Research Report Summary

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Augmented Reality for Safer Pedestrian-Vehicle Interactions

Communicating the presence of pedestrians or bicyclists to drivers can lead to safer interactions with these vulnerable road users. In a connected vehicle environment, it is conceivable that when vehicle sensors detect a vulnerable road user along an unexpected location, that information can be communicated to other drivers. A full-scale driving simulator experiment was designed to study scenarios in which drivers receive advance knowledge of a pedestrian or bicyclist presence.

Research Objectives

The objective of the research was to determine if an advanced warning message (in the form of auditory and visual cues) can have an impact on the detection of pedestrians/bicyclists if the warning is triggered significantly before reaching the pedestrians/bicyclists.

Simulator Scenario

The full-scale driving simulator experiment was conducted on a virtual environment in which subjects drove through a rural highway and then entered an urban environment.

During the simulated driving, subjects were asked to indicate when they detected a pedestrian by pressing a push button on the steering wheel.

Data Analysis Procedures

Locations and timestamps when subjects indicated they detected the presence of a pedestrian or bicyclist were analyzed.

Driver behavior was analyzed for a group of subjects exposed to cues indicating the potential presence of a pedestrian or bicyclist and for subjects not exposed to the cues.

An example of visualized detection data is shown in Figure 1.

Figure 1. Location of pedestrian detection by subjects (sample)

Impact of Cues on Pedestrian Detection

On average, cues were found to result in subjects detecting pedestrians sooner (in terms of distance). However, when the behaviors observed as a result of a cue were analyzed by group, no statistically significant difference was found.

Speed Behavior

While the impact of cues on subject behavior was not found to be significant, lower speeds were observed when subjects were exposed to cues. Speed reductions observed as a result of the visual and auditory cues were limited in duration after the cue.

Future Work

A larger sample should be pursued using lower-fidelity experiments such as dynamic surveys. A larger sample size could help narrow the potential impact that different cue trigger times can have on the detection of unexpected vulnerable road users.

Display of Warning Messages (Cues) Using Vehicle Dash

Warning messages indicating the presence of a pedestrian/bicyclist ahead were displayed to the subject on the dashboard as shown in Figure 2. Each warning message (visual cue) was accompanied by an auditory cue in the form of a beep. The cues were triggered based on a randomized experimental matrix.

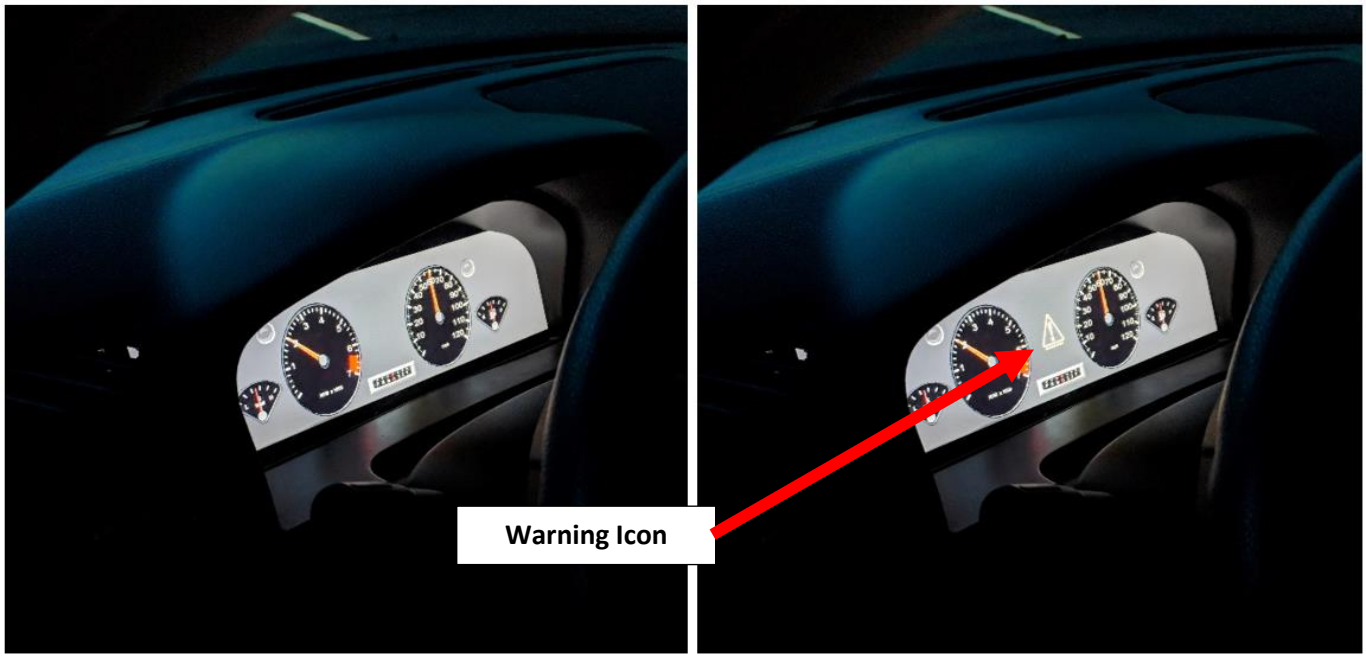

Figure 2. Warning icon flashed on dashboard along with simultaneous audio cue

Instrumentation Used to Collect Responses from Subjects

The combined visual and auditory cues indicated the potential presence of a pedestrian ahead. Once the subject saw the pedestrian, the subject was asked to press the push button shown in Figure 3. Responses from the push button were collected using a cellphone connected to the button via a Bluetooth™ connection.

Figure 3. Bluetooth™ push button used to collect subject responses