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EVALUATION OF DISPLAY CONFIGURATION AND SEAT ORIENTATION CONSIDERING VARIOUS AUTOMATED DRIVING SITUATIONS BY USING A VEHICLE SIMULATOR

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ABSTRACT– This study examines vehicle interiors in terms of display configuration and seat orientation from a user experience viewpoint using a driving simulator. Sixteen volunteers were sat in the driver's seat to evaluate the visibility and mental comfort scores of three display configurations used in the vehicle (i.e., floating, flush, and large display). Another sixteen volunteers were sat in the passenger's seat to evaluate the mental and physical comfort scores of three seat orientations (i.e., forward-facing, 15° inboard, and rear-facing seats). The display configurations were evaluated in the movie-watching, driving-monitoring, and control takeover situations, while the seat orientations were evaluated in the movie-watching, conversation, and driving-monitoring situations. The large display enhanced for movie-watching. However, it was found to be unsuitable for driving-monitoring. The rear-facing and 15° inboard seats were more suited to the conversation situation from the physical comfort viewpoint. The rear-facing seat was found to be unsuitable from the mental comfort viewpoint in the driving-monitoring situation. The effect on drivers and passengers were different depending on the vehicle interiors and the situations. A thoughtful selection of display configuration and seat orientation, considering the context, is vital to enhance driver and passenger comfort. These findings could aid future user-centric vehicle development.

KEY WORDS : User experience, driving simulator, vehicle interior, display configuration, seat orientation, usability

NOMENCLATURE

FF: forward-facing seat
IN: 15° inboard seat
RF: rear-facing seat
MW: movie-watching
DM: driving-monitoring
TO: control takeover
CO: conversation

1. INTRODUCTION

SAE J3016 classifies automated driving into 6 levels from 0 (no driving automation) to 5 (full driving automation). The role of the driver is contingent upon the level of automation implemented. In the context of level 3 or higher automation, the Automated Driving System (ADS) assumes full responsibility for executing the Dynamic Driving Task (DDT) while actively engaged.

At level 3, the driver takes on the role of a fallback-ready user, while the ADS executes the DDT, relieving the driver from the requirement of actively monitoring the driving situation (SAE J3016, 2018). In contrast, at level 4 or beyond, the driver is relegated to the position of a mere passenger as the ADS undertakes the entirety of the DDT. In other words, passengers can perform activities that are not related to driving, such as conversation, business, and sleep, if the vehicle autonomy level is adequately high. In 2019, research firm Capgemini surveyed 5,538 people about their desired activity in Automated Vehicle (AV) (Capgemini, 2019). Socializing was found to be the most

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