DRISI
Caltrans Division of Research, Innovation and System Information

Research Notes

Caltrans UAS-Related Driver Distraction Research

Continue the examination and testing of Unmanned Aircraft Systems (UAS) and driver safety through the use of an eye-tracking system along with a driver simulator

Modal

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Project Title:
Transit Research

Task Number: 4097

Start Date: January 1, 2023

Completion Date: December 31, 2023

Task Manager:
Nathan Loebs
Transportation Engineer (Electrical)
nathan.loebs@dot.ca.gov

WHAT IS THE NEED?

Distraction of drivers causes approximately 25% of all car accidents in the US, with young drivers accounting for more than double of such cases [1]. A visual distraction draws drivers' visual attention away from the road by prompting them to take their eyes off it. This commonly happens when drivers look at advertisement billboards, a map for navigation, their phone, or the car audio system user interface. Visual distractions may be dangerous even for short periods of time. Previous research studies have demonstrated that visual attention and eye movement of the drivers are correlated with each other. Therefore, to monitor and quantify visual attention of the drivers, researchers have leveraged tracking eyeball positions and movements due to high accuracy and relative simplicity of this method.

Only a few studies have investigated the hazards of UASs-related distracted driving. UASs operations with small lateral offsets from the roadways have shown to result in increased numbers of focused glances [2-4]. According to research by Barlow et al. (2019), drone operations with the physical presence of the drone and its two operators, resulted in dangerous glances (i.e., longer than two seconds) more frequently when they were at the zero offset from the road than when they were 25 or 50 feet away laterally [2]. One previous research explored the operational environment and the level of distraction and found that a UAS flying in rural areas results in more driver distractions because of clearer visibility compared to urban environments [4]. In other words, since there are fewer other distractions in rural areas, UASs are more recognizable. Also, previous research performed operational processes along the sides of roads with various lateral offsets, with the theory that the further away from the roadside, the less distracting to drivers. The UAS was a fixation target, with 38% of attendees glancing for more than 2 seconds

[3]. For implementations at higher operational altitudes, these studies did not consider operations over traffic. Researchers also tried to fly routes at an altitude of 26 to 60 feet above ground level (AGL), which is much lower than the altitude at which these operations would occur in real-world applications.

WHAT ARE WE DOING?

The research strategy is to design experiments with two main research tools: a driving simulator and an eye tracker. Driving simulators are machines that allow operators to recreate driving scenarios in a realistic manner. The impact of distractors such as flying UAS in the line of sight of drivers can be studied using a driving simulator. A driving simulator allows researchers to study a variety of performance metrics in a realistic yet safe environment, without exposing the experiment subject to potential driving accidents or injuries due to getting distracted by the UAS. Eye trackers are wearable devices similar to a pair of glasses that can track a subject's eye movement, what they look at, and for how long. Total fixation duration (TFD) will be used as a performance metric to compare the visual distraction between the levels of independent variables. The project will follow the tasks outlined in Figure 2. Detail description of the tasks is as follows.

- Task 1: Literature Review on Driver Distraction - This project will entail a comprehensive review of the literature on driver distraction.
- Task 2: Experimental Design - In Task 2, the design of the experiments in terms of the number of the variables to be tested, potential combination of test variables, and the approach for assigning experiment participants to multiple conditions (e.g., between-subjects or within-subjects) will be determined.
- Task 3: Driving Simulator Scenarios Development - In Task 3, the experiments designed in Task 2 will be implemented inside the DriveSafety RS-250 simulator using the TCL language.
- Task 4: Participant Recruitment and Data Collection - The scenarios developed in Task 3 with the design of the experiments in Task 2 will be tested with the help of human subjects.
- Task 5: Data Analysis - Once the data is collected from the participants experiments (i.e., eye tracker data as well as participants information), in Task 5 they will be cleaned, prepared, and analyzed to generate insights about the levels of distraction.
- Task 6: Final Report, Presentation, and Manuscript Preparation - Task 6 constitutes the culmination of this research project where a final report on the project will be submitted to Caltrans.

WHAT IS OUR GOAL?

In order for Caltrans policy to come into alignment with Federal Aviation Association (FAA) policy as well as to conduct comprehensive research on driver distraction by UAS, this project aims to investigate the level of distraction of drivers when they encounter UAS that are flying around the roadways. The goal is to determine the effect of UAS flying near roadways and highways within the CA State Highway System (SHS) in different operational conditions in order to provide best practices for the use of UAS near roadways and highways.

WHAT IS THE BENEFIT?

The research will serve as guidance for best practices for safety and risk mitigation for the use of UAS near roadways and highways, and will also serve as a model for UAS programs throughout the State, nationally, and internationally. The research will also enhance asset management and decision support tools for Caltrans Aeronautics. Additionally this research will address the UAS safety concerns of underserved communities.

WHAT IS THE PROGRESS TO DATE?

Project will start January 1, 2023

IMAGES

Image 1: DriveSafety RS-250 Simulator

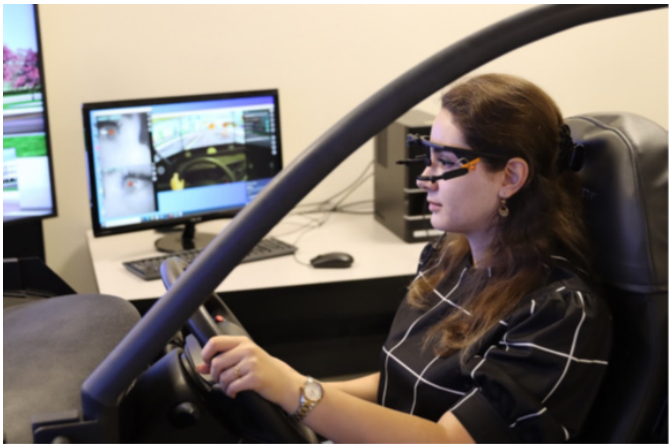

Image 2: Pupil Labs Eye Tracker used with the Driving Simulator