DRISI

CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

Research Results

Mobile Device Application for Wrong Way Driver Detection and Warning

Evaluating the Accuracy and Effectiveness of the Bosch Mobile Device Application for Wrong Way Driver Detection and Warning

Transportation Safety and Mobility

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Project Title:
Wrong Way Driver Mitigation

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WHAT WAS THE NEED?

Many drivers currently use mobile applications such as Waze and Google Maps to assist them in finding their destination and making informed route decisions. Such applications leverage the vast amount of roadway network data collected and maintained by companies such as Google as well as the real-time driving data collected from drivers using the applications. This real-time driving data is transmitted by users' mobile devices, allowing these services to estimate traffic flow and to provide functionality such as route guidance and hazard warnings to their users.

Bosch has taken advantage of these rich sources of roadway and driver data to develop software to detect wrong way drivers in Europe. Bosch currently partners with several cellular phone app providers in Germany to embed their software in the apps. When the app is running on a driver's cell phone, an alert can be sent when he or she is detected by Bosch's software to be heading in the wrong direction. The software can also alert drivers of proximate vehicles whose cellular phones have a Bosch-enabled app running. Caltrans would like to test the functionality and accuracy of the Bosch wrong way driver detection and alert system in California. If positive test results were published, it could help introduce Bosch's wrong way driver detection and alert technology to California and the rest of the United States.

WHAT WAS OUR GOAL?

The anticipated outcome of this research was a report that demonstrates the effectiveness and reliability of the Bosch cloud-based mobile device WWD detection and alert system. The reported positive results could increase awareness of the technology and lead to its implementation in California and the United States.

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WHAT DID WE DO?

A task order was established under the master contract with the Advanced Highway Maintenance and Construction Technology (AHMCT) center at UC Davis to independently evaluate the accuracy and reliability of the Bosch cloud-based mobile device WWD detection and alert system on California state highways. The researchers met with Bosch, and they agreed to share their software development kit for iOS and Android and work with UC Davis to devise a method for testing their system. UC Davis signed a non-disclosure agreement with Bosch to work with their proprietary technology.

Bosch's software uses a mobile devices' GPS data to transmit regular, anonymized position data to a server that contains a database of maps and corresponding permitted directions of travel. When the server detects a conflict in travel direction, the wrong-way driver and any proximate networked road users receive a warning presented through a third-party app. The UC Davis researchers wanted to verify this functionality on exit ramps using their own test vehicles. Bosch had already established a map server for many areas in the United States, but they weren't yet using it for any services. Therefore, Bosch simply reversed the direction of allowed travel on its map server for five on-ramps in the Sacramento area, allowing the researchers to test system functionality without having to drive in the wrong direction.

UC Davis worked with Bosch to write a custom Android smart phone application to receive wrong-way warnings from the Bosch map server. The researchers drove on the test ramps several times while recording the wrong-way movement warnings received by the smart phone application. At the same time, the researchers independently recorded GPS coordinates and corresponding timestamps with separate devices they had procured and configured. These independent measurements correlated with the wrong-way movement warnings sent from the Bosch map server and showed the researcher's exact positions on the on-ramps when the warnings were sent and received.

WHAT WAS THE OUTCOME?

This task independently verified the functionality of Bosch's wrong way driving detection and alert software. The results showed that, in every single case, the application could detect real-world movements by UC Davis researchers driving test vehicles and notify them within, at worst, a few seconds and, usually, within 1 second. The researchers measured latency from when the Bosch map server issued an alert to when the test drivers received it on the smart phone application. Each of the five ramps was tested ten times for a total of 50 tests. In 31 cases an alert was received within 1 second. In 12 cases an alert was received within 2 seconds. In 2 cases an alert was received within 3 seconds. In 3 cases an alert was received within 4 seconds, and in 2 cases an alert was received within 5 seconds.

WHAT IS THE BENEFIT?

Implementation of cellular/cloud-based WWD detection and alert technology in California could lead to the prevention of wrong way collisions on all state highways in a cost-effective way, whereas statewide deployment of hardware-based in situ WWD detection systems would be cost-prohibitive. Detecting WWD movements and sending real-time warnings to the offending driver, other proximate drivers and interested transportation authorities could reduce the number of collisions caused by wrong way entries onto state highways. This would enhance the safety of California's freeways and save lives, which would align with the Caltrans Strategic Goal of Safety and Health.

IMAGES

Image 1: Mobile phones with the custom Bosch app installed (left) and a GPS coordinate logger (right)

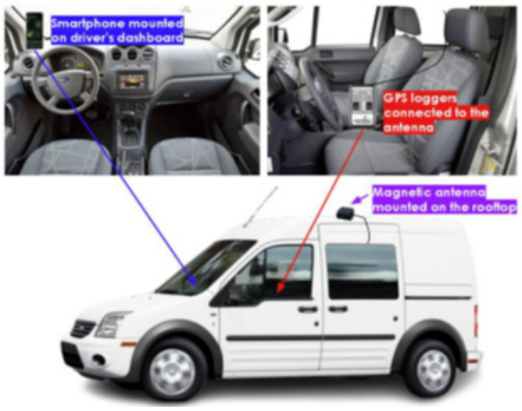

Image 2: Mobile phone and GPS coordinate logger installed in a test vehicle

Image 3: Detection area (pink) encompassing the Sacramento test ramps as shown on the Bosch map server

Image 4: 3 of the 5 test ramps on which the researchers drove as shown in Google Maps

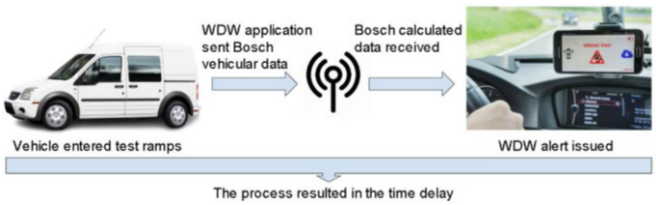

Image 5: The research determined that this process took an average of 1.66 seconds.