Potential Approaches for Wrong-Way Driving Applications

Background

Wrong-way driving is a growing concern on roadways, especially because resulting crashes tend to be severe and often result in fatalities and serious injuries.

Transportation agencies are deploying on-road countermeasures such as low-mounted Wrong Way signs, pavement marking improvements, and blinking lights on signs to capture the attention of drivers who have made a wrong-way maneuver.

However, on-road countermeasures can only go so far to reduce wrong-way crashes, as it is difficult to monitor extensive roadway networks to understand where wrong-way entries occur, and it is not feasible to deploy countermeasures at all locations.

How Can In-Vehicle Navigation Systems and Mobile Apps Help?

In-vehicle navigation systems (Figure 1) and mobile applications (Figure 2) hold significant potential to reduce wrong-way crashes by:

- Detecting wrong-way maneuvers, based on vehicle movement and map data; and
- Warning drivers so they may self-correct prior to a crash occurring.

These interventions could reach many more drivers than on-road countermeasures alone, by providing alerts at all times and all locations while the application is being used.

Figure 1: Concept - Wrong-Way Alert from In-Vehicle Navigation

Figure 2: Concept - Wrong-Way Alert from Mobile App

The Wrong-Way Driving Problem

The National Transportation Safety Board *Highway Special Investigation Report: Wrong-Way Driving*[1] reports that fatalities due to wrong-way driving in the United States average approximately 360 per year. In addition:

- *Severity:* Wrong-way collisions have higher fatality rates than other types of collisions.

- *Driver Characteristics:* Alcohol-impaired drivers and older drivers are over-represented in wrong-way crashes.

- *When:* There is an increased frequency of wrong-way collisions at night and on weekends.

- *Origin:* The primary origin of wrong-way movements is entering at a freeway exit ramp.

While freeway ramps, especially interchanges with side by side entrance/exit ramps, have been identified as a primary origin for wrong-way driving, other entry points such as at-grade intersections should not be ignored. An Iowa DOT study found that a majority of wrong-way driving incidents on a segment of the US 30 expressway from 2014 to 2017 occurred at at-grade intersections.[2] Figure 3 shows a common wrong-way point of entry path at a 4-lane, median separated intersection, where drivers may incorrectly make a left turn into oncoming traffic by failing to cross the median prior to making the turn.

In-Vehicle Navigation and Mobile Apps

Projections estimate that over 41,000,000 vehicles will have in-vehicle navigation systems by 2022.[3] In-vehicle navigation systems, together with on-board GPS, are typically able to detect when vehicles are no longer traveling on the pre-defined route and initiate re-routing algorithms. Provided the underlying maps used include road-level accuracy describing directional travel, a similar concept could detect wrong-way movements and provide visual or audio alerts to drivers, especially on divided highways.
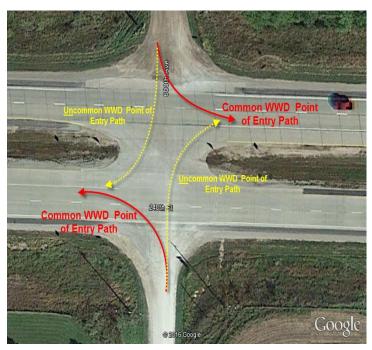

**Figure 3: Common Wrong-Way Driving Entry Path
(Source: Google Maps & Iowa DOT)**

A 2015 survey showed that 64% of drivers reported using a smartphone application to assist with their travel.[4,5] The most used applications were navigation and real-time traffic information, both that typically rely on underlying map tools that include directional travel.

Mobile devices with applications providing navigation services could determine when movement is in the wrong direction on divided highways and alert the drivers or passengers, potentially reaching more than half the drivers with wrong-way alerts.

Contacts

As part of the project on "Potential Approaches for Wrong-Way Driving Applications," the ENTERPRISE Pooled Fund conducted outreach to automobile manufacturers and mobile app developers to explore the potential for in-vehicle navigation systems and mobile apps to provide wrong-way driving alerts.

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[1] National Transportation Safety Board. (2012). *Highway Special Investigation Report: Wrong-Way Driving.* Washington, DC.

[2] Savolainen, et al. (2018). *Investigation of Wrong-Way Driving.* InTrans Project 17-623. CTRE, Iowa State University. Ames, IA.

[3] www.statista.com/statistics/725779/global-car-navigation-and-display-audio-market-size/

[4] www.sciencedirect.com/science/article/pii/S2046043016300648

[5] https://money.cnn.com/2016/10/10/autos/car-navigation-frustration/index.html