Smartphone Application Interface for EV Charging Station

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Project Overview

The project researches the user experience of EV charging using smartphone applications concerning issues such as range anxiety, fragmentation in payment systems, inconsistent real-time data, and safety concerns. It examines existing research on pain points to improve users' satisfaction and increase EV adoption.

Scope

This project focuses on the problems of EV users with charging applications, such as range anxiety and usability, in order to propose several improvements that increase user experience, functionality of applications, and overall satisfaction with EV charging.
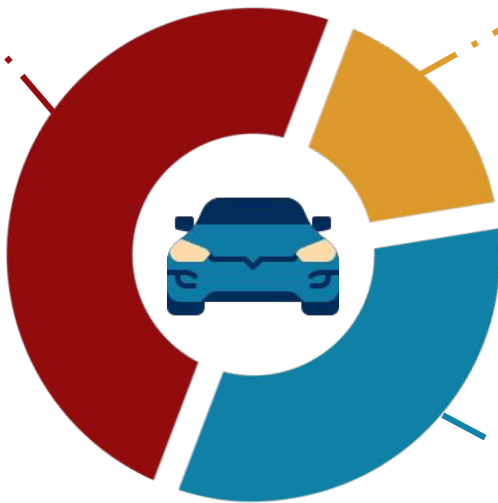
Objective

Understand the needs of EV users regarding charging apps, identify pitfalls in currently existing solutions, and provide recommendations on how to make these applications more user-friendly, less stressful, and more pleasant to use.

Expected Outcome

The project will provide an understanding of user challenges, recommend improved features in apps that best facilitate easier charging, and further make recommendations for improving EV charging apps to be more reliable, user-friendly, and stress-free for drivers.

Research Motivation

The project researches the user experience of EV charging using smartphone applications concerning issues such as range anxiety, fragmentation in payment systems, inconsistent real-time data, and safety concerns. It examines existing research on pain points to improve users' satisfaction and increase EV adoption.

Why focus on EV Apps?

EVs represent the key to sustainable transportation.Yet, despite growing popularity, range anxiety and other charging concerns remains a key barrier to wider use of EVs.

Users worry about battery depletion and access to charging stations.

Key Challenges Users Face:

Payment Fragmentation

Inaccurate Real-Time Data
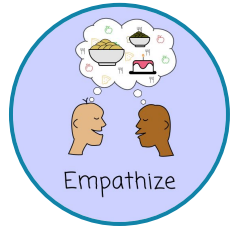
Battery Management Concerns

Amenities and Safety Issues

Why does this matter?

These challenges lead to frustration, increased range anxiety, and slow EV adoption.

Improved user experience will increase trust and make EVs more appealing and may also lead to increase in EV adoption by removing hesitations
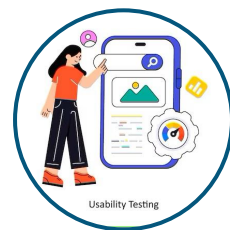
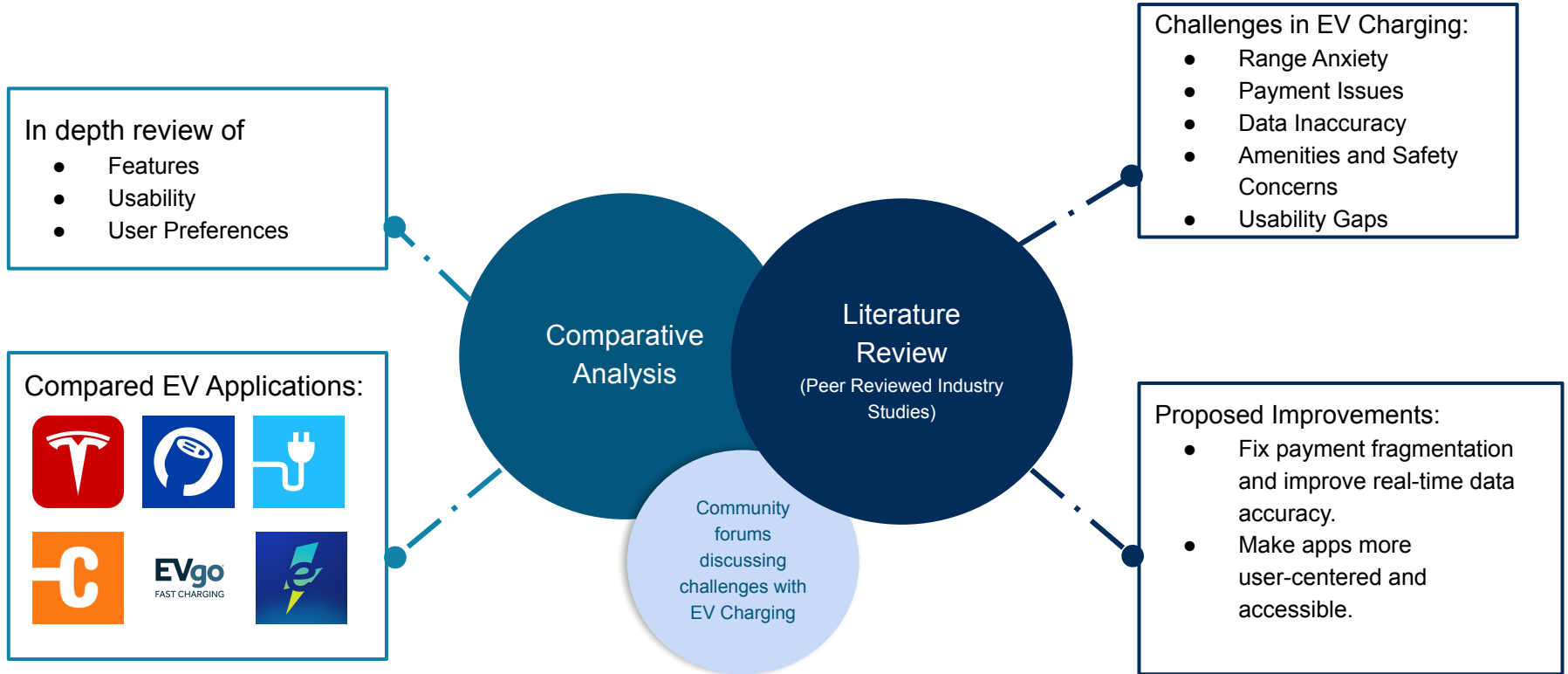**Empathize**   **Define**   **Ideate**   **Prototype**   **Test**

Empathize

In depth review of
- Features
- Usability
- User Preferences

Compared EV Applications:

Comparative Analysis

Literature Review
(Peer Reviewed Industry Studies)

Community forums discussing challenges with EV Charging

Challenges in EV Charging:
- Range Anxiety
- Payment Issues
- Data Inaccuracy
- Amenities and Safety Concerns
- Usability Gaps

Proposed Improvements:
- Fix payment fragmentation and improve real-time data accuracy.
- Make apps more user-centered and accessible.

Define

Fragmented EV charging solutions force users to juggle multiple apps for charger speed, compatibility, availability, payment options, amenities, and security details, disrupting convenience and discouraging EV adoption, particularly for long journeys.

Ideate & Brainstorm

The review of existing EV charging applications such as PlugShare, EVgo, ChargeMap, ChargePoint, etc. highlights critical user challenges in features and find difficulties in accessibility.

Top Challenges

- Range Anxiety
- Fragmented Payment Systems
- Safety Concerns
- Battery Management and Monitoring
- Accessibility Limitations
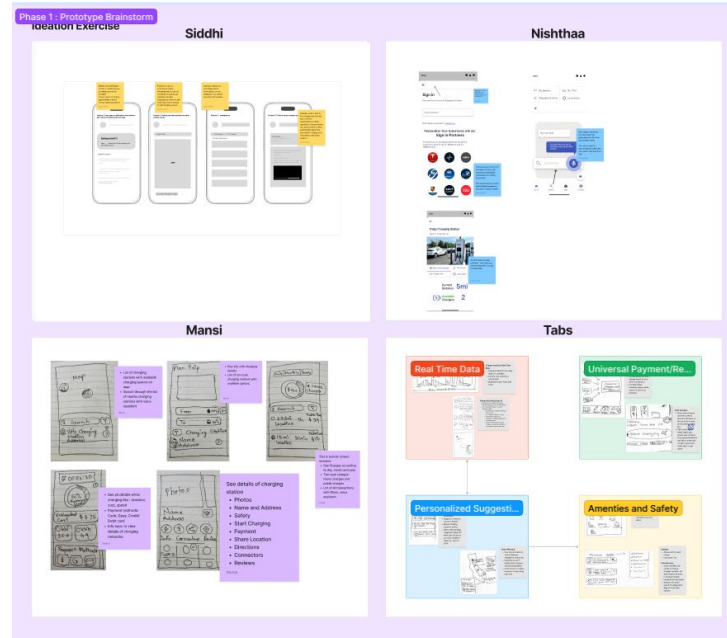
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Top Challenges

- Range Anxiety
- Fragmented Payment Systems
- Safety Concerns
- Battery Management and Monitoring
- Accessibility Limitations

Proposed Solutions

- Simplified Interface
- Unified Payment system
- Enhanced Safety Features
- Detailed Battery monitoring
- Improved real-time data accuracy

Prototype - Features

Plan Your Trip

- Add To-From Location
- List of on-route charging stations

Battery Health & Monitoring

- Detailed battery monitoring
- State of charging

Charging Station details With Amenities

- Charging station details - photos, availability, connector type.
- Amenities - food, shopping

Unified Payment System

- Multiple payment options at one place

Prototype - Design Heuristics

Consistency & standards

Familiar interfaces like Google Maps APIs reduced cognitive load

Visibility of System Status

Real-time updates on station availability and wait times were emphasized

User Control & Freedom

Flexible navigation paths empowered users to make informed choicesFlexible navigation paths empowered users to make informed choices

Error Prevention

Features like compatibility checks minimized the risk of errors during planning

Sketched by hand

Focused on basic flow and features of the application

Developed using Figma

Focused on creating a visually engaging and interactive UI for the core functionality established on Low-Fi designs
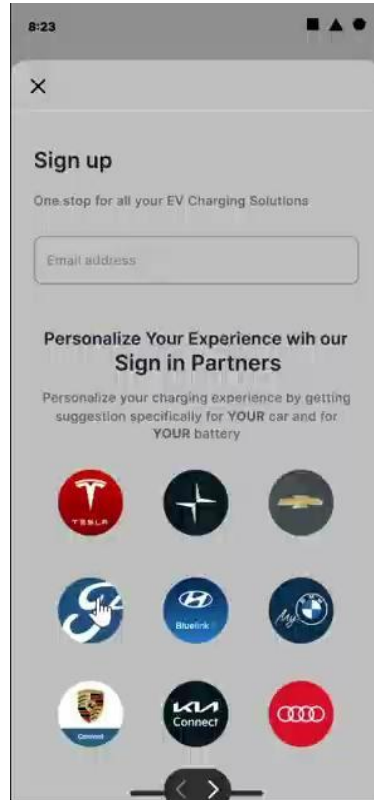
**Low-Fi
Prototype**
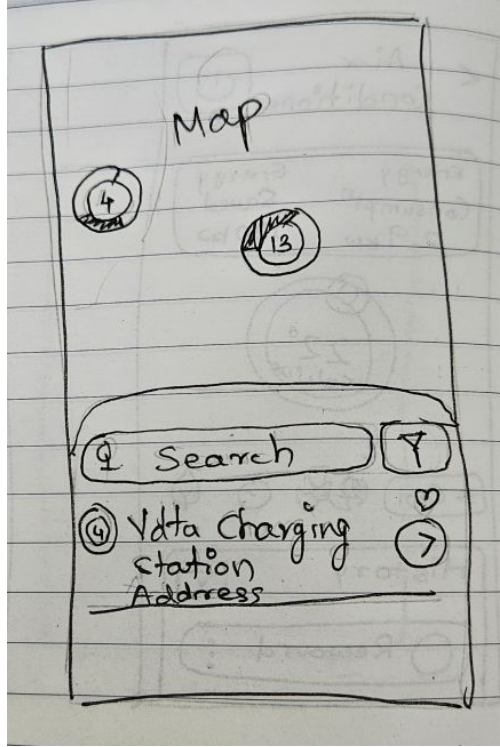
**Hi-Fi
Prototype**

**Low-Fi
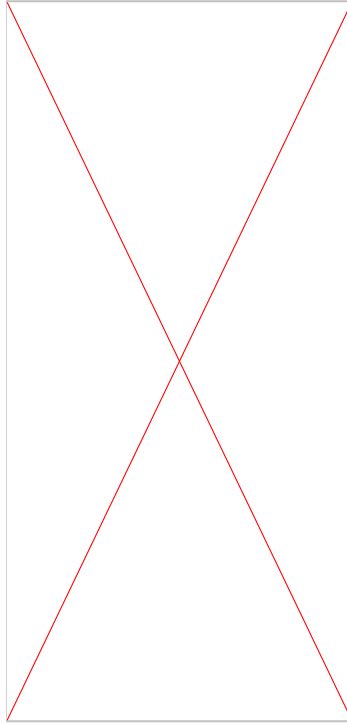Prototype**
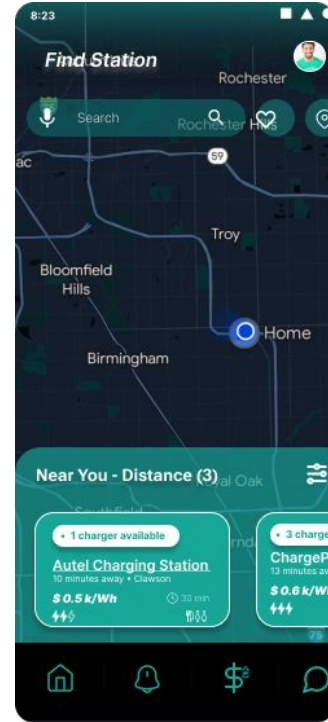
**Hi-Fi
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Prototype Development
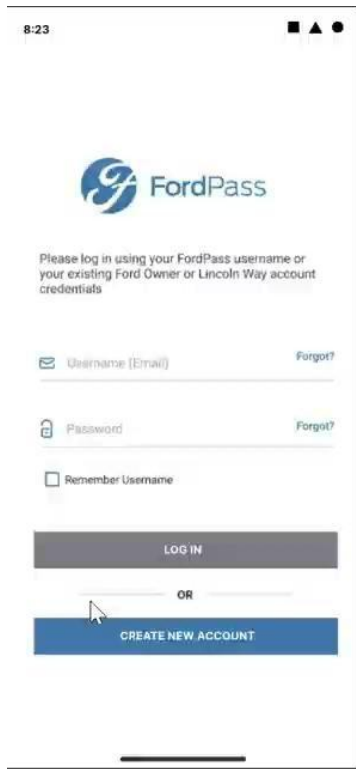
Feature 1: Plan Your Trip

Prototype Development

Feature 2: Battery Health

Prototype Development

Feature 3: Check-in Manually

Prototype Development

Feature 4: Charge & Pay
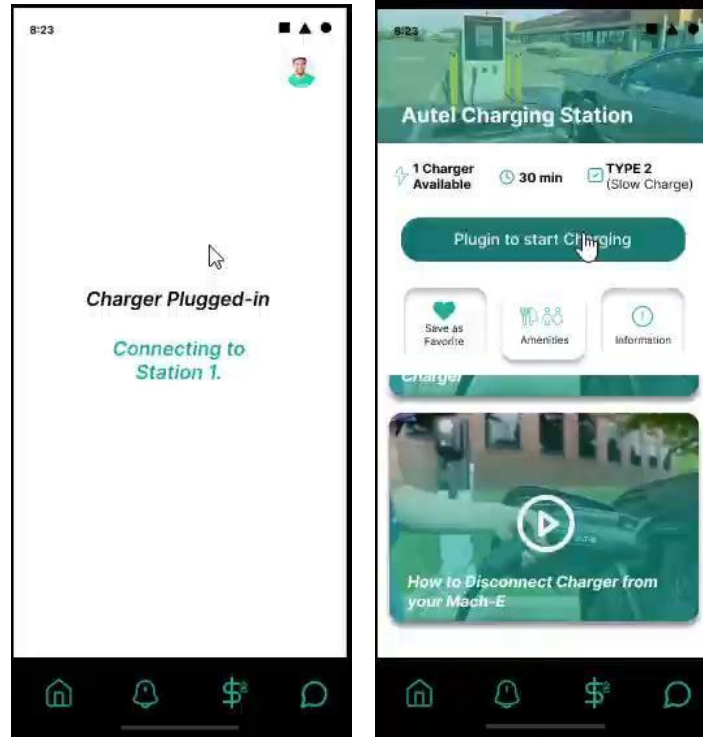
Usability Testing

Testing Goals:

Assess ease of use, clarity of information, and perceived usefulness.
Gain actionable insights into navigation, intuitiveness, and functionality.

Target Audiences:

- Aspiring EV users: Limited familiarity, unbiased insights for new users.
- Experienced EV users: Regularly use apps like Tesla, ChargePoint, or EVgo, providing comparative feedback.

Participants:

- Total: 10 (5 aspiring users, 5 experienced users).

Testing Methods

Task Analysis (BETWEEN SUBJECTS)

- Evaluated key tasks like finding a charging station or planning a trip.
- Identified inefficiencies in user journey.

System Usability Scale (BETWEEN SUBJECTS)

Comparative Usability Testing (EXPERIENCED EV DRIVERS)

- Benchmarked against competitors.

Metrics Used:

- Quantitative: Task completion times, System Usability Scale (SUS)
- Qualitative: Verbal feedback via think-aloud protocol.

Results

Task Time & Difficulty

- Aspiring Users: High efficiency and ease of use (e.g., finding nearby chargers: 5.46 sec, difficulty: 1.2/5).
- Experienced Users: Struggled with payment process (109.66 sec, difficulty: 3.66/5).

Qualitative feedback

Strengths: Real-time data, route planning, and unique amenities feature praised by all users.
Challenges:

- Payment process
- Integrate Advanced features like SOC
- Visual consistency and clearer color coding

SUS

- **Aspiring Users:** Mean SUS score of 89.5, indicating high usability.
- **Experienced Users:** Mean SUS score of 68.0, reflecting average usability.

Comparative Analysis

- Experienced users emphasized the need to match industry benchmarks like Tesla for competitiveness.

Results

Positive Feedback:

- Intuitive design, user-friendly features.
- Route planning with real-time syncing.
- Integrated home screen features for easy navigation.
- High usability score: 78.75 (above benchmark of 68)

Standout Features:

- Detailed station info (charger type, speed, nearby amenities).
- Visually appealing and organized interface compared to competitors.

Challenges

Key Pain Points:

- Lack of advanced planning tools like SOC estimation.
- Cumbersome payment process.
- Need for clearer visual indicators (e.g., charger availability color coding).
- Confusion navigating battery health features.

Quantitative Results:

- Task 3 (payment process): Longest average time (16.06 seconds), maximum time (45.27 seconds).
- P-value: 0.1004 (not statistically significant)

What we improved

Payment Workflow:

- Automated with default payment method for seamless transactions.

Battery Management Interface:

- Simplified layout with clearer terminology ("phantom battery" → "stand-by").

Visual Design Enhancements:

- Brighter accent colors, persistent buttons (e.g., $ icon for payment).

Navigation Adjustments:

- Consolidated and streamlined interface for efficiency.

Next Steps

Future Enhancements:

- Advanced SOC tracking for better planning.
- Streamlined payment features for clarity.
- Unique features like personalized station recommendations.
- Real-time feedback on station status

Takeaway:

- App reduces EV stress and anxiety.
- Welcoming for aspiring users; appreciated by experienced ones.
- Prioritize refinements to remain competitive and user-friendly

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Thank You!