Exercise 04: Urban Mobility E-Scooter Platform

TU Clausthal | Institute: Software and Systems Engineering
Module: Requirements Engineering | **Assignment:** 04 – Agent-Oriented Modeling
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1. System Actors and Responsibilities

After analyzing the ride-share scenario, I identified three actors collaborating to deliver the service:

Actor Type	Role Name	Core Responsibilities
End User (Human)	Rider	Initiates rental: signs up, picks vehicle, travels, approves charge
Physical Device (IoT)	Vehicle Controller	Governs hardware: motor control, GPS tracking, availability updates
Cloud Service (Software)	Billing Engine	Handles validation, duration tracking, fare calculation, fund transfer

2. System Objectives

Functional Objectives

- **FO-01 (Onboarding):** New riders complete signup with credential and card verification before activation.
- **FO-02 (Vehicle Claim):** Riders browse nearby vehicles via app map, claim one—instantly marking it unavailable.
- **FO-03 (Trip Execution):** Once claimed, vehicle motor activates for travel to destination.
- **FO-04 (Trip Termination):** Parking and tapping "End" triggers motor shutdown and GPS location update.
- **FO-05 (Automated Billing):** Platform computes charges and processes transaction without manual input.

Quality Objectives

- **QO-01 (Live Inventory):** Vehicle availability reflects real-world status within seconds.
- **QO-02 (Accurate Charges):** Fare uses server-recorded timestamps for precise billing.
- **QO-03 (Data Protection):** Payment credentials remain encrypted, accessed only during debit.

3. Fare Calculation Logic

I chose a duration-based pricing model for simplicity and fairness.

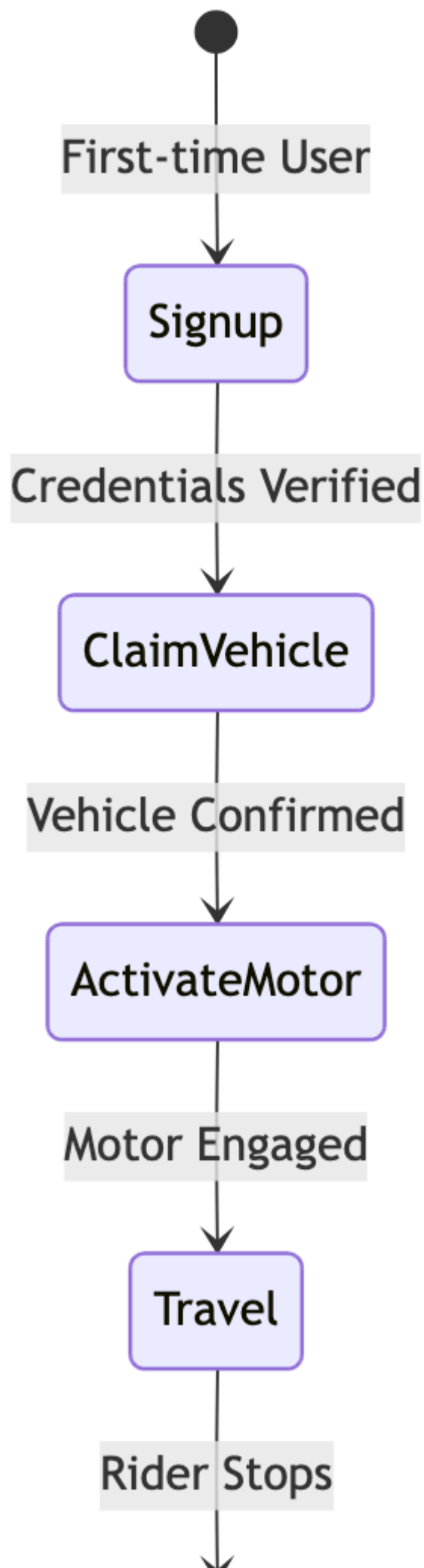$$\text{TripCost} = \text{StartFee} + (\text{Minutes} \times \text{PerMinuteRate})$$

Component	Meaning	Sample Value
StartFee	One-time unlock charge	€1.00
Minutes	Elapsed time from unlock to lock	Variable
PerMinuteRate	Ongoing usage charge	€0.20

Example: 12-minute trip = €1.00 + (12 × €0.20) = **€3.40**

4. Behavioral Interface Model (BIM)

Workflow Narrative

1. **Account Setup:** First-time user registers with payment info
2. **Vehicle Selection:** Rider claims available scooter through app
3. **Travel Phase:** Vehicle Controller unlocks motor; rider travels
4. **Session Close:** Rider ends trip; Controller locks hardware
5. **Settlement:** Billing Engine calculates duration-based fare and charges card
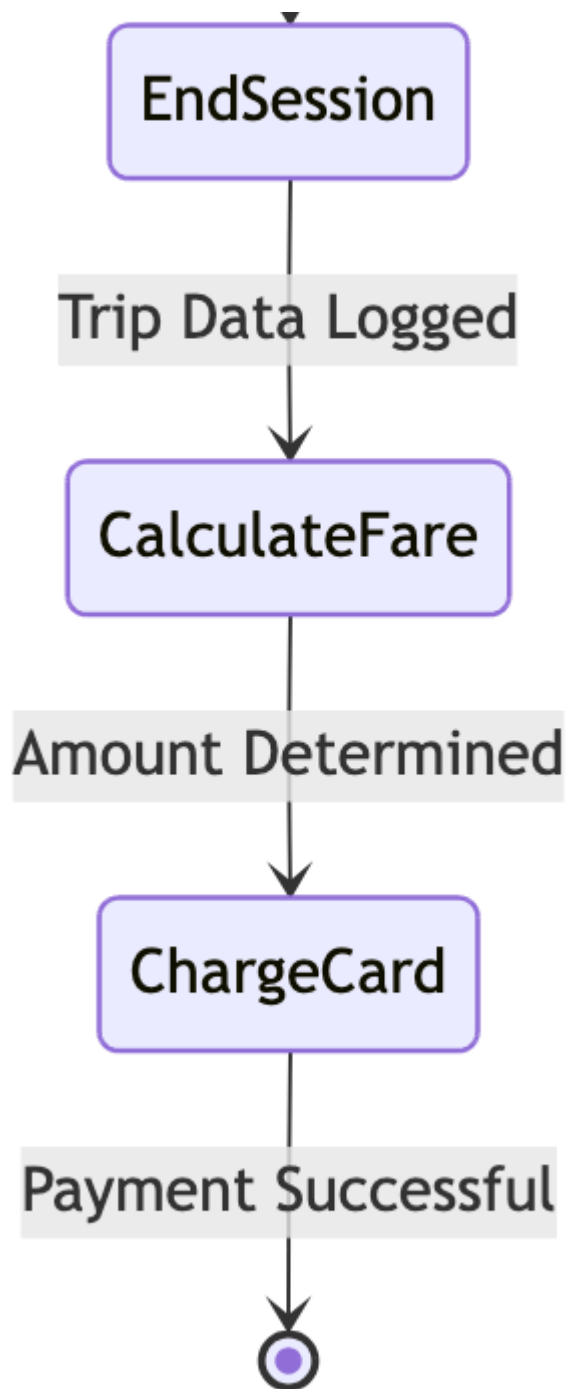
```mermaid
stateDiagram-v2
    [*] --> Signup : First-time User
    Signup --> ClaimVehicle : Credentials Verified
    ClaimVehicle --> ActivateMotor : Vehicle Confirmed
    ActivateMotor --> Travel : Motor Engaged
    Travel --> [*] : Rider Stops
```

First-time User

Signup

Credentials Verified

ClaimVehicle

Vehicle Confirmed

ActivateMotor

Motor Engaged

Travel

Rider Stops

EndSession

Trip Data Logged

CalculateFare

Amount Determined

ChargeCard

Payment Successful

Figure 1: Behavioral Interface Model – State transitions in rental lifecycle

5. Objective Hierarchy Diagram (3 Tiers)

This diagram shows goal decomposition from platform mission to leaf-level tasks:

Figure 2: AOM Goal Model – Three-tier hierarchy
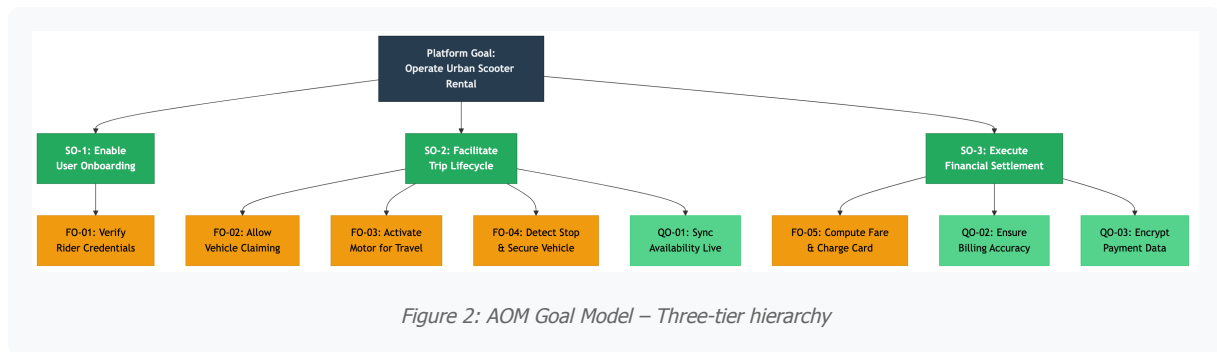
Color Key: ● Tier 1: Platform mission ● Tier 2: Capability areas ● Tier 3: Leaf objectives

Closing Remarks

This solution models a real-world urban mobility scenario using agent-oriented principles:

- Three-role decomposition mirrors actual platform architecture
- Functional and quality objectives ensure comprehensive coverage
- Time-based billing keeps the model practical
- BIM illustrates complete rental lifecycle state flow