

7th Workshop “Automotive HMI”: Safety meets User Experience (UX)

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Abstract

Automotive user interfaces and automated vehicle technology pose numerous challenges to support all diverse facets of user needs. These range from inexperienced, thrill-seeking, young novice drivers to elderly drivers with a mostly opposite set of preferences together with their natural limitations. To allow assessing the (hedonic) quality of automotive user interfaces and automated driving technology (i. e., UX) already during development, the proposed workshop is dedicated to the quest of finding objective, quantifiable criteria to describe future driving experiences. The workshop is intended for human-computer interaction (HCI), AutomotiveUI, and “Human Factors” researchers and practitioners as well for designers and developers. In adherence to the conference main topic “Interaction – Connects – Everyone” (German: “Interaktion – Verbindet – Alle”), this workshop focus in particular on discussions in the area of human factors and ergonomics (i. e., user acceptance, trust, user experience, driving fun, natural user interfaces, etc.) with main emphasis on hedonic quality and design of user experience to enhance the safety feeling in ADS.

1 Introduction

Future advanced driver assistance systems (ADAS) and automated driving systems (ADS) promise to increase both road safety and comfort. However, while operated in potentially safety-critical environments, those systems must be accepted and trusted by highly diverse user groups (Wintersberger and Riener, 2016) and therefore consider both individual differences (age, gender, experience, culture, preferred driving style, etc.) and short-term personality

traits (workload, fatigue, emotional and cognitive state, intoxication, etc.).

To assess the benefit of future ADAS/ADSs, new (compound) quality criteria need to be defined that allow quantifying their potential impact already in early development phases (Riener et al., 2016). Simulator studies and virtual simulation testing methods used today usually evaluate ADAS/ADS quality using pure safety-related parameters. These parameters cannot describe if and to what extent those systems are accepted and perceived by potential users. In contrast to classical (active, passive or integral) safety systems that are active only for a small amount of time (namely in critical traffic situations only), automated driving systems need a holistic consideration of all involved human factors & ergonomics aspects. The multiple facets of user experience (UX), like the pragmatic and hedonic quality of the product as well as its attractiveness (c.f., the AttrakDiff scale Hassenzahl et al., 2003) need to be addressed in order to achieve a wide spread acceptance in society. On the other hand, however, it is obvious that road safety should still be considered more important than a “charming” user interface with bad usability – as drawbacks in the pragmatic quality can likely result in safety-critical situations. For instance, an ADS may succeed in all test cases from the safety perspective, but can still be unacceptable for potential users if it does not fulfill their individual needs. This is, for example, confirmed by a study from (Frison et al., 2017), who showed that an ADS that operates within the generally accepted limits of speed and acceleration might be rated inadequate by users due to individuals different expectations and also based on concurrently performed non-driving-related tasks (NDRTs) (Pfleging and Schmidt, 2015).

The main emphasis of this workshop lies on the identification of quantifiable acceptance/quality criteria for automotive user interfaces and automated driving systems from the perspective of human occupants with individual needs and expectations. We want to emphasize a more human-centered perspective on the topic including a holistic evaluation of experiences with driving systems in the transition from manual to highly automated driving. Potential quantifiable quality criteria may include (but are not limited to) vehicle speed, lateral/longitudinal forces, headway distances, ergonomic aspects, user acceptance, trust in technology, ethical behavior in (crucial/non-crucial) traffic situations, brand expectations, and many more.

In adherence to the thematic orientation “Interaction – Connects – Everyone” (original title: “Interaktion – Verbindet – Alle”) of the conference, this workshop pays particular attention on discussions in the area of human factors and ergonomics (i. e., user acceptance, trust, user experience, driving fun, natural user interfaces, etc.) with main emphasis on hedonic quality and design of user experience to enhance the safety feeling in ADS.

2 Target Audience

To emphasize the need for a human-centered perspective on automated driving, this workshop is intended for researchers and practitioners as well for designers, developers, and PhD students in the domain of human-computer interaction, automotive user interfaces, cognition/psychology, and human factors. The goal is to serve as platform for knowledge-exchange between university, automotive manufacturers, and third-party suppliers regarding measurements, methods and trends as well as critical discussions in the context of the rapidly changing field of road

transport. The expected outcome of the workshop are models, concepts or methods describing reusable criteria for the quantification of user experience in the light of the aspect of safety in the transition from manual to automated driving.

3 Workshop Summary

The workshop is held on Monday, September 3, 2018 and will start, right after the MuC keynote, at 11 AM and run until 6 PM. The workshop is organized in 3 thematic sessions, each of about 90 minutes in length. We allow interested parties to jump in for single sessions only, but encourage everybody, in particular authors of contributed papers, to participate in the workshop throughout the whole day.

After an introduction into the workshop and a quick round of introductions, in *session 1* authors of accepted papers will get a chance to **present their approach** and issues in the field. There is some time reserved for Q&A, which hopefully provokes lively discussions. Next, a **brainstorming session** will be followed to identify common terms, issues, problems, and challenges related to the topic of workshop. i.e., safety versus UX in automated driving. Participants will note down individual opportunities and pain points on PostIts. The workshop co-organizers will then group the collected PostIts on a **brainstorming wall** and compile from the most mentioned keywords, live or during the lunch break, questions for the interactive part in the afternoon. After the lunch break, in *session 2* participants will be **split into groups** and assigned a specific topic each (based on the result of the brainstorming wall). Each group will nominate a moderator and note taker. The group will perform a dive into the current problems and is tasked, by application of **collaborative sketching**, to produce a solution (proposal). Groups will first discuss their approaches internally, refine their concepts in a second sketching phase, discuss once more to select some winner candidates, and finally get a chance to present their results to the rest of the attendees. Presentation and discussion of group work results will further foster the exchange between participants. After discussions in the large group, workshop co-organizers will summarize the interactive part and collect the material created in the group works (i.e., all the sketches). All documents will be provided to the workshop participants/contributors on a secured area of the workshop website (<http://ws-automotive-hmi.human-machine-interaction.de/>). After the coffee break, the workshop participants will split for *session 3* in new groups. Groups will be assigned (or can select) a specific approach in the broader context of the workshop, inspired by the presentations in the previous session. The aim is then, to build a **quick & dirty prototype** in just 70 minutes and to record a **short video** in the following 20 minutes. Results will be shown to the auditorium and made accessible via the workshop website. At the end of the workshop, both participants and organizers will discuss future plans, e.g., to continue with this workshop series at Mensch and Computer (MuC'19), AutoUI'19, CHI'19 and related conferences or try to setup a special issue in renown journal in the broader area of pervasive/ubiquitous computing or automated driving. More discussions are possible in the consecutive MuC conference dinner later the day.

4 Summary of Contributions

All papers submitted to this workshop were individually reviewed by 2 to 3 reviewers. Based on the review scores, 4 papers could be finally accepted for and invited to the workshop. Accepted contributions span various topics within the area of the workshop, ranging from user-centered design challenges for external car displays to voice control in semi-automated driving and moral behavior of automated vehicles/ethical decision making. Two of the accepted papers were submitted in German language, however, for consistency reason, the summaries are subsequently provided in English.

The first paper “**Applying the User-Centered Design Process to External Car Displays**” by Kai Holländer picks-up on the topic of vehicle-pedestrian interaction in the exterior via displays and discusses the problem that in-situ studies for evaluating corresponding concepts are not yet possible, as cars featuring external displays are not established on public roads. The authors propose a solution based on the well known user-centered design process by Don Norman and came with specific suggestions for the four stages of the UCD process. The main contribution of the paper are ideas how to adopt the classical problem solving process for application on external car displays. It presents, however, no specific answers, but some pointers to unresolved challenges related to aspects such as privacy, user experience, etc. It is expected, that the presented suggestions will trigger interesting discussions at the workshop.

The 2nd paper “**Using voice control for partially automated driving: Expectations and requirements**” (original title “Teilautomatisiertes Fahren via Sprachsteuerung: Erwartungen und Anforderungen”) by Henrik Detjen, Stefan Geisler, Maurizio Salini, Martin Wozniak and Colja Borgmann discusses the potential of voice input to control basic functions of partially automated vehicles. Based on the results of an expert workshop and an explorative video study, the authors came-up with basic requirements of voice control (duration [seconds], length of commands [words], acceptance [questionnaire]) as well as with a list of concrete voice commands, c. f., maneuver catalog, to be used in the context of automated driving. The maneuver catalogue is thereby formulated in a systematic way using the Extended Backus-Naur Form (EBNF). Based on a generally high agreement for the use of voice to control automated vehicles by study participants, it is obvious that the design of appropriate, accepted, and natural voice commands is an important topic for the future, in particular with regard to safety and user experience.

The third paper “**Moral Behavior of Automated Vehicles: The Impact on Product Perception**” co-authored by Anna-Katharina Frison, Philipp Wintersberger, Andreas Riener and Clemens Schartmüller provides an in-depth discussion to the fact that responsibilities will be gradually transferred from car drivers to technology. The authors propose that, consequently, decision-making algorithms of highly automated vehicles (in particular for exceptional circumstances, such as, moral dilemmas) should be programmed to behave similarly to the affect- and intuition-based reasoning of human drivers. The underlying assumption is, that the perceived quality of a holistic driving experience is dependent on the accordance of vehicles moral and ethical decisions with a user’s individual expectation concerning values and attitudes. In contrast to paper four below, which focus more on safety, this paper is stronger oriented towards the user experience aspect of the workshop. The paper discusses implementation strategies for

moral behavior in automated driving systems in order to fulfill users needs and values. Based on an online survey with a rather large sample (n=330), results show that the acceptance of moral decisions correlates with the perception of product quality in terms of need fulfillment. Results are further linked back and discussed in the light of recent accident of Uber or Tesla cars. The authors conclude that involving users and their personal values in design decisions will become more important to increase the general acceptance of automated vehicles. This might be an interesting result for the adopted UCD process proposed and discussed in paper one above.

The last paper **“Ethics in autonomous vehicle: On human behavior in impending accident situations”** (original title “Ethik im autonomen Fahrzeug: Zum menschlichen Verhalten in drohenden Unfallsituationen”) by Stefan Geisler, Sabrina Eimler and Philipp Mischewskie is the second that addresses the important topic of ethical decision making and how people think about this critical issue. The paper provides at length an overview of this topic and its controversial facets and provides links to the primary groundwork in that area. Based on related work, the authors come-up with 2 hypotheses with the main stating that test subjects behave differently when filling in an online questionnaire (less immersion) versus driving a “real” simulator with a corresponding critical scenario (moral dilemma-situation) popping-up (high immersion). For the majority of participants, the decision made in the driving simulator was different compared to the online survey. The authors conclude that in real-life situations the moral behavior of drivers differs to their intentions expressed *a priori* – it is thus questionable whether or not moral decisions of future automated vehicles can be implemented based on real-life observation. In addition, by including decisions obtained in manual driving into the “Trolley Problem”, the authors tackles an interesting question not considered so far in similar work. For both aspects safety and user experience, the last two papers will likely (and controversially) contribute to lively discussions at the workshop.

5 Outcome and Conclusions

The main aim of this workshop is to bring together students, researchers, and practitioners as well as designers and developers with particular interest in the workshop topic. The expected outcome is a list of obstacles as well as potential solutions related to the quantification of user experience in the light of the aspect of safety in automated driving (focus on the driver-passenger perspective). The organizers commit to provide a platform for future exchange of problems, ideas and results related to the workshop focus. This way, we should be able to create shared understanding of goals, challenges and potential ways to overcome them.

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7 Organizers



Riener, Andreas

is a professor for Human-Machine Interaction and Virtual Reality at Technische Hochschule Ingolstadt (THI), Germany and heading the degree program “User Experience Design (UXD)” (undergrad). In addition, Andreas Riener has a co-appointment as research professor for “Human factors, ergonomics, and driver-vehicle interaction” 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.

**Geisler, Stefan**

is professor for Applied Computer Science and Human-Machine Interaction at Hochschule Ruhr West, University of Applied Sciences in Bottrop, Germany. After he received his Ph.D. he worked for several years in the industry, at Ford Werke GmbH in Cologne. There he worked in different automotive HMI projects from research to serial development. 2010 he was offered a professorship. In his research he continues working on automotive HMI, but also on usability of different kinds of technology in times of demographic change (User Interfaces for Ambient Assisted Living systems) and for safety-critical systems. He works with user-centered design processes following the goals of the Positive Computing paradigm.

**Van Laack, Alexander**

is “Cockpit of the Future” project partner at Faurecia. In his role, he is identifying disruptive technologies and developing strategies for innovative interior concepts. Alexander van Laack has more than 9 years of automotive experience. He received his PhD in engineering from the RWTH University of Aachen, Germany and he previously held a position as interaction and technical design manager at Visteon.

**Frison, Anna-Katharina**

is an assistant researcher at Technische Hochschule Ingolstadt (THI) and doctoral candidate at Johannes Kepler University (JKU) Linz, Austria. She is researching user experience factors for automated driving systems (ADS) from a user-centered design perspective. She received her Master degree at the chair for Human-Machine Interaction at LMU Munich.

**Pfleging, Bastian**

is a postdoctoral researcher at the Human-Machine Interaction group at LMU Munich. His general research interests are multimodal and natural user interfaces. In particular, he explores novel human-computer interaction techniques in the automotive context. His current focus is on concepts for non-driving-related activities and tasks that drivers will be able to conduct during assisted, highly, and fully automated driving. In 2017, he is program chair for AutomotiveUI, the premier conference for UI research in the automotive domain.

**Detjen, Henrik**

studied Applied Cognitive and Media Sciences (Bachelor/Master) at the University of Duisburg-Essen. Since 2014, he is occupied at the University of Applied Sciences Ruhr West (Campus Bottrop) in the field of human-technology-interaction and is currently working as a lecturer. His research deals with the application of natural user interfaces within autonomous vehicles.