Technical Specifications Report

Elytra

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Index

Product Concept

Requirements Gathering

Actors

There are three primary actors involved in the system: the Station Operator, who is responsible for managing and maintaining the charging stations; the EV Driver, who utilizes the charging infrastructure to power their electric vehicle; and the Admin, who oversees the overall operation, manages user accounts, and ensures compliance with policies and standards

Personas

Figure 1 - Gelson Martins, a station operator

Station Operator

Name: Gelson Martins
Age: 41
Gender: Male
Demographics: Degree in Electrical Engineering
Job Title: Operations Manager
Context: Gelson manages an electric vehicle charging station located in a suburban area. He is responsible for keeping the station running efficiently, ensuring availability, performing maintenance, and controlling operational energy costs.

Needs:

- View real-time status of the station (active, faulty, under maintenance);
- Configure off-peak discount hours to optimize energy costs;
- Schedule maintenance and log faults easily;
- Generate reports on station usage and energy consumption;
- Receive automatic alerts for faults or unauthorized usage;
- Integrate with external systems (maps, billing, maintenance);
- Prevent overbooking and unauthorized access.

Figure 2 - Sofia Martins, a Electrical Vehicle Driver

Electrical Vehicle Driver

Name: Sofia Martins
Age: 34
Gender: Female
Demographics: Urban resident, lives in Aveiro, Portugal
Job Title: Marketing manager at a tech startup
Context: Sofia is a daily EV commuter who relies on her electric vehicle for both personal and professional travel. She values sustainability and digital convenience but often finds the EV charging experience fragmented and unreliable. She wants a seamless solution that allows her to efficiently manage her charging routine without unnecessary detours, delays, or app overload.

Needs:

- Locate compatible and available EV charging stations in real time;
- Book time slots in advance to avoid waiting or unexpected unavailability;
- Monitor charging sessions and track energy usage history;
- Make quick, secure payments through unified platform;
- Filter stations by connector type, power level, and price;
- Receive notifications when a booked slot is about to start or if issues occur.

Scenarios

Station Operator - Gelson

Scenario 1: Real-Time Station Monitoring

It’s Monday morning at 7:45 AM. Gelson logs into the operations dashboard from his office before the first wave of EV commuters arrives. The dashboard shows 12 chargers, 11 in green (active) and one in red (faulty). That unit flagged a power relay issue around 3 AM.

He clicks on the red unit and opens the activity log. It shows intermittent errors during the night. Gelson adds a comment for the maintenance team and marks it as “awaiting technician.” The system updates the unit status to yellow (under maintenance) and removes it from the public booking pool automatically.

This quick morning check allows him to keep availability high and avoid customer complaints during the morning rush.

Scenario 2: Configure Off-Peak Discounts

On Wednesday afternoon, Gelson receives an email from headquarters reminding all regional stations to lower energy costs during peak hours. He opens the pricing control module, reviews recent energy consumption, and notices a clear drop in usage after 9 PM.

To encourage night-time charging, he configures a 20% discount between **9 PM and 6 AM**, starting immediately. The system updates the pricing tiers and applies a discount label to off-peak hours in the booking app.

A few hours later, the customer analytics dashboard shows three users scheduled charging during the new discount window. Gelson makes a note to revisit the impact of this change at the end of the week.

Scenario 3: Fault and Security Alerts

At 10:37 PM on a Saturday night, Gelson is off duty when he receives a push notification: “Unauthorized access attempt at Unit 4 – RFID mismatch – 3 failed swipes.”

He opens the alert on his phone. It shows a failed authentication attempt using a blacklisted RFID tag. The system automatically disables Unit 4 temporarily and logs the incident.

Gelson remotely disables the tag and adds the event to the security incident tracker. He forwards the alert to the central fraud team and sets the unit to be reviewed in person on Monday morning.

Without needing to leave his home, he contained a potential breach within minutes.

Electrical Vehicle Driver - Sofia

Scenario 1: Morning Commute – Booking a Charging Slot Before Work

Sofia finishes her breakfast and opens the Elytra app to check nearby charging stations along her route to work. She notices that her usual charger is already booked, but finds another fast-charger just a few blocks away.

She filters stations by connector type (Type 2) and availability and then books a slot for 8:30 AM. The app confirms the booking and notifies her 10 minutes before the slot begins. Once there, she scans the QR code, unlocks the charger, and starts her session.

She then receives a summary of the session and her**b**, all logged in her dashboard.

Scenario 2: Weekend Trip – Planning a Long-Distance Route with Charging Stops

Sofia and her partner are planning a weekend getaway to the countryside. She uses Elytra's trip planner tool to map the route, automatically highlighting optimal charging stations based on her car's range and driving preferences.

She books two slots: one mid-way to the destination and one on the way back. Elytra provides a forecast of station occupancy during the selected times, helping her avoid peak hours. On the road, she receives live updates in case of unexpected station downtimes, allowing her to reroute if needed.

Epics

EPIC1 - Backoffice Services - User Stories

- As a Station Operator, I want to register a new charging station so that it appears in the system;
- As a Station Operator, I want to view usage data to manage operations effectively;
- As a Station Operator, I want to update the maintenance status of a station so that users see only available chargers.

EPIC2 - Station Discovery - User Stories

- As an EV Driver, I want to search for nearby charging stations so that I can find a convenient location to charge;
- As an EV Driver, I want to filter charging stations by availability, charger type, or cost so that I can choose the best option.

EPIC3 - Slot Booking & Scheduling - User Stories

- As an EV Driver, I want to book a time slot at a charging station so I can ensure availability when I arrive;
- As an EV Driver, I want to receive confirmation of my booking to avoid double booking or overbooking;
- As a Station Operator, I want to manage booking slots and availability so that the station is efficiently used.

EPIC4 - Charging - User Stories

- As an EV Driver, I want to unlock a charger remotely so that I can start charging when I arrive;
- As an EV Driver, I want to track the consumption of my vehicle during the charging session so I can manage costs and monitor battery health.

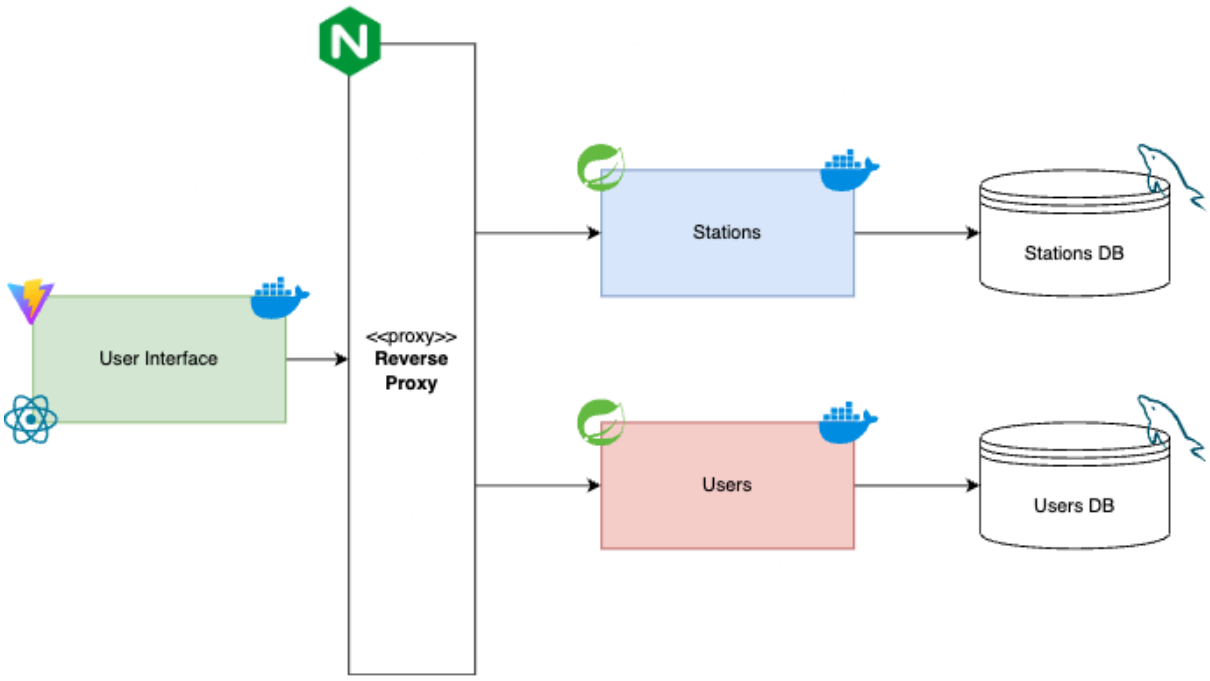
EPIC5 - Payment Integration - User Stories

- As an EV Driver, I want to pay for the charging session using a pay-per-use model so that I only pay for what I use;
- As an EV Driver, I want to subscribe to a plan to save on frequent charging sessions;
- As a Platform, I want to integrate with third-party payment gateways so that I can process transactions securely.

EPIC6 - User Profiles & Charging History - User Stories

- As an EV Driver, I want to view my past charging sessions and stats so I can track my usage over time;
- As an EV Driver, I want to manage my profile and preferences so that my experience is personalized.

System Architecture



High-level view

The platform follows a containerised, layered style architecture.

Technology choices

- **Spring Boot** - fulfils the course requirement to adopt a Jakarta-based framework
- **React + Vite** - delivers a fast SPA with hot-reload during development; the bundle is copied into the NGINX image for simple static hosting.
- **MySQL** - widely-supported relational store.
- **Docker Compose** - Compose for local development.