DRISI

CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

# Research Notes

Maintenance

# Targeted Warning Messages to Protect Moving and Stationary Maintenance Lane Closures

Increasing safety of California's highway maintenance workers and traveling motorists through real-time, active alerts from an intelligent message board system.

SEPTEMBER 2023

Project Title:
Targeted Warning Messages

Task Number: 3919

Start Date: January 1, 2021

Completion Date: March 21, 2024

Task Manager:
Eemon Amini
Transportation Engineer
eemon.amini@dot.ca.gov

## WHAT IS THE NEED?

The California Department of Transportation (Caltrans) uses truck-mounted attenuators (TMAs) to establish moving or stationary temporary highway lane closures. These closures require approaching vehicles to merge out of the lane into adjacent lanes before reaching the TMA. A closed lane typically disrupts traffic flow by slowing traffic in the through lanes as motorists in the merging lane merge over. Some motorists will take advantage of the thinning traffic in the merging lane to leapfrog ahead of traffic.

These drivers often go as far as possible in the merging lane to find a space to quickly merge over immediately before reaching the physical barrier. This behavior increases the risk of their vehicle colliding with the TMA truck. Conventional arrow boards and signboards are placed ahead of the closure on the shoulder and on the in-lane TMA truck to passively inform drivers of the approaching lane closure. Since conventional boards are common and generic, motorists often disregard these safety tools.

Caltrans needs message boards that are more effective in alerting drivers and creating a sense of urgency that consistently enforces timely merging of vehicles into the adjacent lanes.

## WHAT ARE WE DOING?

This research involves development of a reliable hardware/software package reliant on artificial intelligence that can process sensory information and generate meaningful, targeted warning messages to oncoming highway traffic. In order to generate a vehicle-specific warning message targeted at the unsafe vehicle, the artificial intelligence application involves the following two tasks:

1. Identify unsafe driving patterns
2. Extract unsafe vehicle information

The targeted warning message will include vehicle description such as vehicle type, color, speed, etc. to alert the unsafe driver and create a sense of urgency to exhibit safe driving behavior near the lane closure.

In addition to the vehicle-specific information, the warning message will include the characteristics of the observed unsafe behavior such as "Delayed Merge!", "High Speed!" along with a commanded action such as "Merge Over Now!", "Slow Down Now!", etc. Should the motorist not perform the commanded action, the displayed messages could become progressively more persuasive by flashing strobe lights and/or accelerating the arrow flash rate. Part of this research involves determining the most effective messages and lighting combinations to efficiently alert motorists based on human factors testing, as well as Caltrans specifications and regulations.

A final report summarizes the research findings and provides Caltrans with recommendations and options for potential future research to expand the technology's capability and options for future system field-testing and potential implementation.

## WHAT IS OUR GOAL?

The goal of the research is to develop a prototype intelligent TMA truck messaging system based on artificial intelligence that monitors vehicles approaching highway lane closures, recognizes unsafe driving patterns, and generates vehicle-specific warning messages. In addition, the research aims to increase the safety of both highway maintenance workers and traveling motorists through the development of such an intelligent message board system.

## WHAT IS THE BENEFIT?

The research will result in targeted warning capability that potentially would improve driver behavior and promote safer driving habits near highway work zones. Ultimately, a successful targeted warning system would help reduce highway accidents, hence save lives of both the traveling public and highway workers.

## WHAT IS THE PROGRESS TO DATE?

Researchers from the Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center continued developing platforms related to building their Machine Learning (ML) algorithms for vehicle detection. The research team is capable of extracting vehicle specific information, during daytime operations, based on license plate as well as detecting vehicle make and model using the Vidar camera procured for this research. AHMCT is also continuing to use a traffic simulation software, VISSIM, to emulate traffic conditions as well as to determine the ideal position of a changeable message board for the targeted warning messages. This traffic analysis software will aid in understanding the relationship between vehicle speed, average traffic flow and level of safety.

For more information, please contact the task manager.