Situation-Aware Personalization of Automotive User Interfaces

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ABSTRACT

This paper presents an interactive prototype of an automotive user interface that changes its behavior depending on the situation-dependent user preferences. In a first step, the interactive prototype gathers user information implicitly by observing the situation-dependent interaction behavior. Well-known contextual personalized features like situation-aware navigational shortcuts and situation-aware automated routines are used at the second step to support the user either with the presentation of a situation-dependent list of shortcuts or by an situation-aware automatic execution of commonly used functionality. Additionally, the interactive prototype is extended by a real-world driving simulator in order to experience the contextual personalization in real-time.

Categories and Subject Descriptors

H.5.2 [**User Interfaces**]: Prototyping

Keywords

Adaptive user interface; Automotive user interface; Context-aware; Personalization; Situation-aware

1. INTERACTIVE PROTOTYPE

Nowadays, modern in-car-infotainment systems offer a wide range of features which are popular in the area of home-entertainment systems or mobile devices like smartphones or tablets. But the technological progress also affects the way an user interacts with an automotive user interface. In the past, on-board computers were controlled by a limited set of feature-fixed hard-key buttons whereas modern on-board computers are operated by joystick-like central command units or speech commands. Thus, the handling is getting more complex and it becomes challenging to provide additional functionality without an accompanying decrease of usability. But normally, the user only utilizes a small amount of features. Therefore, a modern in-car-infotainment system should be able to adapt its user interface to the users needs. In certain cases commonly used features should be accessed easily or shown on top in order to reduce the cognitive load and distraction induced by navigating in complex menu structures. The automotive user interface presented in this paper observes the situation-dependent user behavior, builds up a situation-aware user model and modifies its structure based on the detected preferences. Hence, frequently used functions within a given environment are either shown within a list of shortcuts or being executed automatically.

Figure 1: Upper left: Real-world driving simulator; Upper right: Situation-aware automotive user interface; Lower left: Steering wheel; Lower right: Central command unit

1.1 Adaptive Automotive User Interface

The prototypical automotive user interface comprises a main screen with the commonly known menu structure and an additional screen on top showing the situation-aware navigational shortcuts [2]. A built-in navigation and audio system as well as an internet browser can be used by a test subject e.g. to enter a destination address, to change the radio station or to open web sites. A background service gathers all user interactions that are supposed to be relevant for the contextual personalization. These relevant user interactions are being grouped by their corresponding environments and stored within a situation-aware user model. The reader is referred to [4] for a detailed description of the rule-based user modeling approach.

If the user approaches a situation in which the user usually e.g. changes the radio station, a shortcut will be pre-

Figure 2: Situation-aware navigational shortcuts based on radio station and web site preferences.

sented within the list of contextual personalized shortcuts (see figure 2). The shortcut consists of an icon representing the basic functionality e.g. symbol of a radio antenna and the parametrization e.g. radio station name placed as text beneath the symbol. In each situation, the number of shortcuts presented in the list is limited to 4. Each shortcut is executed by pressing one of four hard-key buttons which are placed in front of the joystick of the central command unit. Executing a radio shortcut will directly set up the audio system to listen to the corresponding radio station. In this case, the user is relieved of the burden of the time-consuming navigation in the menu in search of the radio application.

Alternatively, a situation-dependent preference can also be used to automate the corresponding task. But the automatically detected preferences are only estimations made by the background service. Therefore, some of the preferences might not represent the situation-dependent user behavior in a correct manner. Prior to being automated, every situation-dependent preference will be listed in an additional feedback view in order to avoid the automation of tasks that are based on inappropriate preferences. The feedback view comprises a list of newly recommended and labeled situation-dependent preferences and their corresponding situations visualized by e.g. a map [1] or a list of the affected days of the week (see figure 3). If the user feels comfortable with a certain recommendation, it can be labeled as being a favorite preference. The automation of a situation-dependent task can be activated by enabling a favorite preference. While approaching a situation that is known to be relevant concerning a favorite preference, the automotive user interface signalizes an upcoming automation by showing a dialog box. It comprises a textual representation of the task, the remaining time until the automation gets executed and a button which can be used to cancel an automation. In a future version, an acoustic signal together with a confirming or aborting speech command might be used as well to signalize and approve an automation.

1.2 Simulation of User Behavior

Testing or demonstrating the abilities of an adaptive automotive user interface is challenging because all situation-dependent adaptations occur after a learning period of variable length and only within a certain context. Furthermore, the user interactions need to be variable concerning the duration or order of the individual interaction steps.

For demonstrating purposes, the learning period can be decreased manually in order to adapt the user interface immediately after detecting only a less amount of similar user

[1]The prototypical automotive user interface and the driving simulator make use of the Google Maps API: https://developers.google.com/maps/

Figure 3: Recommended situation-dependent radio station preferences within the feedback view.

interactions. But for the proper execution of a situation-aware personalization it is still required either to carry out the demonstration within a real car with its context-related sensors or to present the user interface in conjunction with a real-time simulation environment for context-related information generation. Following the latter approach, the presented interactive prototype is connected with a separately implemented real-world driving simulator [1] for the simulation of context-related information like the position of the car, the time of day or the level of fuel (see figure 1). Using the real-world driving simulator together with the prototypical automotive user interface makes it possible to experience a contextual personalized automotive user interface within a lab environment. A user study concerning the usefulness of both types of contextual personalized features was conducted based on the use of the prototypical automotive user interface and the driving simulator [1].

For testing purposes, the user behavior can also be simulated automatically in order to investigate the user interface behavior over a long period of time. This kind of simulation is based on a model of scenario-specific user interactions [3].

2. REFERENCES

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