ASSESSING POTENTIAL FOR ELECTRIFICATION OF DELIVERY ROUTES THROUGH SPATIOTEMPORAL ANALYSIS

PURDUE UNIVERSITY | The Data Mine

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PROJECT BACKGROUND

THE PROBLEM:
The automative sector is facing increasing demands from various stakeholders such as:

- The push for productivity improvements
- The challenge of mitigating increasing urban congestion
- Regulatory mandates for cleaner, more efficient vehicles

These factors collectively contribute to the accelerating trend towards vehicle electrification.

THE GOAL:
Assess the potential for electrification of delivery routes through spaciotemporal analysis.

HOW:
Analyzing how the vehicle is operated through space and time to identify the most and least promising routes for electrification.

METHODS AND DATA

DATA COLLECTION:
Allison collects data from a telematics provider. Over 20+ signals are collected at uneven sampling rates. For example, engine and vehicle speed, GPS position, etc.

DATA CLEANING:
Incorrect, duplicate or incomplete data for different variables is either fixed or removed.

DATA ANALYSIS:
The clean data is then used to summarize elements of "duty cycle" such as:

- Daily distance driven
- Fuel economy per day
- Time spent at delivery location
- Average distance between delivery stops

PROGRESS FROM PREVIOUS SEMESTERS

Previous teams have already developed python functions that are able to:

1. Create interactive maps to show the location of the vehicle during the day.

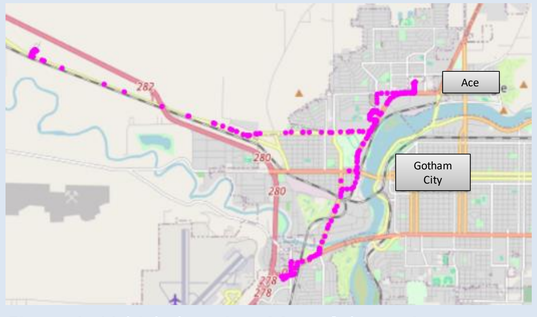

Figure 1 . Vehicle location: Map of the entire journey for 1 day

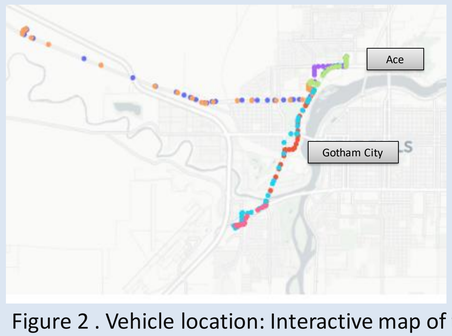

Figure 2 . Vehicle location: Interactive map of the journey for 1 day broken down into trajectories

2. Estimate the fuel economy for any particular day of operation:

FROM DATA

TOTAL FUEL USED PER DAY

TOTAL DISTANCE TRAVLED PER DAY

⇒ FUEL ECONOMY

RESULTS AND FINDINGS

Our team created functions using python to calculate different metrics that provide a deep understanding of how the vehicle is operated:

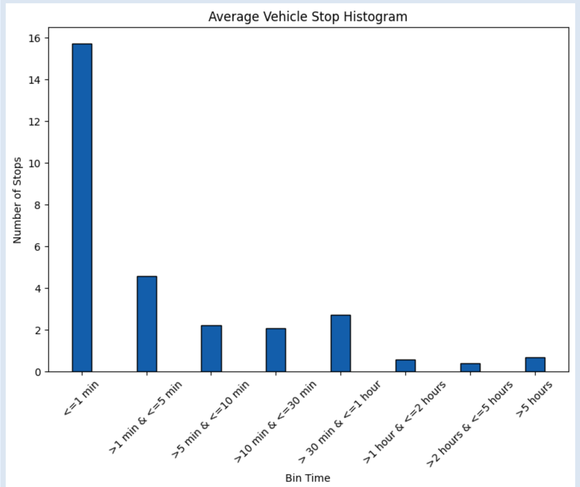

Figure 3 .

Histogram illustrating the percentage of time the vehicle remains stationary, organized by the total duration of each stop. The values shown correspond to the average number of stops with that duration during the analyzed time period.

Figure 4 (below) shows the speed plot for 4 consecutive days. We can see from the figure that for these four days, the truck had similar stop times with some small and reasonable shifts, and similar speed profiles for each trip in the day. It can be inferred that the truck had similar delivery schedules for these four days.

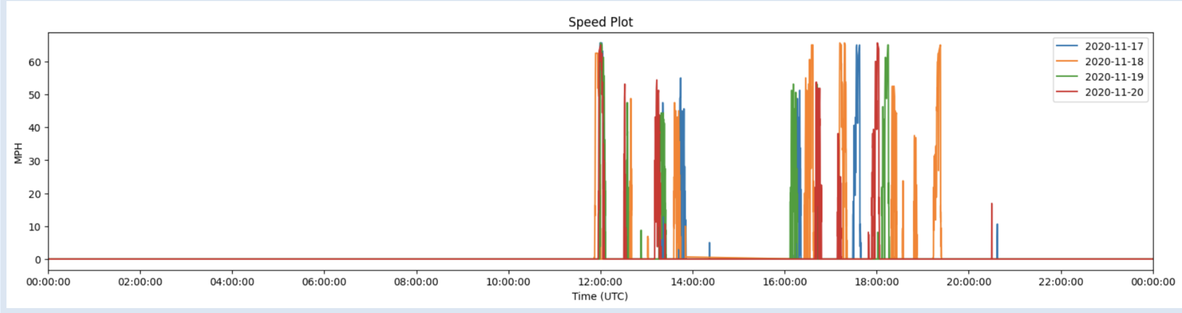

Figure 4 . Speed plot showing the driving speed of the truck in a day for multiple days of selection.

FUTURE GOALS

- Analyzing overnight dwell times for potential recharging opportunities.
- Implementing fuel verification checks during gas station stops.
- Assessing the flexibility of delivery schedules across varying time windows at the same locations.
- Identifying truck stop location type incorporating API information for monitoring purposes.

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