A Basic Study of the Influence of Auditory Stimulus on the Eye-tracking Behavior of a Driver in an Autonomous Vehicle

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Research and development for autonomous vehicle technology have been accelerated to reduce the traffic fatalities, which are the number one reason. In the autonomous vehicle, passengers likely do not pay attention to the environments in front or lateral because they are overestimate autonomous functions. However, until completely autonomous vehicles are launched, driver will be allocated to the passenger from the vehicle in case of emergency or complicated traffic condition. Then, efficient methods need to be developed for passengers to be ready for driving immediately in such conditions. What the driver acts when he/she receives the warning depends on his/her proficiency level of driving, that is an issue to develop the efficient methods. As one of the methods, human-machine (vehicle) interface is an option.

Workload with auditory interface can be lighter than with visual interface in the vehicle[1]. And also, spearcon (time-compressed speech sounds) significantly reduced total glance time toward vehicle monitor[2]. Though there are several researches to investigate the relationship between gaze behavior and audio stimuli, detailed information of the gaze behavior such as scanpath or pupil diameter are not analyzed.

In our research, first, we propose the methods of quantitative measurement of passengers' gaze behavior and develop various acoustic warnings with directional audio sources. Then we measured the gaze behaviors of driving experts and novices to examine the differences in driving experiences. In this paper, we prepared the simple experimental environment with a single screen, one projector and one headphone (Fig. 1). Head-mount eye-tracker was used to capture what the examinees saw and pupil diameter. There is a problem specific to head-mount eye-tracker that the output eye position data is affected by head movements. Then we developed the screen with invisble markers to detect the exact eye positions and corrected the effect of head movements by template matching.

We measured the gaze behavior of several driving novices and experts while they watch the driving movie taken from the inside of the vehicle with additional directional audio sources to compare the difference in the driving experiences. Fig.3 shows the eye positions after correcting the effect of the head movements. As a result, even novices watched the traffic signs, center line on the road or oncoming vehicles, which are what we should pay attention to during driving. As comments of examinees, there is a lack of reality and a sense of tension for driving. We need to analyze the eye-tracking data quantitatively and study deeply appropriate experimental environment for autonomous vehicle as future works.

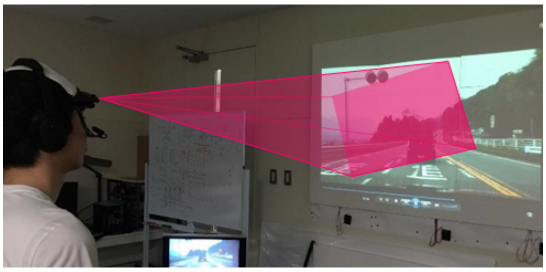

Fig. 1. Experimental environment of eye-tracking

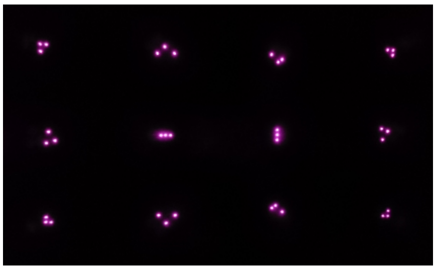

Fig. 2. Markers on the screen(filtered)

Fig. 3. Corrected eye position on the movie

References

1. J. Sodnik, C. Dicke, S. Tomazic, and M. Billinghurst: A user study of auditory versus visual interfaces for use while driving, International Journal of Human-Computer Studies, Vol.66, pp.318-332, 2008.
2. P.Larsson, and M.Niemand: Using Sound to Reduce Visual Distraction from In-vehicle Human-Machine Interfaces, Traffic Injury Prevention, Vol.16, sup1., S25-S30, 2015.