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# Tutorial: The Car as an Environment for Mobile Devices

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**Abstract**

The objective of this tutorial is to provide MobileHCI newcomers to the domain of automotive user interfaces (AutomotiveUI) with an introduction and overview of the field. The tutorial will introduce the specifics and challenges of in-vehicle user interfaces that set this field apart from others. With a clear focus on the integration of mobile devices into the car, 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; mobile user interfaces; in-car user interfaces; car driving; manual and automated driving; mobile device integration.

**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 car to the destination. Besides the driving task, drivers also want to perform (non-driving-related) tasks [13] includ-

ing the operation of safety and comfort functions. In addition, drivers want to be entertained (e.g., listen to music or radio stations) or communicate while on the go. Often, they use mobile devices (e.g., smart phones and tablets) in the car for these tasks. However, performing such activities can distract the drivers from their primary driving task, posing themselves and others at risk. Thus, the challenge for researchers and developers for applications to be used in the car (on mobile devices or in-vehicle interfaces) is to design feature-rich but easy-to-use interfaces for the car that allow for safe driving.

This tutorial is a reworked version of the courses given at CHI '16 and '17 [8, 9] for MobileHCI. In contrast to the CHI courses, the specific focus of this tutorial is on the use of mobile devices and applications in driving situations. It provides an introduction to the topic of automotive UIs and highlights the special properties of this field of human-computer interaction. By providing an overview of the requirements, the design, and evaluation of current automotive UIs, we discuss the specific requirements for in-car applications on mobile devices.

### **Benefits**

The objective of this tutorial is to provide newcomers to the field of AutomotiveUI (with a potential background in MobileHCI) with an introduction and overview of the field and show how it is different from others. An intensive discussion of the requirements, trends, and challenges will help participants to get an overview and might be the basis for new research ideas. Especially with automated driving, we see the car as a platform that becomes more and more important for (Mobile)HCI. We want attendees to leave the tutorial with a fresh perspective on the field and inspire them to build the next generation of in-vehicle or other car-related mobile interfaces or services.

### **Audience**

This tutorial targets 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 assume that also researchers and practitioners with experiences in designing, developing, and evaluating AutomotiveUI are interested in joining and discussing.

### **Prerequisites**

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

### **Content & Practical Work**

During the 2-hour tutorial we first provide an overall introduction to AutomotiveUI. This includes a discussion 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 mobile systems to be used in the car. 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 tutorial, the participants learn how applications and 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). Furthermore, we plan to discuss study-related aspects in the tutorial.

For the fourth part, we elaborate the specific requirements and expected changes and first insights for future automated driving situations. Also based on the Dagstuhl Seminar #16262 on Automotive User Interfaces in the Age of Automation [15], 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 becomes highly or fully automated.

As a concluding part, we outline current challenges and expected trends [3] with regard to AutomotiveUI and MobileHCI and the more general topic of human mobility.

**Tutorial website:**

<http://www.medien.fki.lmu.de/mobilehci17car-tutorial/>

### Presentation Format

The tutorial will be presented as an interactive course 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 course at CHI '16 and '17 [8, 9] and at the premier German HCI conference and received very positive feedback.

By involving the audience, we strive to adapt the presentation to the specific (existing) knowledge and interests of the audience. We plan to have a 2-hour tutorial and assume that an audience size of 30–40 participants is acceptable.

### Resources

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

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#### **Instructor websites:**

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#### **Instructor Backgrounds**

*Bastian Pflöging* is a postdoctoral 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 [11], workload [10], and the support of non-driving-related activities in the car [7], including communication [14]. He received his PhD at the Institute for Visualization and Interactive Systems (VIS) at the University of Stuttgart. Before joining the University of Stuttgart, he was a visiting researcher at the BMW Technology Office. In the HCI community, Bastian was and is involved in organizing different conferences such as AutomotiveUI (Program Chair '17, Work-in-Progress & Interactive Demo Chair '15 and '16), UIST '18, MobileHCI, and Augmented Human, as well as various workshops (e.g., at CHI '16 and AutomotiveUI). Also, he serves as reviewer and member of the program committee for various HCI-related conferences, journals, and magazines.

*Andrew L. Kun* is associate professor of Electrical and Computer Engineering at the University of New Hampshire

in Durham, and Faculty Fellow at the Volpe Center. His research focus is human-computer interaction in vehicles [3, 6], primarily in speech interaction [5], as well as the use of visual behavior and pupil diameter measures [10] to assess and improve the design of user interfaces. He served as the General Chair of the 2012 AutomotiveUI conference [4] and was Work-in-Progress & Interactive Demo Chair in 2015 and 2016.

*Nora Broy* is a researcher at BMW Group in Munich, Germany. Her research interests lie on novel input and output modalities in the car and on the interaction with an automated vehicle [12]. She received her PhD at the Human-Computer Interaction Group of the Institute for Visualization and Interactive Systems (VIS) at the University of Stuttgart, Germany. Her thesis is about new display modalities in the car and particularly addresses the interaction with 3D displays [1, 2]. As part of her Master studies Nora was visiting the BMW Technology Office in Palo Alto. In the scientific community, Nora served as poster chair at Pervasive Displays and was also reviewer for various conferences.