**DEPARTMENT OF COMPUTER & INFORMATION SYSTEMS ENGINEERING**
**BACHELORS IN COMPUTER SYSTEMS ENGINEERING**
**Course Code: CS-116**
**Course Title: Object Oriented Programming**
**Complex Engineering Problem**
**FE Batch 2024, Spring Semester 2025**
**Grading Rubric**
**TERM PROJECT**

**Group Members:**

| Student No. | Name | Roll No. |
|---|---|---|
| S1 | Muhammad Anas Faisal | CS-24083 |
| S2 | Syed Mehdi Raza | CS-24077 |
| S3 | Syed Faizan | CS-24086 |

| CRITERIA AND SCALES | | | | Marks Obtained | | |
|---|---|---|---|---|---|---|
| | | | | S1 | S2 | S3 |
| Criterion 1: Does the application meet the desired specifications and produce the desired outputs? (CPA-1, CPA-3) | | | | | | |
| 1 | 2 | 3 | 4 | | | |
| The application does not meet the desired specifications and is producing incorrect outputs. | The application partially meets the desired specifications and is producing incorrect or partially correct outputs. | The application meets the desired specifications but is producing incorrect or partially correct outputs. | The application meets all the desired specifications and is producing correct outputs. | | | |
| Criterion 2: How well is the code organization? | | | | | | |
| 1 | 2 | 3 | 4 | | | |
| The code is poorly organized and very difficult to read. | The code is readable only to someone who knows what it is supposed to be doing. | Some part of the code is well organized, while some part is difficult to follow. | The code is well organized and very easy to follow. | | | |
| Criterion 3: How friendly is the application interface? (CPA-1, CPA-3) | | | | | | |
| 1 | 2 | 3 | 4 | | | |
| The application interface is difficult to understand and use. | The application interface is easy to understand and but not that comfortable to use. | The application interface is very easy to understand and use. | The application interface is very interesting/ innovative and easy to understand and use. | | | |
| Criterion 4: How does the student performed individually and as a team member? (CPA-2, CPA-3) | | | | | | |
| 1 | 2 | 3 | 4 | | | |
| The student did not work on the assigned task. | The student worked on the assigned task, and accomplished goals partially. | The student worked on the assigned task, and accomplished goals satisfactorily. | The student worked on the assigned task, and accomplished goals beyond expectations. | | | |
| Criterion 5: Does the report adhere to the given format and requirements? | | | | | | |
| 1 | 2 | 3 | 4 | | | |
| The report does not contain the required information and is formatted poorly. | The report contains the required information only partially but is formatted well. | The report contains all the required information but is formatted poorly. | The report contains all the required information and completely adheres to the given format. | | | |
| | | | Total Marks: | | | |

## Problem Description:

The FAM Car Rental System addresses the need for an automated platform to manage vehicle rentals, user accounts, and administrative tasks. Key functionalities include:

- Sleek application interface
- User registration and authentication (customer/administrator roles)
- Rental management with date selection and cost calculation
- Clean dashboard for vehicle inventory management
- User balance management and rental history
- Data persistence using JSON storage

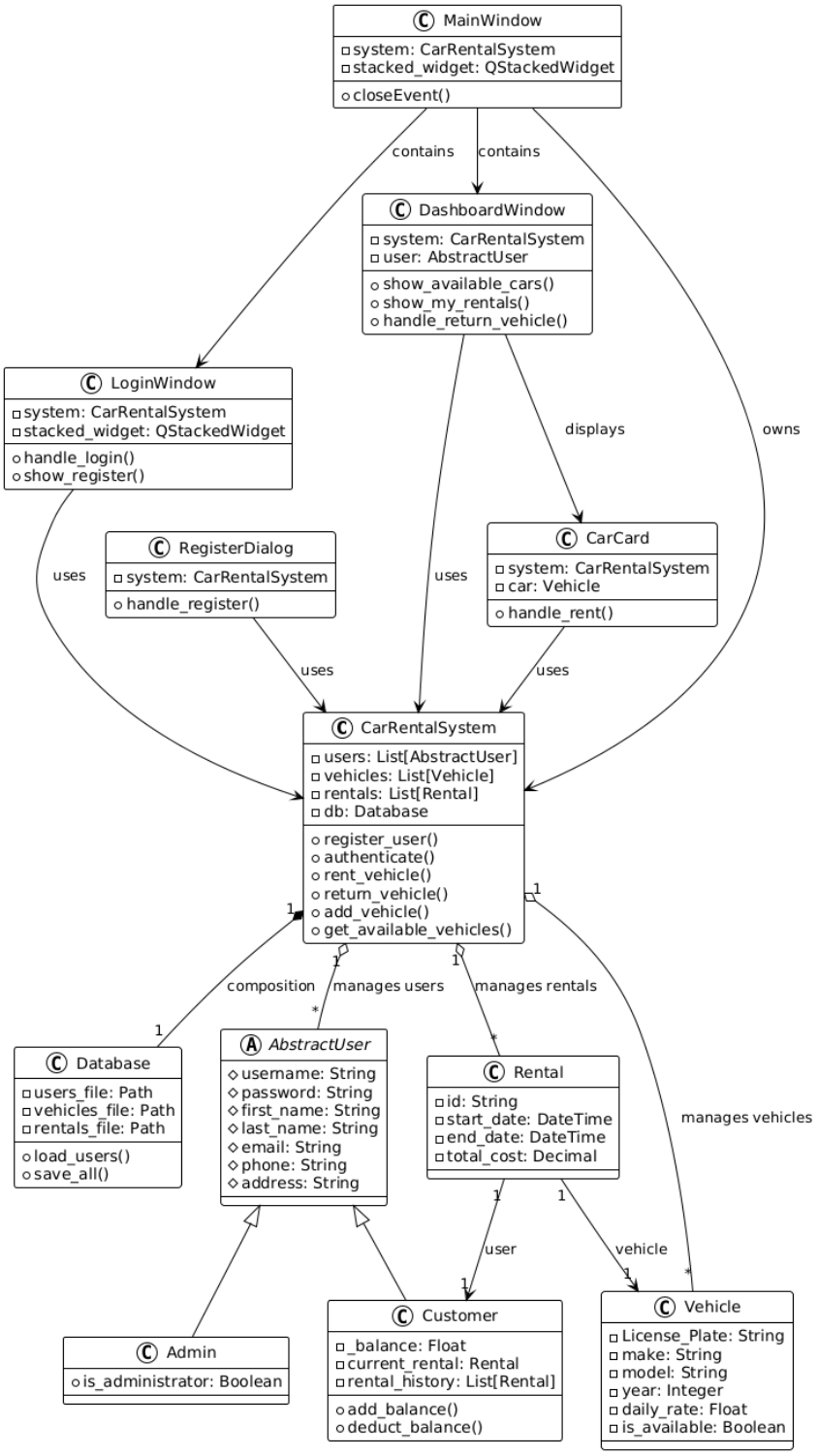
## Distinguishing Features:

1. Dynamic GUI with a modern-looking and intuitive interface.
2. Robust error handling with numerous custom exceptions.
3. Various extra classes for enhanced functionalities.

## Object-Oriented Features Implemented:

1. **Inheritance**:
    a. Admin and Customer inherit from Abstract User.
    b. Car inherits from Vehicle.
2. **Polymorphism**:
    a. Deduct_balance() behaves differently for Admin (raises error) vs. Customer (deducts balance).
3. **Encapsulation**:
    a. Private _balance in Customer class with public add_balance() and deduct_balance().
4. **Abstraction**:
    a. Abstract User defines abstract methods like get_role() and balance.
5. **Composition**:
    a. Car Rental System composes Database, User, Vehicle, and Rental objects.

# Flow of Program Including Class Diagram:



## Development Challenges:

1. **Dynamic UI Management:**
   Coordinating real-time updates between backend data changes and multiple GUI components without performance degradation.
2. **Role-Based Component Architecture:**
   Maintaining a single codebase for admin/customer views, preventing users from registering as admins and synchronizing role changes during the actively running program was a hurdle to overcome. The role-based logic was developed by setting a secret code which has to be entered in order to register as an admin.
3. **Thorough testing and Edge-case Handling:**
   A great deal of effort went into handling errors of all the functionalities used in the application. As a result, over 40 test cases were handled which covered all sorts of edge scenarios and over 15 custom exceptions were made which proved to be extremely time-consuming tasks.

## 5. Any New Thing Learnt in Python while Working on the Project:

- **PySide6**
  Building responsive UIs with widgets, layouts, and signals.
- **Dataclasses**:
  Simplifying class definitions with @dataclass.
- **Type Hints**:
  Using List, Dict, and Optional for code clarity.
- **ABC Module**:
  Implementing abstract classes with @abstractmethod
- **Experience with Testing:**
  Gained hands-on experience in integrating manual testing workflows

## 6. Individual contributions of each member in the project.

**Syed Faizan and Anas Faisal:**

- **Backend:**
  Designed class hierarchies, exception handling, and JSON serialization.
- **Testing:**
  Validated edge cases (e.g., insufficient funds, duplicate vehicles).
- **Integrating frontend and backend:**
  Seamlessly integrated frontend UI components (e.g., calendar widgets, buttons) with backend business logic (e.g., rental validation, balance deduction) to enable end-to-end functionality while maintaining data consistency and error handling.

**Syed Mehdi:**

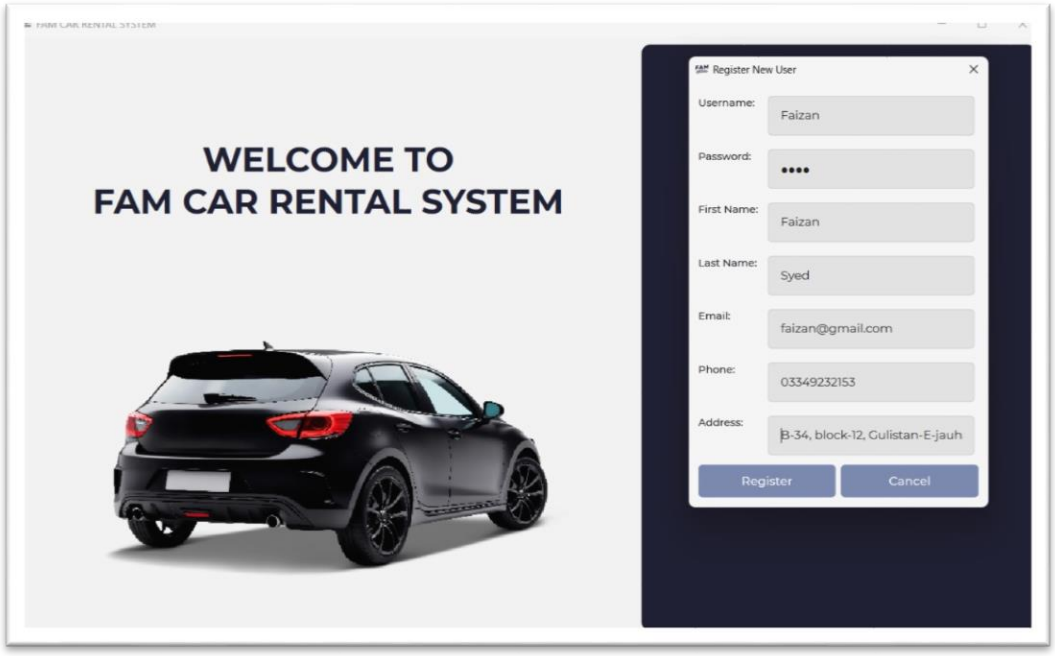
- **Frontend:**
  Developed a dynamic frontend application using PySide6 framework, integrating role-based access control to deliver tailored dashboard interfaces for administrators, users, and stakeholders, each with context-specific features and permissions. Combined Qt widgets, signals/slots, and UI logic to enforce security policies while maintaining a cohesive, responsive user experience.

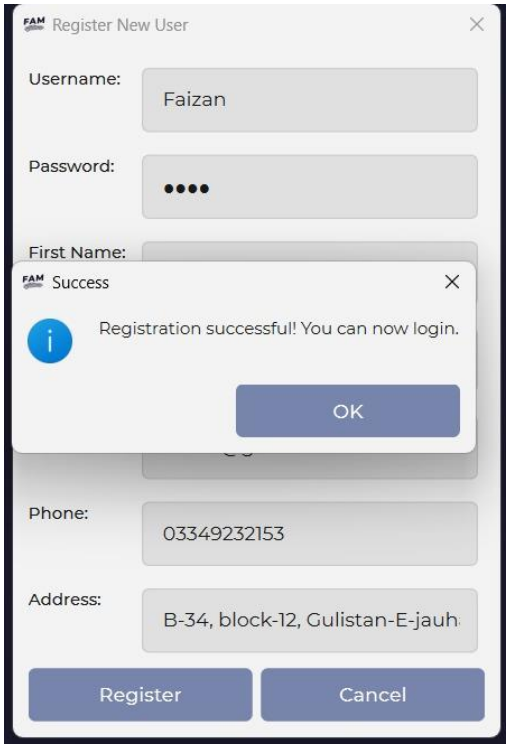
## Future Improvements:

1. **Payment Gateway:**
   Integrate JazzCash/EasyPaisa APIs
2. **GPS Tracking:**
   Live vehicle location mapping for security.
3. **Loyalty Program:**
   Points system for regular customers.
4. **Multi-Language:**
   Support for languages other than English.

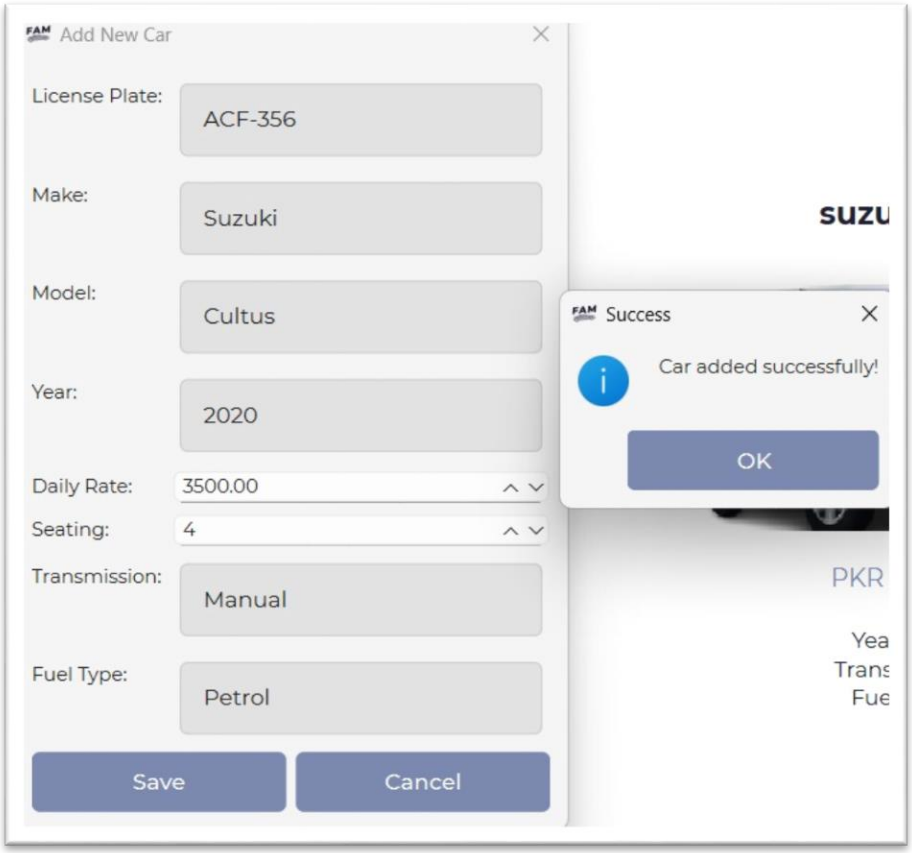
# Test Cases:

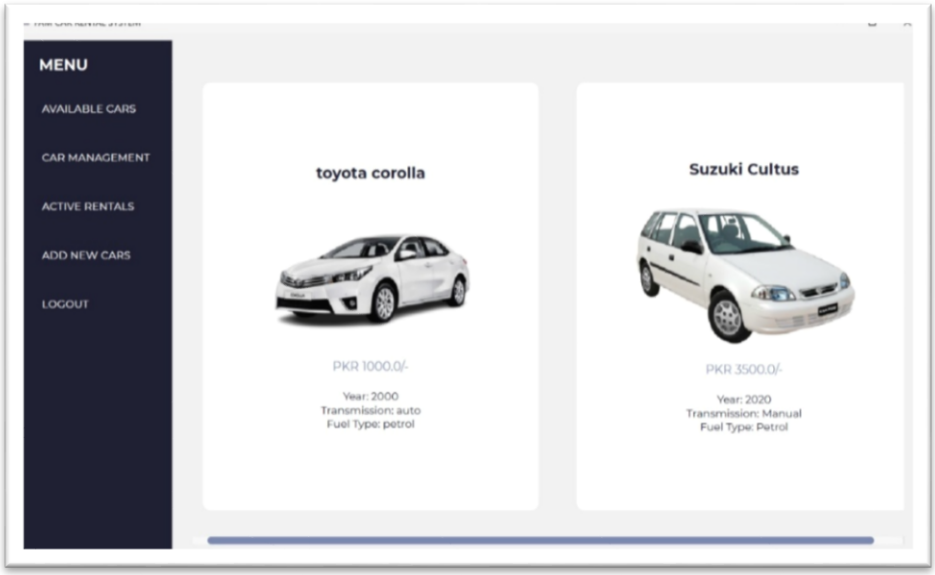
## Test Case 1:



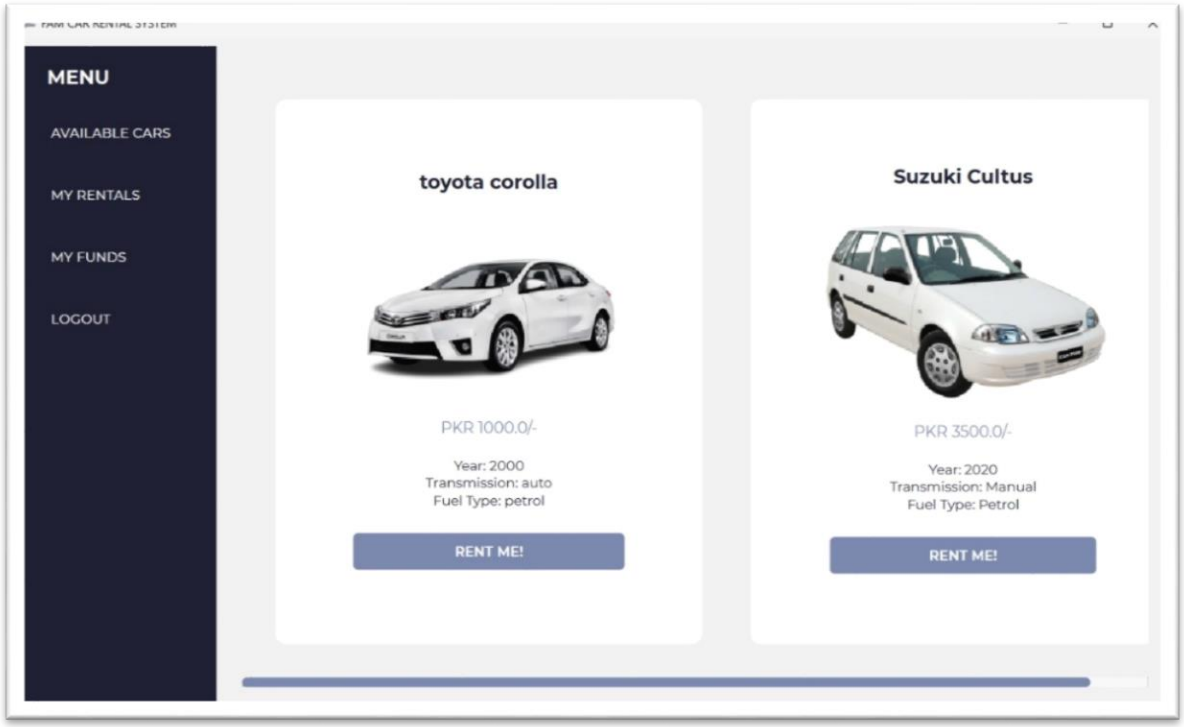



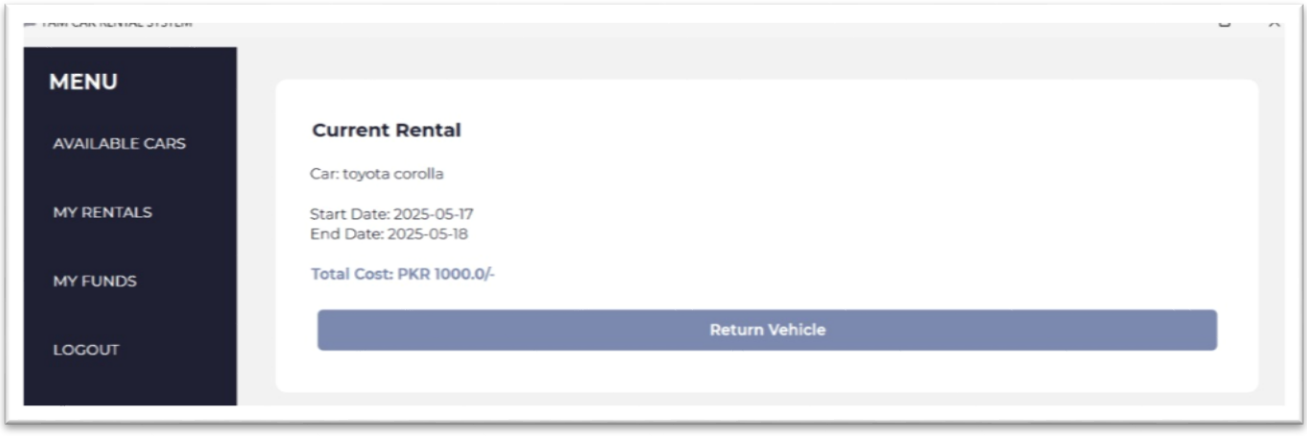
**Test Case 2:**


Add New Car
License Plate:
ACF-356
Make:
Suzuki
Model:
Cultus
Year:
2020
Daily Rate:
3500.00
Seating:
4
Transmission:
Manual
Fuel Type:
Petrol
Save
Cancel
Success
Car added successfully!
OK
PKR

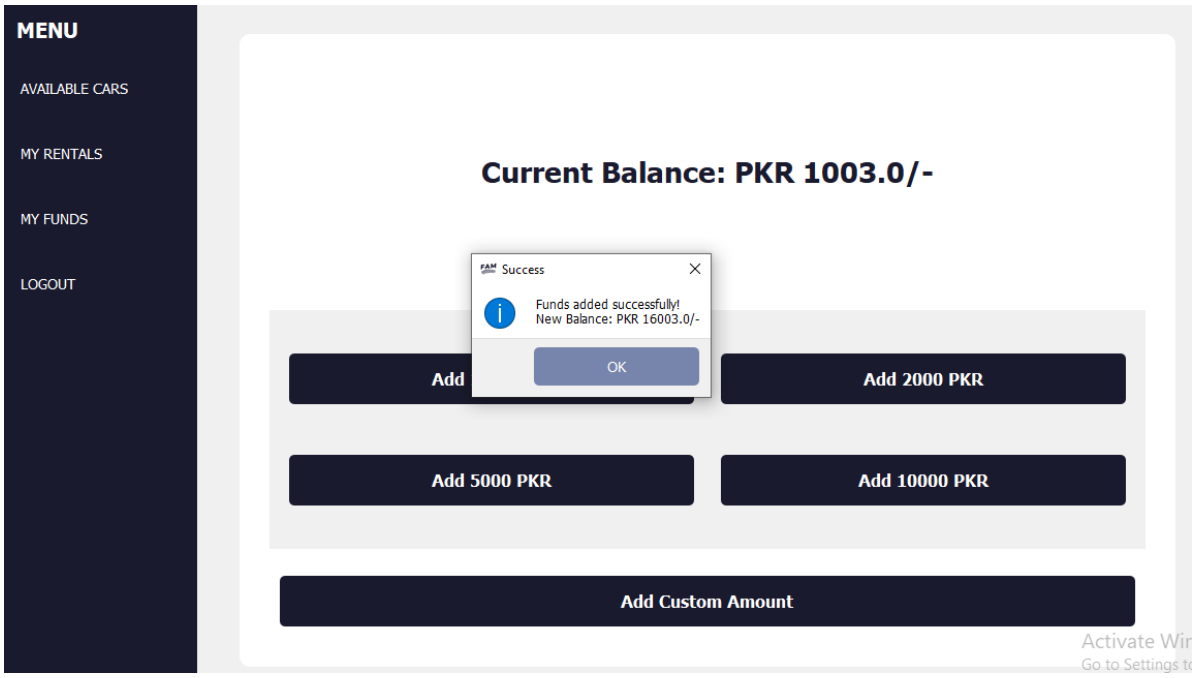

MENU
AVAILABLE CARS
CAR MANAGEMENT
ACTIVE RENTALS
ADD NEW CARS
LOGOUT
toyota corolla
PKR 1000.0/-
Year: 2000
Transmission: auto
Fuel Type: petrol
Suzuki Cultus
PKR 3500.0/-
Year: 2020
Transmission: Manual
Fuel Type: Petrol

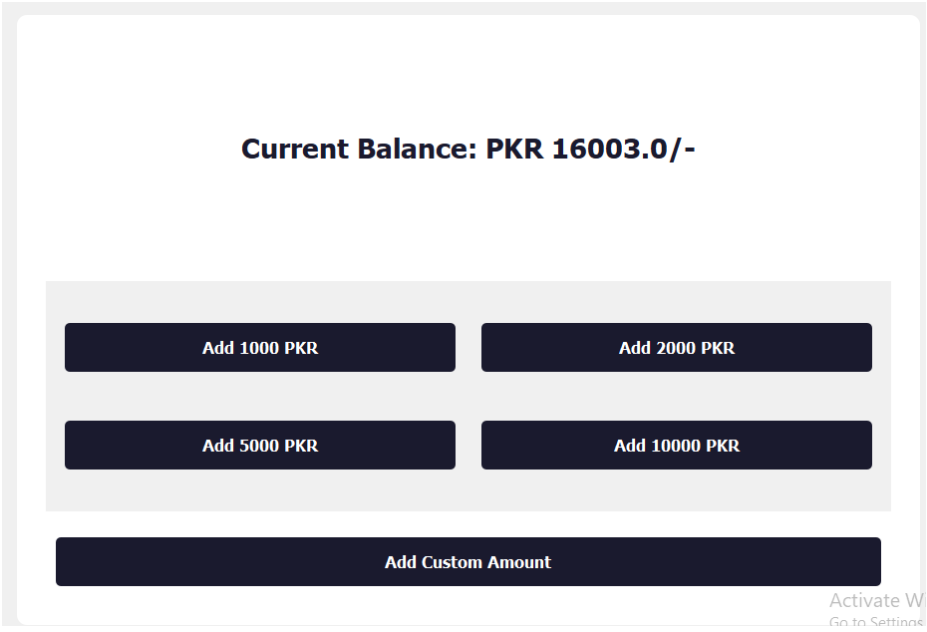
## Test Case 3:


MENU
AVAILABLE CARS
MY RENTALS
MY FUNDS
LOGOUT
toyota corolla
PKR 1000.0/-
Year: 2000
Transmission: auto
Fuel Type: petrol
RENT ME!
Suzuki Cultus
PKR 3500.0/-
Year: 2020
Transmission: Manual
Fuel Type: Petrol
RENT ME!

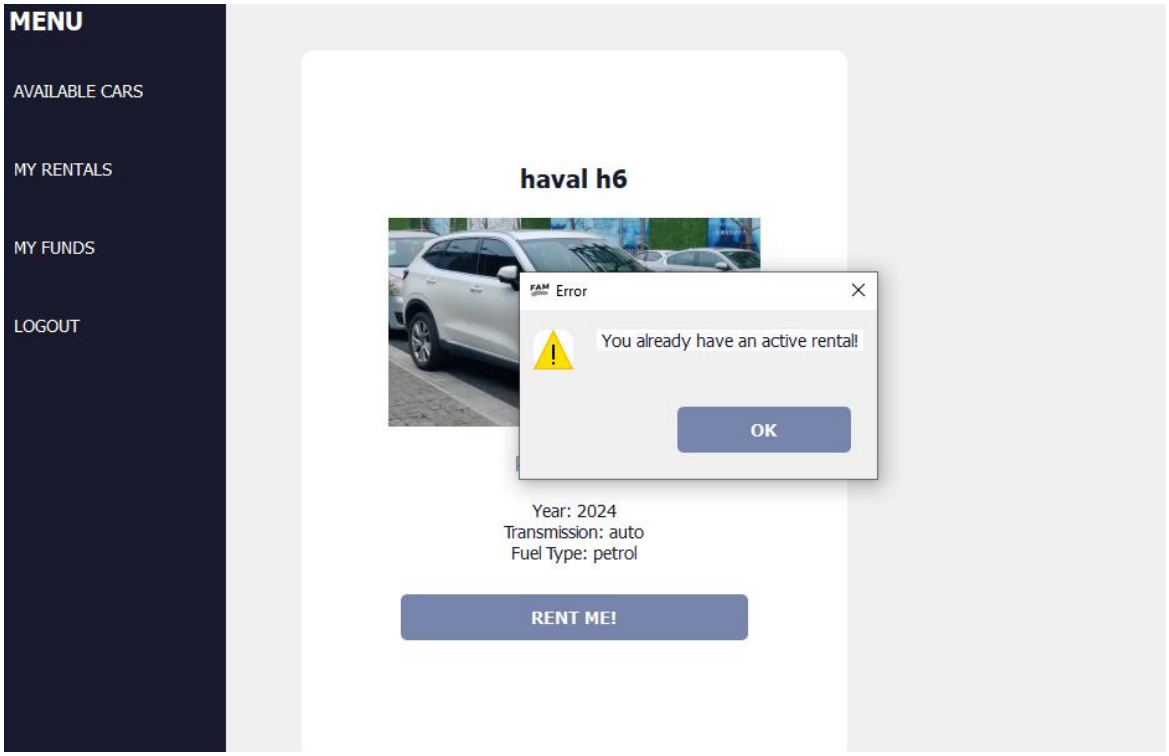

MENU
AVAILABLE CARS
MY RENTALS
MY FUNDS
LOGOUT
Current Rental
Car: toyota corolla
Start Date: 2025-05-17
End Date: 2025-05-18
Total Cost: PKR 1000.0/-
Return Vehicle

## Test Case 4:


MENU
AVAILABLE CARS
MY RENTALS
MY FUNDS
LOGOUT
Current Balance: PKR 1003.0/-
Success
Funds added successfully!
New Balance: PKR 16003.0/-
OK
Add
Add 2000 PKR
Add 5000 PKR
Add 10000 PKR
Add Custom Amount


Current Balance: PKR 16003.0/-
Add 1000 PKR
Add 2000 PKR
Add 5000 PKR
Add 10000 PKR
Add Custom Amount

**Test Case 5:**


MENU
AVAILABLE CARS
MY RENTALS
MY FUNDS
LOGOUT
haval h6
Error
You already have an active rental!
OK
Year: 2024
Transmission: auto
Fuel Type: petrol
RENT ME!