Sneaking Interaction Techniques into Electric Vehicles

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ABSTRACT
Due to the release of several electric vehicles (EV) to the car market, the number of sales is expected to increase soon. Concerning in-vehicle information systems (IVIS) of EVs, different kinds of information need to be communicated to the driver. E.g. displayed numbers for current energy consumption or the energy left in the batteries are hereby critical in terms of a potential increase of range anxiety. In order to meet the special needs of EV drivers, manufacturers will have to rethink common designs known from regular combustion engine cars to create electric vehicle information systems (EVIS). We argue, that this fact will open up the opportunity to introduce novel interaction techniques into the EV, which have been successfully developed but have not yet found their way into the automobile. As an example, we will mention the in-car interaction via freehand gestures.

Categories and Subject Descriptors
H.5.2 User Interfaces: *Input Devices and Strategies*

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Electric Vehicles, EV, Electric Vehicle Information System, EVIS, Gestural Interaction, Freehand Gestures

EVs ON THE RISE
Due to the increased environmental awareness and the need for alternative energy sources, the number of electric vehicles (EV) will increase in the near future. With the introduction of cars like the Nissan Leaf, the Ford Focus Electric or the soon to appear BMW i3, EVs become available to the public and pave the way to reach ambitious goals such as the USA being "the first country to have a million electric vehicles on the road by 2015" [7].

DRAWBACKS AND CHANCES
Concerning the interior design of EVs, manufacturers still seem to follow the paradigm of combustion engines vehicles. Until today, the chance to develop new and exciting interior design concepts has not been taken. Electric vehicle information systems (EVIS) should be carefully designed to go beyond the conventional way of showing plain numbers about the energy left in batteries, the distance to the goal or the current energy efficiency. Instead, these pieces of information need to be combined to create novel understandable interfaces, helping the driver to be confident about capabilities of his EV. This could help to overcome EV opposing phenomena such as range anxiety.

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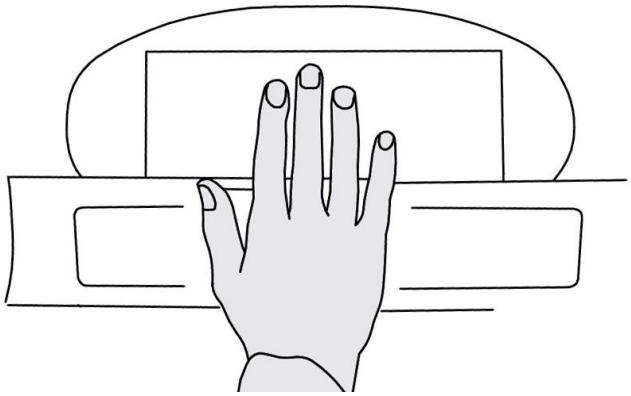

Figure 1. EVIS Interaction using Freehand Gestures

To enhance novel EVIS, and due to the fact that EVs' early adopters are in general open for novel products, the opportunity is given to introduce newly developed interaction techniques into the EV. This could be an important step towards a better acceptance of such novel systems compared to the introduction to conventional combustion engine vehicles, where the majority of drivers may be more skeptical. The example we would like to introduce here are freehand gestures, which at first sight are not directly connected to the concept of an EV, but could sneak into the automotive context with their help.

FREEHAND GESTURES
We understand freehand gestures to be intentional movements carried out by a single hand. We differentiate between microgestures performed by the fingers and midair gestures performed by the hand. The introduction of freehand gestures to the automobile context has two advantages. First, they can be applied to reduce drivers' visual distraction [4]. And second, due to the success of the Kinect in the gaming domain, they bear the potential to enhance the user experience while interacting with EVIS. Therefore, researchers developed different concepts and technologies. Akyol et al. [1] tracked hand gestures by processing the images delivered by a camera. Riener [6] used the depth image of the Kinect sensor to track the movement of a finger in order to move a pointer on a display. Varying lighting conditions while driving, especially caused by direct sunlight, are a major problem for optical gesture tracking. Endres et al. [3] detected micro gestures executed by the driver's fingers using electric field sensing similar to the musical instrument Theremin. A problem of this approach was the difficult gesture classification, meaning that some gestures were confused with similar ones. Technology independent difficulties include the misinterpretation of unintended movements (false positives) as well as undetected but intended gestures (false negatives).

Despite these examples for gestural interaction techniques, no hand gesture interaction concept is used in the interior of today's cars. The only gestural system in the automobile context was introduced by BMW [2] and enables drivers to open the trunk by performing a foot kick gesture below the bumper. Given the success of the Microsoft Kinect in the gaming market and beyond, one of the reasons why no gestural interaction systems are introduced into the car might be the drivers' low acceptance of such novel technologies. It is thus the aim to introduce freehand gestures along with several other novel systems that disregard common implementation conventions in the car by using the effect of required adaption according to changing driving properties.

CONCLUSION

Enthusiasts [5], i.e. customers buying EVs in this early development stage, are open for novel technologies in general and are thus able to pave the way to the markets. Revolutionizing the interior design of EVs can thus offer a chance to bring new technologies into the car, which had problems to be accepted in conventional combustion engine vehicles. The introduction of in-car interaction via freehand gestures, which was started over a decade ago but has not been successful so far, is a possible candidate to test this strategy.

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