1st Workshop on "User Experience for Sustainability in the Age of Automated Driving and Electromobility"

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ABSTRACT

Automation and electromobility are disruptive technologies within the automotive industry at the beginning of the second decade of the 21st century. Both technologies combined are inherent in high potential to lower fuel/energy consumption and increase overall efficiency and thus sustainability in the transportation sector. However, the acceptance of fuel-saving driving modes and of electrified drivetrains is of fundamental importance. Therefor Automotive HMIs offer the possibility to inform the passengers about the environmental impact of their driving behavior or habits of use and enable to persuade towards a more sustainable lifestyle. This workshop is designed for UX researchers, students and interested citizens that want to participate in a discourse and design process for future automotive UIs. Using brainstorming methods combined with clustering of the ideas we will find out which information provided at which time is adequate to cause a change of behaviour which then diminishes the environmental impact of driving.

CCS CONCEPTS

• **Human-centered computing** → *Interaction paradigms*; **HCI theory, concepts and models**.

KEYWORDS

Contextual UIs, Automotive HMIs, Automated Driving, Natural Interaction, Adaptive Interfaces.

1 THE ROLE OF SUSTAINABILITY IN AUTOMATED DRIVING

Modern automated driving functions can significantly contribute to the reduction of greenhouse gas emissions. Intelligent predictive Adaptive Cruise Control (ACC) and Congestion Assistant systems are developed for an increased driving convenience and decreased fuel/energy consumption. In the future, the integration of Vehicle-to-X and Platooning can support these efforts. However, the acceptance of the driver/passengers is a fundamental condition of usage of these consumption reducing technologies. The widespread application of digital cockpits and large touch screen infotainment systems in recent years and upcoming augmented reality head-up displays allow to provide various data about the driving state for the driver. For example for electric cars the remaining range and the location of public charging points is an even more relevant information than the remaining range of gasoline cars and filling stations because the range of gasoline cars is higher and there is a well developed infrastructure for filling stations. Indicators for the current fuel consumption or the ideal gear were built in a lot of cars but not all drivers know where to access the information or how to interpret it. Therefor it is a main issue to visualize relevant information in a transparent and comprehensible way. Thereby it has to be considered that too much information can be irritating or annoying and cause the deactivation of useful messages.

2 STATE-OF-THE-ART

Resulting from the claim of climate protection, the long-term goal is to reduce greenhouse gas emissions, primarily carbon dioxide, within the mobility sector. The carbon dioxide emissions of a vehicle depend on the one hand on concepts of energy supply respectively energy transmission (battery electric, fuel cell electric and combustion engine mobility) and on the other hand on the operating mode (offensively/defensively driving, Platooning, etc.) and the integration in a connected infrastructure (stop and go traffic/congestion, waiting time on traffic lights) [4].

The demand of electricity for the increasing numbers of electric vehicles and the relation to the extension of renewable energy resources makes the usage of automated driving functions even more essential. From the view of energy transmission automated driving has for example immediate impact on the charging scheme and the power demand.

Automated driving is currently a technology driver in the automotive sector. Thus, it has to be researched how HMIs are affected by this trend respectively how HMIs have to be developed and designed to lead to acceptance for automated driving. Therefor the ongoing EU-project *Drive2theFuture* was started [1].

This workshop builds on the knowledge of the project and uses the developed workflows to gain information about user-centered design for sustainability within automated and electrified vehicles.

3 PREPARATION OF THE WORKSHOP

The call for participation will be distributed through the relevant HCI/automotive mailing lists, social media channels, and personal contact lists. Furthermore we will ask state governmental platforms, networks and think nets to share our digital flyer on their websites and and social media channels in order to encourage researchers from various fields of expertise to take part in the workshop and form a multidisciplinary participant group.

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3.1 Content and planned conduct of the workshop

As an introduction, the topic of the workshop is described in a presentation from the organisation team. Thereby current research questions like the impact of auxiliary consumers (e.g. air-condition in electric cars) on the range of electric cars and how to share this information. We will invite a keynote speaker who will report on current trends in automotive user experience design and give an outlook about what is expected to become reality in the near future. Thereafter the participants can apply for three groups to work on a (digital) pinboard or flipchart (Miro, Mural). The topics will be prepared in advance of the workshop, based on submitted position papers or a pre-workshop topic collection activity. When the time limit is reached, each group will determine a presenter who presents the results of the group work to all workshop participants. The result boards will be shared with all participants after the workshop.

Table 1: Workshop schedule

Time	Phases
25 minutes	Welcome and introduction
20 minutes	Opening keynote
45 minutes	Brainstorming in breakout sessions
15 minutes	Presentation of the results
15 minutes	Discussion of the results and summary

3.2 Goals of the workshop

The goals of the workshop are one the one hand to inform about recent development trends regarding sustainability features in automated cars and on the other hand gather information about what possible user interaction could be helpful to increase user acceptance and as a consequence real world driving efficiency. The overarching goal is to create awareness about how automated driving can reduce energy consumption and to achieve a change of consciousness towards what is really needed in the user interface and what is dispensable.

4 ORGANIZERS

Uwe Holzhammer holds a research professorship in energy system technology at the Institute of new Energy Systems (InES) and the faculty of mechanical engineering. Through his various activities such as lead researcher at Fraunhofer IWES in Kassel he is expert on energy system technology, demand-oriented energy supply and energy economics. As Senior Fellow at Ecologic Institut gGmBh in Berlin he consulted the Federal Ministry for the Environment about subsidization of renewable energies with focus on bioenergy.

Maximilian Lenz is a research assistant at the CARISSMA Institute of Automated Driving (C-IAD) of Technische Hochschule Ingolstadt (THI). He obtained his bachelor's degree in Mechanical Engineering in 2016 and his master's degree in Automotive and Combustion Engineering at Technische Universität München in 2019. In October 2020 he joined the Human Computer Interaction Group at THI/CARISSMA as a research assistant, focusing on automated driving, sustainability, and platooning.

Andreas Riener is professor for Human-Machine Interaction and Virtual Reality at Technische Hochschule Ingolstadt (THI) with co-appointment at the CARISSMA Institute of Automated Driving (C-IAD). His research interests include driver state estimation from physiological measures, human factors in driver-vehicle interaction, driving ergonomics, amongst others, with particular focus on automated driving. He is steering committee co-chair of ACM AutomotiveUI and chair of the ACM SIGCHI German chapter. He has co-organized several workshops at Mensch und Computer [2, 3], CHI [4], and AutomotiveUI.

Manuel Schweizer works for the Institute of new Energy Systems (InES) at Technische Hochschule Ingolstadt (THI). He completed his bachelor degree in mechanical engineering at Hochschule Augsburg in 2019 and his master degree in applied research for engineering sciences at THI in 2020. During his master study and his current research work he is researching in resource efficient materials, manufacturing processes and further sustainability issues referring the usage of electric mobility.

Robin Tutunaru works for the Institute of new Energy Systems (InES) at Technische Hochschule Ingolstadt (THI). He completed his bachelor and master degree in Electrical and Computer Engineering at Technische Universität München in 2016 and 2018. As a Research Associate he is researching regional scenarios and impacts of a energy transition and further sustainability issues referring the usage of electric mobility.

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