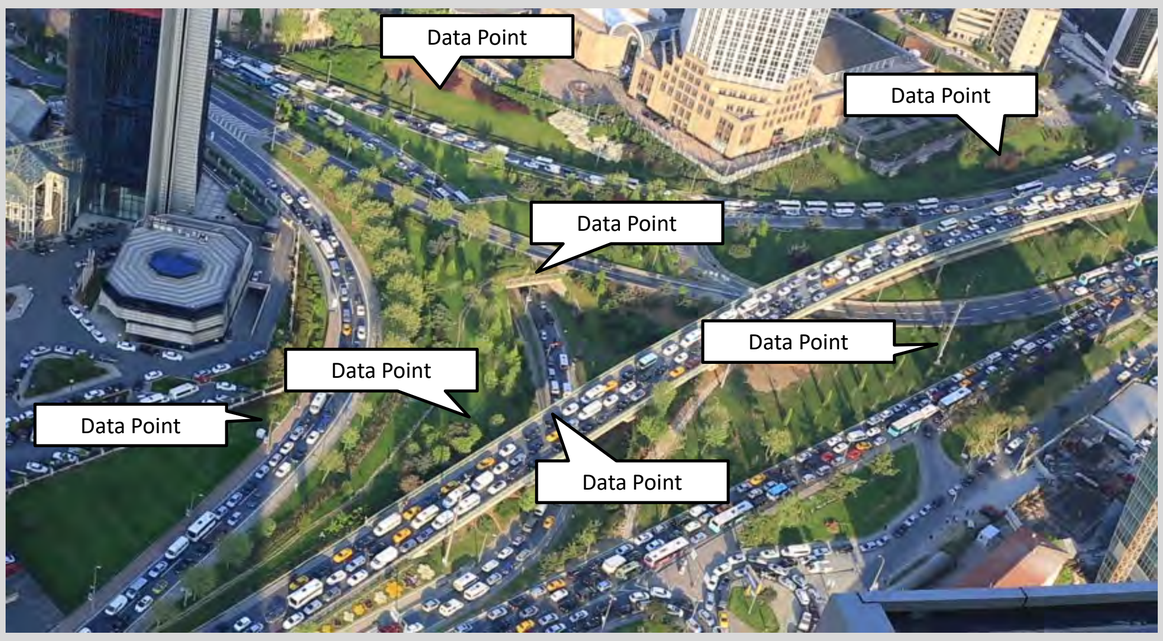
Highway Back-of-Queue in-Vehicle Alerting System Based on Probe Vehicle Data

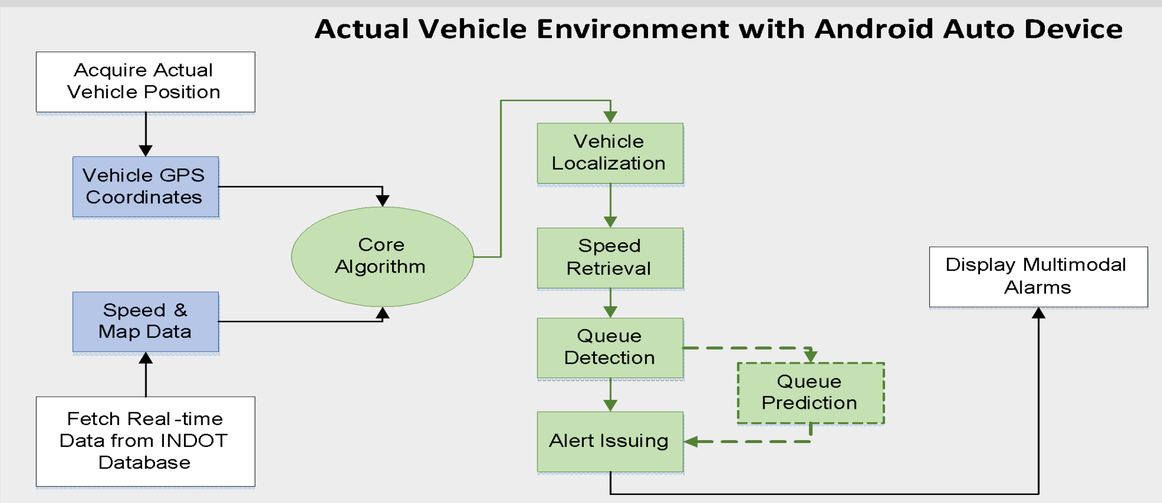
Yaobin Chen, Lingxi Li, Feng Li, Renran Tian, Keyu Ruan, Dan Shen, Zahra Yarmand

Problem Statement

- Highway congestions cause a much higher crash rate compared to uncongested driving conditions. Advanced driver assistance systems (ADAS) may cause increased driver inattention that delays driver response during highway cruising. Published studies show that end-of-queue alerting systems can potentially improve safety in this scenario.
- Using probe vehicle data, INDOT is able to monitor highway congestions, estimate queue locations and queue length. However, there is no effective method available now to inform on-road drivers approaching highway queues.



Overall Project Plan



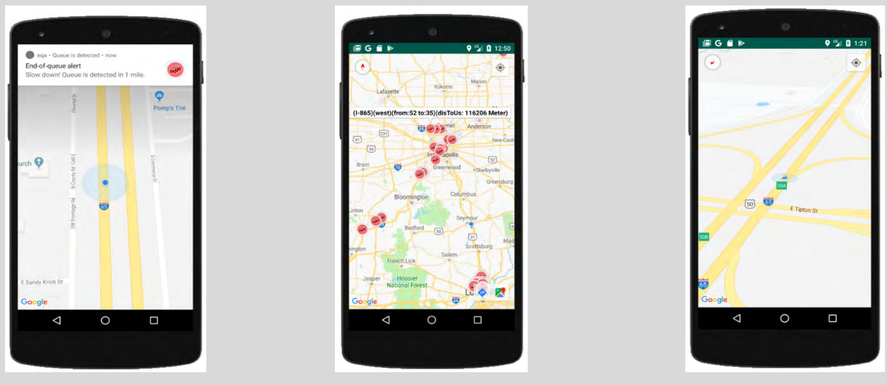
Tasks Accomplished

Task 1 Probe Vehicle Queue Data Acquisition

- Fetched real-time probe vehicle data from INDOT web service.
- Used Google API for traffic visualization and road name detection.
- Developed related software programs and algorithms.

Task 2 Investigation of Feasible End-of Queue Alerting Solutions

- On-board alerting device (e.g., Android Auto).
- Android App: Developed in PC in the simulated Android environment
- Message carrier: 4G/LTE network.
- Smartphone GPS data are used to obtain the real vehicle GPS locations.



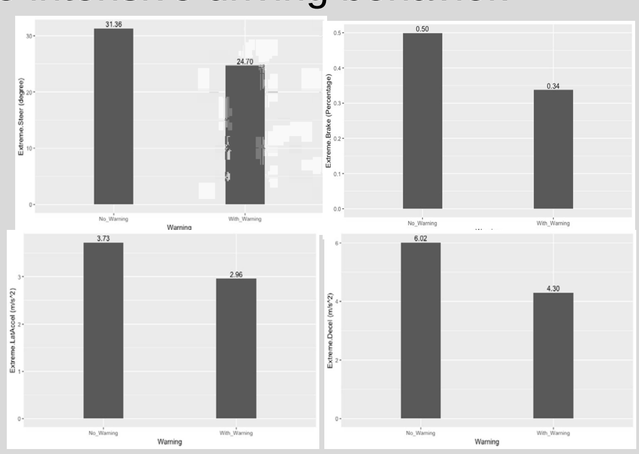
Tasks Accomplished

Task 3 Hardware/Software Implementation for Pilot Alerting Systems

- Set up Android Auto device.
- Established connections between Android phone and Android Auto device.
- Implemented alerting functions on Android Auto device.
- Integrated functions on Android app with Android Auto device.

Task 4 Evaluation of the Pilot Alerting System in the Driving Simulator

- Built Modules for connection and communication.
- Built the test scenarios using the driving simulator.
- Designed the detailed procedure for data collection.
- From subject testing, the results indicated that this alerting system can overall reduce intensive driving behavior.



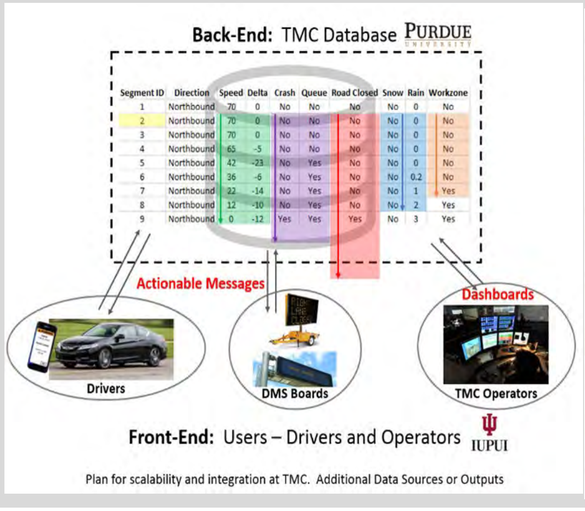
Task 5 Evaluation of Refined Pilot Alerting Systems with Limited Road Testing

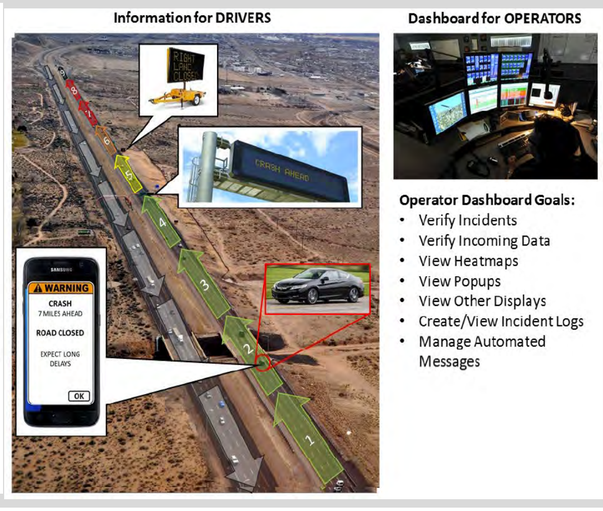
- Tested the App on different highways where a delta-speed event was detected.
- In about 80% of all cases, the alerts were delivered successfully.

Detailed Future Research Plan

An Integrated Critical Information Delivery Platform for Smart Segment Dissemination to Road Users

- Identify and establish computing resource needs
- Develop interstate and state route milepost database and integrated mapping platform
- Integrate identified data sources
- Develop use cases and user interface
- HMI evaluation: Unit test
- Develop message delivery and prioritization platform
- Update TMC dashboards and systems with new mapping platform
- Develop an in-vehicle message delivery system
- Testing and verification of the information delivery systems





IUPUI
SCHOOL OF ENGINEERING AND TECHNOLOGY
INDIANA UNIVERSITY–PURDUE UNIVERSITY
Indianapolis

TASI Transportation & Autonomous Systems Institute