Analysis of Dynamic Advisory Messaging – Phase II

tech transfer summary

A newly designed dynamic advisory messaging system is a good starting point toward using sensor data to provide critical messages to the traveling public, particularly during winter weather conditions.

August 2018

RESEARCH PROJECT TITLE
Analysis of Dynamic Advisory Messaging – Phase II

SPONSORS
Iowa Statewide Transportation Innovation Council
Iowa Department of Transportation
(InTrans Project 16-591)

PRINCIPAL INVESTIGATOR
Skylar Knickerbocker, Research Engineer
Center for Transportation Research and Education, Iowa State University
515-294-7916 / sknick@iastate.edu
(orcid.org/0000-0002-0202-5872)

MORE INFORMATION
intrans.iastate.edu

Problem Statement

Dynamic message signs along the interstate system can provide critical messages to the traveling public, and they need to be displayed in a timely manner, particularly during winter weather events. With traffic management center operators manually inputting the messages, the timeliness of the alerts may be delayed, which reduces the effectiveness of alerting travelers to changes in road conditions.

Solution

The deployment of a dynamic system that can automatically generate messages based on sensor data and thresholds that are tied to outgoing message sets has the potential to more quickly advise the traveling public of deteriorating roadway conditions and prevent sudden lane departures, braking, and crashes.

Goal

The goal of the Phase II project was to contrast sensor-driven messages (dynamically derived), based on an algorithm developed in Phase I, with measurements of both traveling vehicle speed and roadway friction data under various winter weather conditions.

Background

This project was a continuation of the Phase I project that supported the Iowa Department of Transportation's (DOT's) desire to explore how a dynamic advisory system might work with their Intelligent Transportation Systems (ITS) platform through data obtained for a segment of I-35 between the Huxley and Ankeny, Iowa.

In Phase I, the research team developed and implemented a condition-based dynamic advisory messaging system that could be used to alert motorists of slow traffic during winter weather conditions. Friction data were also evaluated as an additional input for advisory messaging and compared to the speed-based algorithm that was developed.

The performance of the system was evaluated in simulation for multiple winter weather events over the course of two winter seasons. Due to existing policies, the dynamic system was not activated for the public; therefore, no evaluation under live conditions was possible.

CTRE
Iowa State University
2711 S. Loop Drive, Suite 4700
Ames, IA 50010-8664
515-294-8103

The mission of the Center for Transportation Research and Education (CTRE) at Iowa State University is to develop and implement innovative methods, materials, and technologies for improving transportation efficiency, safety, reliability, and sustainability while improving the learning environment of students, faculty, and staff in transportation-related fields.

IOWA STATE UNIVERSITY
Institute for Transportation

ITSP-VSLP-(015)--90-00

Project Description

The real-time dynamic advisory application launched in fall 2016. The research team reviewed all events for two winter seasons (2016/2017 and 2017/2018) to validate the accuracy of the system. The study consisted of the corridor of southbound I-35 between Huxley and Ankeny with four Wavetronix sensors installed and associated with four virtual simulated dynamic message sign (DMS) display boards.

The research team parsed the raw data from the sensors, and then extracted the traffic speed and occupancy data, before applying a wavelet filter to de-noise the sensor data. A supervised learning algorithm decision tree was trained to find the underlying function (experts' engineering judgment) that mapped the new incoming sensor data (speed and occupancy) to a desired advised speed limit.

To validate the accuracy of the real-time implementation, the team compared the generated dynamic messages with multiple data sources, including the roadway weather information sensor (surface friction), TransSuite Traveler Information System (TIS) internal message logging report, roadway cameras, and Wavetronix speed sensor profiles. However, these data sources were not available for all sites or events.

Vehicle speed data were collected through a feed from the DOT ITS network on a 20-second frequency. For this analysis, friction data were obtained from the DOT's Office of Maintenance after each winter event. The frequency of data from the friction sensors range from 1 minute to 10 minutes but typically was reported every 5 minutes.

Key Findings

- The newly designed DMS display logic system showed significant improvement over the existing system and its accuracy was verified using multiple data sources, including surface friction, video camera, and TIS historical messaging reporting.
- The dynamic advisory messaging system performed as desired by alerting travelers of deteriorating conditions during severe events. The system also had the ability to identify other sources of traffic impacts outside of winter weather conditions. This allowed for a responsive system that could notify travelers of slow speeds for any incidents on the roadway.
- During light snow events, with minimal impacts to speed, the system did not activate even though speeds were lower than typically observed. Advisory speeds may not be the most applicable during these conditions as opposed to providing advisory messaging such as "slow speeds ahead" and "traffic delays," which may be preferred.
- Both the speed and friction sensors responded to the winter weather events. However, the speed and friction data sources are not on equal footing. The speed data (accessible on the ITS network and available every 20 seconds) are of superior fidelity to the friction data (which are not on the ITS network and are reported every 5 minutes). Contrasting these two potential data streams as a method to drive dynamic messages should correct for this bias.

Implementation Readiness and Benefits

This effort served as a good starting point toward considering these data streams for dynamic advisory messages and their capability to enhance traveler information during critical travel times.

- Friction data has the potential to enhance the advisory messaging system but, overall, performed similar to the traffic data that are already being collected. The friction data are also currently limited by collection frequency, but, in the future, friction sensors could be used in specific locations to provide additional inputs to the advisory messaging system.
- The system developed could be further modified to produce advisory messages (e.g., "slow traffic," "traffic delays"), which may be more suitable for use in a variety of conditions including winter weather. The benefits of the current system design is the applicability to other situations such as work zones or other non-recurring traffic conditions.
- The system should continue to be improved by incorporating additional data inputs such as probe speed data, weather data, and friction data. The current system will continue to be tested and implemented by the Iowa DOT (specifically related to work zones).

While the Iowa DOT does not currently have policies in place to activate this type of dynamic system, a research methodology for this project's test section of I-35 is in place when implementation becomes possible.