Adjunct Proceedings of the 5th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI ,13), October 28–30, 2013, Eindhoven, The Netherlands.

AutoNUI: 3rd Workshop on Automotive Natural User Interfaces

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ABSTRACT
Natural user interfaces—generally based on gesture and speech interaction—are an increasingly hot topic in research and are already being applied in a multitude of commercial products. Most use cases currently involve consumer electronics devices like smart phones, tablets, TV sets, game consoles, or large-screen tabletop computers.

Motivated by the latest results in those areas, our vision is to apply natural user interfaces, for example gesture and conversational speech interaction, to the automotive domain as well. This integration might on one hand reduce driver distraction in certain cases and on the other hand might allow the design of new user experiences for infotainment and entertainment systems.

The goal of this workshop is to continue the discussion and exploration of the design space of natural multi-modal automotive user interfaces and to continue the fruitful discussions held at the first two workshops on Automotive Natural User Interfaces at AutomotiveUI 2011 and 2012 [8], [9]. We would like to analyze where and how new interaction techniques can be integrated into the car – for manual and (semi-) autonomous driving situations.

Categories and Subject Descriptors
H.5.2 [**Information interfaces and presentation (e.g., HCI)**]: User Interfaces – Input devices and strategies (e.g. mouse, touchscreen), Interaction styles (e.g., commands, menus, forms, direct manipulation), Natural language, Voice I/O.

Keywords
Automotive user interfaces; gesture interaction; multimodal interaction, natural user interfaces, speech interaction.

1. INTRODUCTION
Human-computer interaction (HCI) depends, in most use cases, on the context in which the interaction between user and computer takes place. This is especially true for the automotive domain with its multitude of environment-specific requirements. The primary task of driving a car can itself often be very challenging for the driver — despite advances in assistive driving — especially as overall traffic density is growing. At the same time the car's cockpit is getting more complex due to new, feature-rich assistance and infotainment systems on both built-in and mobile devices. In order to complete secondary and tertiary tasks [2] with these systems, many drivers execute several tasks simultaneously besides the driving task. Efficient and easy-to-use HCI is therefore of particular interest in the automotive domain, with the background goals of most research being the reduction of driver distraction and the support of safe driving.

According to the U.S. Department of Transportation, the average time drivers spend per day in their cars while commuting, shopping, or traveling is 43 minutes/day in Europe and 86 minutes/day in the United States. As most drivers spend this time alone, they demand ever-wider entertainment options and an almost living room-like environment for their vehicles. This underlines the need to enhance the emotional attachment between driver and car. Interaction design with an eye towards usability can help to foster this attachment. Furthermore, societal and IT trends are resulting in an always-connected environment in which drivers and passengers demand constant access to information and in which vehicles have to be aware of their surroundings. Adding to this challenge are upcoming systems for (semi-) autonomous driving as well as the increased prevalence of car-sharing and a higher need for information when using electric cars. New interaction techniques are clearly needed to enable a new generation of interactive systems for information access and the accomplishment of tertiary tasks while driving.

Buttons and similar physical controls are still predominant in the automotive design space [4], however the increasing number of available functions has lead to a situation where dashboard space

precludes a one-to-one mapping from physical key to function. In order to circumvent this problem, current systems tend to provide hierarchical menu structures to access certain functions. The drawback of this approach is that immediate access to these hierarchically nested functions is no longer possible. This might lead to longer task completion times and—depending on the visualization—might increase visual distraction.

The introduction of new electronic consumer devices like smart phones, tablet computers, and game consoles has brought with it new ways of interacting with computers and embedded devices. Thus, a growing number of people today is used to interacting with touch-sensitive devices (touchscreens and touchpads) and many have some first-hand experience with speech technologies and gestural interaction. Within HCI research, "natural user interfaces" (NUIs) [11] have become a fruitful research topic encompassing multi-touch and full body gestures, conversational dialogs and affective systems, among many others. The introduction of computer vision-based tracking technology like the Kinect for Xbox 360[1], Leap Motion[2] and natural speech systems like Apple's Siri[3] has extended the interaction space for consumer devices. Inspired by these developments, the question arises whether these interaction techniques might also be suitable for automotive user interfaces. Although some early research has been carried out in the automotive context (e.g., [1], [5], [7], [10]), only some basic touch- and voice-activated interfaces have found their way into deployed in-vehicle systems so far. Gestural and multimodal interfaces are not yet broadly deployed. As they might facilitate the execution of secondary or tertiary tasks without increasing driver distraction, the integration of such interfaces is of particular interest (e.g., [6]). Moreover, further development of display technologies like glasses-free 3D, high resolution, shaped, or transparent displays offer new ways for visualizing interactive as well as informative content. So far, output technologies are less investigated in terms of natural user interfaces and especially inside the car.

Additionally, natural user interfaces have the potential to enhance the user experience. Designing experiences with these user interfaces can address and fulfill psychological needs of the user while interacting with the car (e.g., [3]). The resulting emotional attachment to the car can ease the acceptance of a system and avoid disuse. Considering the daily drive times mentioned above, the user experience offered by automotive user interfaces´is likely to gain prominence in the car-buying decision. This will become even more important with the rise of assistive systems and autonomous driving modes when the driver might have more time to concentrate on secondary and tertiary tasks. Depending on the situation, these interfaces might still need to offer easy means of notifying the driver to re-gain control of the car.

Besides supporting interaction for the driver, suitable infotainment and entertainment functionalities are also of special interest for co-drivers and passengers on the backseat. Compared to living room setups, the interaction space for passengers is limited by the dimensions of the car and through safety regulations (e.g., wearing seat belts). In combination with the increased robustness requirements of a moving environment, multimodal, natural interaction might also support this sub-domain of automotive user interfaces.

Besides integrating these technologies into the car in general, we must also be concerned with how potential new interaction techniques are designed and evaluated. How can individual NUI technologies be used, and how might they be combined in new and interesting ways to foster the overall user experience?

2. OBJECTIVES

This workshop addresses the following issues:

- Generating an overview of which (natural) user interfaces are already used in the car and how they might be used in the future.
- Concepts for future multimodal interactions in the car.
- Discussion of new display modalities in the car (e.g. 3D displays, shaped displays).
- Automotive user interface frameworks and toolkits.
- Looking into special sub-domains: the driver, the co-driver, the backseat area, or connection to the outside.
- Understanding the definition of "natural" for different users. What are the differences across generations, cultures, and driving habits (e.g., occasional drivers vs. professional drivers)?
- Understanding how NUIs can be used in the automotive domain: do they replace or rather augment other interfaces?
- Discussion of potential issues of bringing NUIs into the car.
- Researching the relevance of traditional UX factors to the automotive NUI context.
- Researching how UX factors might motivate the integration of new NUIs into the car.
- New concepts for in-car user interfaces enhancing UX and experience design in the car.
- Multimedia interfaces, in-car entertainment, in-car gaming.
- Future trends: the ubiquitous car in a mobile society.
- Automotive user interfaces supporting the special needs and flexibility of (semi-) autonomous driving modes.

3. BEFORE THE CONFERENCE

The workshop organizers will commit to publicize their workshop. The call for participation for this workshop will be distributed via HCI and Automotive UI related mailing list like, e.g., ACM SIGCHI, British HCI News, and Local SIGs lists. Additionally, we intend to distribute the call for participation as a one-page leaflet at HCI related conferences. We will further use our own/personal distribution lists. The website of the workshop series[4] will be updated in order to provide information about the upcoming workshop, the submission modality and links to related material, so candidates can get familiar with the scope of the subject and the goals of the workshop. Accepted position papers and other pre-workshop materials will be made available to participants. This way, presentations during the workshop can be kept short and the reflection on the subject is stimulated before the workshop. In the sense of the workshop we will set up a weblog on the workshop website to facilitate a pre-workshop discussion.

[1] http://www.xbox.com/kinect

[2] http://www.leapmotion.com

[3] http://www.apple.com/iphone/features/siri.html

[4] http://blog.hcilab.org/autonui

4. DETAILED PLAN FOR CONDUCTING THE WORKSHOP

This workshop is planned as a one-day workshop with breakout sessions, alternated with a moderated group discussion.

The workshop will start with an introduction to the workshop topic (9:00-9:15), followed by very short introductory presentations (e.g., in a pecha kucha style) to get familiar with the participants and the topics they are working on. The introductory presentations will be kept short and focused, so there is ample time for discussion (9:15-10.30). After the break (10:30-11:00) the organizers present the common themes of the submitted papers, grouping them into different sessions (3-5 topics). The different groups will then discuss their topics during a first breakout session, creating a list of conclusions (11:00-12.15). The organizers will actively interact with the audience to stimulate discussion around the workshop topic.

After the lunch break (12:15-13:15) a short alignment of pre-lunch discussions will happen in the whole group. This continues into a second round of break-out sessions to further discuss grouped topics (13:15-14:30). After the coffee break (14:30-14:45) the results of the breakout sessions will be discussed in the whole group. The conclusions of the workshop will be worked out and follow up activities will be specified (14.45-16:00).

5. PARTICIPATION

Workshop candidates are requested to submit a position paper (no longer than 4 pages in the CHI extended abstracts format) about their research that links to the workshop theme. Participants will be selected on the basis of the relevance of their work and interests and familiarity with the topic.

6. EXPECTED PARTICIPANTS AND SELECTION PROCESS

The workshop aims to bring together researchers, students, and practitioners, who are interested specifically in the automotive context. In particular, we hope for participants with different backgrounds and perspectives, e.g., automotive user interface (UI) designers, experience designers and engineers from a scientific as well as from an industrial perspective are welcome to submit position papers and join the workshop. The number of participants should be limited to 20. Participants will be selected based on their submission through a review process. The organizers as well as selected researchers working in this area will form the program committee and will conduct the review process as usual for this kind of venue.

7. OUTCOMES

We have identified the potential for a fruitful continuation of our workshop series on Automotive Natural User Interfaces [8], [9]. We want to give researchers and practitioners the possibility to discuss the ways of integrating NUIs into the car and measuring the “naturalness” of their designs. We think that it is furthermore necessary to identify challenges related to understanding and addressing users’ psychological and affective needs with respect to automotive user experiences. We expect that the coverage of these topics will further participants’ understanding of the role of NUIs in the car, and that workshop outcomes advancing automotive NUIs will more broadly advance the entire discipline of automotive user experience.

To capture the outcomes of the workshop, different methods will be taken. On the one hand, we intend to build up a website that discusses the different ideas on natural user interfaces. The idea is to ask all workshop participants to take part in building up content for this website and do so even beyond the boundaries of our workshop. As the topic of natural user interface has already advanced quite a bit over the last workshops, a second idea is to also discuss the creation of a book on natural user interfaces. In this case, a call for participation could be set up after the workshop to write and submit chapters for this book. Workshop participants would be encouraged to extend their workshop contribution into separate book chapters. In order to ensure a certain scientific contribution of this book, a suitable review process would be set up.

8. Organizers’ Backgrounds

Bastian Pfleging holds a Master’s (Diploma) degree in Computer Science from TU Dortmund, Germany. He is a research assistant at the Human-Computer Interaction Group of the Institute for Visualization and Interactive Systems (VIS) at the University of Stuttgart, Germany. His general research interests are multi-modal and natural user interfaces. In particular, he is interested in human-computer interaction in the automotive context. From 2010 to 2011 he was visiting the BMW Technology Office in Palo Alto, CA, USA. Bastian was involved in organizing the first two workshops on Automotive Natural User Interfaces at AutomotiveUI ’11 and ‘12 and was Publication Co-Chair of AutomotiveUI ‘12.

Ignacio Alvarez received a PhD from the University of the Basque Country and was a Research Assistant at the Human-Centered Computing Lab of the Clemson University. His research areas encompass ubiquitous computing, automotive user interface design, spoken-dialog systems and affective computing. Since 2009 he worked as a research associate at the BMW IT Research Center in South Carolina in the fields of mobility services and user experience. In February 2012 he joined BMW AG as IT Systems Architect focusing in development of vehicular speech technologies.

Jennifer Healey is a scientist at Intel Corporation Research Labs, she researches devices and systems that would allow for innovations that imagines a future where computers and smartphones are capable of being sensitive to human emotions and where cars are able to talk to each other, and thus keep their drivers away from accidents. She holds a PhD from MIT in electrical engineering and computer science. While there, she pioneered “Affective Computing” with Rosalind Picard and developed the first wearable computer with physiological sensors and a video camera that allows the wearer to track their daily activities and how they feel while doing them. From there, she moved to IBM where she worked on the next generation of multi-modal interactive smartphones and helped architect the "Interaction Mark-Up language" that allows users to switch from voice to speech input seamlessly.

Nora Broy holds a Master’s degree in Computer Science from TU Munich, 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. Her general research interests are new display modalities in the car. In particular, she aims at integrating 3D content and interaction into the car. In 2011 she was visiting the BMW Technology Office in Palo Alto, CA, USA and is now affiliated with BMW Research & Technology in Munich, Germany.

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