SALT LAKE CITY MOBILITY EXPLORER: VISUALIZING HOW THE CITY MOVES

(Shreesh, Minh Lee)

Final Project: DS 5630, University of Utah

(Project Milestone Version)

Group Member: Shreesh Srivastava and Minh Lee

Final Project Process Book:

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Introduction

Overview and Motivation

The *Salt Lake City Mobility Explorer* is an interactive web-based visualization that explores the daily rhythm of transportation across Salt Lake City. The project aims to make **traffic and transit data more understandable and engaging** for both citizens and planners.

The city's residents experience congestion daily, yet the underlying movement patterns - how roads and transit interact across hours of the day remain hidden in spreadsheets and static reports. This project transforms those datasets into an accessible, story-driven visualization.

The visualization answers questions such as:

- How do traffic volumes change over the course of a typical day?
- Where are the busiest roads and transit stations?
- How do traffic congestion and public-transit ridership correlate?

By connecting UDOT traffic sensors with UTA ridership data, the project highlights how the city *breathes* through its movement, pulsing with cars and trains during the morning rush and quieting in the evening calm.

Related Work and Questions We are Targeting:

The visualization draws inspiration from several notable sources:

“NYC Mobility Explorer” (NYC Open Data, 2021): A project that combined taxi and subway data to show daily commuting patterns. It inspired my integration of road and transit data into a unified map.

Udacity “Data Visualization” course projects: Demonstrated how narrative scrollytelling helps general audiences understand temporal data.

“Pulse of the City” (MIT Senseable Lab): Used mobile data to show urban activity rhythms which is an aesthetic inspiration for the “Transit Pulse” glowing animation.

Class examples: Fitts’ Law and Steering Law assignments reinforced perceptual principles such as color encoding, contrast, and motion for clarity.

These works emphasized storytelling and emotional engagement moving beyond static charts to make urban data feel alive.

Question:

At the proposal stage, I wanted to answer:

How do traffic volumes vary by hour and day?

Where are the busiest corridors?

How does transit ridership fluctuate during those times?

Evolving Questions

During exploration, new questions emerged:

Are there spatial correlations between congested roads and nearby transit stops?

Does weekend traffic differ significantly from weekdays?

Can we visualize mode switching opportunities, areas where heavy road congestion coincides with high transit activity?

These questions pushed the design from simple visualization toward comparative storytelling, requiring temporal and spatial integration.

Exploratory Data Analysis (EDA)

EDA helped shape the story and confirmed that the data held meaningful temporal patterns.

Traffic Patterns

- Plotted hourly traffic counts → clear peaks at **7–9 AM** and **4–6 PM**.
- Weekends showed flatter curves and lower volumes.
- Certain highways (I-15, State St) dominated traffic totals.

Transit Patterns

- TRAX ridership also peaked at **8 AM** and **5 PM**, mirroring roads.
- Bus ridership was more evenly distributed, showing broader use throughout the day.

Insights from EDA

1. Traffic and transit peaks align — strong commuter correlation.
2. Evening peaks lasted longer for roads than for transit.
3. Data coverage was sufficient for hourly animation.

These findings confirmed that **a temporal animation** would effectively tell the city's "mobility story."

(Insert sample Matplotlib/D3 line chart showing hourly peaks.

Design Evolution

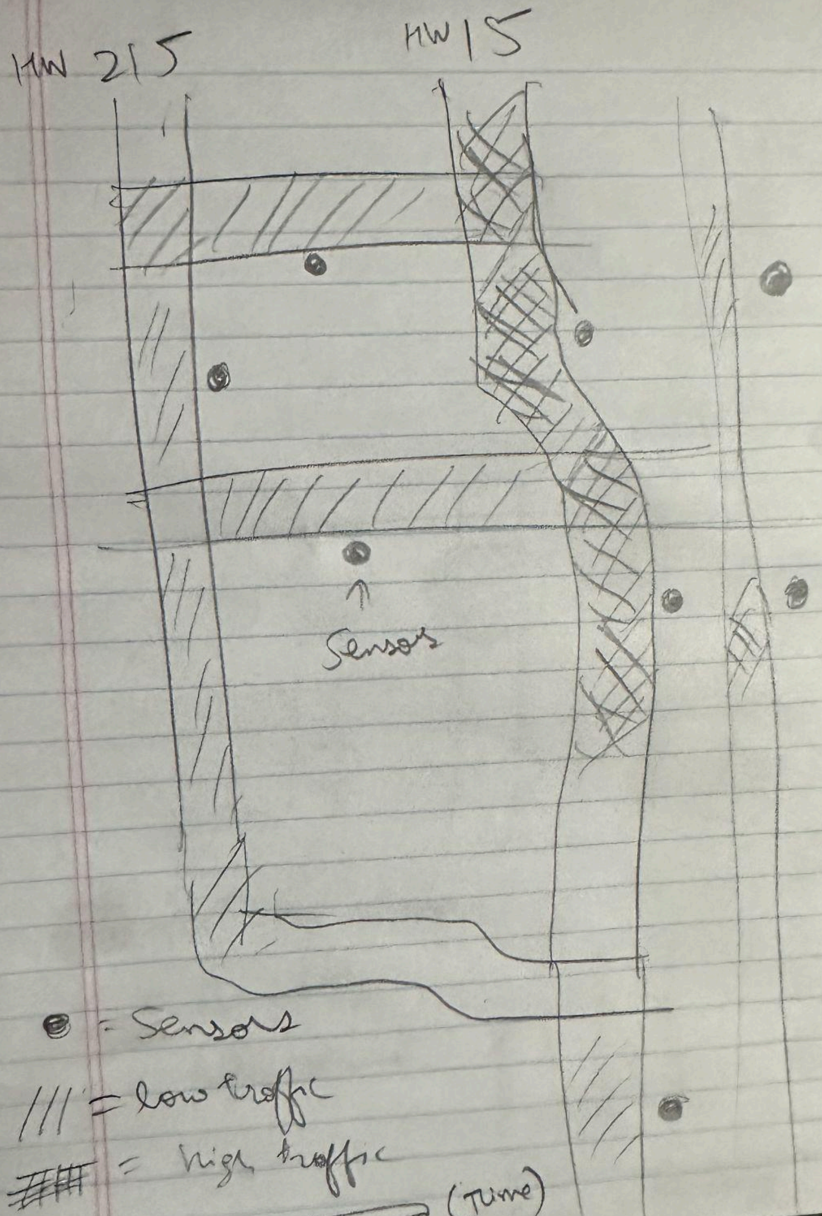
The design evolved through three main prototype stages, each addressing different perspectives of the same data.

Prototype 1 – “City in Motion” (Traffic Heatmap)

- Interactive map of Salt Lake City showing hourly vehicle volume.
- Color intensity represents congestion (light yellow → deep red).
- Time slider or playback animation to show the day’s rhythm.
- Tooltips with street names and hourly counts.
- **Goal:** Visualize the heartbeat of the city’s traffic.

This is the Prototype we decided on and combined elements from other 2 prototypes to produce the final version.

SKETCH-1



= Sensors

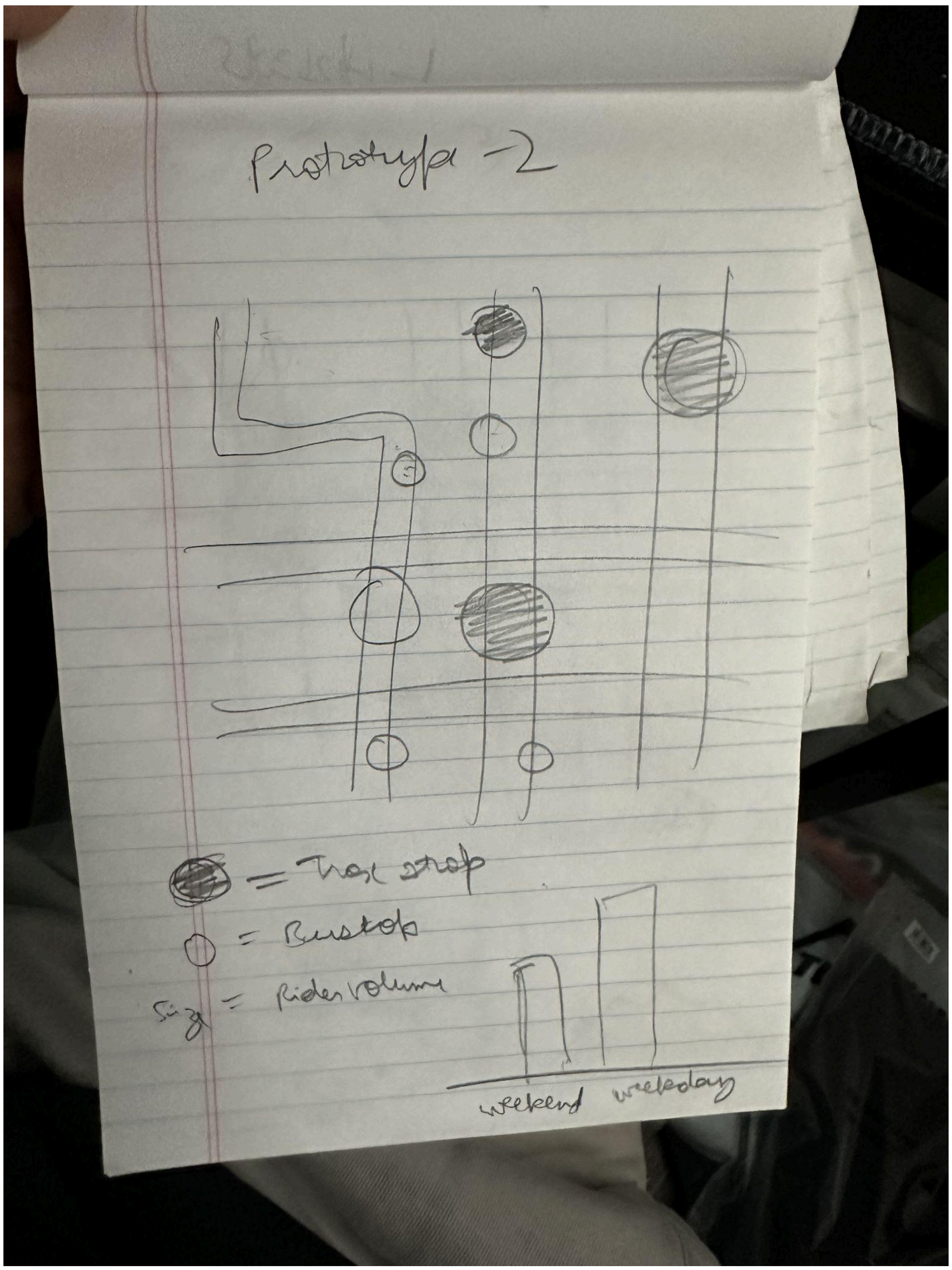
/// = low traffic

= high traffic

Slider → 3:20 pm (Time)

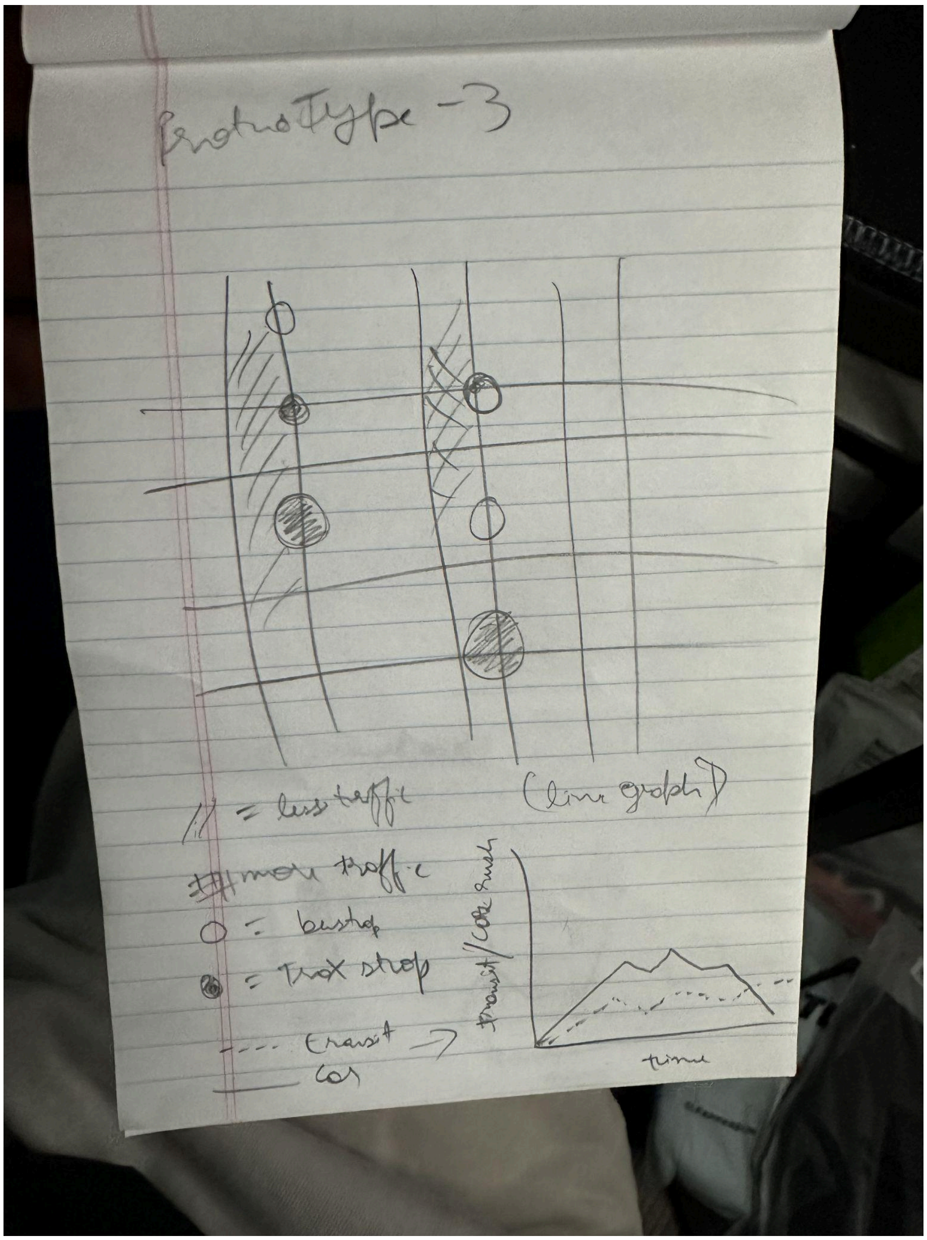
Prototype 2 – “Transit Pulse” (Ridership Map)

- TRAX stations and major bus stops are represented as glowing circles.
- Circle size = ridership volume; color = mode (TRAX, bus, FrontRunner).
- Pulse animation during peak hours.
- Side chart showing daily ridership trend.
- **Goal:** Show the dynamic activity of public transit throughout the day.



Prototype 3 – “Compare Your Commute” (Interactive Comparison)

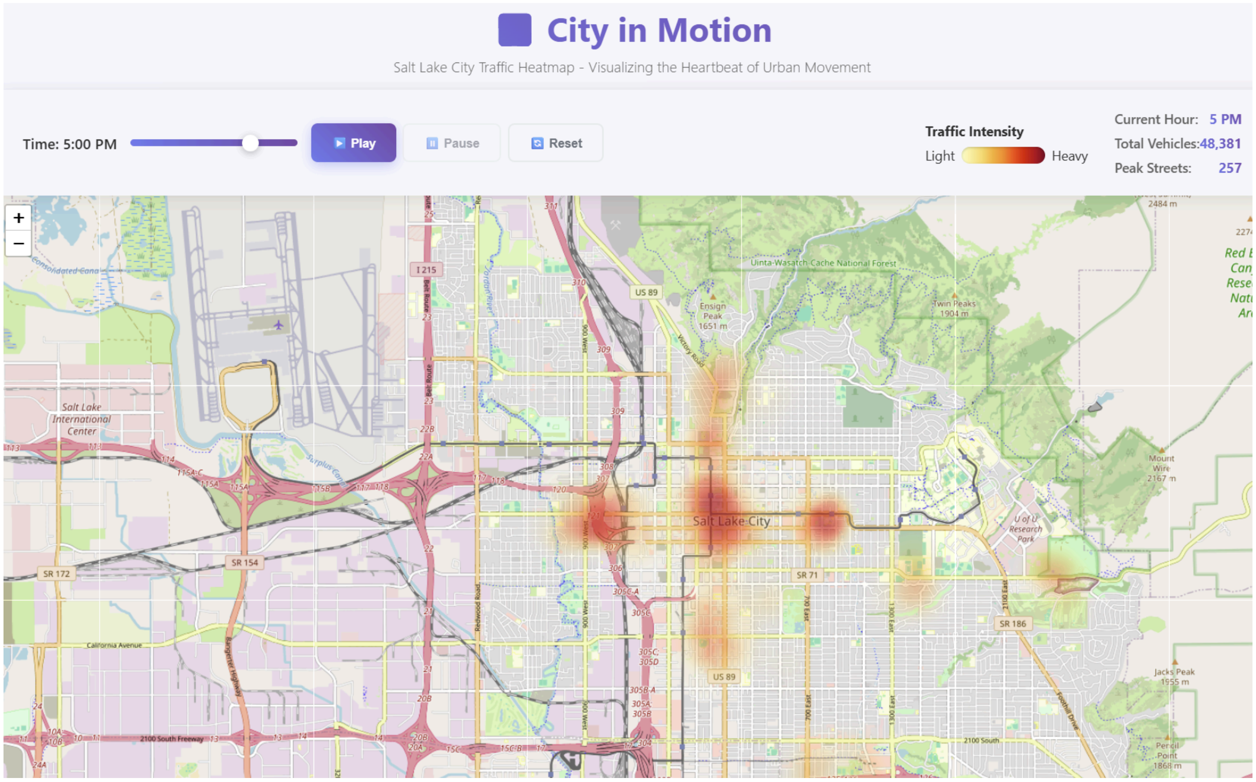
- Users select a neighborhood (Downtown, Sugar House, University area).
- Dashboard shows two linked charts: traffic vs. transit ridership over time.
- Clicking highlights related areas on the map.
- Labels like “Morning Rush,” “Midday Calm,” “Evening Commute” instead of raw timestamps.
- **Goal:** Let users explore how their commute fits into the city’s broader flow



Design Evolution Summary

Version	Focus	Key Change	Lesson
v1	Traffic Heatmap	Introduced animation	Needed spatial context
v2	Transit Pulse	Added second dataset	Needed comparison tool

Progression of our Prototype 1:



Iteration 1: Static Heatmap:
- Initial approach using simple color gradients
- Limitation: No temporal context, limited interactivity
- Learning: Users needed time-based exploration capabilities

Iteration 2: Time-Series Charts:
- Added temporal dimension with line charts
- Limitation: Lost spatial context, difficult to correlate patterns
- Learning: Geographic context is essential for urban data

Iteration 3: Interactive Map with Controls:
- Combined spatial and temporal visualization
- Success: Users could explore both dimensions simultaneously
- Enhancement: Added animation controls for better pattern recognition

Color Theory Application
Color Palette Selection:
- Light Yellow: Low intensity, non-threatening

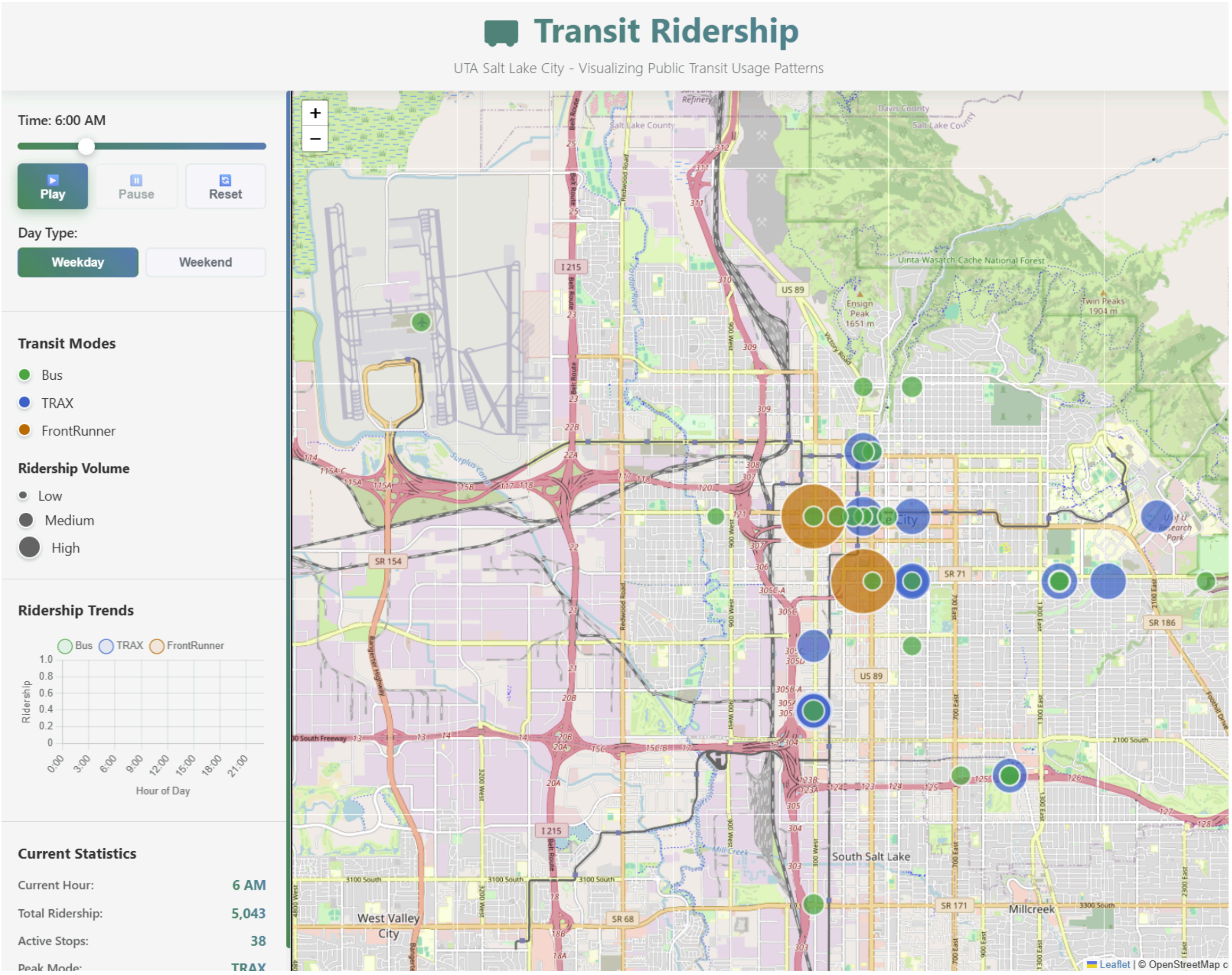
- Orange-Red: Medium intensity, attention-grabbing
- Deep Red: High intensity, urgent warning

Accessibility Considerations:
- Colorblind-friendly palette tested with simulation tools
- High contrast ratios maintained throughout gradient
- Alternative intensity indicators (size, opacity) considered

User Experience Design

Information Architecture:
- Primary: Map visualization (80% of screen real estate)
- Secondary: Time controls (top panel)
- Tertiary: Statistics and legend (side panel)

Progression of our Prototype 2:



Our initial concept focused on visualizing vehicular traffic patterns through a heatmap approach, which successfully demonstrated the "heartbeat" of urban movement. However, as we developed the first prototype, we realized that understanding urban mobility requires a more holistic perspective. Traffic congestion and public transit usage are deeply interconnected, when roads are congested, transit becomes more attractive, and vice versa. This insight led us to develop a second visualization focusing on UTA (Utah Transit Authority) ridership patterns using circle-based markers. Rather than creating separate tools, our final solution integrates the best elements from both prototypes: we adopted the interactive time controls and animation features from the traffic heatmap, while incorporating the circle-based visualization approach and multi-modal color coding from the transit prototype. The result is a unified visualization that combines heatmap-style temporal patterns with discrete point-based spatial data, allowing users to explore both traffic intensity and transit ridership within a single, cohesive interface. This integrated approach tells a complete story of urban mobility by showing how different transportation modes interact throughout the day, providing city planners and residents with comprehensive insights for transportation planning and policy decisions.

Implementation

Architecture

- **Frontend:** HTML, CSS, JavaScript.
- **Visualization Libraries:** D3.js for charts, Leaflet for map layers, and GeoJSON for data.
- **Data Preprocessing:** Python (Pandas, GeoPandas) aggregated and exported final files.
- **Hosting:** GitHub Pages for the public prototype.

Core Features

1. **Interactive Map:** Toggle between road and transit layers.
2. **Time Slider / Play Button:** Animate 12-hour cycles.
3. **Tooltips:** Display oad name with hourly volume.
4. **Mode Switch:** “Roads / Transit / Both.”
5. **Busiest Locations Panel:** Lists top 5 stations and roads dynamically.

Interaction Design

- Smooth transitions maintain spatial orientation (Gestalt continuity).

- Limited color range to avoid perceptual overload.
- Responsive layout for smaller screens.

Evaluation

Data Insights

- **Traffic and transit share synchronized peaks** — both surge around standard work hours.
- **Transit hubs like Courthouse and City Center TRAX** align with high nearby traffic — suggesting multimodal congestion zones.
- **Weekend traffic drops**, while ridership remains moderately consistent indicating recreational or leisure trips sustain transit demand.

Effectiveness

The visualization effectively communicates movement trends through motion and color.
However, improvements could include:

- Real-time feeds for current conditions.
- Additional demographic overlays (population, workplaces).
- A mobile-optimized vertical layout.