**2.1 Heads-Up Displays**

HUDs were introduced to production cars as early as the 1988 Oldsmobile Cutlass Supreme Indianapolis 500 Pace Car Parade Convertible. Since then, while the breadth of content available has increased from vehicle status (such as speed or fuel) to include road and trip details (such as collision warnings or navigation), most standard or add-on HUDs on-the-road still reproduce the information available in existing displays.

To best support drivers’ comprehension of the information displayed in a HUD, its images should appear to be located several meters ahead of the vehicle, within the driving environment. When placed central to drivers’ field of vision, HUDs are likely to capture their attention and keep it there. However, despite the apparent advantages of keeping drivers’ heads up and their eyes on the road, HUDs can also monopolize drivers’ attention through cognitive capture, potentially diverting them from the broader context and leading to primary/secondary task inversion, where an operator begins to rely on the backup system (the HUD, in this case) as the primary source of information. A relevant distinction is thus between two primary modes of visualization used for HUDs. Static visualization refers to the stationary presentation of information on a particular part of the screen or windshield, but not in a location or manner that is registered to the world outside. This format can work well for the kind of content in current vehicle information displays. AR visualization, on the other hand, presents information such that it occurs visually near, and/or in realistic perspective with the objects and events that it refers to, perhaps moving as the scene changes. AR HUDs are therefore well suited to communicating spatially relevant information in context.

**DESIGN RECOMMENDATIONS**

Our results suggest that driving style is a critical factor in the HUD’s role of raising drivers’ situation awareness in various settings. However, HUDs may not be as effective in enhancing drivers’ situation awareness as they are intended to be, given the strong influence of the immediate road environment. We observed some drivers, including those with no distinct style, performing worse (on situation awareness measurements) with greater HUD complexity in the more static, while also performing better with the same HUD in the more dynamic. Other drivers, such as those with the Anxious driving style, demonstrated a reverse pattern, performing better with the Complex HUD, and worse with the same HUD.

Therefore, designers should account for both driving style and scene complexity when designing the kinds and amount of information to include in HUD visualizations. Not only do we see these differences in performance patterns in situation awareness metrics, but also in driver perceptions of the vehicle and their own states. HUDs, and in turn, vehicles, may be perceived differently depending on both scene complexity and driver characteristics. Therefore, we propose that HUDs be designed to account for drivers’ individual styles, and to change their presentation behavior (regarding complexity, in particular) based on the immediate driving context. As the same HUD can be seen as clear or unclear in different situations, more work is needed to understand what information to display, and how to clearly display it in a given context. In effect, there may not be an optimal solution that improves situation awareness across drivers and situations. This insight suggests that adaptive displays, rather than fixed comprehensive designs, may provide the most benefit to a greater number of drivers

**ABSTRACT**

The automobile industry has produced many cars with new features over the past decade. Taking advantage of advances in technology, cars today have fuel-efficient hybrid engines, proximately sensors, windshield wipers that can detect rain, built-in multimedia entertainment, and all-wheel drive systems that adjust power in real-time. However, the interaction between the driver and the car has not changed significantly. The information being delivered – both in quantity and method – from the car to the driver has not seen the same improvements as there has been “under the hood.” This is a position paper that proposes immersing the driver inside an additional layer of traffic and navigation data and presenting that data to the driver by embedding display systems into the automobile windows and mirrors. We have developed the initial concepts and ideas for this type of virtual display. Through gaze tracking the digital information is superimposed and registered with real world entities such as street signs and traffic intersections.

**Intro**

In recent years, HUD's have been incorporated into more cars. Popular in airplanes, both real and simulated, HUD's provide information to the driver (or pilot) without forcing them to shift their line of sight. HUDs are not a new concept in cars, having been seen as early as 1988. In the past 20 years, advances in technology have allowed more information to be displayed, and in considerably better quality. Today, several different car companies - including BMW, Lexus, and GM to name a few - have built HUDs into their vehicles. For cars without built-in HUD's, one can purchase 3rd party systems that can be installed to perform similar tasks.Over time, HUD technology has seen many improvements. For example, HUDs are now capable of adjusting to ambient light, so the images are just as clear whether you are driving at day or night.

* + Comprehensive description of the requirements, scope and complete  
    technical diagrams to illustrate the project.
  + A clear justification of the approach towards the task achievement, APIs and technologies used
  + Elaboration of the usefulness in the real-world applications
  + The description of the issues faced during the implementation of the project and the actions taken to overcome
  + Identify realistic and practical future enhancements to the project
  + With a proper structure, presentation, and appropriate referencing

Presented HUD in this paper is made by using the capability of mobile phones which makes the whole system very economical compared to other HUD’s in the market. The presented HUD is capable of displaying instructions and turn by turn directions which makes driving safer and comfortable. Heads Up display for automobiles can be used for providing many types of features and assistance to the driver. In future it can be integrated with the voice recognition, voice control, gesture control so that while driving without touching the touch screen or any other input device simply by gesture of voice command the HUD can perform the functions. Adding to the navigation feature HUD can also be used for picking up a call, texting, playing music, volume control of music, operating head lamps of automobile, operating windows, and roof of a car and many more. HUD with integrating sensors can be used to form Ad-hoc network which can be used for creating traffic management system. HUD is a platform; it is the future. With innovation in augmented reality in upcoming future HUD are also able to sense the objects and they can also be integrated with the automatic driving system to give user a best experience possible.

To make more accurate and reliable navigation technology, Global Positioning System (GPS) a space based navigation system was started as a project by United States Department of Defense (DoD) in 1973. With advancement of technologies GPS is adopted by mass population. Mobile phones and applications like Google map has brought a big revolution in navigation technology. Today any one with mobile phone having GPS, by using application like Google Map can navigate the routes with ease, adding to this user can also navigate route for going by a car or by walking. Traffic status on the route, each turn by turn instructions for navigation, estimated time to reach the destination are the few features to be named which are included in Google Map. Now a day’s automobiles are also having a navigation system in it, which is placed usually on the dashboard. While driving it is very important that driver concentration should be on the road but the problem is that for navigation the driver has to look in to their mobile phones or onboard displays at dashboard which is not at all safe and can lead to accidents. Generally, a normal human takes 1.2-1.5 seconds for observing the scene which is displaying on phone or dashboard and react, this much of time the concentration of driver is not on the road.

**AR**

Augmented Reality (AR) has become a truly productive, and even lifesaving, technology, with applications from medicine to manufacturing. And yet, other than in a few early explorations, AR is absent from our modern vehicles, which are among the few places that we spend the most time, and where real-time computer analysis offers great potential to benefit safety and comfort. The Heads-Up-Display (HUD) is a promising technology to introduce AR into road vehicles. As only smaller optical projection systems can ft within a vehicle’s dashboard, current HUDs limit frame size to about a 20° horizontal field of view. Interaction designers are thus challenged to represent ongoing information as well as fleeting (or possibly anticipated) events that occur inside, as well as outside, of this small frame. An initial design approach might be to have the HUD present all the information that the vehicle’s sensor and analysis systems are aware of. After all, this seems transparent and communicative.

However, such an approach gives rise to several concerns: (a) more complex displays could distract from the main task of driving, more so than spartan displays might; (b) it could be difficult for drivers to discern relevant, or critical, events from merely advisory information within complex displays; and (c) drivers’ abilities to observe and interpret information are variable—both among people and for the same person across different times or contexts—so a single design approach might not be optimal. In addition to these perceptual challenges, HUDs may introduce cognitive processing effects. First, redirecting drivers’ attention toward a HUD can increase their cognitive load, which in turn can alter typical visual scanning of the driving environment. And second, different formats of HUDs’ visual warnings can influence reaction times and detection rates, [32], which correspond to accident involvement [40]. Our contributions are inspired by two gaps in the literature: (1) the scope of prior explanations of HUD complexity, and (2) exploring the interaction between display complexity, driving style, and situation awareness. Prior work has generally considered HUD complexity to be the number of symbols visible in the display [9] or the busyness in the background scene [68]. But as we describe later, HUD complexity can be defined by categories or instances of scene features, or of symbols, or even a count of pixels, and can also be independent of the background. No prior work compares these. In addition to display complexity, drivers’ preferences and driving styles can also impact their behavior and perception of the vehicle [33, 47] and driving environment. For example, easily distracted drivers and attentive drivers likely notice different things in the environment and would benefit from different interface support. A recent participatory design exercise [3] and follow-up evaluation study [2] by Becerra et al. compared the use of personal HUD display profiles for thrill seeking drivers and found matches between display and driving style. While the work used still images, focused on a single driving style, and used basic descriptions to represent understanding of components of the display, it suggests a connection between display and one driving style not explored elsewhere. Research within the CHI community has explored alternative AR visualizations [30], HUDs compared to handheld devices in non-driving task interruption [22], and windshield-displayed applications [25]. In the latter, Haeuslschmid et al. [25] compiled and categorized such applications into entertainment and communication, navigation, vehicle monitoring, and safety—however, only a few relate directly to supporting drivers’ situation awareness. Little prior work, within or outside of CHI, has focused on the influence of complexity on drivers’ perceptions and awareness from an interaction design perspective.