Workshop on Prototyping HMI for Autonomous Vehicles

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ABSTRACT
In Autonomous vehicles the role of the driver is relegated to a supervisor and in more advanced levels a passenger. Most of the HMI research in the past has been in the manual driving context and either assume or enable hands-on, eyes-on and brain-on driving. Autonomous Vehicles in increasing levels of automation relieve the driver of mission critical tasks and hence take up the role of a partner in completing the common goal. This changing dynamic in the relationship between the car and the driver has a profound influence on the interaction and user experience, increasing the demands of HMI design. As HMI experts across the globe conceptualize and hypothesis new paradigms of interaction there are many inherent problems they (particularly, new to this field) are exposed to: Needs finding, framing the experiment setting, (e.g., lab/field, sensors and technology, mobile hardware, protocol, synchronization issues, analysis, validation etc.) to have been made very early in the design phase, but there are few best practices, code of conduct, etc. available to support them in the process of identifying the optimal solution to answer a specific research question. Another obvious but critical challenge is that most researchers do not have access to autonomous test vehicles. From a design stand point this is an issue because there is a critical gap in the iterative process where designers do not have sufficient information to solve HMI problems. Specifically, we want to focus on challenges in the development of systems for usage in Autonomous Vehicle HMI research and the challenges in evaluating these systems in the wild, especially with regard to long-term interaction. Hence, this workshop invites a) people active in the field to share their experiences in designing novel interface and interaction for cars of the future b) researchers to draft research questions, present their problems, and discuss possible solutions with the other participants. c) hands-on introduction to human-centered design fundamentals and techniques, intended for researchers with a variety of backgrounds. d) an opportunity for the organizers to share some interesting success stories and challenges in both lab and on-road studies.

Author Keywords
Driver State and Intent Recognition; Information Fusion; Human Factors and HMI in Autonomous Vehicles; Novel Interfaces; Sensing and modeling, Lab/field studies, Driver behavior, Good/bad experimental settings, Best practices, Human-centered design, design improvisations, Wizard of Oz.

INTRODUCTION AND MOTIVATION
In a fully autonomous car – steering, deceleration and acceleration are completely controlled by the intelligence built into it. The technology that determines this intelligence is highly complex and drivers find it hard to establish clear mental models. This leads to a major change in the user experience as the driver needs different information when the car is in autonomous mode, and more so during transition from one mode to another. It is hence fair to say that there is an expectation that the car explains its actions to the driver. [1]. Through the HMI, it is envisioned that, the car communicates it’s intent [2], it’s status, the driver’s status, infotainment, navigation and critical messages. To build trust and reduce anxiety the messages need to provide “why” information describing reasoning for actions [3] in addition to “what” which traditionally only aids situational awareness. More importantly all of this is highly contextual and dependent on the level of automation. We envision UI design being guided by
metaphors in a coherent way by covering different modalities of interactions between driver and car. Furthermore, we envision an adaptive HMI that can call upon the right language and communication modality based on the context and ecological situation encountered. This is something many researchers across the globe are working on; however, have difficulty in testing on road. Needless to say very few human-factor people have access to a fully autonomous test vehicle to build HMI for, test on road and iterate. [4] This is a huge road block in not just academic research, but also corporations (OEMs, TIER1, etc) for whom the differentiator may just be the HMI and services delivered through them.

OBJECTIVES
To encourage interaction among the attendees of this workshop, the structure of the workshop is built from a ‘design thinking’ lens so researchers interact through a human-centered design exercise. The goal of the workshop is of course to bring together both young and experienced researchers in the field of automotive UI research and discuss settings, experiences, best practices, etc. for conducting lab or field experiments. This includes building the connections (especially serendipitous ones) for meaningful discussions post workshop (during lunch and beyond). Through activity based interaction we hope the discussions lead to ones about how to improve user studies (setting), what types of sensors and recording platforms are suitable for which studies, feasibility of results (e.g., transfer of lab results to real scenarios), which should help “new” researchers (first year PhD or before) that are just starting with auto UI research to learn from the experience and mistakes of others.

Preferably, submissions include diverse small-scale studies in lab/field (even with a low number of participants) or “settings” used in automotive UI studies. These works should provide us with an opportunity in the workshop to explain the methodology and discuss pros and cons of the chosen approach, etc.

Consolidated, the workshop is about

- Opportunity for participants from around the world to present their work in Autonomous Vehicle HMI Research. More specifically research challenges in ‘natural interaction’ settings and over ‘long-term’ periods of interaction.
- Introduction to a ‘design thinking’ approach, through activity based exercise, to user-center design of HMI for Automated Vehicles.
- Networking and exchanging ideas and learning from each other (different fields, projects, etc.)
- Demonstrating best practices and discussing optimal settings for driver-vehicle interaction research. (videos of previous work by organizers)

SOLICITING SUBMISSIONS
In order to attract as many as possible submissions and participants, our publicity plan consists of making use of several lines of “advertisement”. The call for papers and participation (CfP) for this workshop will be distributed via HCI , Human Factors, and Automotive UI related mailing list like, e.g., ACM SIGCHI, UBICOMP, AutoUI, British HCI News, HFES, and Local SIGs lists. Also, social media such as Facebook, Twitter, Linkedin Groups etc. will be used to distribute the CfP. We think that one important success factor of the workshop is to personally approach people working in the field (“colleagues and friends”) and motivate them to submit their work to this workshop.

A workshop website will be set up at www.portology.org in order to provide information about the upcoming workshop, important deadlines, submission modalities and links to related material, so that participants can get familiar with the scope of the subject and the goals of the workshop. Accepted position papers and other pre-workshop materials will be made available to participants and published on the website (opt-in). This way, presentations during the workshop can be kept short and the reflection on the subject is stimulated before meeting at the workshop. In the sense of the workshop we will set up a weblog on the workshop website to facilitate a pre-workshop discussion.

Estimation of papers and workshop attendees
We hope to attract a reasonable number of submissions for the workshop and to compile an attractive program for potential attendees. As of now, we expect an audience of around 25 persons (including the organizers) for the workshop. Depending on capacity at the workshop venue, we would allow other interested conference attendees to participate in the workshop (without submitting contributions to the workshop). For that, we would encourage an early notification by the conference organizers (registration committee) about additional workshop participants (i.e., allow to register for the workshop already at the time of conference registration).

Submission process and selection of participants
Electronic submission of the workshop papers is due by March15’2016 at http://its.papercept.net . Notification of workshop papers acceptance is April 8, 2016. The code to the workshop is i2164. Please email Nikhil.gowda@renault.com for clarifications or visit our website for updates.

SCHEDULE (AT THE WORKSHOP)
Post a quick introduction session (with a twist to make things interesting and lively), the workshop will feature a 3-minute madness session, during which Paper submitters will present a brief summary of their paper / research.
Over coffee and snacks (through the day – sugar is your best friend!), the organizers will give a crash course on human-centered design fundamentals and techniques. This will encompass (tentatively and/or but not limited to) the following:

Over 30 minutes we will demonstrate ‘Needfinding’ as a means to address research questions such as: who will benefit from the outcome of this work, who will be study participants, do they have particular needs that can serve as measures of success. The process starts with the ‘Discovery Phase’ of unmet needs to ‘Framing’ the design question before the ‘Imagine Phase’ where we think about creative solutions to meet the needs of the end-user. To help with ‘Discovery’ and ‘Framing’ we will introduce the participants to ‘Design Sketching’ (including tools and materials) of people and their interaction over time through storyboards. Design sketching is a way to develop ideas with oneself, and quickly build upon, and communicate, ideas with colleagues.

Over the next 90 minutes the participants will practice these processes in an organically while developing tangible prototypes. We will explore ‘Improvisation’ techniques, such as puppeteering and embodied improvisation, as a way to prototype motion, action and interaction. And finally, by focusing on lightweight paper prototypes we demonstrate ‘Rapid prototyping’ as a way to explore alternatives prior to developing expensive or time-consuming technologies.

This tutorial is designed to be a hands-on introduction to human-centered design fundamentals and techniques, intended for researchers with a variety of backgrounds, particularly those with little or no prior experience in design. The session will end with 5-minute presentation by the 5 teams of 4-5 individuals. Not before the organizers have a chance to show-off some bright spots and success stories, in HMI prototyping for Autonomous Cars, by following the ‘Human-centered Design’ process.

Lunch break of 45 minutes will be at around noon. All shorter breaks are not scheduled in and up to participants to excuse themselves to use the restrooms and such. Coffee and snacks will be at hand to keep energy levels and creativity levels up.

The workshop is tailored to end by 4pm allowing an hour of a deep dive (discussion on the state of the art for automotive sensing technology and occupant/pedestrian and vehicle-driver interaction modeling) where more experienced researchers have the opportunity to discuss, share, and take away insights, strategies, tips and tricks in dealing with sensor technologies, sensor placement, data analysis, sensor fusion, and modeling techniques. We expect to achieve consensus and commitment for sharing of best-known methods. In this way the organizers commit to provide a platform for exchange of ideas and results, (wiki or similar) that will help us speed innovation using a shared vocabulary and understanding of goals, challenges and potential ways to overcome them. To bring order to this session, each organizers will propose one topic of high relevance and groups will form around these topics for a deeper discussion. This part of the workshop is optional; however, from previous experience happens anyway while people huddle and discussions pop up naturally. By proposing key topics, we hope to curate a part of this ‘natural discussion’.

Table 1. Preliminary workshop schedule (half day, morning).

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>08:30 – 09:00</td>
<td>Introductions</td>
</tr>
<tr>
<td>09:00 – 10:00</td>
<td>3-minute paper summaries (selected 20 max)</td>
</tr>
<tr>
<td>10:00 – 10:30</td>
<td>Crash course on human-centered design fundamentals and techniques</td>
</tr>
<tr>
<td>10:30 – 12:00</td>
<td>Design Sprint (Discover, Frame, Imagine)</td>
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<tr>
<td>12:00 – 12:45</td>
<td>Networking over lunch</td>
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<tr>
<td>12:45 – 2:15</td>
<td>Prototyping</td>
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<tr>
<td>02:15 – 03:15</td>
<td>Organizers Presentation of Previous Work in Autonomous Vehicle HMI prototyping</td>
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<tr>
<td>03:15 – 03:45</td>
<td>5-minute presentations by participants</td>
</tr>
<tr>
<td>03:45 onwards</td>
<td>Deep Dive</td>
</tr>
</tbody>
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*All breaks (coffee, bio, etc) are on an as-an-when-needed basis. Besides lunch the session will not stop.
Outcome of the Workshop
The aim of this workshop is to bring together people who are active in HMI/HRI research on topics relevant to cars of the future (Autonomous, VTI, VTX, etc). The expected outcome is a review of human-centered design methodology and building the context for a deeper dive into the state of the art for automotive sensing technology and occupant and vehicle-driver interaction modeling. Participants are expected to discuss, share, and take away insights, strategies, tips and tricks in dealing with sensor technologies, sensor placement, data analysis, sensor fusion, and modeling techniques. We expect to achieve consensus and commitment for sharing of best-known methods. In this way the organizers commit to provide a platform for exchange of ideas and results, (wiki or similar) that will help us speed innovation using a shared vocabulary and understanding of goals, challenges and potential ways to overcome them.

ORGANIZERS
Nikhil Gowda is an Autonomous Vehicle HMI Researcher at Renault Innovation Silicon Valley. His research interests are what the car should know about the driver, what the driver needs to know about the car and how the two partners on a common mission communicate with each other.

David B Miller Dave Miller is a doctoral candidate in the Department of Communication, and works with the Center for Design Research, exploring the psychology of interaction with agentic systems. He has degrees in behavior design and human factors, and his research spans these areas.

Brian Mok is a PhD candidate in mechanical engineering at Stanford. He works on interactions between automated vehicles and human drivers. Particularly on transition of control and how to improve it and post transition performance

David Sirkin is a Lecturer in EE and Research Associate in ME at Stanford. He teaches interactive device design and human-centered design methods, and conducts research on the role of movement in interactions with expressive everyday (robotic) objects.

Kirstin Kohler Professor for User Experience and Interaction Design at the University of Applied Sciences in Mannheim in the faculty for computer science. Her research is primarily focused on prototyping, new forms of interactions (TUI, NUI) and user experience driven innovation in various domains like automotive, health care and energy

Wendy Ju is Executive Director for Interaction Design Research at Stanford’s Center for Design Research, and an Associate Professor in the Graduate Design Program at the California College of the Arts in San Francisco. Her research is primarily focused on the design of interactive devices, particularly human-robot interaction and autonomous car interfaces.

REFERENCES


