Solution for Exercise 04: E-Scooter Ride-Share System

TU Clausthal | Institut für Software and Systems Engineering
Course: Requirements Engineering | **Exercise:** 04 (Agent-Oriented Modeling)
Submitted By: Nikunj | **Date:** 11.01.2026

1. Agents and Roles

The E-Scooter ride-share system comprises three interacting agents, each fulfilling a specific role:

Agent	Role	Description
Customer (Human)	Rider Role	Manages account setup, vehicle booking, trip execution, and authorizes payment deduction
Vehicle Unit (Hardware)	Mobility Controller Role	Operates lock/unlock mechanism, monitors battery status, tracks GPS position, controls motor
Central Server (Software)	Operations Coordinator Role	Handles user verification, fleet coordination, fare computation, and payment processing

> **Design Rationale:** The three-agent model separates human interaction (Customer), physical device control (Vehicle Unit), and business logic (Central Server), enabling independent development and maintenance of each component.

2. Goals

2.1 Functional Goals

ID	Goal	Description
F-1	Account Creation	Enable customers to register with identity verification and payment method linkage
F-2	Vehicle Booking	Allow customers to locate nearby vehicles and reserve for immediate use
F-3	Trip Start	Authenticate customer and activate vehicle motor upon booking confirmation
F-4	Trip Completion	Detect destination arrival, deactivate motor, and secure vehicle lock
F-5	Fee Settlement	Calculate fare based on usage metrics and execute automatic payment

2.2 Quality Goals

ID	Goal	Description
Q-1	Fleet Visibility	Maintain real-time synchronization of all vehicle locations and availability status
Q-2	Billing Transparency	Provide itemized fare breakdown visible to customer before payment
Q-3	Payment Security	Store and transmit financial data using industry-standard encryption

3. Ride Cost Computation

The system uses a **hybrid pricing model** combining time and distance:

TotalFare = BaseFee + (Minutes × TimeRate) + (Kilometers × DistanceRate)

Parameter	Description	Value
BaseFee	Initial unlock charge	€0.75
TimeRate	Per-minute charge	€0.10
DistanceRate	Per-kilometer charge	€0.15

Example: A 12-minute, 3 km ride: €0.75 + (12 × €0.10) + (3 × €0.15) = **€2.40**

4. Behavioral Interface Model (BIM)

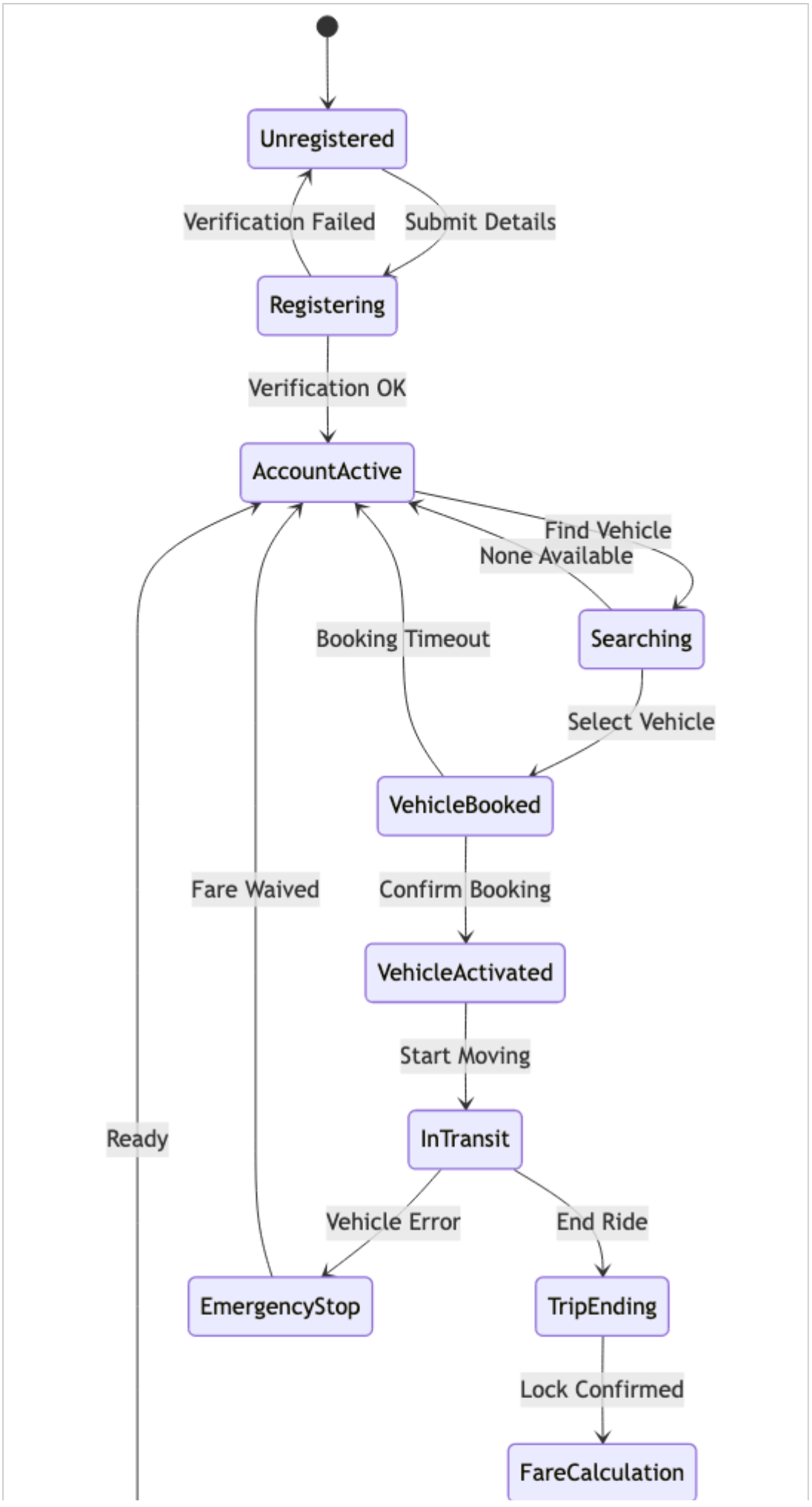
The BIM captures the complete interaction flow between agents, including normal operation and exception handling:

4.1 Normal Workflow

1. **Register:** Customer creates account with verified credentials
2. **Search:** Customer browses available vehicles on map
3. **Book:** Customer selects and reserves specific vehicle
4. **Activate:** Vehicle Unit unlocks upon customer proximity verification
5. **Ride:** Customer travels to destination
6. **Park:** Customer ends ride, Vehicle Unit locks automatically
7. **Pay:** Central Server calculates fare and debits registered payment method

4.2 Exception Handling

Exception	Trigger	Recovery Action
BookingExpiry	Customer doesn't activate within 5 minutes	Release vehicle to pool, no charge applied
PaymentRejected	Insufficient balance or card error	Notify customer, allow 3 retry attempts, then suspend account
VehicleMalfunction	Hardware failure during ride	End ride at current location, waive fare, report for maintenance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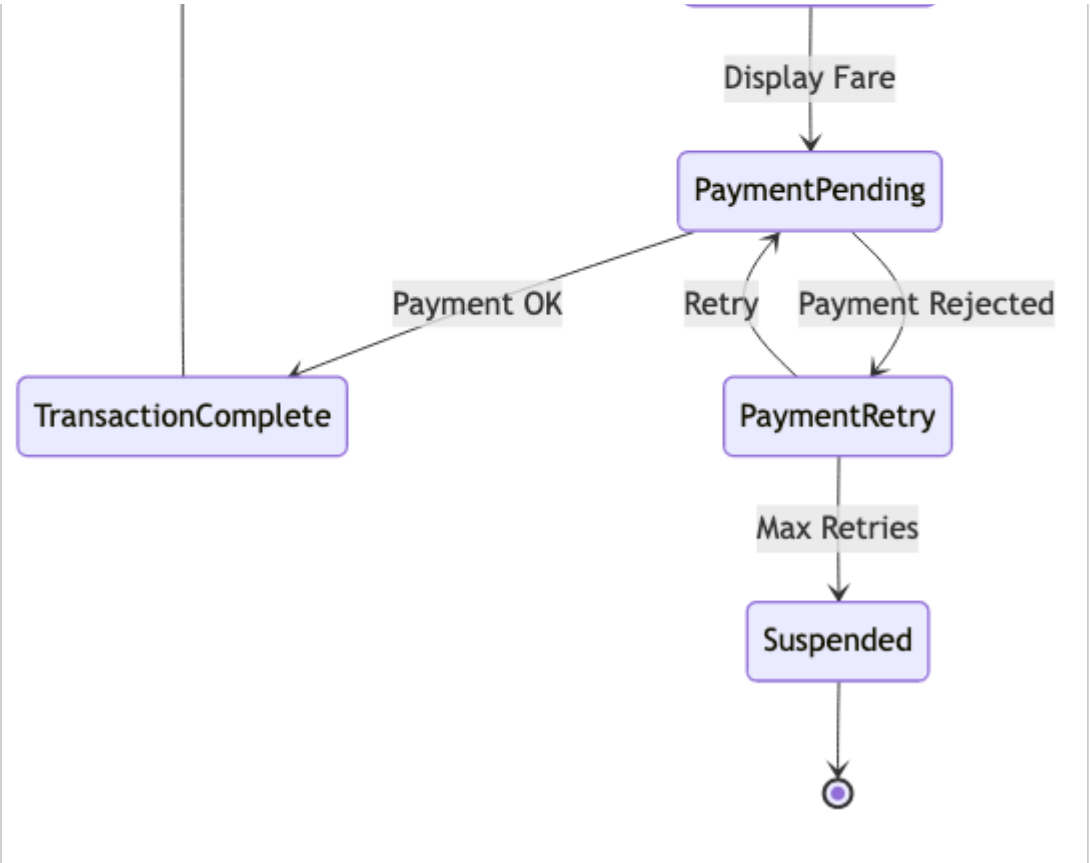

Figure 1: Behavioral Interface Model - State Diagram with Exception Handling

5. AOM Goal Hierarchy (3-Level Model)

The goal model follows a balanced three-level structure ensuring clear traceability:

- **Level 1 (Main Goal):** Operate E-Scooter Ride-Share Service
- **Level 2 (Sub-Goals):**
  - SG-A: Manage Customer Lifecycle
  - SG-B: Manage Vehicle Operations
  - SG-C: Manage Financial Processing
- **Level 3 (Leaf Goals):** 5 Functional Goals (F-1 to F-5) + 3 Quality Goals (Q-1 to Q-3)

Goal-to-Role Mapping

Goal	Primary Role	Supporting Role(s)
F-1: Account Creation	Operations Coordinator	Rider
F-2: Vehicle Booking	Operations Coordinator	Mobility Controller
F-3: Trip Start	Mobility Controller	Operations Coordinator
F-4: Trip Completion	Mobility Controller	Rider
F-5: Fee Settlement	Operations Coordinator	-
Q-1: Fleet Visibility	Mobility Controller	Operations Coordinator
Q-2: Billing Transparency	Operations Coordinator	-
Q-3: Payment Security	Operations Coordinator	-

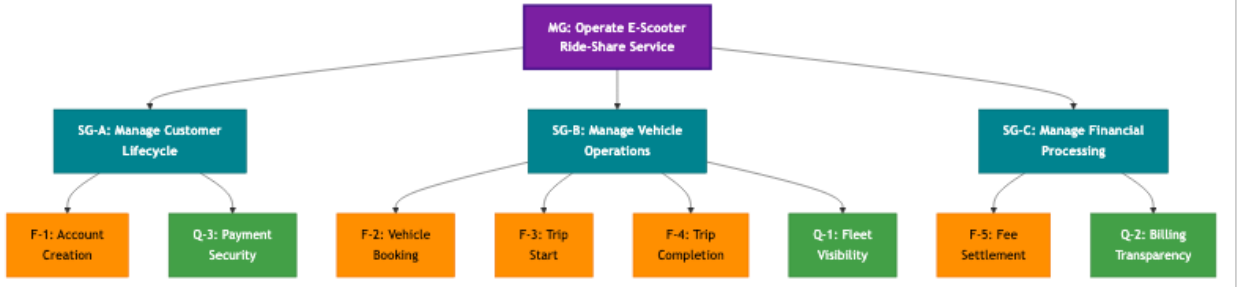

Figure 2: AOM Goal Model - Three-Level Hierarchy