Performance of Input Devices in FPS Target Acquisition

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ABSTRACT

We evaluated the performance of a wheel mouse, an XBox360 controller, the combination of a mouse and a keyboard, and a Trackmouse in FPS target acquisition. The device combinations where mouse was used for aiming performed better than the Xbox360 controller.

Author Keywords

First person shooter, game, gamepad, mouse, keyboard, trackmouse, trackball.

ACM Classification Keywords

H5.2. [Information interfaces and presentation]: User Interfaces --- Input devices and strategies, Evaluation, Interaction styles.

General Terms: Experimentation, Human Factors, Performance.

INTRODUCTION

We report results on an experiment that measured the efficiency of input devices in first person shooter (FPS) games. There is a body of previous work on the efficiency and effectiveness of pointing devices in general [4]. There is also a lot of work on pointing devices applied in pointing and manipulating objects in virtual worlds, including some that closely resembles FPS navigation [2]. Use of FPS games as a general platform for input device testing has also been considered [3].

In practice player's choice of input devices is limited to keyboards, gamepads, and mice. In addition, our experiment included the Trackmouse [1], which is a combination of a trackball and a mouse. FPS players prefer to aim with the mouse. Our goal was to verify and quantify the reasons for this behavior.

PARTICIPANTS

We had six participants (3 male and 3 female) with average age of the 27.7 years. All participants were right handed and all had played a FPS games previously. Using the wheel for moving and the mouse movements for aiming in an FPS was a new configuration to all. All participants reported some experience in using the keyboard for moving and the mouse for aiming. Three of the participants had two hours of experience with trackmice from previous experiments. All participants had some experience in using a two-stick gamepad.

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APPARATUS

Complete FPS games tend to have functionality than can interfere with input device tests. Consequently, we modified a simplified FPS engine developed by Maurice Svay and Laurent Gomilla for our purposes.

The Game world consisted of a 1000x1000 unit terrain with a random height profile. There were 150 randomly placed trees and 1000 tufts of grass. The trees and the grass were impenetrable to the weapon, but only the trees blocked the movement of the player. Nothing blocked the movement of the targets. There were 10 targets with a penguin logo on them moving on random trajectories. Whenever a target was destroyed, a new one spawned up. Ammunition was not limited. A scene from the game is shown in Figure 1.

Figure 1. A screenshot from the Penguin Hunt game.

The input device configurations are shown in Table 1. The Logitech Optical Mouse was used both in the Wheelmouse and the KBMouse configuration. A 17-inch LCD display was used in 1280x1024 resolution. The display was rendered over 100 times per second.

The maximum angular velocity in rotations with the Xbox360 controller was set to 270 degrees per second following the Xbox version of the Halo game by Microsoft. The displacement-velocity transfer curve was cubed as suggested in the Xbox controller programming manual. The shoulder buttons were used as triggers. See Isokoski et al. [1] for details on the Trackmouse prototype.

The maximal moving velocity may affect player performance. We set the speed on all devices as high as

possible without making small corrective movements

Configuration	Left hand	Right hand
KBMouse	**Keyboard** *moving:* arrow keys	**Mouse** *aiming:* mouse, *trigger:* left button
Wheelmouse		**Mouse** *aiming:* mouse, *moving:* wheel, *trigger:* left button
Trackmouse		**Trackmouse** *moving:* ball, *aiming:* mouse, *trigger:* left button.
Xbox360	**Left stick** *moving:* stick (velocity) *trigger:* shoulder button	**Right stick** *aiming:* stick (angular velocity), *trigger:* shoulder button

Table 1. The Input device configurations.

impossible. Unfortunately we did not find an objective way of making the velocities on all devices "the same".

PROCEDURE

There were two sessions with one five-minute sub-session for each input device configuration. The order of the configurations was balanced between the participants. The usage of each input device configuration was explained just before the first time a participant used it. The participants were not allowed to practice before the first session.

RESULTS AND DISCUSSION

Hits

Figure 2 shows the average number of hits for each device for the two sessions. We performed Bonferroni corrected two-way paired-samples t-tests on all pairings of the devices in the second session. The results showed that the differences between KBMouse and Trackmouse (t_5=4.8, $p<0.005$), KBMouse and Xbox360 (t_5=12.3, $p<0.001$), Wheelmouse and Xbox360 (t_5=5.0, $p<0.005$), and Trackmouse and Xbox360 (t_5=5.5, $p<0.005$) were statistically significant. It appears that the performance with all devices was still improving during the second session. Therefore, these results do not represent the performance of fully trained players.

Misses

The average number of shots that missed the target varied between 18 (Trackmouse) and 28 (KBMouse) in session 2. There were no statistically significant differences. Between sessions the trend was that the number of missed shots decreased slightly. The KBMouse was an exception with a clear increase in missed shots from session 1 to session 2.

Shooting distance

The mean distance from the player to the target at the time of trigger press for the second session was 205 (SD=34) for the wheel mouse, 195 (SD=42) for the Trackmouse, 177 (SD=43) for KBmouse, and 161 (SD=35) for the Xbox360 controller. The only statistically significant difference was the difference between the wheel mouse and the Xbox360 controller (t_5=4.8, $p<0.005$).

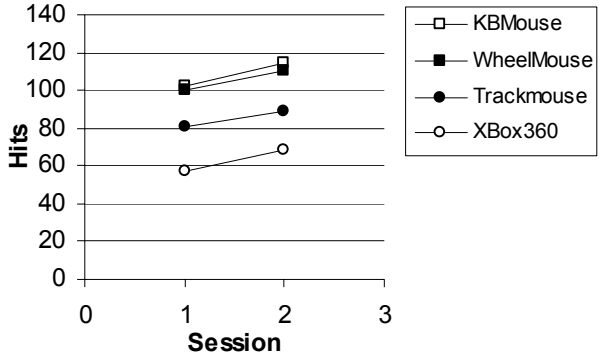

Figure 2. The average number of targets hit.

CONCLUSIONS AND FURTHER WORK

Aiming with the mouse was almost twice as efficient as aiming with the gamepad. It is possible to argue that all our results amount to is the measurement of the user's previous training. However, we do not believe this to be the case with the Xbox360 controller. We ran pilot experiments with two participants beyond 20 sessions without seeing signs of it catching up with the other devices. Further work is obviously needed to assess the effects of learning on the efficiency of input devices in FPS games.

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