Autonomous Vehicle Communication Strategies Modeled in Virtual Reality

Creating and assessing strategies for AV communications with human road users

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$120,000

Autonomous vehicles (AVs) can help improve transportation efficiency, safety, equity, and environmental impacts. However, for these benefits to be feasible, the technology must be properly adopted. For some generations, there will be a transition period in which both human-driven vehicles and AVs share the road. Along with human drivers, pedestrians and bicyclists will share street space with AVs. How will AVs and human users of the road interact and communicate, and how will this impact perception and behavior outcomes? Human perceptions of AVs are important because trusting new technologies is integral to their successful incorporation into the transportation infrastructure. Recent research shows that many people are apprehensive about sharing roads with AVs. However, better AV communication has been linked with increased trust and acceptance. Understanding behavior in the interaction of humans and AVs is important for two types of outcomes: safety and operations. Because approximately 94% of motor vehicle crashes can be attributed to human error, this can be an incredible opportunity to improve traffic safety outcomes. However, to realize these benefits, users must properly interact with each other.

On March 18, 2018, Elaine Herzberg became the first person killed by an autonomous vehicle (AV). While the incident was a tragedy, the fact remains: with approximately 94% of vehicular crashes attributed to human error, AVs can considerably reduce about 40,000 fatalities occurring on American streets each year. Along with major traffic safety benefits, AVs also can improve traffic operations, equity, and environmental impacts. Public acceptance is currently low, however, and trust and acceptance of these new technologies must be earned. Much of this trust will depend on effective communication between AVs and humans on roadways. We anticipate that the way AVs communicate the answers to these questions will impact how human road users behave and, in turn, their safety outcomes. This holds heavy implications for the acceptance of these new technologies, the simulation of roadway environments, and the design and prioritization of transportation projects.

Objectives

The objective of this research is to create and assess strategies for AV communication with human road users (drivers and pedestrians). Testing will occur in a three-dimensional VR environment in which participants encounter AVs in a typical urban intersection. The AVs will use various external communication interfaces including a variety of lighting, color, sequence, text, and noise interfaces. We will gather user perceptions through a post-experiment survey, asking users whether they understood the AV's intentions, how long it took them to do so, and whether or not they trusted the AVs. VR headset sensors will read users' body and eye movements to better understand human users' interaction time and visual focus in interacting with AVs.

Intended Implementation of Research

Workforce Development: This will be achieved directly by training graduate, undergraduate, and high school students interested in pursuing a career in STEM or Transportation Engineering career.

Education: This task supports the federal initiative to build the next generation of transportation professionals to meet the demands of the rapidly changing 21st-century transportation system and its evaluation practices.

Outreach: Technical articles, posters, and presentations will be delivered at national and local conferences and symposia such as ASCE, Transportation Research Board, TxDOT, and Tran-SET.

Figure 1: Example of VR scenario that is currently being used for AV testing in our lab.

Anticipated Impacts/Benefits of Implementation

The main deliverables from this study are:

(1) A final report on AV communication language and interfaces. This report will contain the problem description, proposed solution, data, procedures, and recommendations.

(2) Webinars and presentations to disseminate the findings of this study to a DOTS nationwide and an overall broader audience.

Web links

- Tran-SET's website https://transet.lsu.edu/research-in-progress/

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit our website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.