Computer Science & Computer Engineering

General Motors
Vehicle to Grid Energy Buy Back

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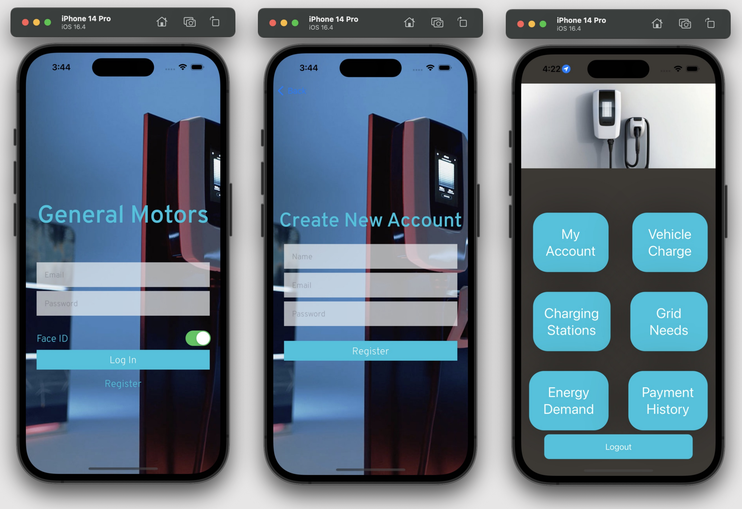
Introduction

The prevalence of electric vehicles in our society has resulted in a record demand for energy and an increase in unused energy stored in these electric vehicles. However, no system is in place to allow the sharing of electric vehicle energy with the grid.

This project aims to create an iOS application that will assist in facilitating energy transfer between General Motors customers and the power grid. Our solution will allow users to set up accounts, update their information, locate charging stations, identify grid areas of need, and monitor their transactions.

Frontend Design



We went with SwiftUI which is programmatically created UI vs the storyboards(older version). This made it easier to get desired layout over all the devices. This means every design had to be hard coded based on device constraints. All colors and pictures used are the official GM designs.

Backend Design

User Information Storage: We used Firebase's Firestore Database to the storage of all user information.

Authentication: To authenticate the user's identity as they logged in, we utilized Firebase's Authentication services to allow for password authentication.

Payment: Because users could be receiving payments from multiple dedicated grid accounts, we provided in our application a way for them to keep track of their transactions using PayPal's API.

Vehicle Charge Display: General motors communicates with their vehicles to gather current charge data using Apache Kafka. We simulated this connection in our application using a mock Kafka consumer.

Grid Need: While API pricing blocked us from displaying real-time data, we were determined to produce a system modular enough that such functionality could easily be 'plugged in' at a future date. To do so, we used the NREL Utility Rates V3 API to gather annualized average electricity price per zip code. To gather zip codes and their location, we used the ZipCodeBase API. We then used Perlin Noise to generate realistic mock real-time prices, allowing us to calculate grid need.

Charging Stations: To gather nearby charging station location information, we made use of the NREL Alternate Stations API. This made it easy to quickly query for nearby stations within a given range. We also made use of the OpenChargeMap API to gather deeper information about each station, such as their address and phone number.

Challenges

- We discovered that the API we intended to gather charging cost data from (Genability) cost $500
- Certain APIs used were not easily compatible with SwiftUI, making their implementation more difficult than anticipated.
- Without one explicit payment account to draw from, we had to reimagine how our payment system would function.

Results

Our application was designed to assist in facilitating energy transfer between General Motors drivers and the energy grid.

The resulting application will allow users to:

- Set up an account
- Update their information
- See their vehicle's current level of charge
- Locate charging stations and see charging station information
- Identify grid areas of need
- Access a payment system to monitor energy transfer payments

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