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OFFICE OF POLICY ANALYSIS, RESEARCH & INNOVATION

TECHNICAL SUMMARY

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PROJECT COST:
$61,986

The new SS300 radar module from Houston Radar Inc. successfully detects vehicles and is reasonably priced.

Improving Technology to Alert Drivers to Work Zones

What Was the Need?

Distracted drivers pose a serious safety hazard in work zones, particularly to flaggers. When drivers ignore or don't notice work zone traffic control devices and other driver warning information systems, they are unlikely to notice a flagger until it is too late to stop safely. These situations have led to fatalities, and while Minnesota does not track data on near misses, anecdotal evidence suggests that there are one to two each year involving semitrailers and several more involving smaller vehicles.

By creating a tactile vibration and sound, rumble strips effectively alert distracted drivers to potential danger. However, they are not suitable for moving operations because repositioning them is too labor-intensive.

MnDOT needed a method of alerting drivers about upcoming work zones that is more dynamic than static signs but is portable and can be used in a moving work zone.

The Intelligent Drum Line system developed in this study could significantly improve work zone safety by providing audible and visual warnings to speeding drivers as they approach. Further development is needed to ensure the system is cost-effective and portable to serve MnDOT's needs.

What Was Our Goal?

The objective of this study was to develop a working prototype of the Intelligent Drum Line, a work zone alert system designed to attract the attention of speeding or distracted drivers more effectively than signs.

To be used in work zones, the IDL system needs to be sufficiently rugged to pass crash tests, cost-effective and contain as few parts as possible so a single worker can deploy and move the system. While this proof-of-concept prototype was not expected to satisfy all of these requirements, the project sought to discover cost-effective components that could deliver adequate functionality and to identify any gaps where satisfactory components are not currently available.

What Did We Do?

To begin, researchers developed a series of conceptual designs for the IDL system. After discussions with MnDOT maintenance personnel, they refined these designs for the prototype.

The prototype design uses two modified traffic drums placed 1 to 3 feet from the shoulder of the road and 300 to 400 feet apart. Sensors in the first drum detect vehicles, measure their speed and distance, and communicate this information to the second drum through a wireless communication subsystem. Both drums contain processing components and auditory and visual warning systems. Researchers evaluated a variety of components for each of these systems, including active infrared, passive infrared, ultrasonic, magnetic and microwave sensors.

When the IDL system detects an oncoming vehicle traveling faster than a threshold speed, the system activates visual warning systems in both drums and initiates a countdown. When the speeding vehicle is approximately 1 second away from the first drum, the system activates an air horn to warn the driver.

As the vehicle passes the first drum, the audible alarm terminates and the system transmits a command to the second drum to start another countdown. When the vehicle

continued

"There are too many close calls with our flaggers. Once or twice a year, semis will miss all the warning signs and have to come sliding to a stop."

—Randy Reznicek,
MnDOT District 3 Maintenance Superintendent

"If a sufficiently obvious and directed warning is delivered to distracted drivers, we can limit the risk of serious accidents near work zones."

—John Hourdos,
Director, Minnesota Traffic Observatory

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While the IDL system successfully attracted the attention of drivers when tested at MnROAD, future testing will need to assess the alarm when drivers are unaware of the system.

is approximately 1 second away from the second drum, the system activates another audible alarm.

Most of the IDL prototype testing was conducted at the MnROAD facility. Tests involved a passenger vehicle, a light truck and a 3-ton truck traveling at speeds up to 85 mph.

What Did We Learn?

Researchers determined that the IDL's design strategy was effective: MnROAD testing revealed that the audible and visual alarms both successfully attracted drivers' attention.

Finding an appropriate speed and distance measurement sensor proved to be the most significant impediment to meeting MnDOT's technical and cost requirements. Microwave technology is currently capable of measuring vehicle speed and distance, but the sensors start at $3,000, which is too expensive to be practical.

As a result, investigators created two working, but imperfect prototypes of the IDL system. One used a less expensive sensor that cannot measure vehicle distance and assumed a 300-foot detection distance instead. This prototype was suitable for most vehicles, but large trailers can prematurely trigger the alarm. The second prototype incorporated a separate advance sensing cone approximately 100 feet upstream of the first traffic drum. While this configuration was successful, it violates MnDOT's mandate for a system with no more than two drums.

Microwave speed and distance sensors are relatively new to the market. While currently too expensive to be cost-effective, their cost may decrease in the next few years to the $500 range necessary for wider implementation.

What's Next?

The IDL prototype needs additional design modifications to pass Federal Highway Administration crashworthiness tests, which would be necessary for it to be tested in actual work zones. Testing of the system's effects on drivers in real-world conditions is also needed; drivers in the MnROAD tests were aware of the system beforehand and therefore not surprised by the air horn. A MnDOT project to evaluate these human factors for a number of different systems is currently underway.

This Technical Summary pertains to Report 2012-26, "Portable, Non-Intrusive Advance Warning Devices for Work Zones with or without Flag Operators," published October 2012. The full report can be accessed at http://www.lrrb.org/PDF/201226.pdf.