Personalized situation-adaptive User Interaction in the Car

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ABSTRACT

The complexity of the interaction with DAS and IVIS increases due to the steadily rising number of functions in the vehicle which can result in the problem of driver distraction. A solution is to provide a personalized and situation-adaptive support. This means offering an easy and fast way to access the needed functionality. The existing approaches provide solutions only for specific functions in the field of IVIS. Our approach is based on an overall architecture, which includes DAS and IVIS and which provides a prioritization of support possibilities depending on the situation. The needs of the driver are identified depending on the situation and a support in form of the adaptation of the function set in the menu or executing preconfigured actions with or without confirmation of the driver is provided. Both reduce the complexity of the interaction by minimizing the number of operation steps.

Categories and Subject Descriptors

H.1.2 [**User/Machine Systems**]: Human factors

General Terms

Architecture, Human Factors

Keywords

distraction, personalization, situation awareness, adaption, user interaction

1. INTRODUCTION

The rising number of functions in the vehicle within both driver assistance systems (DAS) and in-vehicle information systems (IVIS) results in an increasing complexity of the interaction which can lead to driver distraction. A study from the German Federal Highway Research Institute (BASt) on the topic of distraction due to non-driving tasks points out this problem. For instance 12% of the accidents caused by distraction in the vehicle are related to entertainment systems. And 92% of these accidents happened because the driver was operating the system [5]. The challenge for the human-machine interaction (HMI) development is to support the driver by providing an easy way to operate and use the functions of such a complex system. This means having a higher user acceptance and less distraction, e.g. by reducing the number of operation steps. At present, several approaches provide solutions for specific functions in the field of IVIS. But there is no solution, which addresses an overall architecture, where both DAS and IVIS are integrated, and which provides a prioritization of support possibilities depending on user needs. To achieve this, we propose an approach which is based on an overall architecture and provides prioritization to realize a fast access of functions.

2. RELATED WORK

Within the project AIDE, wherein the goal was to develop technologies for integration of ADAS, IVIS and nomadic devices into the driving environment, an overall system with an Interaction and Communication Assistant (ICA) and a Driver-Vehicle-Environment (DVE) module was developed. The DVE module gets sensor information about driver, vehicle and environment, deduces knowledge and provides the knowledge to applications and the ICA. The ICA manages and adapts the driver system interaction based on rules and dependent on the knowledge provided by the DVE module [1]. A DVE module for situation recognition similar to the one from AIDE was developed in the smart car project to provide context-awareness in the vehicle. It uses a layered architecture to deduce context information from sensor values and then concludes situations using an ontology [8].

On this basis, the needs of the driver can be identified. Many approaches that support the driver within a specific task like [4] and [7] primarily observe the user behavior concerning the use of functions relating to a situation to identify the needs and preferences in the present and future. In [2] a model for situation recognition similar to the one in the smart car project is used, which also uses knowledge about the past and the current situation and in [3] only a user model and a data base for personalization is used.

If the driver needs are identified, there are several strategies to provide an easy and comfortable access to functions. One approach is to use adaptive user interfaces (AUIs) which adapt menus or the set of functions according to the situation. The major disadvantage of AUIs is their inconsistency, therefore different levels of adaptivity from intermediate to fully adaptive relating to the requirements (e.g. routine vs. non-routine tasks) could be offered [6]. Another approach to support the driver is to provide preconfigured functions relating to personal preferences and the situation for example by using information about the situation to predict the next destination to which the driver wants to navigate [4].

This saves additional steps within the user interaction. In [7] a support through situation-adaptive shortcuts of functions and the offer of autonomous execution of actions in recognized situations after a configuration through the driver is proposed. Similar is also the support of [2] who implemented a proactive recommendation system, which provides actively situation-related recommendations to the driver.

3. APPROACH

The referred approaches are not integrated in an overall architecture and therefore doesn't benefit from it. The AIDE architecture is an overall architecture but it is not designed to support the driver by providing an easy access to functions. If all approaches for specific functions are integrated in an overall architecture a prioritization is needed. Otherwise, when several support strategies address the driver at the same time, this would result in driver distraction as well.
In our approach we use the architecture of AIDE as a basis and extended the functionality of the ICA to identify the user needs and to deduce support possibilities. A scheme of our architecture is shown in figure 1.

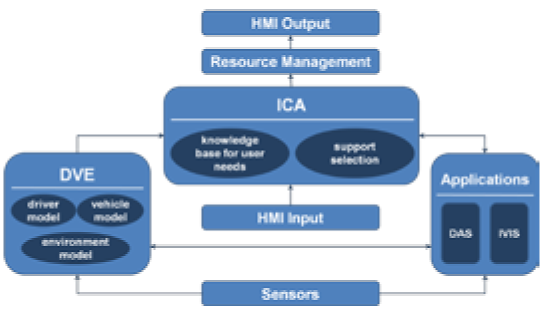

Figure 1: overall architecture related to AIDE

The situation is recognized by the DVE module, which is a central knowledge base for all elements in the architecture. The benefit of the DVE module as a central instance is the provision of extensive knowledge based on the exchange of knowledge. The recognized situation is used as an input for the ICA. The ICA of AIDE is extended by a component to detect user needs and a logic element to determine the best support for the identified driver needs. An example of such a process is illustrated in figure 2.

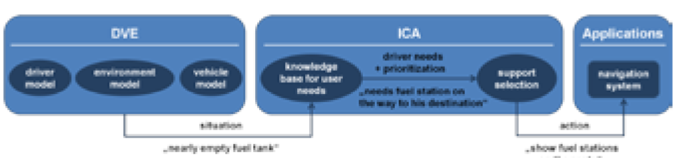

Figure 2: support of the driver

If several user needs are identified at the same time, the ICA decides which one should be prioritized related to the situation. The safety of the driver is the highest criteria for this prioritization. Depending on the driver needs, the driver is supported by the adaptation of the function set in the menu or by the execution of preconfigured actions with or without confirmation of the driver. Both reduce the complexity of the interaction by minimizing the number of operation steps. The preconfiguration of the actions is based on the situation, the observed user behavior in the past and knowledge from stereotypes. Using stereotypes reduces the learning phase of the ICA. To provide an efficient situation recognition and identification of driver needs, missing information, which is needed to make decisions, could be actively requested by the system.

4. CONCLUSION AND FUTURE WORK

We introduced an approach that provides a personalized and situation-adaptive support. This means to offer an easy and fast access to functions in an overall architecture with a prioritization of support possibilities depending on the situation. With our approach workload and distraction of the driver can be reduced.
In future we will further develop our approach and will have a deeper look into methods for prioritization and identification of user needs. Further concretion is planned with the help of use cases and requirements that need to be defined. As a result a prototype will be implemented and integrated in a driving simulator to evaluate the approach with the help of user studies.

5. REFERENCES

[1] A. Amditis, L. Andreone, K. Pagle, G. Markkula, E. Deregibus, M. Rue, F. Bellotti, A. Engelsberg, R. Brouwer, B. Peters, and A. De Gloria. Towards the Automotive HMI of the Future: Overview of the AIDE-Integrated Project Results. *IEEE Transactions on Intelligent Transportation Systems*, 11(3):567–578, 2010.

[2] R. Bader, W. Woerndl, and V. Prinz. Situation Awareness for Proactive In-Car Recommendations of Points-Of-Interest (POI). *Proc. Workshop Context Aware Intelligent Assistance (CAIA 2010), 33rd Annual German Conference on Artificial Intelligence (KI 2010)*, Sep. 2010.

[3] M. Feld, G. Meixner, A. Mahr, M. Seissler, and B. Kalyanasundaram. Generating a Personalized UI for the Car: A User-Adaptive Rendering Architecture. In *UMAP*, pages 344–346, 2013.

[4] M. Hofmann, K. Bengler, and M. Lang. An assistance system for driver-and situation-adaptive destination prediction for a robust interaction with speech controlled navigation systems. In *VDI Bericht 1646*, pages 979–996, 2001.

[5] A. K. Huemer and M. Vollrath. Ablenkung durch fahrfremde Tätigkeiten - Machbarkeitsstudie. Technical report, Bibliothek der Bundesanstalt für Straßenwesen (BASt), 2012.

[6] T. Lavie and J. Meyer. Benefits and costs of adaptive user interfaces. *International Journal of Human-Computer Studies*, 68(8):508–524, 2010.

[7] S. Rodriguez Garzon. Situation-Aware Personalization of Automotive User Interfaces. In *Adjunct Proceedings of 4th Int. Conf. on Automotive User Interfaces and Interactive Vehicular Applications*, October 2012.

[8] J. Sun, Y. Zhang, and K. He. Providing Context-awareness in the Smart Car Environment. In *2010 IEEE 10th International Conference on Computer and Information Technology (CIT)*, pages 13–19, 2010.