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Configuring user information by considering trust threatening factors associated with automated vehicles

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Abstract

Background: The accelerated development of automated driving technology has raised the expectation that commercially available automated vehicles will be increasingly become ubiquitous. It has been claimed that automated vehicles are safer than conventional manual vehicles, leading to the expectation of fewer accidents. However, people expect not only better but also near-perfect machines. Given that accidents involving automated vehicle do occur and are highlighted by the media, negative reactions toward automated vehicles have increased. For this reason, it is critical to research human–machine interaction to develop suitable levels of trust between human users and newly introduced automated vehicle systems.

Method: We start this study by defining user distrust toward automated vehicles in terms of four types of trustthreatening factors (TTFs) along with trust-threatening situations. Next, with 30 volunteer participants, we conduct a survey and a humanin-the-loop experiment involving riding in a simulated automated vehicle and experiencing 21 distrust scenarios.

Result: In terms of the information configuration type suitable for alleviating the TTFs, the participants preferred to receive information on external object recognition for all TTFs in general with an average necessity level score of 24.2, which was 8.0 points higher on average than the scores of the other information configuration types. The haptic modality-based method was the least preferred compared to the other information configuration methods, namely visual and auditory.

Conclusion: In this study, we focused on participants' subjective responses and complementary quantitative studies, and the results of these studies put together are expected to serve as a foundation for designing a user interface that can induce trust toward automated vehicle among users.

Keywords: Automated driving, User interface, Human–machine interaction, Distrust, Driving simulator

1 Introduction

Automated vehicle systems assist humans with driving, and they are being actively developed with expected outcomes such as crash elimination, productivity improvement for users, and improved energy efficiency. The Society of Automotive Engineers (SAE) automation standard level 3 vehicles (partially automated but the driver is necessary) are expected to be mass produced soon, and SAE automation standard level 4 vehicles (highly automated but with optional control by the driver) are in the pipeline [20]. These automated vehicles are expected to be safer than conventional human-driven vehicles. For instance, 94% of traffic accidents are caused by human driver error, for instance, driving under the influence, driving when drowsy, and reckless driving. By contrast, automated vehicles can monitor the

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