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# Effectiveness of Pedestrian-Information Display for Right-Turning Vehicles at Intersections.

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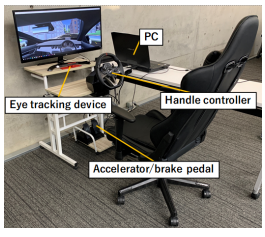
The number of fatalities caused by traffic accidents has decreased in Japan. However, the pedestrian fatalities accounted for the highest percentage in 2020. Therefore, preventing accidents between vehicles and pedestrians is one of key countermeasures for realizing a safe traffic society. A literature studied the characteristics of pedestrian fatality involving vehicles traveling at low speeds and reported that the highest percentage was shown for right-turning vehicle behaviors. However, the mechanism of these traffic accidents has not been clarified. In the future, when there is a high risk of a collision between a vehicle turning right and a pedestrian at an intersection, it is expected that a driver support system that detects the pedestrian using a Human Machine Interface (HMI) and alerts the driver will be put into practical use.

In this study, to clarify the driver's behavioral characteristics when a vehicle turns right at an intersection, we conducted experiments using a simplified driving simulator (DS) as shown in Fig.1. In addition, to obtain knowledge about the effectiveness of an HMI, we conducted experiments with and without an HMI that showed the presence of a pedestrian at the intersection where the vehicle was turning right, and alerted the driver when there was a high risk of collision. In the DS, HMI display was displayed on the dashboard in front of the driver's seat as shown in Fig.1 (b).

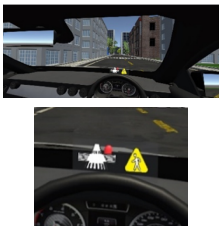
In this study, we investigated the effect of the presence of other vehicles and pedestrians at the intersection where the vehicle made a right turn, and the effectiveness of HMI. In the experiment, we set the 5 turning-right cases with combination of other vehicles or a pedestrian in one scenario, as shown in Fig.2.

Table 1 shows $Time_{Visible}$ (the total time at which pedestrians could be seen in the intersection), $Time_{Pedestrian}$ (the averaged total time at which the driver gazed at the pedestrian in the intersection), and the percentages of the driver's average gazing time at the pedestrian when the ego vehicle turned right. The results showed that an increase in four conditions of the cases with HMI: Case 1 (73.8% to 74.1%), Case 2 (76.9% to 81.5%), Case 3 (60.8% to 73.4%), and Case 4 (65.5% to 71.1%) compared to without HMI. We also observed the increasing percentage of the ego vehicle that stopped moving forward to avoid a collision with the pedestrian in the intersection.

It was found that the percentage of drivers' gazing time at pedestrians was affected by the presence of other vehicles when the ego vehicle was turning right at an intersection. Thus, the HMI display was effective in increasing the percentage of gazing time at pedestrians and ensuring safety.




(a) Hardware configuration



(b) HMI

Fig.1 Driving simulator

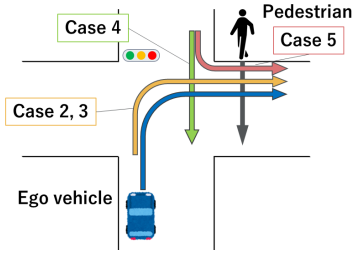



Fig.2 Experimental scenario

Table1 $Time_{visible}$, $Time_{pedestrian}$, and the percentage of gazing time at pedestrian

| Experimental scenarios | $Time_{Visible}$ (a) | | | | $Time_{Pedestrian}$ (b) | | | | The percentage of gazing time [%] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | w/o HMI | | w/h HMI | | w/o HMI | | w/h HMI | | w/o HMI | w/h HMI |
| | mean [s] | SD | mean [s] | SD | mean [s] | SD | mean [s] | SD | {(a) / (b)}×100 | {(a) / (b)}×100 |
| **Case1 (ego only)** | 2.01 | 1.95 | 2.26 | 1.91 | 1.49 | 1.37 | 1.67 | 1.48 | 73.8 | 74.1 |
| **Case2 (pre-1)** | 1.54 | 1.35 | 1.31 | 1.04 | 1.19 | 1.14 | 1.07 | 0.88 | 76.9 | 81.5 |
| **Case3 (pre-3)** | 2.26 | 1.14 | 1.34 | 0.92 | 1.37 | 0.81 | 0.99 | 0.69 | 60.8 | 73.4 |
| **Case4 (oncoming-s)** | 1.66 | 1.88 | 1.19 | 1.23 | 1.09 | 1.35 | 0.84 | 0.92 | 65.5 | 71.1 |
| **Case5 (oncoming-l)** | 2.59 | 1.56 | 2.74 | 2.01 | 1.70 | 1.22 | 1.74 | 1.21 | 65.7 | 63.5 |

SD: standard deviation