Player Performance with Different Input Devices in Virtual Reality First-Person Shooter Games

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(a) (b) (c)

Figure 1. Mouse, Razer Hydra and Xbox gamepad are the main test conditions (a) Hardware setup, (b) Software interface (c) The HMD is used for head rotation, and the controller is used with ray-based aiming to shoot targets.

1 INTRODUCTION

First-person shooter (FPS) games are a competitive game genre. Players of these games commonly try to maximize their performance through using a better input device. Numerous previous studies have analyzed different game controllers (see e.g., [2]). Tracked input devices such as the Hydra offer some advantages over desktop input devices in VR FPS games. We thus hypothesize that VR controllers will offer substantially better performance than both the mouse and gamepad in first-person shooter targeting, due to the improved naturalness of control. Our study compared 3D selection performance between the mouse, 3D tracker, and game controller in a head-mounted display VR context.

2 USER STUDY

We recruited 9 participants (6 male). All had at least some FPS experience. The experiment was conducted on a desktop PC (GeForce GTX 970 GPU, 8GB RAM) with an Oculus Rift CV1. The input devices included a Razer Hydra, an Xbox gamepad, and mouse. The hardware is seen in Figure 1(a). We used a custom VR FPS game (Figure 1(b)). Head-tracking was enabled and aiming was decoupled from head motion, unlike non-VR FPS games where the mouse both aims and rotates the viewpoint with game pad stick (see Figure 1(c)). The participants shot 20 targets in a sequence of 3 target sizes (small, medium, large). In total, each participant completed 180 shooting trials. Our experiment employed a 3x3 within-subjects design. The independent variables and their levels were: **Input Device**: mouse, Razer Hydra, gamepad and **Target Width**: small, medium, large. (3 × 3 × 60: 1800 trials). We employed Fitts' law [1] to measure movement time and also we calculate the number of missing targets as error rate during the test.

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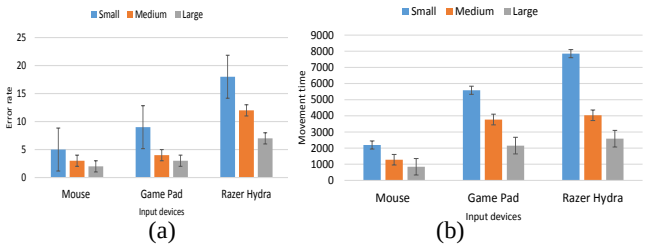
3 RESULTS and CONCLUSIONS

Average error rates and movement times are seen in Figure 2. ANOVA revealed that the mouse was fastest (550 ms average), and the Razer Hydra was slowest (average of 7850 ms). Consistent with Fitts' law [1], smaller targets were harder to hit, and hence movement time increased ($F_{2,8} = 93.6$, $p < .05$). The Razer Hydra had the highest error rate. Our results suggest somewhat disappointing prospects for 3D VR controller in VR FPS game.



(a) (b)

Figure 2. Average error rates (a) by input device and movement time (b). Error bars show ±1 SD.

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