A Survey on Gestural Interaction in the Car

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Abstract. Gestural interaction has entered the automotive domain, allowing the driver to control secondary and tertiary functions of the vehicle. The design space ranges from mid-air gestures to surface-based gestures requiring little or no visual attention of the user. In this paper, we present an up-to-date survey on current gestural interaction methods in the vehicle. We here focus on the driver as the user. We discuss applications, advantages and disadvantages of representative approaches.

Keywords: gestural interaction, automotive, driver-car interface

1 Introduction

The activities performed by a driver in the car can be divided in three categories. Primary tasks are directly related to driving, e.g. steering. Activities that support driving like controlling turn signals are secondary tasks. Infotainment-related activities like radio control make up tertiary tasks. Today's widespread interconnectedness and popular trends e.g. in social media allow for a growing variety of the types of these tertiary tasks. New user needs for intuitive interaction with vehicle systems led to the introduction of gesture controls in the car. Gestures in the car can be utilized for both secondary and tertiary tasks and can be distinguished by different criteria (see classification in table 1). Contact-free gestures have been investigated in the restricted design space of the steering wheel [1] and the gearshift area [3], but also as full-hand, mid-air gestures. These are mostly performed in the area spanned by rear mirror, steering wheel and gearshift [2]. We suggest an approach with a depth camera where the fingers are used while holding (that includes using) the gearshift or resting the hand loosely on it. In contrast to a forefinger-based theremin gearshift interface [3], we plan to utilize all five fingers for a combined micro-gestural and button input.

property	contact type	application type	body input	gesture size
values	surface-based	secondary tasks	1-5 fingers	micro (finger, facial)
	non-contact	tertiary tasks	1-2 hands	macro (full hand)

Table 1. Classification of in-car gestural interaction methods.

2 Idea and Concept

Holding the gearshift poses problems when trying to execute gestures. Gripping the stick usually results in having the three fingers from middle finger to little finger firmly attached to the side of the stick. This makes them unsuited for performing well-recognizable gestures. We propose to use these fingers for pressing buttons that are to be attached to the side of the gearshift (one to three buttons). These could serve for activating gesture recognition and as modifier buttons for switching between recognition modes. The micro-gestures themselves should be performed with thumb, pointer finger and combinations of both. We acknowledge that the actual times of practical applicability could be limited: through roads like freeways require longer periods of driving without changing gears. Drivers would not need to keep their hand close to the gearshift. However, we believe that drivers tend to see it as a natural position to have the arm lying on the center armrest and the hand on top of or in the area of the gearshift. For gestural interaction, this could provide the driver with a more relaxed basic posture than with free-hand gestures in vertically higher interaction spaces like in front of the center console. A main question will be how many and what kinds of different gestures can be reliably recognized with such a restricted interaction. They have to be clearly distinguishable for drivers as well. Which in-car camera positions provide the best results? Which micro-gestures lend themselves to which secondary or tertiary tasks in the car?

3 Future Work

As part of this survey, we present a case study on micro-gestural interactions. We plan an evaluation of our gearshift micro-gestural control with participants in a driving simulator to draw conclusions about the influence on driver distraction and the usability of the interface. We are also interested in providing a mapping of gearshift micro-gestures to typical in-car secondary and tertiary tasks.

References

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