# Exploring In-Car Augmented Reality Navigation Aids: A Pilot Study

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## Abstract
We evaluate the effects of in-car augmented reality navigation aids on driving performance and driver visual attention. Results from a pilot simulator study suggest that augmented reality navigation aids which overlay a route directly on the windshield are safer than today's standard navigation aids.

## Keywords
In-car navigation, user interfaces, driving performance

## ACM Classification Keywords
H5.2. User Interfaces: Evaluation/methodology.

## Introduction
Augmented reality personal navigation aids integrate a virtual navigation route into the real-world scene. One method is to display a route directly on the windshield with a head-up-display (HUD). Other methods may involve overlaying a route on a standalone, head-down display (HDD) unit with a live video feed of the road [1]. Previous research indicates that response times to HUD navigation aids will be shorter than for similar HDD aids [2]. Our objective is to perform an in-depth analysis of the influence of augmented reality HUD and HDD navigation aids on driving performance and visual attention before the technology becomes commercially

available. We hypothesize that HUD augmented reality navigation aids will perform better than both HDD aids and the standard navigation aids found in today's cars, as measured by driving performance metrics (such as lane keeping) and visual attention metrics (such as the percent time spent looking at the road ahead). We posit this because HUD augmented reality navigation provides guidance without requiring users to take their eyes off the road at any time.

## Pilot Study and Future Work

Using our high fidelity driving simulator, we conducted a pilot study comparing a HUD augmented reality navigation aid and a standard navigation aid. Five participants (4 male, 1 female, average age 19.4) drove two city routes, one with each of the navigation aids. The augmented reality navigation aid displayed a narrow, elevated surface to guide the driver (figure 1, left), while the standard navigation aid displayed a map (figure 1, right). Both aids issued identical voice prompts at identical locations. Using two eye trackers we measured the percent dwell time on the outside world (PDT), defined as the percentage of time the driver spent looking at the three simulator screens (most importantly the roadway). A low value may indicate that the driver was distracted, which in turn could result in an accident. We performed a one-way ANOVA for PDT with the navigation aid type as the independent variable. We found that PDT was higher when using augmented reality as compared to the standard navigation aid, $p<.05$. Specifically, for augmented reality, the PDT mean was 94.9%, while it was 87.6% for the standard navigation aid (figure 2).

We are currently planning a within-subjects factorial design experiment comparing driving performance and visual attention when using a standard navigation aid, a HUD and a HDD augmented reality aid. While the HDD aid may be useful for pedestrians, we expect that it will be too distracting for drivers.

**figure 1.** Augmented reality (left) and standard navigation aid.

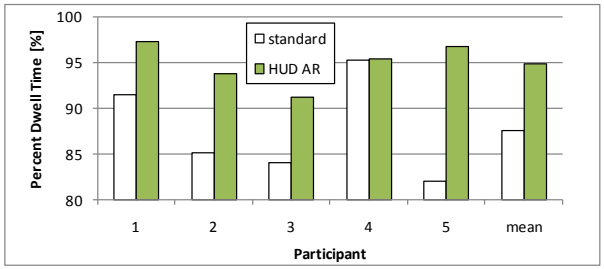


**figure 2.** Percent dwell time by participant.

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## Citations

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