Towards a Multi-OS Architecture for Consistent User Interface Experience

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Abstract

Vehicles have greatly changed over the last decades. Originally, they were used as a means of transportation, and their drivers were solely engaged in the driving task. In modern cars, the user, i.e., the former driver, has to interact with many different systems, which provide access to different domains, such as vehicle functions (monitoring speed, fuel consumption), safety related features, comfort and infotainment. Advancements in technologies make it possible to cope with the increasing amount of features, as for example the introduction of input and output modalities that allow new ways of interaction, such as touchscreens, voice control or gesture recognition. In the end, a user has to interact with all systems through the overall user-interface. This requires a high usability and a consistent look and feel in order to provide a consistent user experience.

On the technology side, developers have to cope with rising complexity, dependencies and interconnections of about 80 different embedded systems in a premium car. The introduction of multicore systems opened the way for new approaches, like Multi-OS environments. There multiple operating systems are consolidated onto a single hardware platform by the use of hardware/software virtualization. This allows for example to run real-time operating systems (RTOS) for safety critical cluster applications next to a general purpose operating system (GPOS) for infotainment applications. This also poses new challenges, such as the contradiction between a clear separation meant to reduce complexity, dependencies and to mitigate the risk of interferences, and interconnections that are required to create a composited user-interface.

In this thesis, the challenges of compositing heterogeneous systems in an automotive context are explored. Current approaches are studied and the contradiction of separation and interconnection is explained. Based on this, concepts are introduced and software architectures are proposed, which can be used to implement composited user interfaces for Multi-OS environments. Furthermore, an application prototype that is used to verify the proposed software architecture in regard of graphical user-interfaces, called HTML-UI-Compositor, has been implemented. The HTML-UI-Compositor also provides a simple way of compositing graphical user-interfaces through the adaptation of a web browser engine, which allows well-known standard web development tools and languages to be used to create composited user-interfaces. Those are the first steps towards a Multi-OS architecture that supports a consistent user interface experience.
Publications included in the Licentiate Thesis


Not included in the Licentiate Thesis


Ubiquitous computing

Computing as environmental process and environment as computing devices. Computational devices become ever smaller, distributed and increasingly integrated into the surroundings; they disappear into environment with only the user interface remaining perceivable for users. Ubicomp studies both intrinsic computing, as it appears in nature, and designed computing, that converges towards ambient intelligence. Research has human-centric focus with emphasis on interaction; user experience and cognitive support that alleviates users informational overload as well as extend cognition.
The ITS-EASY post graduate school for Embedded Software and Systems

ITS-EASY is an industrial research school in Embedded Software and Systems, affiliated with the School of Innovation, Design and Engineering (IDT) at Mälardalen University (MDH) as an integrated part of the MDH strategic research area Embedded Systems (ES).

ITS-EASY is funded by the Knowledge Foundation (KKS), and the eleven participating companies. ITS-EASY started October 1st 2011, and will continue until September 30th 2020. During that period the PhD students will complete their studies and obtain the doctoral degree in Computer Science.

ITS-EASY is a large organization: it counts 22 PhD students, 14 main advisors from IDT, 18 co-advisors from IDT and the partner companies, and more than 25 associated members; senior researchers and industrial specialists. The board, led by Helena Malmqvist, ABB, has six members, and the industrial committee where all participating companies are represented, has 11 members. The management team of the research school consists of four members. All in all, about 85 persons are directly engaged in ITS-EASY.

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