Rural ITS Safety Solution Systems (RITSS)

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Thomas A. Sohrweide, PE, PTOE
SEH Inc.
Problem

  - 455 fatalities down from 510 in 2007
  - 33,379 injuries down from 35,318 in 2007
  - Rural areas account for 2 out of 3 fatalities
  - 1/3 involve single vehicle
  - 2/3 involve 2 or more vehicles
  - 2008 crashes cost Minnesota $1.5 billion
Underlying Causes

- In Single Vehicle Crashes
  - Illegal or *unsafe speed* contributing factor most often cited for all drivers

- In Multiple Vehicle Crashes
  - For drivers through age 64 *driver inattention* or distraction most often cited
    - *Failure to yield* second most common

- Over Age 65 Pattern Reverses
  - *Failure to yield* most common
  - *Driver inattention* or distraction second most common
Driving Conditions

• Most Crashes Occur in Good Driving Conditions
  □ 54% of fatal and 2/3 of nonfatal occur during daylight hours
  □ Good Weather Conditions
    • 61% of fatal and 56% of nonfatal Ò clear Ô weather
  □ Road Surface Condition for Fatal Crashes
    • Usually Ò good Ô
    • 10% on wet roads
    • 15% on snowy or icy roads
  □ Road Surface Condition for Nonfatal Crashes
    • 60% of nonfatal on dry roads
    • 13% on wet roads
    • 25% on snowy or icy roads
Literature Search

• Discovered considerable research
• Found few off-the-shelf products available
• Found nothing to address
  □ low-volume dynamic rural intersection warning systems
  □ dynamic lane departure warning systems specifically relating to horizontal curves
Goal

To develop low-cost, readily deployable, low maintenance systems that can be used to improve safety on rural roadways.
RITSS

- Driver Behavior Evaluation System (DBES)
- Stop Sign Warning System (SSWS)
- Curve Warning System (CWS)
Project Inception

• Mn/DOT Innovative Ideas Program
• SEH
• Network Transportation Technologies, LLC (NTT)
• Mn/DOT ☐ TST
• Mn/DOT Metro District
• US DOT - FHWA
• Minnesota Counties
  ☑ Freeborn County
  ☑ Hennepin County
  ☑ McLeod County
  ☑ Olmsted County
  ☑ Otter Tail County
  ☑ Washington County
  ☑ Wright County
• SEH / NTT
• Independent Evaluation Consultant (Iteris)
Project Deliverables

- Concept of Operations
- System Requirements
- System Design
- Experimental Waiver
- Laboratory Test
- Field Operational Test
Innovation

- Merits of dynamic warning systems
- Moving from research to reality
- Leveraged work on *Intersection Warning System (2007 Mn/DOT Innovative Ideas Program Project)*
- Off-the-shelf components
- Solar-powered with battery backup
- Modular design
- Ease of installation and maintenance
- Relative low-cost
System Configurations

Detection Node

Warning Node
Driver Behavior Evaluation System
Concept

• Need to know exactly what the problem is:
  □ System to provide reliable data
  □ Driver behavior underlying the problem
  □ At rural intersection stop signs
    • Behavior of driver approaching stop sign
    • Behavior of driver on through road
    • Speed profiles
  □ At horizontal curve
    • Behavior of driver approaching curve
    • Speed profile
Driver Behavior Evaluation System

• Hardware
  □ Doppler radar
  □ GPS receiver
  □ Data logger
  □ Battery powered with life of 3 weeks
  □ Up to 4 devices to cover 4-way intersection
  □ Single device to cover each approach to a curve

• Software
  □ Analysis and reporting strategies
Driver Behavior Evaluation System
Olmsted County, MN
TH 42/CSAH 9
Driver Behavior Evaluation System Data

Preliminary Data taken from DBES in Wright County
Stop Sign Warning System Concept

- Radar-based detection to monitor speed profile of vehicle approaching a stop sign
- Provide a flashing warning of the stop based on speed
  - Within normal stop profile: No warning
  - Excessive speed detected: Flashing lights to alert driver
Stop Sign Warning System

- **Hardware**
  - Doppler radar
  - Wireless link
  - Controller
  - Flasher stop sign
  - Fault notification

- **Software**
  - Speed/distance data algorithm to set parameters
  - Determine spatial position of the vehicle
  - Activate flashers

On-Site Fault Notification Device
Stop Sign Warning System Design

- Deceleration Rate $= 14.8 \text{ ft/s}^2$
- Maximum Approach Speed Design $= 80 \text{ mph}$
- Duration of Flash $= \text{Detection Speed} / 14.8 \text{ ft/s}^2$
- Enhance Border of Near Right Stop Sign
Stop Sign Warning System
Washington County, MN
CR 64 (McKusik Rd)/ CSAH 15 (Manning Ave)
Stop Sign Warning System
Washington County, MN
CR 64 (McKusik Rd)/ CSAH 15 (Manning Ave)
Curve Warning System
Concept

- Radar-based detection to monitor speed profile of vehicle approaching a horizontal curve
- Provide a flashing warning of the curve ahead based on speed
  - Within normal stop profile: No warning
  - Excessive speed detected: Flashing lights to alert driver
Curve Warning System
Line of Sight
Curve Warning System
Wright County, MN
CSAH 37
Curve Warning System
Wright County, MN
CSAH 37
Curve Warning System Design

- Deceleration Rate = 14.8 ft/s²
- Design for Curve Entry Speed = 47 mph
- Maximum Approach Speed Design = 75 mph
- Enhance Chevron Signs 3, 4, and 5
- Duration of Flash = 4 seconds from curve entry (50 mph to Sign 5 from Curve Entry)
Evaluation Test Plans

- Safety Impacts
- Owner Satisfaction
- User Perception
- Performance
• Laboratory tests are currently underway
  □ April 22 - 23 - Place DBES units at Hennepin County Lab Test sites to gather data and in preparation for Lab Test
  □ April 28 - Based on data collected, finalize algorithm for tests
  □ April 29 - 30 - Install CWS at Hennepin County Lab Test site
  □ May 5 - Install SSWS at Washington County Lab Test site
  □ May 13 - PMT Lab Test Review
Questions?

Tom Sohrweide
SEH Inc.
651.490.2072
tsohrweide@sehinc.com