
An Introduction to Automotive User Interfaces

Bastian Pfleging

University of Munich (LMU)
80333 München, Germany
bastian.pfleging@ifi.lmu.de

Nora Broy

BMW Group
80788 München, Germany
nora.nb.broy@bmw.de

Andrew L. Kun

University of New Hampshire
Durham, NH 03824, USA
andrew.kun@unh.edu

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored.

For all other uses, contact the Owner/Author.

Copyright is held by the owner/author(s).

CHI'16 Extended Abstracts, May 07–12, 2016, San Jose, CA, USA

ACM 978-1-4503-4082-3/16/05.

<http://dx.doi.org/10.1145/2851581.2856685>

Abstract

The objective of this course is to provide newcomers to Automotive User Interfaces with an introduction and overview of the field. The course will introduce the specifics and challenges of In-Vehicle User Interfaces that set this field apart from others. We will provide an overview of the specific requirements of AutomotiveUI, discuss the design of such interfaces, also with regard to standards and guidelines. We further outline how to evaluate interfaces in the car, discuss the challenges with upcoming automated driving and present trends and challenges in this domain.

Author Keywords

Automotive user interfaces; in-car user interfaces; car driving; manual and automated driving.

ACM Classification Keywords

H.5.2 [Information interfaces and presentation (e.g., HCI)]: User Interfaces

Introduction

Today, driving a car is more than the activity of maneuvering the vehicle from one location to the other. Besides the driving task, drivers also want to perform multiple (non-driving-related) activities including the operation of safety and comfort functions or the in-vehicle infotainment system. Drivers want to be entertained (e.g., listen to music or radio

stations) or communicate with the outside world while on the go. Performing such activities can distract the drivers from their primary driving task, posing themselves and the environment at risk. Thus, the challenge for researchers and developers is to design feature-rich but easy-to-use interfaces for the car that allow for safe driving.

This course provides an introduction into the topic of automotive user interfaces (AutomotiveUI). It highlights the special properties of this field of human-computer interaction (HCI) and provides an overview of the requirements, the design, and evaluation of current automotive UIs. We also provide an outlook on automated driving.

Benefits

Participants will benefit from seeing the “bigger picture” of AutomotiveUI and will understand the specifics of this field with regard to HCI. As we see the trend that many interactive innovations find their way into the car, this is a convenient opportunity for an introductory explanation of this field.

Content

During the course we first provide an overall introduction to AutomotiveUI. This includes an introduction of important terms, such as driving task, driver distraction, and vehicle systems. In this part, we also discuss the influence of in-vehicle activities on road accidents.

As a second part, we provide an overview on principles, guidelines, and standards that one should consider during the design of AutomotiveUI. We take this as a basis to also give deeper insights into the design of such interfaces, enriched with practical experiences from previous projects.

In the third part of the course, the participants learn how in-vehicle interfaces can be evaluated during the design. This includes the explanation of various measures with regard to

evaluation, different testing procedures (e.g., Lane Change Task, Detection Response Task, and real road field trials) as well as a discussion of advantages and disadvantage of the different testing procedures.

For the fourth part, we elaborate the specific requirements and expected changes for future automated driving situations. This includes a discussion of the different driving modes from manual driving to fully automated driving, as well as the possibilities that arise when driving highly and fully automated. Also, the importance of take-over requests while highly automated driving will be explained.

As a concluding part, we outline remaining challenges and expected trends with regard to AutomotiveUI and more general human mobility.

Audience and Learning Objectives

This course is targeted at a broad audience including graduate students as well as industrial and academic researchers. We expect to present it to novices in the field of AutomotiveUI but imagine that also researchers and practitioners with experiences in designing, developing, evaluating, and deploying AutomotiveUI may be interested in joining and discussing.

Participants will benefit from seeing the “bigger picture” of AutomotiveUI and will understand in which respects this field is different from others. The objective of this course is to provide newcomers to AutomotiveUI with an introduction and overview of the field. An intensive discussion of the requirements, trends, and challenges will help researchers to get a suitable overview and might be the basis for new research ideas and projects. Especially with automated driving, we see the car as a platform that will become more and more important for HCI.

We want attendees to leave the course with a fresh perspective on the field and inspire them to build the next generation of in-vehicle interfaces or services.

Prerequisites

The expected audience should have a basic knowledge of HCI. This could be a previously attended course or a basic lecture at university or experiences from own projects in this domain. Since we provide an introduction for AutomotiveUI, there are no additional prerequisites.

Presentation Format

The course will be presented as an interactive lecture with slides, videos, and group discussions. This format has been proven to be very suitable for this kind of introductory course. We previously held a similar tutorial at the premier German HCI conference for about 50 tutorial participants and received very positive feedback for content and presentation format.

Regarding the presentation format, we want to offer an interactive lecture where we include various interactive elements for the audience. By involving the audience, we strive to adapt the presentation to the specific (existing) knowledge and interests of the audience. We prefer to stretch the course over two sessions and assume that a typical audience size of 50 participants is acceptable.

Instructor Background

Bastian Pflöging is a senior researcher at the Human-Machine Interaction Group at the University of Munich (LMU), Germany. His research interests are automotive user interfaces, with a focus on multimodal interaction [6] and the support of non-driving-related activities in the car (e.g., communication [8]). Before joining LMU Munich, he was a researcher and PhD student at the Institute for Vi-

sualization and Interactive Systems at the University of Stuttgart. From 2010 to 2011 Bastian was a visiting researcher at the BMW Technology Office USA in California. He holds a Diploma in Computer Science from TU Dortmund, Germany.

In the HCI community, Bastian is involved in many scientific activities. This includes co-organizing different conferences, including AutomotiveUI (Work-in-Progress & Demo Chair [7], Publication Chair), MobileHCI, and Augmented Human. Additionally, he co-organizes various workshops (e.g., Workshop on Automotive Natural User Interfaces, Workshop on Practical Experiences in Measuring and Modeling Drivers and Driver-Vehicle Interaction, both co-located with AutomotiveUI). Also, he serves as reviewer or member of the program committee for various HCI-related journals, magazines, conferences, and workshops.

Nora Broy is a researcher at BMW Group in Munich, Germany. She holds a Master's degree in the Elite Graduate Program Software Engineering of the University of Augsburg, TU Munich, and University of Munich (LMU), Germany. She is a PhD candidate at the Human-Computer Interaction Group of the Institute for Visualization and Interactive Systems (VIS) at the University of Stuttgart, Germany. The focus of her thesis lies on new display modalities in the car. In particular, she investigates the interaction with 3D displays [1, 2]. In 2011 she was visiting the BMW Technology Office in Palo Alto, CA, USA. Now she is affiliated with BMW Group in Munich, Germany, and explores novel in-car UI concepts. In the scientific community, Nora served as poster chair at Pervasive Displays and was also reviewer for various conferences (e.g., CHI, TEI, AutomotiveUI) .

Andrew L. Kun is associate professor of Electrical and Computer Engineering at the University of New Hampshire, and Faculty Fellow at the Volpe Center. His research fo-

Instructor websites:

Bastian Pflöging

<http://www.medien.ifi.lmu.de/team/bastian.pflöging/>

Nora Broy

<http://www.medien.ifi.lmu.de/team/nora.broy/>

Andrew L. Kun

<http://www.andrewkun.com/>

cus is human-computer interaction in vehicles [4, 5]. In this area he is primarily interested in speech interaction, as well as the use of visual behavior and pupil diameter measures to assess and improve the design of user interfaces. He served as the General Chair of the 2012 AutomotiveUI conference [3].

Resources

Additional details about the course as well as accompanying material will be published on our course-related website (see sidebar). It provides information about the course and links to related material, so that participants can get familiar with the scope of the subject and the goals of the course.

Course website:

<http://www.medien.fki.lmu.de/chi16auto/>

REFERENCES

1. Nora Broy, Mengbing Guo, Stefan Schneegass, Bastian Pfleging, and Florian Alt. 2015. Introducing Novel Technologies in the Car: Conducting a Real-world Study to Test 3D Dashboards. In *Proceedings of the 7th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI '15)*. ACM, New York, NY, USA, 179–186. DOI : <http://dx.doi.org/10.1145/2799250.2799280>
2. Nora Broy, Stefan Schneegass, Florian Alt, and Albrecht Schmidt. 2014. FrameBox and MirrorBox: Tools and Guidelines to Support Designers in Prototyping Interfaces for 3D Displays. In *Proceedings of the 32nd Annual ACM Conference on Human Factors in Computing Systems (CHI '14)*. ACM, New York, NY, USA, 2037–2046. DOI : <http://dx.doi.org/10.1145/2556288.2557183>
3. Andrew L. Kun, Linda Ng Boyle, Bryan Reimer, and Andreas Riener. 2013a. AutomotiveUI: Interacting with Technology in Vehicles. *IEEE Pervasive Computing* 12, 2 (April 2013), 80–82. DOI : <http://dx.doi.org/10.1109/MPRV.2013.27>
4. Andrew L. Kun, Alexander Shyrovkov, and Peter A. Heeman. 2013b. Interactions between human–human multi-threaded dialogues and driving. *Personal and Ubiquitous Computing* 17, 5 (2013), 825–834. DOI : <http://dx.doi.org/10.1007/s00779-012-0518-1>
5. Andrew L. Kun, Jerry Wachtel, W. Thomas Miller, Patrick Son, and Martin Lavallière. 2015. User Interfaces for First Responder Vehicles: Views from Practitioners, Industry, and Academia. In *Proceedings of the 7th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI '15)*. ACM, New York, NY, USA, 163–170. DOI : <http://dx.doi.org/10.1145/2799250.2799289>
6. Bastian Pfleging, Dagmar Kern, Tanja Döring, and Albrecht Schmidt. 2012. Reducing Non-Primary Task Distraction in Cars Through Multi-Modal Interaction. *it - Information Technology* 54, 4 (2012), 179–187. DOI : <http://dx.doi.org/10.1524/itit.2012.0679>
7. Bastian Pfleging and Andrew L. Kun (Eds.). 2015. *AutomotiveUI '15: Adjunct Proceedings of the 7th International Conference on Automotive User Interfaces and Interactive Vehicular Applications*. ACM, New York, NY, USA. <http://dl.acm.org/citation.cfm?id=2809730>
8. Bastian Pfleging, Stefan Schneegass, and Albrecht Schmidt. 2013. Exploring User Expectations for Context and Road Video Sharing While Calling and Driving. In *Proceedings of the 5th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI '13)*. ACM, New York, NY, USA, 132–139. DOI : <http://dx.doi.org/10.1145/2516540.2516547>