

Guest Editorial Preface

Special Issue on Automotive User-Interfaces (Part 1)

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It is widely recognized that the automobile is progressing towards the status of “computer on wheels” with greater connectivity to the outside world and higher levels of autonomy. As a consequence, not only will what we consider to be “driving” fundamentally change, but also a plethora of novel functions and services will become available to the users of future vehicles. The design of the automotive user-interface is/will be complex, dependent on many ‘hard’ (e.g. performance, safety) and ‘soft’ (e.g. likes/ dislikes) variables.

This, the first of a two part Special Issue of the International Journal of Mobile Human-Computer Interaction (IJMHCI) dedicated to Automotive User-Interfaces, reflects this breadth and depth of challenges, ranging from specific user-centred issues facing industry now (e.g., relating to evaluation of distraction), through to longer-term perspectives, such as how to design user-interfaces for car interiors in which the “driver” spends large amounts of time not in control of his/her vehicle.

The eight papers in this special issue (split across two consecutive issues of the IJMHCI) are drawn from the highest ranking submissions to the Seventh International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI’15) which was held at the University of Nottingham, UK in September 1-3, 2015. Eighty papers were submitted to the conference of which 42 (53%) were accepted for aural/poster presentation. Authors for this special issue were invited to update their conference articles to include new data and analysis and also to provide further insights and conclusions from their work. The original papers were all reviewed by at least three experts in the area and a meta-review was also undertaken for the final journal papers by the guest editor.

The first two papers consider interesting issues for the design of Augmented Reality (AR) Head-Up Displays (HUDs) within vehicles, potentially using the whole windshield as a display. This is an area for which there is considerable interest within the research and industry communities given the range of potential advantages for AR HUDs in this context (information closer to line of sight, reduced visual accommodation, new functions/ services etc.), but where there are many open questions (issues of legibility, cognitive capture, depth perception, and so on). For Smith, Gabbard, Burnett and Doucheva the concern is the nature of driver distraction when using a HUD versus a traditional in-vehicle (head-down) display (HDD). A driving simulator study is reported with 16 participants carrying out a range of visual search tasks while following a lead vehicle along a motorway. Importantly, they conclude that approaches to evaluating distraction based on HDD research may not apply for a HUD. In other words, we need to find better methods/metrics for understanding what constitutes a ‘distracting’ HUD. For Large, Burnett and Bolton the focus is on the use of AR HUDs to present novel navigation information, particularly referring to landmarks in the environment. Their simulator study required 20 participants to locate turnings using different AR HUD methods (conventional, arrows on road, arrow pointing to landmark and box around landmark). The results demonstrated clearly how important landmarks are for effective navigation. Most importantly, they

showed how an AR HUD can allow potentially poor landmarks (limited visibility, uniqueness etc.) to be enhanced and thus serve as useful guidance cues.

The next paper also considers some issues relating to distraction, this time with common user-interfaces in the market today. Giang, Chen and Donmez investigate the impact of different mobile devices (notably smartphones and smartwatches) on drivers' performance (objective and subjective). Two studies are reported both within a simulator in which participants carried out a series of tasks related to notifications while driving. Importantly, the authors established that smartwatches can have more negative effects on safety-related driving performance than smartphones, but drivers do not necessarily recognize these increased risks.

The final paper in this part of the special issue shares a common desire with the first two papers to appear in the second installment (thus nicely linking the two parts of the special issue) and that is the desire to understand how people might need to interact with future highly automated vehicles – particularly when moving in/out of control (the so-called handover problem). This is a major issue for NHTSA level 3 automated vehicles in which the driver will still need to have some role, for instance when a problem with a sensor is identified. In the paper by Walch, Lange, Baumann and Weber they use a driving simulator with 30 participants to investigate how a bi-modal (visual and auditory) user-interface can prepare a driver to resume manual control of an automated vehicle in situations where the system cannot cope (e.g. heavy fog). They conclude that the time required to regain situation awareness (known as the time budget) is critical for users of future highly automated vehicles. In their study 4 seconds was considered to be too short, whereas 6 seconds was sufficient for the non-critical scenarios they investigated.

As a whole these papers (together with those to appear in part 2) offer a significant contribution to our understanding of 'state in the art' for automotive user-interfaces. The research community will have significant and many issues to consider over the coming years as vehicles become simultaneously more complex from a technology perspective, yet the task of the 'driver' will fundamentally change. It is interesting to reflect on the special issue as a whole from a methodology perspective. In this respect, two points are quite apparent. Firstly, almost all of the studies were either conducted within driving simulators or were focused on the development of a simulator. This is perhaps understandable given the fact that the research is considering unproven user-interfaces, together with the clear experimental control afforded by a simulator. Nevertheless, one cannot help feeling that more road-based studies are required in this area, as a more ecologically valid means of understanding behaviour in context. Secondly, most of the studies adopt an experimental approach with manipulation of independent variables and precise measurements – mainly related to safety/performance criteria. This is important too, but there is clearly a place for qualitative studies too in this area, particularly as a means of investigating 'softer' issues concerning driver trust, acceptance, attitudes, motivations, and so on.

The guest editor would like to thank his co-chairs for the conference (Joe Gabbard from Virginia Tech, US; Paul Green from UMTRI, US; and Sebastian Osswald from Audi, Germany) who assisted in the choosing of the papers for the conference and for this special issue. He would also like to thank the 78 reviewers from across the world who gave up their time to read the original papers for the conference and provided insightful formative feedback in all cases. Finally, he would like to thank all those who helped with the organization of the conference, especially Diane Karim and Lesley Gray (Faculty conference management team) and Ayse Eren and Vicki Antrobus who worked tirelessly on the day-to-day planning and running of the event and acted as publication co-chairs. All that remains is to welcome you again to this, the first of a two part special issue, and hope that you enjoy reading the interesting articles included here and look forward to the second part of this exciting issue!

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Gary Burnett has been investigating Human Factors issues since 1992, specialising on the human-related design issues for in-vehicle computing and communication systems, such as navigation, adaptive cruise control, vision enhancement, collision avoidance. His research has been funded by a range of organisations, including the UK Engineering research council (EPSRC), the UK Department of Transport and Highways Agency and the European Union. Most recently, he has worked closely on a range of projects concerning novel in-vehicle interfaces in collaboration with several vehicle manufacturers. He is an author for over 100 articles in peer-reviewed venues and was the general chair for the 2015 ACM conference on Automotive User-Interfaces (Auto-UI).