing engine.
  - Hosted on a **Linux-based server** with **PHP-FPM** and **Nginx** (or Apache).
  - Form submissions, session management, and CSRF protection are handled by Laravel natively.

- **Database Server**:
  - A relational database stores all application data, including users, reservations, invoices, and logs.
  - Laravel Eloquent ORM is used for all database interactions.
  - File uploads (e.g., receipts, documents) are managed via Laravel's filesystem and stored locally or in cloud storage (e.g., Amazon S3).

3.6.4.3 Hosting Options

- **Local Deployment** (Docker Compose / VMs)
- **Cloud Deployment** (e.g., AWS EC2 + RDS + S3)
- **Hybrid Deployment** (cloud DB + local services)

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4. IMPLEMENTATION TECHNOLOGY

This section outlines the key technologies, frameworks, tools, and architectural choices used to implement the Car Rental Management System. The chosen stack prioritizes performance, modularity, scalability, and developer productivity.

4.1 Frontend

- **Framework**: Laravel Blade Templating Engine
- **Language**: PHP, HTML, JavaScript
- **Styling**: Tailwind CSS
- **Routing**: Laravel Web Routes (`routes/web.php`)
- **Forms**: Blade Forms with CSRF protection (`@csrf` , `old()` , validation errors)
- **Build Tool**: Vite (via Laravel Mix or default setup)

4.2 Backend

- **Framework**: Laravel (PHP)
- **Authentication**:
  - Laravel Sanctum or Passport for token-based authentication
  - Bcrypt (default in Laravel) for password hashing
- **Business Logic**:
  - Service-oriented architecture using Controllers, Service classes, and Repositories
- **API Protocol**:
  - RESTful API with JSON responses over HTTPS
  - Defined in `routes/api.php`
- **Validation**:
  - Laravel Form Request classes (`Illuminate\Foundation\Http\FormRequest`)
  - Built-in `Validator` facade for manual validation
- **Testing**:
  - Laravel's built-in testing tools using PHPUnit
  - Optional: Laravel Dusk for browser testing

4.3 Database

- **RDBMS**: MySQL or PostgreSQL
- **ORM/Query Layer**:
  - Eloquent ORM (Laravel's built-in ORM)
  - Optional: Fluent query builder for complex queries
- **Schema Management**:
  - Laravel Migrations for version-controlled database schema changes
  - Optional: Laravel Seeders and Factories for test and dummy data generation

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4.4 DevOps & Deployment

- **Containerization**: Docker & Docker Compose
- **Web Server**: Nginx (reverse proxy, SSL termination)
- **CI/CD**: GitHub Actions / GitLab CI
- **Monitoring & Logging**: PM2, Logrotate, Grafana, or custom logging middleware
- **Environment**: `.env` files, `.dockerignore` , secrets manager for production

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4.5 Optional Enhancements

- **Notifications**: Email (Nodemailer / SMTP), SMS (Twilio API)
- **Cloud Services**: AWS S3 (file storage), RDS (managed DB), EC2
- **Access Control**: RBAC (Role-Based Access Control) for Admin, Owner, Manager

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5. Appendix – Detailed Designs

This section contains references to detailed design artifacts, additional documentation, and resources used throughout the project.

5.1 Supporting Documents

- **Use Case Tables**: Detailed for all 36 use cases with preconditions, postconditions, and actors.
- **Sequence Diagrams**: Individual Mermaid-based diagrams for each use case using actual method names.
- **Activity Diagrams**: Step-by-step action flows covering all user workflows.
- **Class Diagram**: Full system-wide class structure with attributes and methods.
- **ERD**: Complete relational structure showing foreign key relationships and logical grouping.
- **Component Diagram**: Frontend/backend decomposition including services and DB communication.
- **Deployment Diagram**: Runtime environment setup showing servers and interconnections.
- **Relational Schema**: Tabular mapping of all entities and their field types.
- **Object Diagram**: Example snapshot of runtime entity instances.
- **Use Case Diagram**: High-level overview of actor-system interaction.