Joint Transportation Research Program

Principal Investigators: Lingxi Li, Indiana University-Purdue University Indianapolis, LL7@iupui.edu, 317.274.3643
Yaobin Chen, Indiana University-Purdue University Indianapolis, ychen@iupui.edu, 317.274.4032
Renran Tian, Indiana University-Purdue University Indianapolis, rtian@iupui.edu, 317.278.8717
Feng Li, Indiana University-Purdue University Indianapolis, fengli@iupui.edu, 317.278.8391

Program Office: jtrp@purdue.edu, 765.494.6508, www.purdue.edu/jtrp
Sponsor: Indiana Department of Transportation, 765.463.1521

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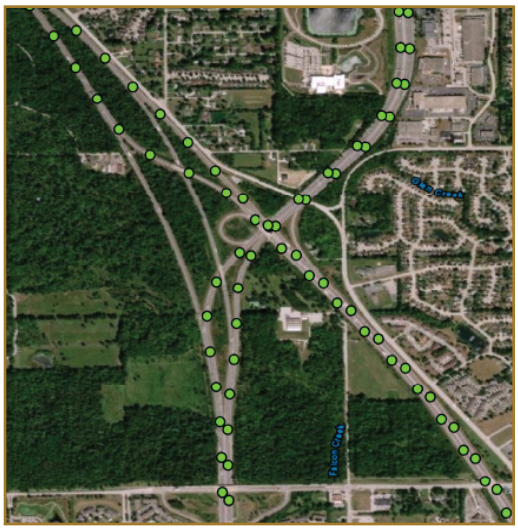
An Integrated Critical Information Delivery Platform for Smart Segment Dissemination to Road Users

Introduction

As more datasets have been made available to transportation industry practitioners that contain increasing volumes, varieties, and frequencies, a consistent mapping scheme has become necessary for the efficient uptake, transformation, and integration of this data into existing data systems and business processes. A streamlined process can quickly turn massive amounts of data into critical information delivered to stakeholders and motorists in real-time with potentially life-saving impact (Li et al., 2015).

Commonly-occurring use cases in Indiana are secondary crash incidents that significantly impact the safety of road users. Locations with stopped queues have an increased crash factor of up to twenty-four times more than when there were no queues (Mekker et al., 2020). Recent innovations in back-of-queue detection using crowdsourced connected vehicle (CV) data, paired with statewide road status information and weather data, have allowed practitioners to monitor highway traffic conditions and respond based on the information. However, it's been a major challenge to consolidate an evolving assemblage of data sources so that user interface points—e.g., overhead and portable dynamic message sign (DMS) boards, traffic management applications, traffic information systems, mobile phones, and vehicle infotainment systems— can receive this data effectively and consistently without frequent reengineering due to changes in the underlying data sources. This project developed an information delivery platform that consistently segments data statewide to integrate and consume, generate, prioritize, and send alert messages based on the synthesis of underlying sources with the developed heuristics.

Testing of stationary field alert device using developed geodatabase of 0.1-mile reference points.



Mapping of 0.1-mile reference points along segments of interstate using GIS tool.

Methodology

The research team collaborated with INDOT Traffic Management Center (TMC) colleagues to inventory and consolidate existing data resources for this project. By combining resources with new techniques and applications, a statewide baseline milepost geodatabase, dubbed “smart segment,” was developed. A real-time web application programming interface (API) was created to deliver roadway milepost and direction, speed, road status, and weather information to a requestor after a set of latitude and longitude points were provided. The message delivery system was developed and tested with both Android-based and iOS-based smartphone applications in the field. In addition, a driving simulator was employed to test the effects of the system on human drivers in the virtual environment.

The smart segment platform was implemented in both new and existing web dashboards to align sources of data to Indiana roads. Figure 1.1 in the report shows the heatmap dashboard with trajectory traces of CV data linear referenced using the smart segment platform during a 12-mile queuing event on July 14, 2021. The orange, red, and pink areas are locations of slowdowns that visually allow operators to assess roadway conditions as an incident unfolded.

The human-machine interface (HMI) simulator, developed to test the back-of-queue warning system for smartphones, provided a safe and flexible environment for user evaluations on the developed applications and to document driver responses to roadway incidents without exposing drivers to real-world dangers. The results of the tests provided quantifiable data for implementations that were developed and deployed in parallel, such as the ongoing Protect the Queue efforts in Indiana (INDOT, n.d.a). Figure 1.2 in the report shows an example of a virtual vehicle and a field-deployed vehicle for queue alerting.

Findings

The findings of this research were as follows.

1. The team successfully developed a smart segment geodatabase platform that consistently provides route, direction, and mileposts statewide for efficiently integrating existing and future data sources.
2. The team successfully developed an API for quickly processing GPS location information along sections of roadway that can be used by external systems for decision-making and information dissemination.
3. The team successfully developed three new web dashboards, one new data service, two smart phone applications, and updated two legacy applications for traffic operations and information dissemination use.
4. The team evaluated the performance of the integrated platform using both the driving simulator and on-road tests.

Implementation Recommendations

Near- and medium-term recommendations are as follows.

1. Near-term (6–18 months)
   - Integration with winter weather operations.
   - Integration with workzone operations.
   - Distribution of the smartphone apps to the selected group of users.
2. Long-term (18 months or longer)
   - Integration of the developed smartphone apps with the existing INDOT app.
   - Assessing roadway maintenance needs.
   - Institutionalizing geodatabase for future mapping needs

Recommended Citation for Report

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