Evaluation of Human-Machine-Interface of Automobiles with Gaze Measurement

Introduction

A car navigation system on a smart phone is a popular method to provide traffic information. To ensure driving safety, driver behaviors are evaluated by the eye-gaze tracking analysis, time-to-collision investigation, and subjective evaluation on the display sizes and positions.
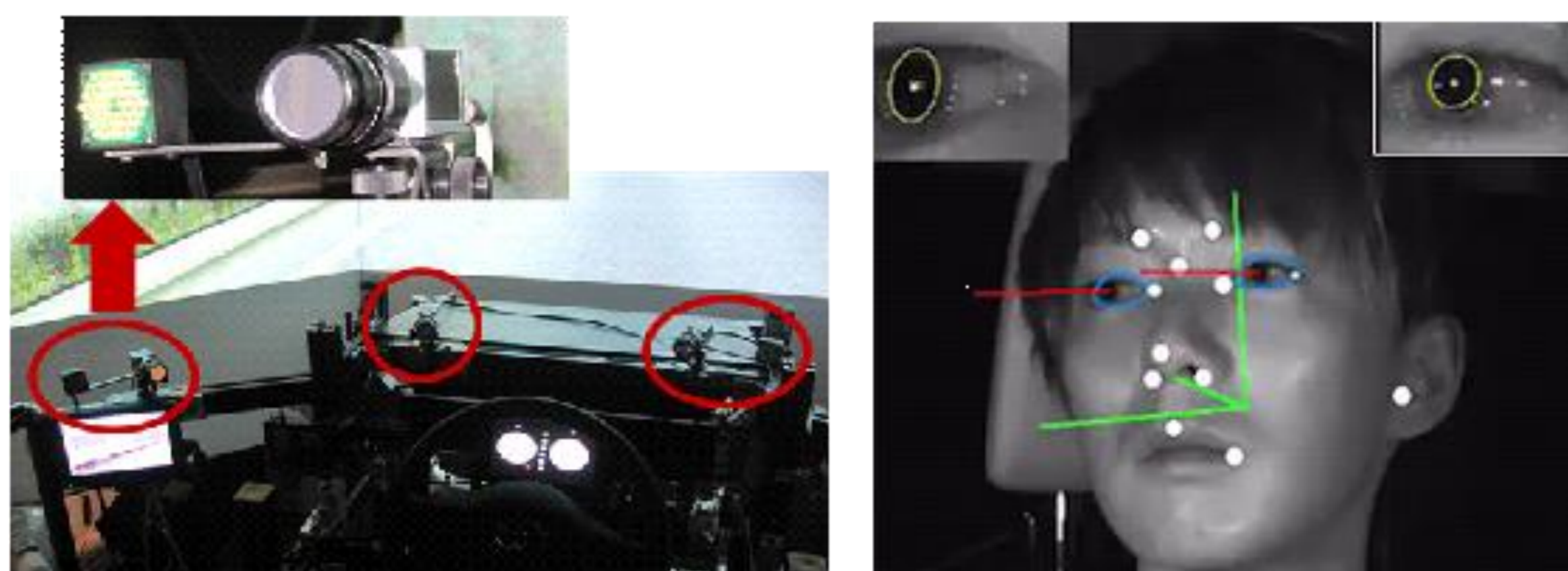
Navigation system

A navigation system can real-time operates, connecting to the Host PC of the Driving Simulator systems, based on actual urban roads as a driving scenario.
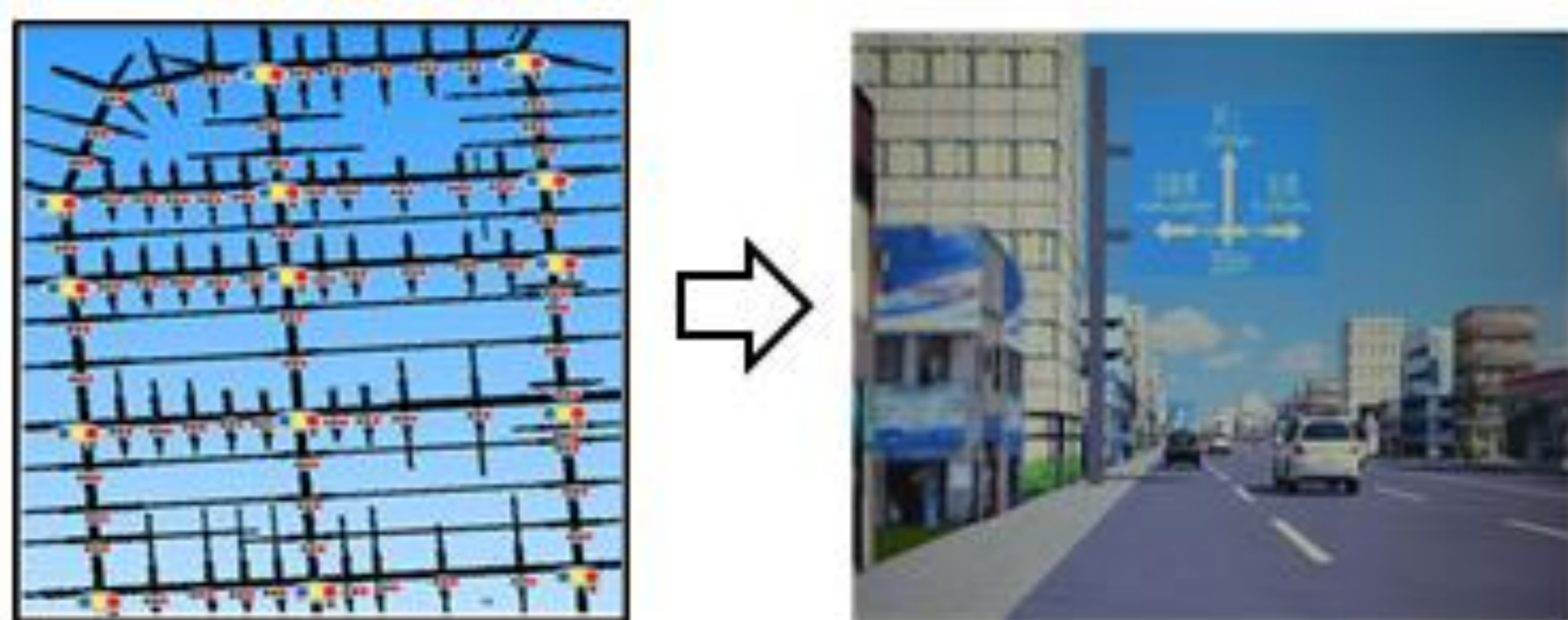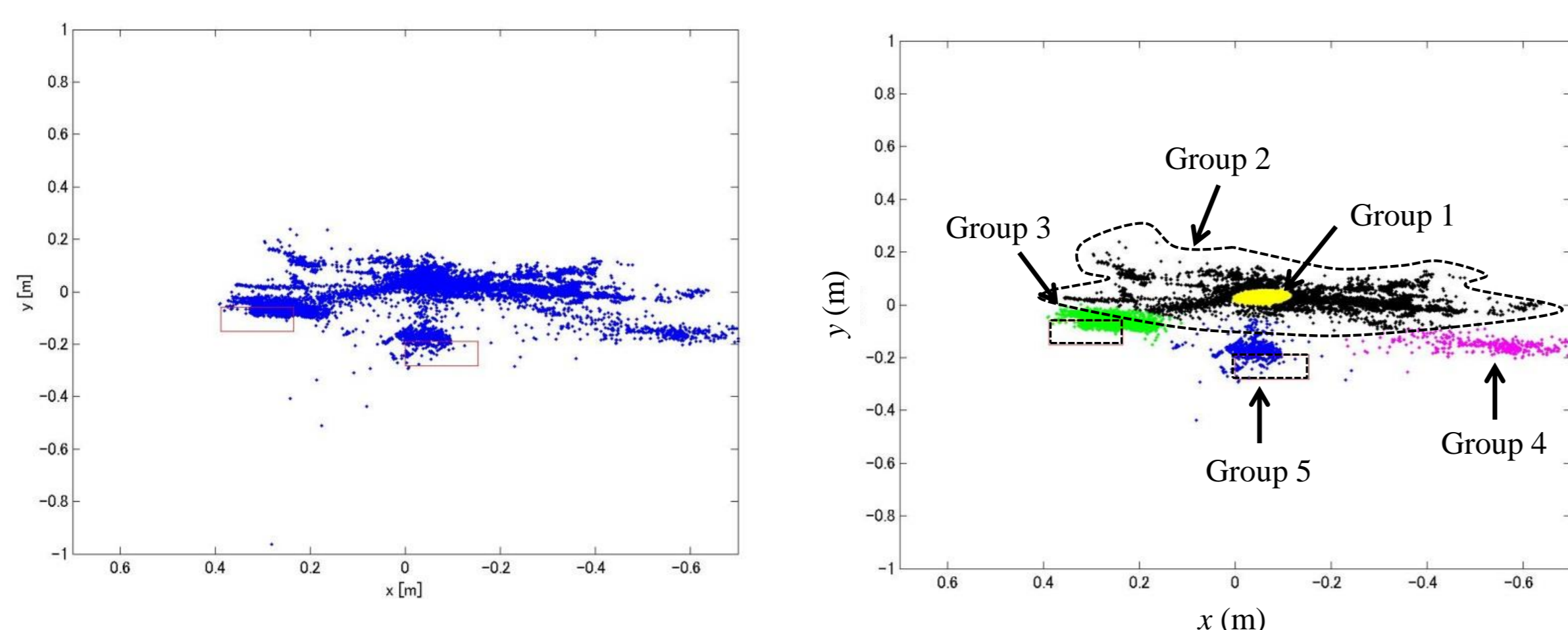

Gaze measurement system

A non-contact eye-gaze tracking system, Smart Eye, is employed to measure the direction of gaze of the driver.

EM algorithm

To efficiently classify the gazing points on the navigation display, EM, expectation maximum, algorithm was employed. The gazing point was classified as the different gazing targets by EM algorithm.

Experiment

Experiments are conducted for two sizes, and three positions of display. For comparison, actual navigation is utilized under the condition 7.
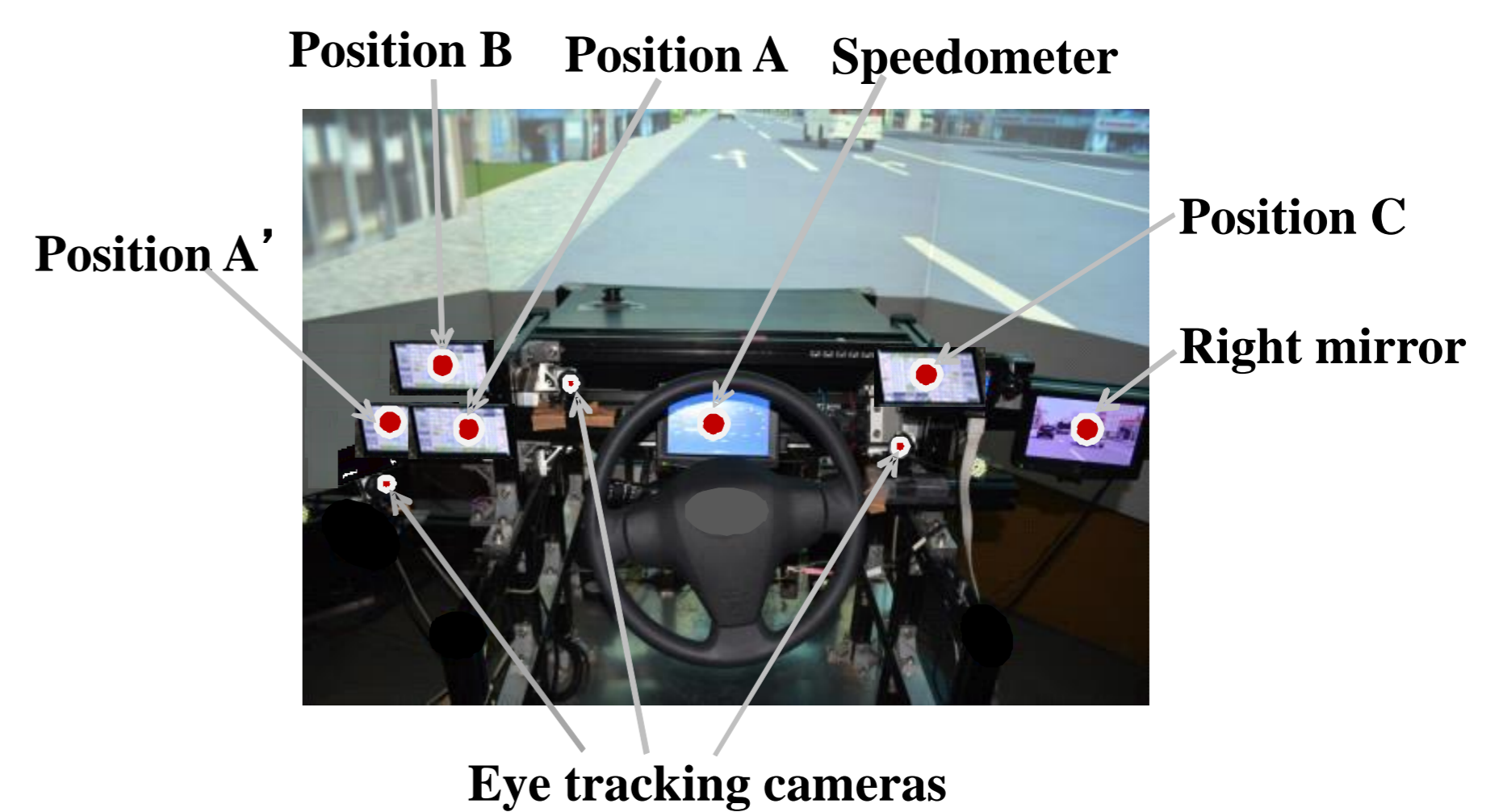
Condition	Type	Scales	Sizes	Positions
1	Mapfan	4:25000	4.3-inch	A
2	Mapfan	4:25000	4.3-inch	B
3	Mapfan	4:25000	4.3-inch	C
4	Mapfan	7:50000	7-inch	A
5	Mapfan	7:50000	7-inch	B
6	Mapfan	7:50000	7-inch	C
7	Carrozzeria	7:50000	7-inch	A'

Results

Glance frequencies of positions A and B were significantly lower than that of position C ($p<0.05$, n=20). Glance time of 4.3-inch display was significantly longer than that of 7-inch displays ($p < 0.05$), and glance times of positions A and B were significantly longer than that of position C ($p < 0.001$). Time when TTC, time-to-collision, is less than 1s decreases when the 7inch display is used in position C.

Glance frequency

Mean glance time
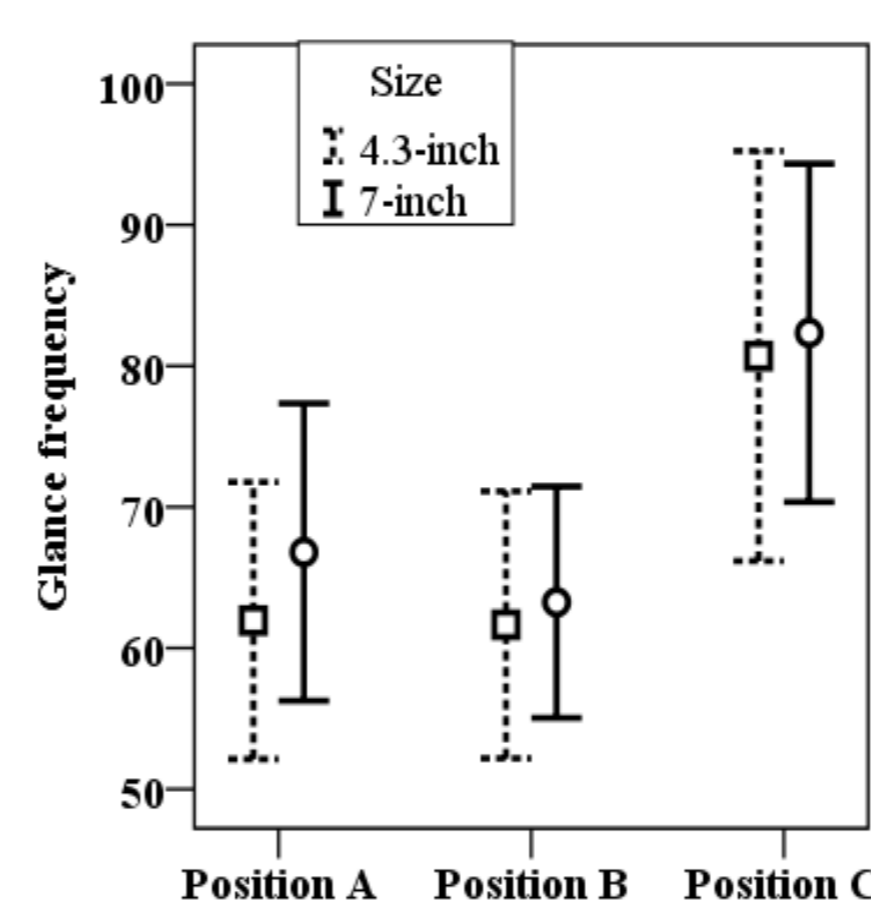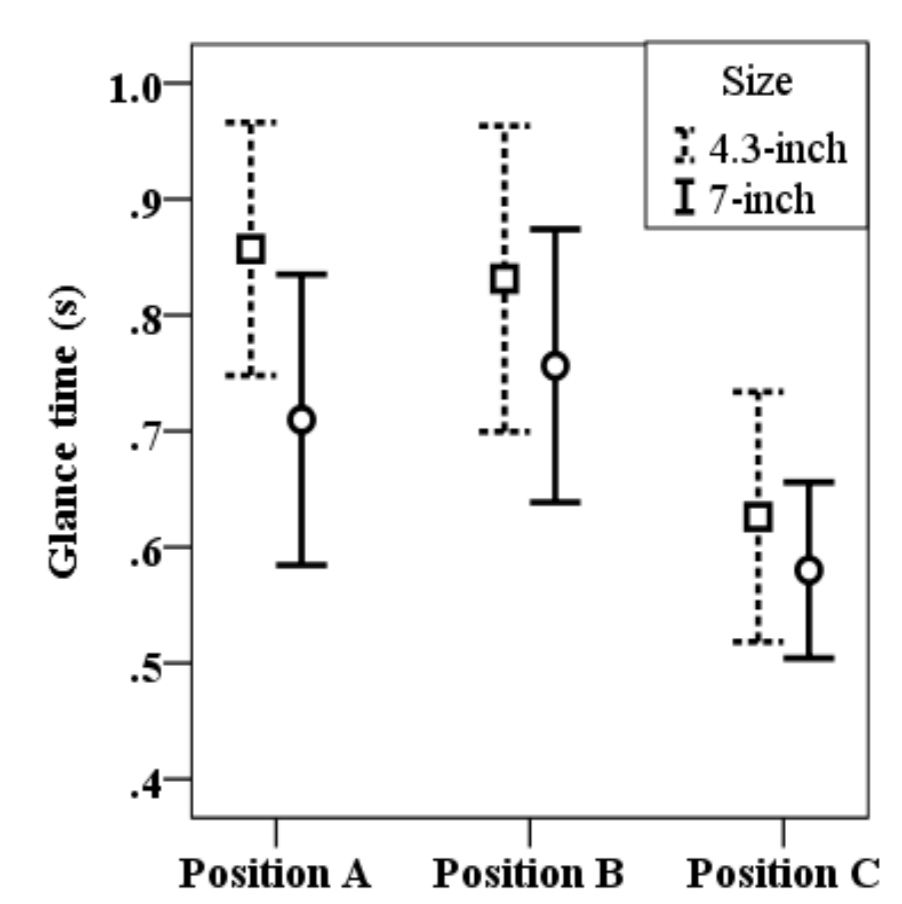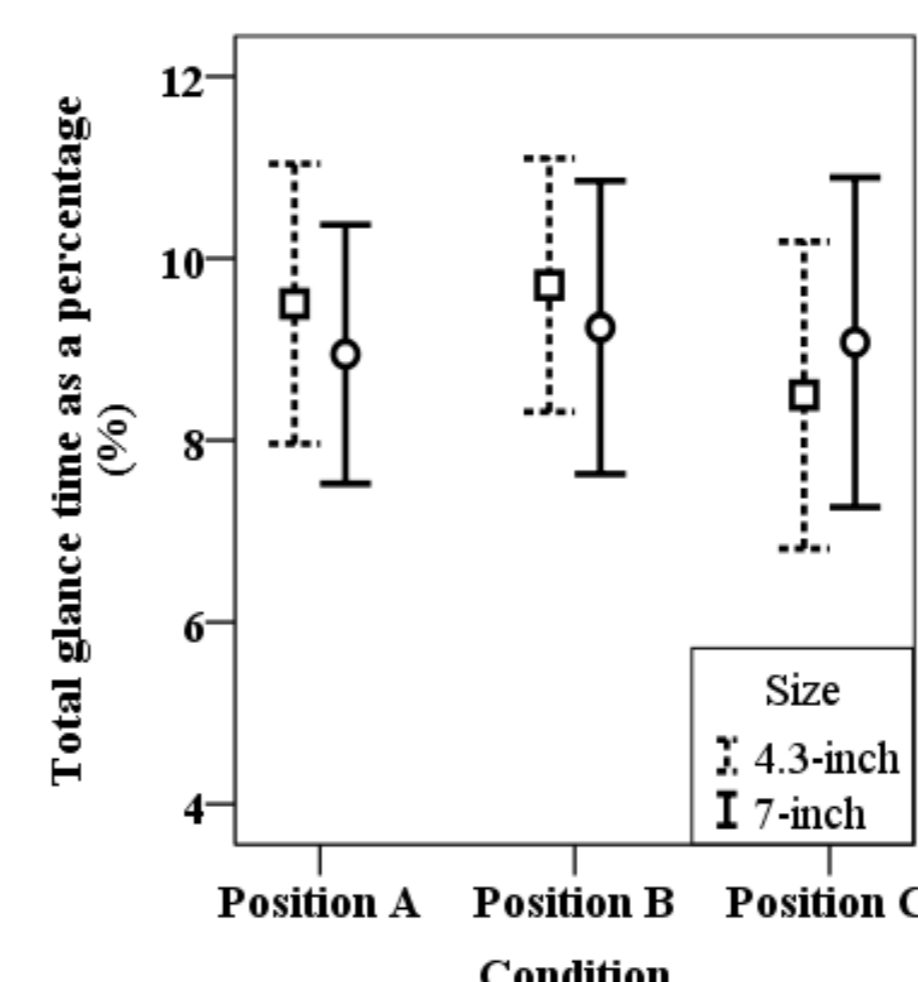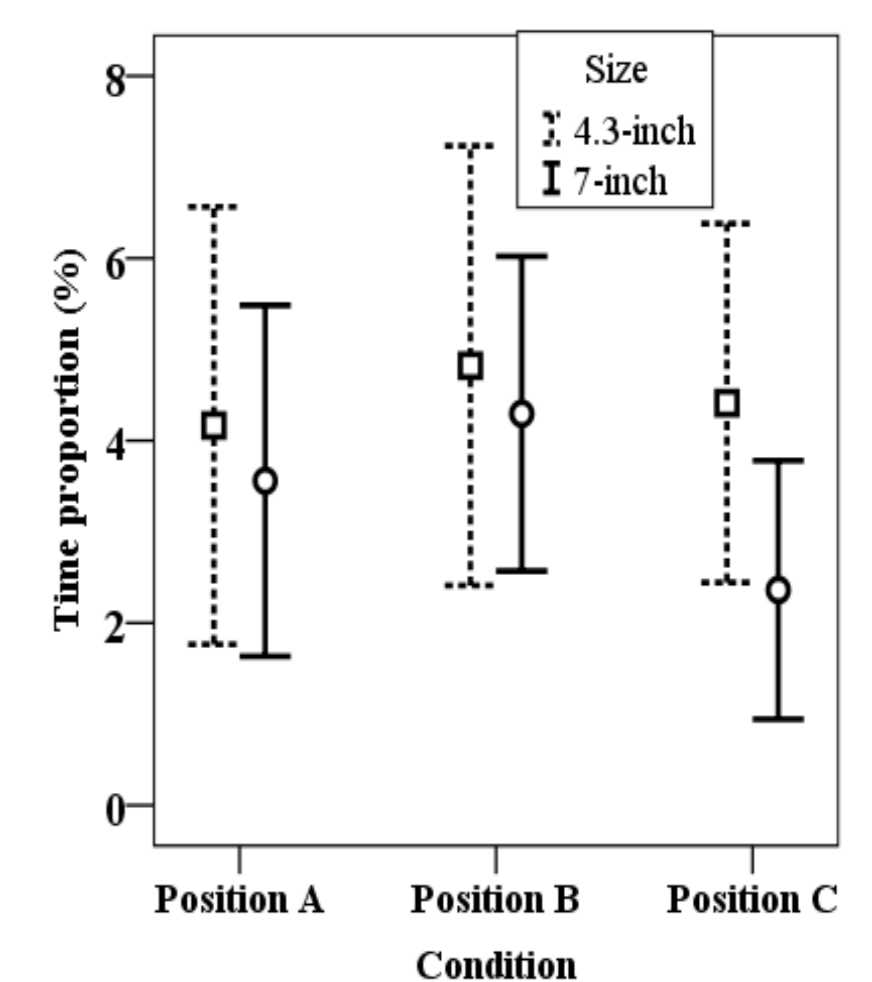

Total glance time

TTC less than 1 seconds

Publications

Zheng R., Nakano K., Ishiko H., Hagita K., Kihira M., Yokozeki T., 2015, Eye-Gaze Tracking Analysis of Driver Behavior While Interacting with Navigation Systems in an Urban Area, IEEE Transactions on Human-Machine Systems, PP-99, pp. 1-11, DOI: 10.1109/THMS.2015.2504083.