Adjunct Proceedings of the 9th International ACM Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI '17), September 24–27, 2017, Oldenburg, Germany.

ARV 2017: Workshop on Augmented Reality for Intelligent Vehicles

Andrew L. Kun
University of New Hampshire
Durham, NH 03824, USA
andrew.kun@unh.edu

Hidde van der Meulen
University of New Hampshire
Durham, NH 03824, USA
hiddevandermeulen@gmail.com

Manfred Tscheligi
University of Salzburg
Salzburg, Austria
manfred.tscheligi@sbg.ac.at

Andreas Riener
Technische Hochschule Ingolstadt
85049 Ingolstadt, Germany
andreas.riener@thi.de

AutomotiveUI '17 Adjunct, September 24–27, 2017, Oldenburg, Germany

ACM ISBN 978-1-4503-5151-5/17/09…$15.00
https://doi.org/10.1145/3131726.3131735

Abstract
It is forecast that augmented reality (AR automotive applications will increase road safety, bring intuitive activities to driving, and finally enhance driving experience. AR technology may also help on the transition towards automated driving. However, many technological challenges need to be addressed before AR applications will hit the mainstream market. In this workshop, we will discuss the potential and constraints as well as impact, role, and adequacy of AR in driving applications. The overarching goal is to define a research agenda for the general use of AR in intelligent vehicles within the next 3 to5 years.

Author Keywords
Augmented reality; driving; intelligent vehicles.

CCS Concepts
• Human-centered computing~HCI design and evaluation methods • Human-centered computing~Interaction devices

Introduction
The use of augmented reality (AR) in vehicles has been explored by a number of researchers over the years [1-5, 7, 8, 9]. This body of work has shown that AR has the potential to improve the safety and comfort of driving.

Investigation of augmented reality (AR) timing constraints in a driving simulator environment.

However, in most of these cases the AR technology was simulated, because there was no simple way to create AR in vehicles, or even in driving simulators. This is now changing, with the advent of devices such as Microsoft's HoloLens. As of 2017 developers can purchase HoloLens for about $3,000, and they can quickly start exploring AR concepts in the laboratory. The ideas explored by simulating AR can now be explored more realistically using actual AR devices.

Furthermore, exploration of human-machine interactions in vehicles, as well as between vehicles and road users outside the vehicle, has changed significantly over the last several years. This is due to the fact that vehicle automation is making significant advances, and this has attracted the attention of researchers interested in a number of questions surrounding human-machine interaction for vehicles [6]. Many of these researchers are now asking not only how AR technology can be of use in manual driving situations, but also how it can be used with automated driving.

As of today, technology for AR in driving is not yet technically mature. Open problems include accurate capturing and interpretation of road geometry through computing intensive sensor fusion, precise vehicle positioning, compensation for vibrations, delays, and jitter, laser projection, driver monitoring via inward facing cameras, implementation of sophisticated algorithms to generate precise augmentation content in the viewing field of the driver, and others. A holistic understanding of AR use in driving is required in order to be able to address and solve these issues.

Workshop goals

The overarching goal of this workshop is to provide an avenue for researchers exploring human-machine interaction in and around vehicles to exchange ideas related to the use of AR in their work, and to start charting a path towards productive collaboration in the field.

The aim of the workshop can be broken up into three specific goals.

Goal 1: Discuss practical usage
First, we aim to exchange ideas on the practical usage of AR devices in exploring AR for vehicles. In our call for participation we will invite experts to present their experiences with, and reflections on, using AR, and relate these experiences and reflections to use in or around vehicles. Specifically, we will ask that they relate their practical experiences to the next two goals of the workshop.

Goal 2: Identify challenges and hypotheses
Second, we aim to outline a set of research challenges, for the coming 3-5 years, to provide reflections about these challenges, and to support these challenges with a set of hypotheses.

Goal 3: Chart research roadmap
Finally, we aim to propose a roadmap to tackle the challenges and test some of the hypotheses.

Workshop organization

Before the workshop

1. **Program committee recruitment.** We will recruit a program committee of 5-10 experts in the field, in addition to the workshop organizers. The

program committee will be selected from the contact lists of the organizers, encompassing academia, industry, and government. The program committee's tasks will include promoting the workshop, and reviewing reflection statements.

2. **Publicity.** The workshop will be publicized on dedicated a website. The call for participation will be distributed through the CHI mailing list, the Driving Assessment mailing list, the AutomotiveUI social media channels, and through the personal contacts of the organizers.
3. **Reflection statement submission and review.** We will invite reflection statements that contribute to one or more of the workshop goals stated above. The program committee will review the statements, and make recommendations for acceptance or rejection.
4. **Session organization.** The organizers will group the accepted reflection statements into three groups, by their relative contribution to each of the three workshop goals. Based on the reflection statements the organizers will also formulate seed questions to be used in small-group discussions during the workshop.
5. **Pre-workshop activities.** We will invite members of the AutomotiveUI community to attend the workshop; this will include both participants who have an accepted reflection statement, and those who are interested in contributing to the discussions at the workshop. We will post the list of participants online, and share the accepted reflection statements with all participants in preparation for the workshop. We will also invite all participants to share at least one publication that they feel would be valuable for all participants to be familiar with, and we will share the list of these publications. We will also ask participants to share at least one of their own publications that they feel would be useful for the workshop participants, and will share this list too.

During the workshop

We will start the workshop with a brief introduction of all attendees. Next, the workshop will feature three sessions that will introduce the three goals of the workshop. Each of these sessions will consist of three parts. First, we will have brief presentations of accepted reflection statements that are most relevant to the given goal. Next, we will present the seed questions formulated by the organizers, and ask for further seed questions from the participants. Next, we will form small groups of 3-5 participants, and each group will discuss the goal under consideration, using the presentations and the seed questions as starting points. After about 15 minutes of discussion, each group will give a 2-3 minute overview of their suggestions for accomplishing the given goal. Finally, these suggestions will be discussed by the entire group.

After the workshop

Following the workshop, the organizers will synthesize the proposals that were presented as a result of small-group discussions. Our goal will be to create an overview document that is appropriate for publication in a relevant journal, or at a relevant conference. All interested workshop participants who are able to devote sufficient time to the effort will be invited to collaborate on the publication.

Organizers

Andrew L. Kun is associate professor of Electrical and Computer Engineering at the University of New

Hampshire, and Faculty Fellow at the Volpe Center. His research focus is human-computer interaction in vehicles, primarily in speech interaction, as well as the use of visual behavior and pupil diameter measures to assess and improve the design of user interfaces. He served as the General Chair of the 2012 AutomotiveUI conference.

Manfred Tscheligi is professor for Human-Computer Interaction at the University of Salzburg, where he is directing the Center for Human-Computer Interaction. His main research interest is about Contextual Experience and Interaction in a variety of application contexts. He is further directing the Center for Technology Experience at AIT, Vienna (Austrian Institute of Technology).

Andreas Riener is a professor for Human-Machine Interaction and Virtual Reality at Technische Hochschule Ingolstadt (THI), Germany with co-appointment at CARISSMA (Center of Automotive Research on Integrated Safety Systems and Measurement Area). His research interests include driving ergonomics, driver state estimation from physiological measures, human factors in driver-vehicle interfaces and trust/acceptance/ethics in automated driving.

Hidde van der Meulen is a research assistant at the Electrical and Computer Engineering department of the University of New Hampshire and prospective PhD candidate at University College Dublin. Using eye-tracking he studies human-computer interaction in relation to driving attention, multi-device environments, augmented reality and combinations of those contexts.

References

1. Karlin Bark, Cuong Tran, Kikuo Fujimura and Victor Ng-Thow-Hing. 2014. Personal Navi: Benefits of an Augmented Reality Navigational Aid Using a See-Thru 3D Volumetric HUD. In *Proceedings of the Proceedings of the 6th International Conference on Automotive User Interfaces and Interactive Vehicular Applications*, 1-8.
2. Adam Bolton, Gary Burnett and David R Large. 2015. An investigation of augmented reality presentations of landmark-based navigation using a head-up display. In *Proceedings of the Proceedings of the 7th International Conference on Automotive User Interfaces and Interactive Vehicular Applications*, 56-63.
3. Peter Fröhlich, Matthias Baldauf, Marion Hagen, Stefan Suette, Dietmar Schabus and Andrew L Kun. 2011. Investigating Safety Services on the Motorway: the Role of Realistic Visualization. In *Proceedings of the Proc. AutomotiveUI 2011*.
4. Joseph L Gabbard, Gregory M Fitch and Hyungil Kim. 2014. Behind the Glass: Driver challenges and opportunities for AR automotive applications. *Proceedings of the IEEE*, 102, 2 (2014), 124-136.
5. SeungJun Kim and Anind K Dey. 2009. Simulated augmented reality windshield display as a cognitive mapping aid for elder driver navigation. In *Proceedings of the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 133-142.
6. Andrew L Kun, Susanne Boll and Albrecht Schmidt. 2016. Shifting Gears: User Interfaces in the Age of Autonomous Driving. *IEEE Pervasive Computing*, 15, 1 (2016), 32-38.

7. Andrew L. Kun, Hidde van der Muelen and Christian P. Janssen. 2017. Calling while driving: An initial experiment with HoloLens. In *Proceedings of the Driving Assessment*.

8. Zeljko Medenica, Andrew L Kun, Tim Paek and Oskar Palinko. 2011. Augmented reality vs. street views: a driving simulator study comparing two emerging navigation aids. In *Proceedings of the Proceedings of the 13th International Conference on Human Computer Interaction with Mobile Devices and Services*, 265-274.

9. Tamara von Sawitzky, Philipp Wintersberger, Katharina Frison, and Andreas Riener. 2017. Traffic Augmentation as a Means to Increase Trust in Automated Driving, In Proceedings of the12th biannual Conference of the Italian SIGCHI Chapter (CHIItaly'17), pp. 6.