Automotive User Interfaces

Benutzungsschnittstellen im Automobil

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In the last 20 years, we have observed a massive change in the way users operate vehicles and interact with systems in the car. Information and entertainment systems as well assistance and comfort functions have become the norm in the car. Formerly complex tasks, such as starting to drive uphill and side parking in tight city areas, are in modern cars supported or autonomously performed by technical systems in the vehicle.

Mobile communication, permanent availability, and ubiquitous access to information are taken for granted. Many users value these technologies highly and do not want to miss them while driving. Overall we see that these developments are an exciting trend: on one hand complex and difficult tasks are taken over by technologies and ease the primary driving task for the user. On the other hand, we see that new interaction needs arise from the use of mobile and embedded technologies in the automotive context. The idea for this special issue on "Automotive User Interfaces" developed from this tension between automation and need for more interaction.

Given the topic it is self-evident that the contributions included in this issue are from a multidisciplinary community. Besides computer science, the contributing authors have backgrounds in media informatics, psychology, design, and mechanical engineering. These changes that we describe in the automotive area are symptomatic for many other domains where technical systems are developed and implemented. Traditionally, such technical systems have their origin in mechanical and electrical engineering. Then computer science started to play an increasing role in innovating these products and in creating value. More recently, we see that on top of this further requirements evolve and Human-Computer Interaction becomes a central element. The overall user experience, basically how the contact with the technical system in the context of usage is perceived by the user, is what the user sees and what in many cases influences the purchasing decisions. It is however important to understand that for this shift in focus the underlying technical quality in mechanical and electrical engineering as well as in computer science has to be excellent.

In this special issue we have included five papers discussing modern automotive user interfaces and technologies. The contributions look at the topic from various angles and also show different research approaches and methods used in this field.

Bengler et al. analyze current development towards systems, where humans and machines cooperate in order to reach a goal. In their paper they provide a descriptive taxonomy for systems with joined control. Their motivation is drawn from the automotive field, but more widely applicable to Human-Robot Interaction and command centers. With a layered model they provide a means to describe and reflect on human-machine systems with different levels of cooperation.

Eckholdt et al. investigate how the use of Advanced Driver Assistance Systems (ADAS) influences the driving experience. Based on a qualitative study of the use of an Adaptive Cruise Control System (ACC), they describe the resulting different user experiences. In particular, they look at the question: how to design such systems in order to improve the user experience while driving. One finding of their work is that driver assistance systems should be designed to empower human capabilities rather than as means to provide assistance or help (to maintain the "joy of driving").

The paper by Angela Mahr assesses the use of acoustic warning signals in the car. In current systems primitive acoustic outputs (e. g., beeps) are used to steer the driver's attention to certain events in the car or to deliver warnings. In her contribution she focuses on the use of spoken text output in automotive user interfaces. In a series of experiments, where crossmodal effects are investigated, she shows that speech priming can have a positive effect on the recognition of visual objects.

Different technical solutions to reduce the driver distraction are presented in the paper by Pfleging et al. The first prototype describes a system that supports attention

switches between the real world and the interaction with a screen in the car. Using an eye-tracker that supports highlighting of the last gaze position, the time for the attention switch can be significantly reduced. In a second prototype it is shown that by using multi-touch interaction on the steering wheel the required visual attention can be reduced.

Asif et al. describe in their paper an approach for tactile information presentation in the car. The prototype uses a belt with integrated vibration actuators to communicated directional instructions from the navigation system to the driver. In their experiment they show that such a belt (or later perhaps integrated into a seat belt) presenting vibration patterns can be used as a further output channel. Their paper describes vibration patterns and reports differences in user preference and the measured performance of the information transmission.

The papers included in this issue provide an overview of current research in the area of Human-Vehicle Interaction. We expect that over the next decade the changes in interaction with the car will be even more significant. With developments of semi-autonomous vehicles and with additional freedom and requirements from e-mobility we expect that the future is posing many exciting interdisciplinary research questions.

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