1st Workshop on User Interfaces for Heavy Vehicles: Let's Get to Work

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Abstract

There are more types of vehicles than the automobile. Many are used for purposes other than transporting passengers or goods. They are often dedicated to enable the user in performing specific manual tasks, in parallel to driving. Such heavy vehicles range from construction vehicles, such as excavators and articulated haulers, to agriculture vehicles, such as tractors and harvesters. They also include speciality vehicles such as lifts and cranes. Recent advances in information technology radically increases their productivity and safety. Moreover, heavy vehicles are increasingly sensor and software-driven, as well as connected and integrated with information systems. This development creates new interaction challenges and research areas. The aim of this workshop is to gather practitioners, researchers, and professionals who wish to explore the potential opportunities, identify research challenges, and innovate in the domain of heavy vehicles.

Author Keywords

Heavy vehicle interaction; automotive interaction; situation awareness; notifications.

ACM Classification Keywords

• Human-centered computing~Interaction design

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Figure 1: Examples of photos for the "mood cards" pictures to be used in the workshop. Upper: An operator controlling and monitoring an implement behind a tractor, while the tractor automatically drives on the field. Photo by Markus Wallmyr. Lower: Operator interface inside a forest excavator. Photo from CrossControl.

Introduction

Vehicles used in industrial applications, such as in agriculture, construction, and forestry, are increasingly relying on digital information. This serves to aid the operator's task fulfilment, improve productivity, enhance safety, as well as facilitate the innovation of interaction paradigms [1,9,13,17]. In addition, there is also an increase in the digital information exchange with external systems, as well as with other machines [11]. Higher levels of vehicle automation are likely to transform the activities and objectives of the operator from manual labour to managerial activities [14,15]. The operator might, for example, control not only one, but a team of machines [12]. This is a technical revolution that offers numerous opportunities in terms of machine interaction, user experience, increased productivity, and higher safety.

The operation of heavy vehicles often involves cognitive challenges and high mental load. For example, operating a forest harvester has been compared to the load of controlling a fighter jet [10]. Thus, increasing the information load on the operator can potentially lead to higher burden and increase the risk of accidents [3,8,16]. Another challenge can also be found in ensuring fluent collaboration between human operators and increasingly autonomous systems [2,4,6].

Interaction in heavy vehicles is significantly different to automobiles. In heavy vehicles, the focus is on performing a task rather than on driving per se [5,7]. The operator is often a professional, sometimes trained to operate the vehicle. Moreover, the operator focus is not necessarily ahead, to attend to a well-defined traffic infrastructure. Instead, the cabin is designed for one person, with large windows to aid efficient and omni-directional visual perception [16].

Objectives of the Workshop

The objectives of the workshop are twofold. First, we intend to define similarities and differences between automotive and heavy vehicle interaction. This will include differences in primary and secondary task requirements, types of available and relevant information, mental models of users, physical design, available interaction technologies, and more. Doing so will create a broad platform that will allow existing and future research to be discussed in a way that is inclusive of types of automotive that are not automobiles. Second, we will identify solutions, challenges, and research approaches in the areas that are defined in the next section. The diverse expertise and backgrounds of the attendees should allow for fruitful discussions, which could inform targeted development of user interfaces in heavy vehicles', as well as identify new topics of research.

Stages and Areas to be Addressed in Group Discussion

The workshop will be divided into three stages, with the purpose of building a common base in understanding and ending in possible future solutions and potential research areas. The stages are:

- *Information session* – The workshop will start with a short session, by the organisers, and/or by experienced invited speakers. Its purpose is to give an overview on heavy vehicle interaction and the current state of research. We anticipate some participants to be unfamiliar with heavy vehicles and, hence, appreciate this overview for activities

in the next stages. This stage will also include short lightning talks [18] from reflection statements and position papers that can aid continued discussions.
- *Similarities and differences* – The next session is a group activity where the participants will discuss differences and similarities between heavy vehicles and automobiles. The aim is to encourage exchange and reuse of research in the automotive domain and challenges that might exist within the heavy vehicle research domain and vice versa.
- *Possible improvement* – Building upon the established base, the different groups will discuss potential future designs and potential research areas for the topic areas presented below.

A set of topic areas will be used to guide the discussion in the third stage of the workshop. Among the presented areas, prospective participants will be encouraged to express their area of interest before the workshop, in order to facilitate efficient division into groups. We will not require lengthy position papers, but we will give opportunity to provide short reflection statements or position papers that contribute to the workshop objectives (written in the CHI Extended Abstract template). Received submissions will be reviewed before acceptance. The topics include, but are not limited to:

- *Cognitive load and the exchange of more and more complex information with the operator* – Systems are getting more advanced, potentially resulting in higher cognitive loads for the operators. What are the risks and how can we approach this in the interaction design?
- *Maintaining or increasing the operator's situation awareness* – Advanced sensor capabilities could allow the heavy vehicle to be more aware of its surroundings, while the operator might pay attention elsewhere. How can we provide notifications and alerts to facilitate an effective information exchange between the operator and the machine?
- *Safety* – It is essential to emphasize safe operations for the operator as well as third parties. How can road safety knowledge be applied to heavy vehicles and how do these vehicle types differ?

Supplementary Materials for Group Discussions

To aid the group discussion, participants will be provided with a set of mood cards. These mood cards will show images from the current cabins of different cars and heavy vehicles, work scenery from inside and outside the heavy vehicle, images that represent future scenario concepts, etc.

Furthermore, the participants will be provided with flipchart-sized papers, as well as pens, clips, post-it notes, and other common material, so that they can attach the images to the papers and annotate around their ideas. This can then be used by the groups as they will present a summary of their discussions after each stage.

Schedule

The workshop is oriented towards discussions and collaborative sessions, rather than presentations. A tentative schedule of the workshop is indicated below.

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From	To	Topic
00:00	00:15	Introduction by organizers and introduction by attendees.
00:15	01:15	Introduction to the heavy vehicle domain and its interaction. Lightning talks.
01:15	01:20	Introduction to the different thematic areas.
01:20	01:50	Break-out discussion groups on the difference between Automotive and Heavy vehicles.
01:50	02:10	Report back on topics and discussions.
02:10	03:10	Break-out on possible futures for providing better interaction, awareness, or safety in the heavy vehicle domain. What if? or How could we?
03:10	03:40	Report back on topics and discussion.
03:40	04:00	Discussion on possible futures and wrap up the workshop.

Expected Outcomes

We expect the workshop to result in new approaches on interaction design as well as future roadmaps on development and research that will improve the situation for operators of heavy vehicles in terms of user experiences, situation awareness, and productivity. In addition, it is also expected that a fruitful knowledge transfer will happen between existing knowledge, in research on automotive and heavy vehicle interaction, a transfer that will hopefully result in new opportunities for research collaboration.

Biographies

Markus Wallmyr is an industrial Ph.D. student at Mälardalen University, Sweden with an M.Sc. in Computer Science from Uppsala University and a Licentiate Degree in Interaction Design from Mälardalen University. He studies interaction design in heavy vehicles. Professionally, Markus works as user experience lead at CrossControl, who's aim is to enable better products, functionality and experiences for OEMs and end users.

Lewis Chuang is an Akademischer Rat at Ludwig-Maximilian-Universität München, within the Institute for Informatics. He employs gaze tracking and psycho-physiological methods (i.e., EEG) to understand how humans seek out and process information when interacting with closed-loop machine systems (e.g., vehicle handling). He studied psychology at the Universities of York (BSc) and Manchester (MPhil) and received his PhD in neuroscience at the University of Tübingen. See http://lewischuang.com

Taufik Akbar Sitompul is an industrial Ph.D. student at Mälardalen University, Sweden and a researcher at CrossControl. His research topic is industrial visualization in heavy-duty vehicles. He received his B.Sc in Multimedia Studies from the National University of Malaysia and M.Sc in Service Design and Engineering from both Aalto University, Finland and University of Trento, Italy.

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