RESEARCH SUMMARY

DEPARTMENT OF TRANSPORTATION

LRRB LOCAL ROAD RESEARCH BOARD

OCTOBER 2024

New Smartphone App Uses GPS Technology to Warn Drivers of Lane Departures

Preventing vehicles from drifting out of traffic lanes is a top safety priority for transportation officials. An ongoing research project has produced a smartphone app that alerts drivers when their vehicles drift from a lane. The current phase of the project improved upon earlier versions of the app by adding GPS and significantly increasing the effectiveness of lane departure detection.

What Was the Need?

Unintentional lane departure that occurs when drivers are speeding, distracted or drowsy poses a significant safety risk on roadways. Some newer vehicles have integrated lane departure warning systems (LDWS) that use cameras or laser sensors to visually scan driving lanes. These systems, however, are operationally complex, costly to implement and generally installed only on higher-end vehicles. Additionally, existing LDWS may not work when weather is severe, visibility is limited or road markings are unclear.

The first phase of this research project developed an alternative LDWS that incorporated GPS technology to create a lane departure algorithm. In the second phase, a separate algorithm created road reference headings (RRH) for a given route—referring to the direction a vehicle is traveling at any point on a road—from the

"Most of the serious crashes in Minnesota are the result of roadway departure crashes. This research developed new technology that places a lane departure warning system in vehicles that are not equipped with this technology."

—VICTOR LUND, TRAFFIC ENGINEER,
ST. LOUIS COUNTY PUBLIC WORKS

position data generated during the vehicle's past trips on the same road. Together, these algorithms enabled the alternative LDWS to compare the RRH to the real-time vehicle position to determine if a lane departure is occurring.

However, relying solely on past trips—or trajectories—to produce the RRH significantly limits the system's effectiveness. The current phase of the project sought to address this limitation and to increase accessibility to this alternative LDWS technology.

What Did We Do?

To improve the previously developed LDWS, researchers first explored ways to create RRH for roads that a vehicle has never traveled to compare that vehicle's real-time position in the driving lane. Geographic location data from driving routes contained in Google Maps, which includes almost every road in the U.S., enabled the modification of the previously developed RRH algorithm. Numerous test drives, including multiple lane changes on a section of I-35, compared the RRH generated from past vehicle trips with the RRH generated from Google Maps to assess the accuracy of lane departure warnings generated with each.

To enable wide deployment of the LDWS, researchers developed a smartphone app, including a backend browser component. A cloud server houses the modified RRH algorithm containing the Google Maps route database in addition to the database of past trajectories. The cloud is accessed by the smartphone app that contains the LDWS algorithm to detect and warn drivers of lane departures.

What Did We Learn?

A field demonstration of the smartphone app's functionality showed high accuracy in detecting real-time lane departures on straight road sections where unintentional lane departures mainly occur. On curved road segments where drivers are generally more attentive, the accuracy depended on the accuracy of the RRH. An audible warning alerted the driver when the system detected a lane departure. The app's operation is visualized in a demo video showing a representative test drive.

Because the RRH algorithm is generated on the cloud server, an RRH generated by a past trip of one vehicle can be stored in the cloud and used by another vehicle for lane departure detection. If past trajectories are not available, the RRH is generated from Google Maps routes, which, in turn, is improved as actual vehicle trajectories are created.

Smartphones operating on both Android and iOS platforms currently force the internal GPS to operate at 1 Hz due to the power draw. Effective operation of the LDWS app requires GPS data to be accessed at 10 Hz frequency. A separate, external GPS device can be used with a smartphone as researchers work to resolve this limitation.

What's Next?

While researchers received the patents for the software incorporating the LDWS and RRH algorithms, they will continue working to patent the lane departure warning smartphone app and work with mapping entities to determine if the LDWS function can be incorporated into the mapping software. Using a mapping system's GPS at a 10 Hz frequency would eliminate reliance on a smartphone GPS. Once the technology is available to consumers, transportation agencies in Minnesota can participate in outreach efforts to encourage use by the driving public.

About This Project

REPORT 2024-25
"Development of a Smartphone App to Warn the Driver of Unintentional Lane Departure Using GPS Technology."
Find it at mdl.mndot.gov.

CONTACT
research.dot@state.mn.us.

TECHNICAL LIAISON
Victor Lund, St. Louis County,
LundV@stlouiscountymn.gov

INVESTIGATOR
Imran Hayee, University of Minnesota Duluth, IHayee@d.umn.edu

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$147,145

www.mndot.gov/research