

The 3rd Workshop on Localization vs. Internationalization: Accessibility of Autonomous Vehicles by Different End-Users

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ABSTRACT

The elderly, children, and people with disabilities are among vulnerable users who can benefit the most from the autonomous vehicles (AVs). Yet, most AV concepts discussed in the past decade, including the AutomotiveUI conferences, seem to focus on the mobility needs of younger and middle-aged drivers, who are the overeducated working population, technological enthusiasts, and above middle-class users. In that regard, the third workshop on Localization vs. Internationalization aims to explore these disparities, identify the accessibility barriers and search for research approaches that can increase the accessibility opportunities of the vulnerable AV end-users. Built upon the findings from the previous workshops, which focused on diversity, inclusion and differences among cultures regarding AV-related research approaches, the purpose of the present workshop is to provide an in-depth insight into the state of global AV research and identify areas that still need to be explored to increase the AV accessibility, locally and internationally.

CCS CONCEPTS

• **Social and professional topics** → User characteristics; Cultural characteristics, Geographic characteristics, Age, People with disabilities.

KEYWORDS

Mobility needs, Autonomous vehicles, Internationalization, End-users

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1 INTRODUCTION

Fully automated or autonomous vehicles (AVs) as defined by the Society of Automotive Engineers (SAE) [16] are expected to contribute to road safety and labor-saving, reducing economic and environmental burdens, improving route optimization, allowing for time savings, and reducing traffic jams and increasing productivity due to the role change from driver to passenger [17],[2],[5],[3]. In addition, one of the often referred to as the most beneficial and widely awaited opportunities AVs will bring, is the increase in (and prolongation of) accessibility to mobility of a larger group of users. The elderly, children, people with disabilities, and people with deteriorating and reduced cognitive, motoric and sensory skills are among the many identified groups that would benefit significantly from a self-driving vehicle [14],[1]. Considerable research has also been done investigating the factors that influence trust, acceptance and willingness to use an AV. The available results often reveal concerns regarding technological advancements, legal liabilities, affordability, and cybersecurity [4],[8],[13],[9],[15]. As these topics have been studied by a significant number of experts in the field, we will not focus on them in this workshop, but we will try to address the questions that affect AV accessibility beyond these obstacles from the perspectives of Human Factors and Human-Computer Interaction. In particular, we will focus on the barriers that may be affecting AV accessibility to vulnerable users and search for opportunities and solutions that could eliminate them.

When considering AV's accessibility based on currently envisioned vehicle concepts and prototypes, there seems to be a disparity between the end-users who would benefit most from AVs and the end-users that could actually use them. One of the reasons behind this could be that the available research primarily focuses on the idea of eliminating the operation of the vehicle from the driving task. However, for an independent vehicle use, the act of driving is just one part of the journey, as the driver or later AV user, will still have to define the trip details, such as destination, duration vs. cost preferences, parking options. Furthermore, it will

have to be able to make unplanned changes during the journey such as short stops, route changes or adjust to any kind of emergency. These processes rely on higher levels of cognitive functions, such as information processing and decision making. In addition, they require sensory-motor capabilities for the users to be able to engage in human-machine interaction (HMI) to efficiently and effectively communicate their intentions and information to the AV. Lastly, AVs are often envisioned as part of car- and ride-sharing schemes to maximize vehicle use and optimize transportation infrastructure. This reveals another set of skills future AV users are expected to possess, such as digital skills to use novel user interfaces in order to be able to access these AV services. However, the end-users who are envisioned to benefit most from AVs are people who lack the functional skills required to use an AV, which prevents them from the independent use of a manual driving vehicle today. This raises the question of whether the AVs as envisioned today provide the same accessibility opportunities to different non-driving populations or mainly respond to the mobility needs of the drivers of today.

Based on this background, this workshop aims to discuss the use of AV as a whole journey process from the perspective of diversity and inclusion of different end-users. It aims to include researchers and practitioners from different cultural backgrounds to provide a holistic overview of the state of AV research globally and identify areas that still need to be explored in order to increase the AV accessibility, locally and internationally.

1.1 Topic of the workshop

This is the third workshop on localization vs. internalization, following the successful two workshops conducted in 2019 [11] and 2020 [10] in which more than 60 participants took part from 10 countries (Australia, USA, Korea, Japan, China, India, Austria, Slovenia, The Netherlands and Germany). After discussing diversity, inclusion and differences among cultures regarding AV-related research approaches on standardization and localization in the first workshop, and the impact of COVID19 pandemic in the second one, this year we will take into consideration the lessons learned, and apply the gained insights to further focus on the research questions on how to increase the mobility accessibility of AV users of two particular groups characterized by:

- age, and
- physical and/or mental impairments.

The age-dependent end-users' group will focus on the specific needs of children and elderly people. AVs can enable underage children to travel without their parents to supervise and ensure their safety [9],[7]. AVs can also prolong independent mobility to the elderly, who can experience a decline in sensory-motor and cognitive capabilities due to age [9]. AVs can further increase mobility accessibility to the elderly that do not have any driving experience and have never obtained a driving license.

The second group will try to identify the accessibility needs of people with different disabilities and impairments, which limit their capabilities to operate a vehicle [12]. By taking over the driving task, AVs can provide independent mobility to people with disabilities [6]. It will focus on (but not limit to) people with physical disabilities such as sensory (for example visual or hearing) and

physical impairments, but also psychological impairments, such as divided, sustained and selective attention deficits.

1.2 Main outcome and foreseen impact of the workshop

The goal of this workshop is to identify the accessibility needs of end-users and propose a new user-centered and mobility need-based approach for future design and development of AV vehicles. The results from this workshop will be used to highlight the differences in mobility needs of vulnerable groups and raise awareness about the gap between currently envisioned and actually required AVs. With the inclusion of international participants and experts from different areas, we will try to provide a diverse and inclusive point of view from the end-user perspective, which goes beyond the need for safety-related, ecological and economic benefits of AVs.

2 WORKSHOP DETAILS

To achieve its fullest potential, the workshop will be conducted in two interactive sessions, which will follow the same format. The first session will be based around time zones which enable participation of Europe/Africa (morning) and Asia/Australia (late afternoon) attendees. The second session will be then repeated to enable participation of North and South America (noon) attendees. The first session will focus on the age-related group, whereas the second session will focus on the users with disabilities. Prior to the interactive sessions, a session with short but highly informative invited talks from experts in the proposed topics of the workshop will be conducted. The talks will provide theoretical background and past experiences on: *Elderly drivers and AVs* - Dr. Miltiadis Kyriakidis (Paul Scherrer Institute, Switzerland); *Dementia and driving decisions* - Dr. Victoria Traynor (Aged and Dementia Health Education Research, Australia) on dementia and driving decisions; *Driving and people with neurological disabilities* - Dr. Carolina Diaz-Piedra (Mind, Brain, and Behavior Research Center, UGR, Spain); *Available and potential solutions for increasing AV accessibility to different end-users* - Dr. Alexander Miring (PLUS, Austria), and more.

2.1 Workshop Schedule

The 90-minute-long interactive workshops, will have the following schedule:

- 00.00-00.10 Introduction and presentation of workshop flow
- 00.10-00.15 Role allocation and split into groups (breakout rooms)
- 00.15-01.00 In each breakout room – Create a persona, define AV accessibility needs and propose AV solution
- 01.00-01.20 Presentation of personas and proposed AV solutions
- 01.20-01.30 Conclusions and calls for action

2.2 Reasoning behind using more than one time zone

The accessibility needs for mobility are as diverse as the number of potential end-users. For example, in terms of trip duration and associated costs, the mobility needs of people in rural environments can differ significantly from the needs of people living in cities. They can also be affected by specific characteristics of a country, such

as the public transportation availability or cultural preferences. As this workshop focuses on a user-centered and mobility need-based approach, we believe that it is important to include the cultural and other geo-dependent aspects of the end user. In this regard, we will repeat this workshop two times in different time zones, to be able to include participants from all continents and compare similarities and differences among the same group of end-users. In addition to the regular AutomotiveUI attendees, we will specifically reach out and invite researchers from different regions and cultures who have never participated in AutomotiveUI before, with the purpose of gathering new points of view to culturally and diversely enrich the AutomotiveUI community.

2.3 Active involvement and engagement of workshop participants

The workshop will be conducted using Zoom. Within each workshop session, we will split the participants into three breakout rooms. Each group will be asked to create a persona using Xtenso online tool for one specific representative of the two groups of vulnerable end-users. Accompanied by the persona description, the group will also have to identify the accessibility needs and propose AV solutions which could accommodate them. Using materials provided by the organizers, participants will have to create a visual representation of their persona and AV design considerations, and then, present them in a story-based manner for the other two groups.

3 WORKSHOP ORGANIZERS' BIOGRAPHIES

Kristina Stojmenova is a Research Associate at the Faculty of electrical engineering, University of Ljubljana. Her field of research is in-vehicle human-computer interaction. She is mainly focusing on assessment of driver behavior and driver's cognitive load modeling, with the use of biometric and driving performance data. She has also experience in user-oriented design, having worked on development of user-interfaces for dispatching systems at Iskratel, and innovation creation in multidisciplinary teams at the Demola Network.

Seul Chan Lee is an Assistant Professor of the Department of Industrial and Systems Engineering at Gyeongsang National University. His research goal is to explore user's needs and requirements, to evaluate system artifacts, and to make systems and devices better based on the theories and methodologies of Human Factors and Human-Computer Interaction.

Jaka Sodnik is a Professor at the Faculty of Electrical Engineering, University of Ljubljana. He is an active researcher and supervisor in the fields of human-machine interaction, web technologies and acoustics. His early research focused on the analysis and generation of spatial sound and its use in human-machine interaction, and he was involved in several research projects in the field of virtual and augmented reality. In the past few years, he has focused on assessment of driver and vehicle performance, different aspects of safety, driving simulation, and human-machine interaction in manual and automated driving.

Miltos Kyriakidis is a Scientist at Paul Scherrer Institut. Miltos holds a PhD in human factors and railway safety from Imperial College London, an MSc in Mechanical Engineering from ETH

Zurich and a Diploma in Mechanical Engineering from the Aristotle University of Thessaloniki. His principal research interests lie in the fields of human factors, human performance, safety and resilience of critical infrastructure systems, and the interaction between humans, operators and/or users, with emerging technologies in the transportation, energy and healthcare sectors. He has also been analyzing the legal aspects and market perspectives of automated driving vehicles, and conducting surveys on public acceptance on AVs.

Carolina Díaz Piedra is an Assistant Professor at the Department of Behavioral Sciences Methodology, University of Granada. She holds a BSc in Psychology, a MSc in Research Designs in Health and an International PhD in Psychology. She completed her post-doctoral studies at the Veterans Affairs Medical Center (Phoenix, USA) and the College of Health Solutions (Arizona State University, USA). Since 2019, she is one of the leading researchers in Holistic Approach for Driver Role Integration and Automation Allocation for European Mobility Needs – HADRIAN project.

Myounghoon Jeon is an Associate Professor of the Department of Industrial and Systems Engineering and the Department of Computer Science at Virginia Tech. His Mind Music Machine Lab conducts human-automation (vehicles, robots, and agents) interaction research with a focus on affect, audio, and accessibility. He served as the diversity & inclusion co-chair at AutoUI 2019 & 2020. Dr. Jeon will serve as a General Co-chair for AutoUI 2022.

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