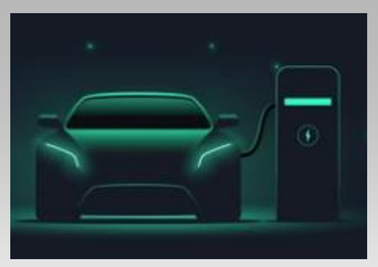

EV Charging Station LocOp with Hotspot Visualization

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Poster presentation for CSE 6242 project

Introduction

- Governments across the globe are promoting **Electric Vehicles** (EVs) as a green alternative to fossil-fuel vehicles (FFVs) . EVs will constitute about **24%** of all vehicles by the year **2030**
- However, there are several challenges to the wider adoption of EVs. Many surveys and studies point to **range anxiety**, infrastructure, initial cost of adoption being the primary reasons and coupled with the fact that EV charging stations cannot be built into the existing conventional gas stations because of large recharging times for EVs

Data

There are 4 primary **datasets** related to EVs we used to solve this problem.

- **Traffic Volume** across US road networks and highways
- **EV Charging Station** Locations & Characteristics
- **EV Sales** across regions
- **EV Power Usage** and Range

The EV charging stations data is obtained from NREL (National Laboratory of the U.S. Department of Energy) downloaded using their provided **APIs**.

Traffic flow data was **scraped** using from official site of U.S. Department of Transportation. The EV sales data was obtained from Atlas EV hub dashboard as a **direct download**. The power usage was **estimated** by combining these datasets.

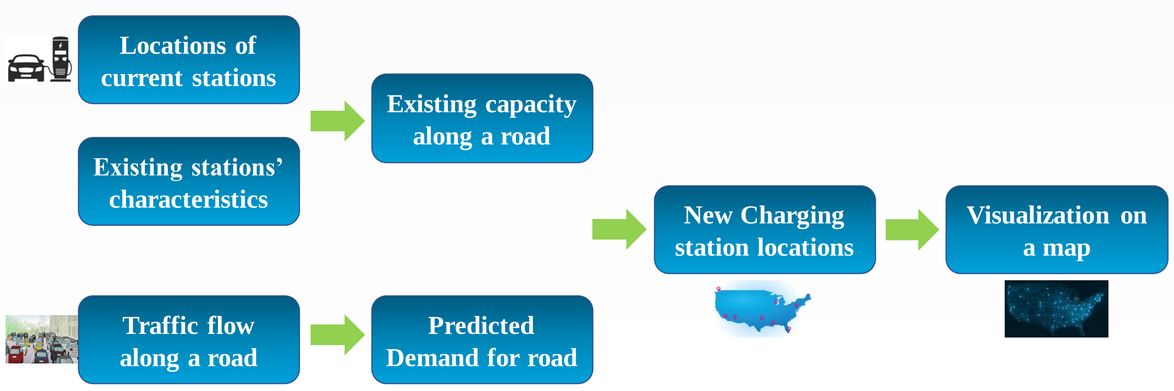
Characteristics of the Data:

- The data is not temporal and contains information for the year 2020.
- The total **size on disk** for the merged and cleaned datasets: **105 MB**
- The attributes are as given below :

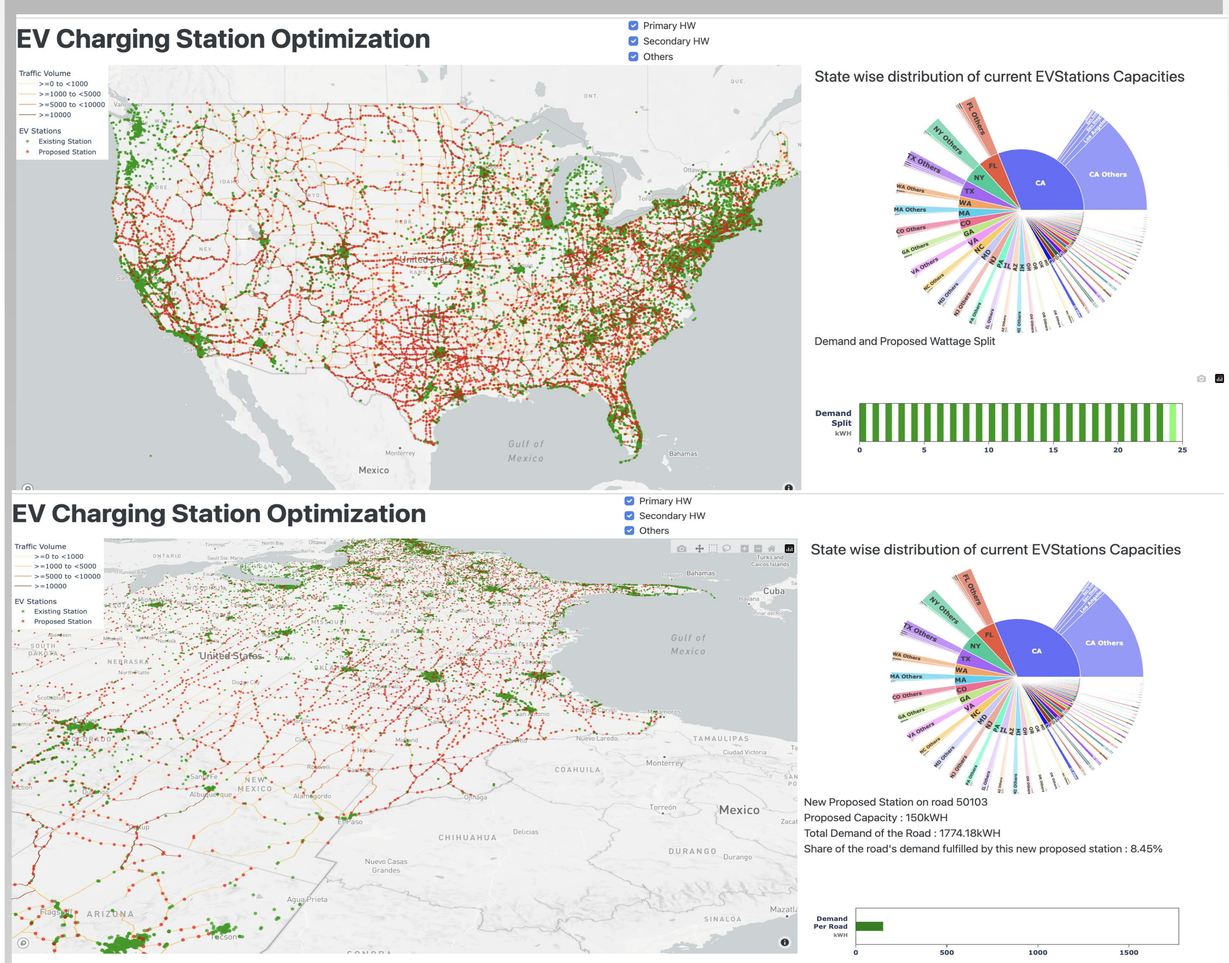
Dataset	Number of Records
Traffic Volumes	41490
Road Networks	85423
EV Charging Stations	56184

Approach

- To help expand the EV infrastructure in the country, this tool serves as a guide by not only helping in identifying potential hotspots for new EV station locations but also by providing a comprehensive **visual representation** of the existing charging stations across the whole country
- This approach uses the existing data for EV stations consisting of their capacities, locations etc. and
- The locations for new charging stations are found by an **optimization** formulation where demand gap (current demand – current capacity) along a road is met by minimizing the capacity and number of new stations
- These locations are then plotted in a **visualization** spanning the **entire US**
- The sequential steps taken for solving the problem are as follows:



The visualization of new stations and existing stations is as follows (new stations are depicted in 'Red'):



Experiments and Results

- This tool allows users to make rational judgement based on the visualizations. This tool also makes information interpretation simpler. We used several tests with both quantitative and qualitative factors to determine whether this aim was met.
- To ensure that users can navigate the different features easily we measured the **loading times** for the application and **latency** while making use of the features in the GUI. The loading times and latency for the application are given below.
- To assess whether the users were able to make meaningful inferences from the application we asked them to judge whether certain patterns existed and could be easily identified. Finally, the users were asked for their opinion about the different characteristics of the application.
- The accuracy of our predictive model was tested by removing specific high demand charging stations from the network to check whether the algorithm would predict a new station in the vicinity of the old one.

Feature	Latency
Zoom In/Zoom out	~250 ms
Chart Generation	7.5 - 8 s
Changing Filters	8.7 secs

GUI	Average Rating
Visual Quality	4.62
Map resolution	4.81
Ease of use	4.33
Latency	4.17

Conclusions and Discussion

- We have analyzed the trends of EV charging station infrastructure across the United States and identified definite areas of improvement. The visualization can be utilized by EV owners, manufacturers as well as government entities and companies investing in EV infrastructure
- The project is unique primarily due to its application over such a large area. It is accurate in predicting locations of charging stations given constraints on maximum and minimum capacity
- Future Improvements to this application include augmentation with responses from a predictive model for future traffic trends. The package could also be linked with existing applications such as Google Maps to synchronize with existing navigational services