
Automotive User Interface Research Moves into the Fast Lane

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Abstract

This SIG will explore issues related to the design of in-vehicle human-computer interfaces. A modern vehicle's human-computer interface often facilitates the basic operation of the vehicle, but also provides more advanced features, such as assistive cruise control and lane keeping. Furthermore, today's drivers and passengers frequently use brought-in devices, in order to access navigation instructions, and use non-driving related types of digital information such as social media. The SIG will explore how in-vehicle interfaces can facilitate safe interactions for all of the occupants of the vehicle, and how they can take advantage of connected vehicle technologies.

Keywords

Automotive Industry; Cars; Vehicular Information Systems; Car Entertainment; Driver Information Systems; Driver Interaction; Special Interest Group

ACM Classification Keywords

H.5.2 [INFORMATION INTERFACES AND PRESENTATION]: User Interfaces---Ergonomics, Input devices and strategies, Interaction styles, Voice I/O.

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Introduction

For a long period of time, in-vehicle human-machine interaction provided very few surprises. Drivers knew how to operate the steering wheel, adjust the temperature and change radio channels. This state of affairs changed drastically with the introduction of smart mobile phones. Drivers wanted to have the types of communication and information that was previously reserved for their homes and offices. Today, due to tremendous advances in ubiquitous computing, in-vehicle devices provide myriad communication options and sources of information. However, in-vehicle human-machine interaction, and more specifically automotive user interfaces (AUI), are now perceived as a critical area of research by government, industry and academia. Major funding bodies such as the EU aim at an early and wide availability of services for consumers, increasing driving safety, comfort and efficiency [1].

Further complicating the situation, the design of in-car user interfaces, which was historically the responsibility of car manufacturers and OEMs, but now they face the challenge of incorporating additional features from. This group includes the car manufacturers and OEMs, but also the designers of devices that are brought in to the car, such as personal navigation devices and mp3 players.

In light of the need for exploration of in-vehicle HCI, and following up on the 2010 CHI SIG entitled "Automotive User Interfaces: Human Computer Interaction in the Car," [2] this Special Interest Group will focus on the following questions:

- How can we design in-vehicle user interaction, even with multiple devices (e.g. phones and

tablets), without unduly compromising driving performance and safety?

- How can we enhance the experience for *all* of the occupants of the vehicle through novel interactive services?
- What are the UI challenges and opportunities for connected vehicles and cooperative driving?

Research and development of user interfaces in the automotive domain is in many ways different from desktop settings or other mobile environments because safe driving is always the primary task and addresses very different aspects of HCI research [3][4]. Therefore we hope to start a discussion on methods, tools, and techniques for research in this area. Through this special interest group, we hope to bring together HCI researchers and practitioners in government, industry and academia to discuss both the needs for improved and innovative interaction and interfaces in the car, and techniques for achieving these.

Managing Multiple Devices and Functions

Drivers may interact with many devices while driving and these interactions might influence driving performance as well as visual attention for the primary driving task. Unfortunately, without careful design, interactions with in-car devices will most likely make driving performance worse and will reduce visual attention on the road ahead. In various studies, researchers have shown the negative influence of interacting with police radios, mp3 players, portable navigation devices (PNDs) and many other devices. But, it is clear that interactions with these devices provide value to the user. How can we design interactive services that seamlessly integrate with the car user interface? How can we design interactions with

these devices such that they do not negatively influence driving performance and visual attention? How can we design the interactions such that they do not introduce a cognitive load that the driver cannot safely handle under the given driving conditions? Of course this latter question introduces yet another important one: what exactly is the relationship between increased cognitive load and driving safety? Is there also an opportunity to go beyond simply eliminating the negative effects of in-car devices and designing interfaces that will improve driving performance and visual attention thus, hopefully, driving safety? Reaching beyond the car, how can the communication with the environment and the surrounding traffic and drivers contribute to information and services that increase safety and cooperation on the road?

Enhancing the Experience of all Occupants

Car manufactures are adding more and more information and entertainment functionality in the car. Users can access information about the current status of the car (e.g., power efficiency and driving mode in a hybrid drive), information collected by the car, and information gathered over the Internet (e.g., weather and traffic information). With upcoming car-to-car communication technologies, the available information related to the car and its environment will increase and can contribute to the driving experience. We hope to start a discussion about what types of information about the car, the passengers and the environment can be integral parts of the information presentation and experience in the car.

Similar to the trend in information presentation we can observe an increase in entertainment functionality. Many car manufacturers offer sophisticated systems for

media consumption for drivers and passengers ranging from audio presentation to Internet access, TV and games. In the future we might see more cooperative entertainment services for passengers in the car and, with the connectivity to others, social games and entertainment [5] along the road. In a time when driving becomes more and more automated, entertainment and infotainment may rise to a different level, even for the driver of the car. On the other hand, we also need to explore whether the safety and attentiveness of the drivers may even be improved when allowing a certain amount of entertainment that requires visual attention.

UI Opportunities of the Connected Car

Currently, researchers and practitioners in industry, government, and academia are heavily involved in the development of vehicle-to-vehicle and vehicle-to-infrastructure technologies [6], in order to enable highly trustable traffic-related bidirectional real-time information. However, such initiatives strongly focus on the challenges of technical realization and performance, and typically do not pursue the innovation of end-user interaction as a primary goal. To this end, we need to get a thorough understanding of how to design real-time traffic services that demand significant behavior changes, such as spontaneously changing the transportation mode means due to dynamic navigation and rerouting services. With the advent of communication of the car with its environment and other cars we can expect interactive infotainment and entertainment involving the surroundings and other travelers on the route.

The design implications for highly urgent traffic-related messages, enabled by connected cars should be

investigated. For example, when the system detects an accident around the upcoming curve, drivers may require automatic support provided by advanced driver assistance systems (ADAS). In this respect, we also have to look at aspects with automated systems. Technically, it might be possible to receive driving information from the traffic ahead; yet the question of how to select and present this information and how the presentation and interaction will impact the driving performance are still open. We need to discuss the challenges of transparently informing drivers about the capabilities and limitations of such automated driving support. Also here, novel networked services must not result in unsafe multitasking, which in turn demands sophisticated driver distraction management methods.

Conclusion

This special interest group session aims to gather researchers and practitioners from government, industry, and academia in order to find ways to further catalyze the innovation of automotive user interfaces. We hope to jointly increase our understanding of the automotive interface questions selected for this session.

Interesting directions and collaboration potentials identified within this discussion can feed into the definition of the program of upcoming events within the annual Automotive User Interfaces conference, which is organized in cooperation with ACM SIGCHI (<http://auto-ui.org>).

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