Cloud Based Dynamic Warning System

National Rural ITS Conference 2018

Brad Wentz, P.E.
Mohammad Smadi

Advanced Traffic Analysis Center
Upper Great Plains Transportation Institute
North Dakota State University
About UGPTI

• The Upper Great Plains Transportation Institute is a research and education center at North Dakota State University.
• Mission: Providing innovative transportation research, education, and outreach that promote the safe and efficient movement of people and goods.
• The institute has centers working on various transportation areas including traffic; transit; safety and security; and freight and logistics.
research
Enhancing rural & small urban mobility for people & goods

education
Building tomorrow's transportation professionals

outreach
Putting research to work through relationships
“The mission of the LRRB is to serve local road practitioners through the development of new initiatives, the acquisition and application of new knowledge, and the exploration and implementation of new technologies.”

Partners: MnDOT, Otter Tail and Pope counties, MN
Synopsis

• Emulate a connected vehicle environment by utilizing a smartphone application to deliver dynamic, speed-based, directional warnings at locations in an online database.
The Problem

- Vehicles entering horizontal curves at speeds that may be too high for safe travel
- >25% of fatal crashes
- Crash rate 3X of other highway segments
- Vehicles with features such as adaptive cruise control and access to curve warnings
Existing Solutions

- Static Warning Signs
- Dynamic Warning Signs
Dynamic Systems

- Consist of a detection component, and a warning component, in addition to power and communications
- Cost: roughly $14,000
- Limited to high-crash locations
  - $\geq 10$ crashes in a 24 month period and $\geq 7$ crashes in a 12 month period
  - Research: dynamic systems are more effective at reducing vehicle speeds
Goals

• Expand safety improvement potential of dynamic CSW system-wide to all reduced speed curves
• No infrastructure investment
• Provide cloud database maintained by agency in charge of roadway
• Warning database flexibility for additional warning situations
System Overview
Warning Database

- Managed through an online tool created at UGPTI: Geographic Roadway Inventory Tool (GRIT)
- GRIT is a web application that allows agencies to manage an inventory of their transportation assets
- A layer within the application was created for managing speed warning locations
Warning Locations - Otter Tail CO
Dynamic Warning

Geographic Location
46.2583800,-95.9889500

Advisory Type
Curve Warning

Advisory Speed
45

Highway Legal Speed
55

Sign Facing Direction
N

Enabled
Warning Application

• Android smartphone app utilizing Google Maps API
• The app captures location, heading, and speed data from the phone (GPS) which are checked against the warning database
• The app pulls warning locations within a 20 mile radius with a 15 minute refresh to handle large volumes of data
Warning Application

• The app applies geo-fencing technologies to determine when a vehicle enters a warning location.
• The warnings are directional based on sign facing.
• Warning levels:
  – The initial warning is a caution for approaching a curve.
  – If speed is not reduced, an audible warning is applied.
Warning Application

- Curve Approaching: 45 MPH
- Curve Approaching: 45 MPH
- SLOW DOWN: 45 MPH
- 44 MPH
- 47 MPH
- 51 MPH
Testing

- Ottertail County Road 33 – 15 CSW signs
- Drove 4 times each direction at varying speeds
- Results:
  - 100% accuracy picking up CSW sign
  - 100% accuracy in providing the audible warning only when warranted
Expanded Benefits

• Ob-board dynamic warning systems can be used for other situations requiring reduced travel speed:
  – Bumps and cracks (seasonal changes)
  – Maintenance and construction activities
  – Special events
Questions?

Brad Wentz
bradley.wentz@ndsu.edu

Mohammad Smadi
m.smadi@ndsu.edu