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IN-VEHICLE TECHNOLOGY FOR SELF-DRIVING CARS: ADVANTAGES AND CHALLENGES FOR AGING DRIVERS

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ABSTRACT−The development of self-driving cars or autonomous vehicles has progressed at an unanticipated pace. Ironically, the driver or the driver–vehicle interaction is a largely neglected factor in the development of enabling technologies for autonomous vehicles. Therefore, this paper discusses the advantages and challenges faced by aging drivers with reference to in-vehicle technology for self-driving cars, on the basis of findings of recent studies. We summarize age-related characteristics of sensory, motor, and cognitive functions on the basis of extensive age-related research, which can provide a familiar to better aging drivers. Furthermore, we discuss some key aspects that need to be considered, such as familar to learnability, acceptance, and net effectiveness of new in-vehicle technology, as addressed in relevant studies. In addition, we present research-based examples on aging drivers and advanced technology, including a holistic approach that is being developed by MIT AgeLab, advanced navigation systems, and health monitoring systems. This paper anticipates many questions that may arise owing to the interaction of autonomous technologies with an older driver population. We expect the results of our study to be a foundation for further developments toward the consideration of needs of aging drivers while designing self-driving vehicles.

KEY WORDS : In-vehicle technology, Self-driving cars, Aging drivers, Navigation systems, Health monitoring systems

NOMENCLATURE

AARP : american association of retired persons
ACC : adaptive cruise control
ADAS : advanced driver assistance system
AGNES : age gain now empathy system
ATIS : advanced traveler information system
FCW : forward collision warning
HUD : head-up display
IEEE : institute of electrical and electronics engineers
IT : interaction time
IVNS : in-vehicle navigation system
LKAS : lane keeping assistance system
NT : neglect time
NVE : night vision enhancement
SPAS : smart parking assistance system
UAV : unmanned aerial vehicle

1. INTRODUCTION

The Institute of Electrical and Electronics Engineers (IEEE) predicts that by the year 2040, highways will have designated lanes for autonomous vehicles (Read, 2013). Semi-autonomous features, such as the smart parking assistance system (SPAS), lane keeping assistance system (LKAS), and adaptive cruise control (ACC), have already been commercialized, and fully autonomous vehicles will probably become available within the next 10–20 years. The development of self-driving cars or autonomous vehicles has progressed at an unanticipated pace in recent years. A few years ago, state legislators had not even considered autonomous cars; currently, however, three states have enacted legislation on operating self-driving cars and several more states are considering it. Despite the speed of technological development, people will probably accept and adapt to this new technology in the same manner as they did with other intelligent systems.

Ironically, the driver or the driver–vehicle interaction is a largely neglected factor in the development of enabling technologies for autonomous vehicles. For example, some vehicle automation features cause considerable confusion and frustration in the driver, which is typically associated with poorly integrated systems (Norman, 2003). Despite humans being adaptable, several critical issues related to human–vehicle automation become noticeable with advancements in technology. For example, the term “self-driving” or “autonomous” can easily mislead people into thinking that the driver’s role in vehicle operation will become insignificant with the arrival of advanced vehicles. In fact, the role of humans in driving is changing from conventional manual control to supervisory control with an

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