VDOT Anomaly Detection Capstone

6 DECEMBER 2024

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Purpose & Background

"This project aims to analyze connected vehicle trajectory data from SmarterRoads, RITIS, and the Virginia Department of Transportation (VDOT) to identify anomalies in roadway networks, focusing on the Staunton, Virginia region. Using machine learning-based techniques, the project will investigate shifts in traffic patterns caused by the installation of new detour signs. By detecting deviations from normal traffic behavior, the project seeks to minimize disruptions and reduce the number of trucks entering city areas due to detours."

Data

- **Data Sources:** SmarterRoads.org, INRIX, TMC & XD Road Segments, Probe Speed Dataset, NPMRDS
- **Target Variable:** Detection of traffic anomalies
- **Potential Predictor Variables:** Traffic volume, average (mean) and median vehicle speeds, vehicle type, time of day, day of the week, weather conditions, etc.

Return to Purpose & Background

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Project Plan

identify anomalies in roadway networks, focusing on the Staunton, Virginia region

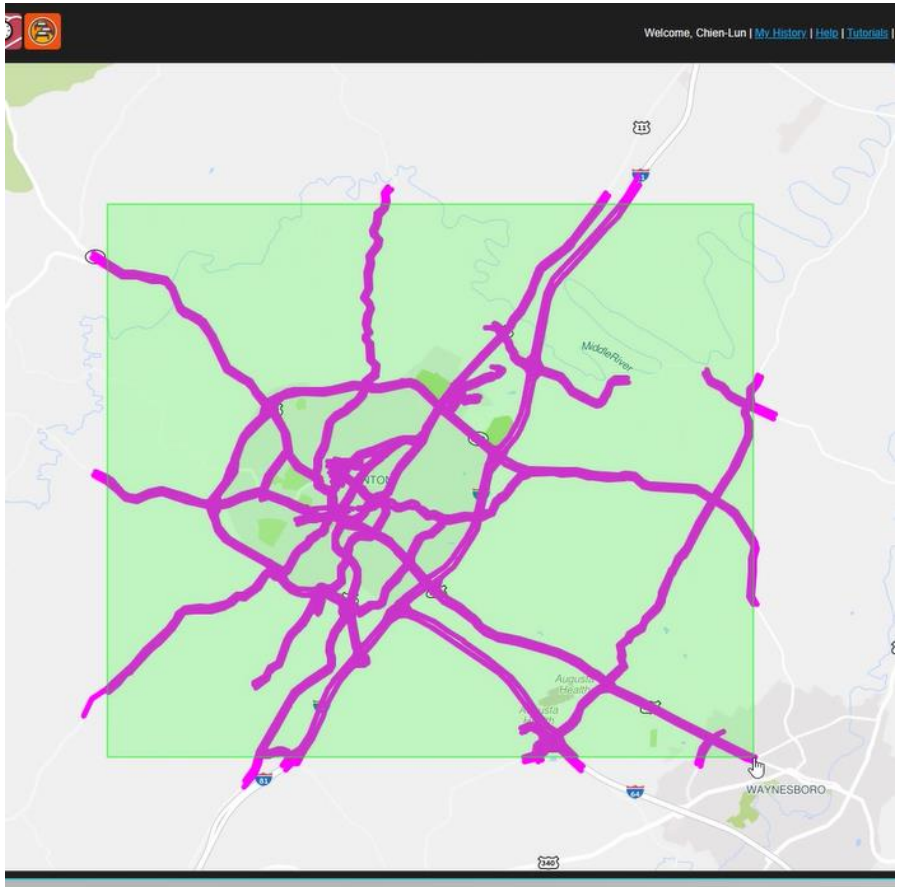
investigate shifts in traffic patterns caused by the installation of new detour signs

detecting deviations from normal traffic behavior

minimize disruptions and reduce the number of trucks entering city areas due to detours

Project Plan

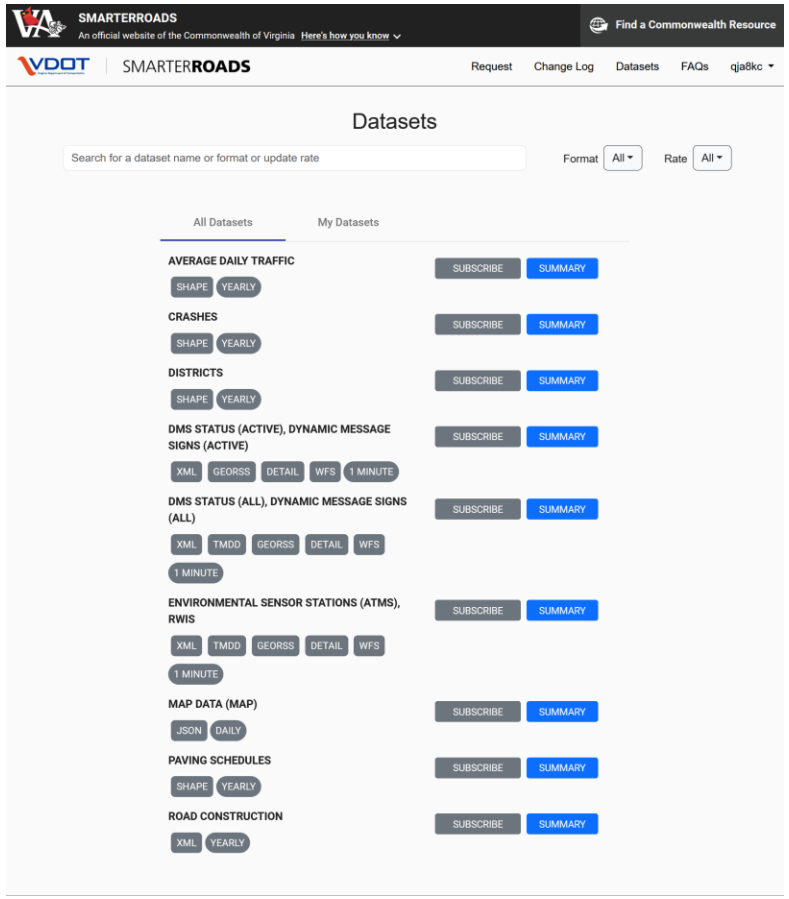
- Data Collection
  - Historic Traffic Volume, Vehicle Count and Speed Stations
  - Detour Sign Locations
  - Anomalies (Crashes, Detours)
- Establish Normal Traffic Behavior
  - Understand Flow Dynamics and Influencers
- Spatiotemporal Modeling for Deviation
  - Spatiotemporal Graph Neural Networks (ST-GNNs)
  - Validation on Previous Anomaly Data



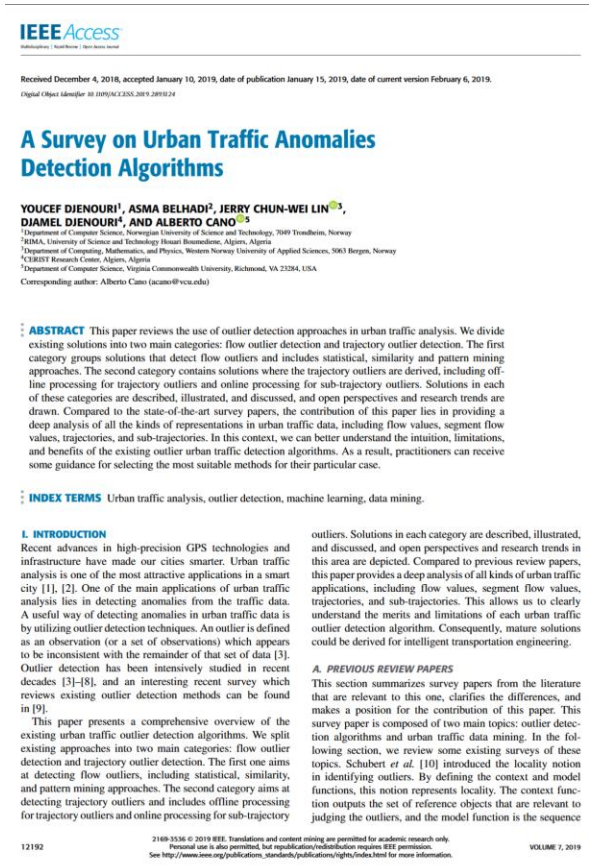
Map of Staunton, Virginia with roads in bold.

Background Material

- *SmarterRoads, INRIX, TMC, XD*
- *Probe speed dataset*
- *NPMRDS National Performance Measure Research Dataset*
- *Virginia Transportation Research Council. (2024). Leveraging connected vehicle trajectory data to improve roadway networks:*
- *Song, J., Zhang, Y., & Cui, Z. (2021). Traffic anomaly detection: A review of methods and applications. Transportation Research Part C: Emerging Technologies, 129, 103211.*
- *Liu, L., & Wang, J. (2019). An outlier detection approach based on improved self-organizing feature map clustering algorithm. ResearchGate.*
- *Djenouri, Y., Belhadi, A., Lin, J., Djenouri, D., & Cano, A. (2019). A Survey on Urban Traffic Anomalies Detection Algorithms. IEEE.*



https://smarterroads.org/



A Survey on Urban Traffic Anomalies Detection Algorithms

Potential Concerns

- Data Access
  - Staunton controls its roads, not the VDOT
  - Licensing to VDOT Sources
- Possible Rescopes
  - Limit scope to detour route data, no city data
  - Model for historic anomaly detection rather than real-time