Workshop on Mixed Reality Applications for In-Vehicle Experiences in Automated Driving

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ABSTRACT

With the increasing development of mixed reality (MR), the number of its purposes and applications in vehicles increases. Mixed reality may help to increase road safety, allow drivers to perform non-driving related tasks (NDRTs), and enhance passenger experiences. MR can also be helpful in the transition towards automated driving. However, there are still a number of challenges with the use of MR when applied in vehicles, and also several human factors issues need to be solved. Additionally, virtual reality (VR) has the potential to simulate mixed reality applications for HCI research, such as pedestrian and passenger experiences. In a schedule tailored to fit the requirements of a hybrid presence and online event, participants will define relevant user stories and use cases and elaborate experimental designs with measurable outcomes to contribute to the research roadmap.

CCS CONCEPTS

• **Human-centered computing** → **Mixed / augmented reality**; **Virtual reality**; **Interaction techniques**; *User studies*; *Scenario-based design*; *Interface design prototyping*.

KEYWORDS

workshop, mixed reality, automated driving, user experience

1 PROBLEM STATEMENT & WORKSHOP AIM

Mixed reality technology in vehicles has been researched for several years now (e.g., [1, 2, 7–9, 22, 24]) and shown to have the ability to foster comfort of driving as well as increase trust and safety in automated driving. The emergence of the Microsoft HoloLens, Magic Leap and similar AR technology allows to research in-vehicle use of AR in a more immersive way [10]. This allows developers to explore human-machine interaction concepts more realistically using these AR devices in both lab as well as field studies. Additionally, VR head-mounted displays (HMDs) such as the HTC Vive and Oculus Quest, in conjunction with interaction tracking technologies like Leap Motion for hand tracking and Ultraleap Stratos for haptics provide immersive experiences in fully simulated digital environments. Advances in vehicle automation provide further use cases for MR applications to support activities for work and well-being in vehicles [18, 19, 23] or increase trust in technology [7, 24]. As consequence, researchers working in the field may further explore use cases for this technology in the context of automated driving [16]. However, there is still a number of open issues to clarify prior to a broad application of MR technology in vehicles, e.g., questions addressing the use of head-mounted displays or the utilization of windshield displays (WSDs) [5, 17], as well as context awareness, information relevancy, and view management (e.g., [14]). In addition, further interaction modalities (e.g., finger/ hand gestures, speech commands, gaze input [12]) in combination with MR content should be evaluated. The technical progress also extends the use cases of MR applications with implications on new human factors research fields, e.g., passenger or entertaining experiences [23]. Furthermore, the advances of virtual reality (VR) can be used to investigate vehicle-pedestrian interactions [11]. Open-source available VR driving simulators [4, 15] could further assist HCI researchers in prototyping MR applications for intelligent vehicles.

In this workshop, we would like to bridge the gap between MR designers and HCI researchers from academia and industry, and build upon the results from our previously conducted workshops ([13, 20]). In particular, we are interested in radical innovative ideas for future HMI research in augmented and virtual reality in the context of automated driving. The interactive group sessions will further foster participants to come up with new ideas, provide a catalyst for new cooperative projects, and outline future work in this research area. Topics of interest include, but are not limited to:

- Mixed reality user interface concepts to foster driver and passenger experiences (e.g., non-driving related tasks) for the different levels of vehicle automation [21]
- User experience design for automated vehicles [3]
- Personalization of vehicle interiors, behavior, user interactions, and interfaces [6, 18]

We welcome contributions from both academia and industry!

2 TARGET AUDIENCE

We welcome researchers and practitioners, as well as designers, developers, and students interested in human factors, interaction design, human-computer interface development, mixed reality applications, and automated driving to participate in this workshop. Its goal is to foster a know-how transfer between academia and

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Duration	Phases
15 min	Welcome, introduction round, and presentation of workshop goals.
15 min	Presentation of key concepts in mixed reality and automated driving.
30 min	Session 1: Live/pre-recorded video presentation of ideas/reflection statements.
60 min	Session 2: Brainstorming opportunities and pain points of mixed reality applications in automated vehicles. The findings will be used in Session 3 as starting points for defining research scenarios.
15 min	Coffee break.
90 min	Session 3: Brainstorming and collaborative sketching in groups. Participants will get to design MR applications by choosing from a multitude of options (e.g., AR + HUD + L5 driving + Passenger Experience). The outcome will be presented by each group followed by an engaging discussion.
15 min	Presentation of group discussions.
-	Wrap-up and closing.

Table 1: Proposed workshop schedule (half-day; hybrid workshop).

industry (automotive manufacturers, third-party suppliers) regarding novel approaches for MR HMI research (e.g., augmented and virtual reality) in the transition to automated driving.

3 WORKSHOP DETAILS

This workshop is planned for hybrid (physical and virtual) attendance, and is organized in several sessions, including discussions, interactive hands-on sessions, and presentations, for the duration of approx. half a day (see Table 1). The number of workshop participants will be limited to 30, excluding the organizers.

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A ORGANIZERS

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