Gaze-Based Moving Target Acquisition using Pseudo Stopping for the Time predicted via Fitts' Law

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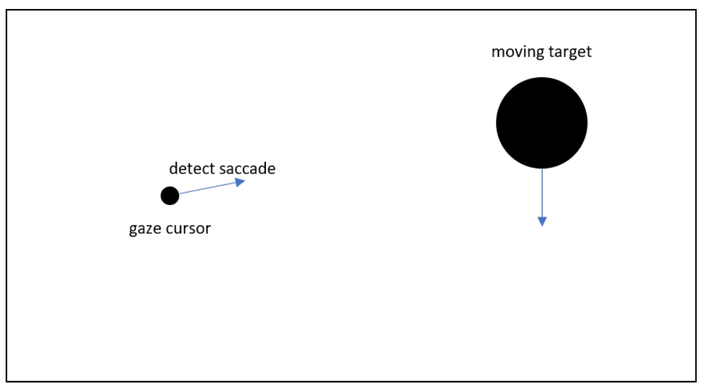
1. ABSTRACT

This paper describes a technique of gaze-based moving target acquisition achieved by pseudo stopping the target for the time predicted via Fitts' Law, after saccades have been detected. This technique only requires eye-movements for the acquisition of moving targets. The results indicate that participants were able to acquire targets moving at various speeds and with different widths.

2. METHOD

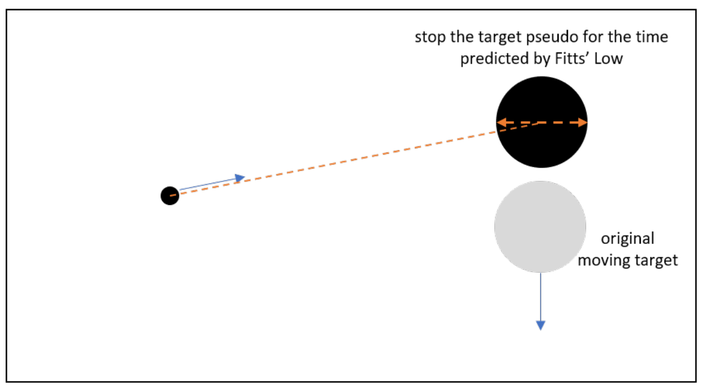
①detect saccade

A saccade is a quick eye movement between two fixation. In this technique, saccade detection was achieved by employing the technique proposed by Kumar et al [1].



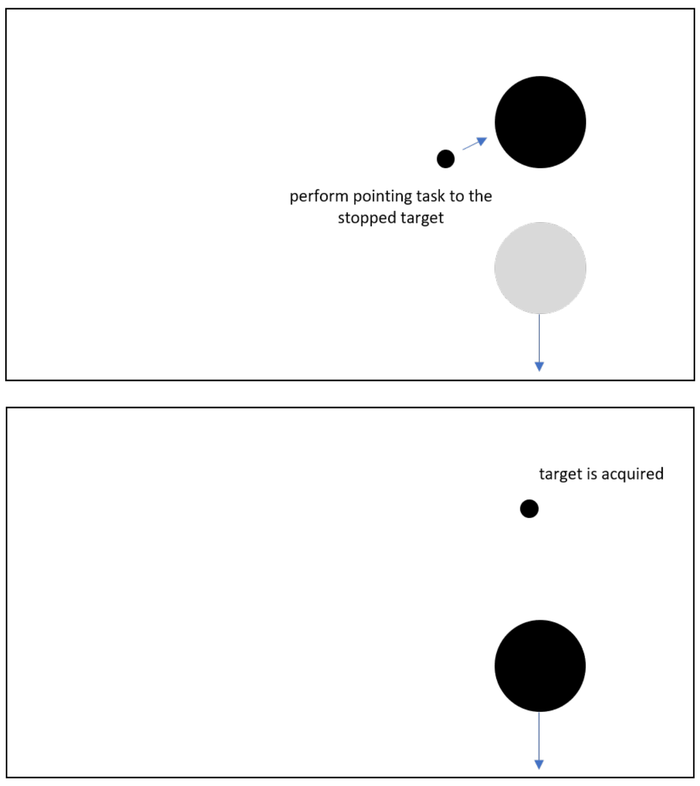
②stop the target pseudo for the time predicted by Fitts' Low

After saccades have been detected, the target is pseudo stopped. The original moving target is also displayed to make it inconspicuous while the target is stopped.



③acquire the target

After users gaze at the stopped target or the time predicted by Fitts' Law has been passed, the target has been acquired. Then, we employing a dwell time reduction technique proposed by Isomoto et al [2] because the user must acquire the target within the time predicted using Fitts' Law.



3. EXPERIMENTS

The proposed technique was compared with the technique that involves the acquisition of moving targets by gazing at the targets for 400 ms. Eight subjects participated in this experiment. We selected Tobii Eye Tracker 4C as the eye tracking device. The participants were required to acquire all 96 types of moving target (4 target width conditions 6 target velocities 4 target movement patterns) with each technique once. In this task, when the participants judge the target to be impossible to acquire, they can skip the pointing task of the target by pushing a particular key. We acquired each ratio of which all participants skipped the task by judging the target to be impossible to acquire. (Table1, Table2)

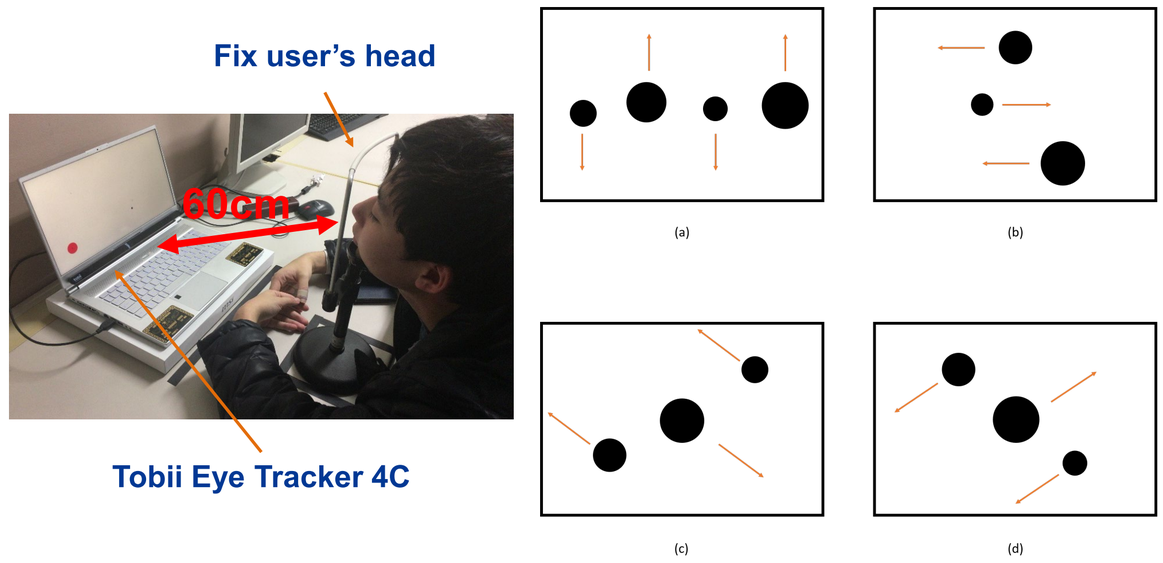


Figure1. Experiment setup (left) and four types of moving target which the participants require to acquire (right)

Table1. Skip rate for gazing at targets for 400ms

	speed [inch/ms]					
	0.025	0.05	0.075	0.1	0.125	0.15
width [inch] 0.75	21.9	87.5	93.8	93.8	100	100
1	12.5	40.6	75	96.9	100	90.6
1.25	6.3	31.3	78.1	100	93.8	100
1.5	3.1	15.6	31.3	90.6	100	100

Table2. Skip rate of proposed technique

	speed [inch/ms]					
	0.025	0.05	0.075	0.1	0.125	0.15
width [inch] 0.75	3.1	3.1	6.3	0	0	0
1	0	0	0	3.1	0	3.1
1.25	0	0	0	6.3	0	0
1.5	0	0	0	0	0	3.1

4. CONCLUSION

We propose a technique for the gaze-based acquisition of moving targets by pseudo stopping the target for the time predicted by Fitts' Law, after saccades have been detected. Therefore, this technique enables the acquisition of targets moving at various speed and with different widths. Moreover, we are currently attempting to develop a system for the acquisition of targets in virtual reality (VR) and augmented reality (AR), using the proposed technique.

Reference

[1] Manu Kumar, Jeff. Klingner, Rohan. Puranik, Terry Winograd and Andreas Paepcke, 2008. Improving the Accuracy of Gaze Input for Interaction, In Proceedings of the 2008 symposium on Eye tracking research & application CHI Conference on Human Factors in Computing Systems (CHI' 08), pp. 65- 68. https://doi.org/10.1145/1344471.1344488

[2] Toshiya Isomoto, Toshiyuki Ando, Buntarou Shizuki and Shin Takahashi, 2018. Dwell Time Reduction Technique using Fitts' Law for Gaze-Based Target Acquisition, In Proceedings of the 2018 ACM Symposium on Eye Tracking Research & Application (ETRA' 18, 2018), Article No26, pp. 1-7. https://doi.org/10.1145/3204493.3204532