The Effects of Delay on Game Actions: Moving Target Selection with a Mouse

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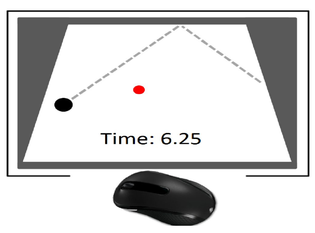
Abstract

- User input in computer games is affected by local systems, networks and servers and can create a negative impact on player performance and quality of experience
- **Problem:** Unaware of how to quantify impact of delay on specific player actions when a delay is present
- **Proposed Solution:** User study created to gather data using a range of delay and game conditions for selecting a moving target with a mouse
- **Result:** Derived an analytic model to understand and compensate for delay in games and interactive applications

Puck Hunt

Game created in C++ using Angel2D game engine and OpenGL.



Speed	
Slow	150 pixels/sec
Medium	300 pixels/sec
Fast	450 pixels/sec

Table 1: Puck speeds for user study.

- A puck bounces across a screen.
- Player controls red dot using mouse.
- Player must put the red dot over the puck and click on the mouse to finish the round

Delay (milliseconds)
0, 25, 50, 75
100, 125, 150, 175
200
300
400

Table 2: Delays for user study.

Figure 3: Quality of Experience prompt to player.

Moving Target Selection

- Selecting a moving target with a mouse is common to many PC games
- Most notably, the popular first person shooter (FPS) genre (e.g., Call of Duty, Activision, 2003) has moving target selection with the mouse as the primary method of aiming and shooting
- Likewise, the newer multiplayer online battle arena (MOBA) genre (e.g., League of Legends, Riot Games, 2009) uses moving target selection with a mouse for casting spells

Methodology

- Short demographic survey
- The game and incentive options were described
- Two practice rounds
- 5 iterations of all shuffled combinations of delay & puck speed (Table 1 and Table 2)
- One QoE question for each delay-speed combination
- One forced pause every 30 rounds

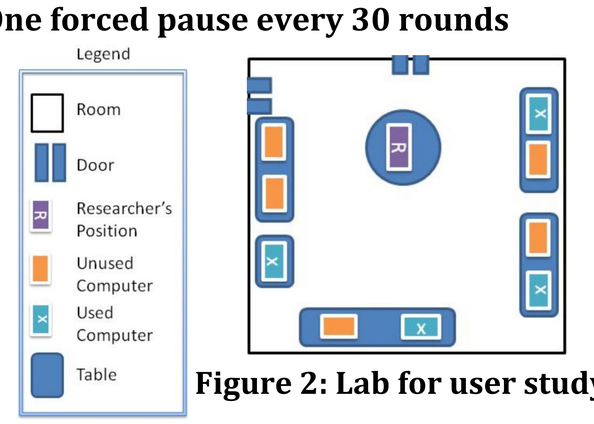


Figure 2: Lab for user study.

Results

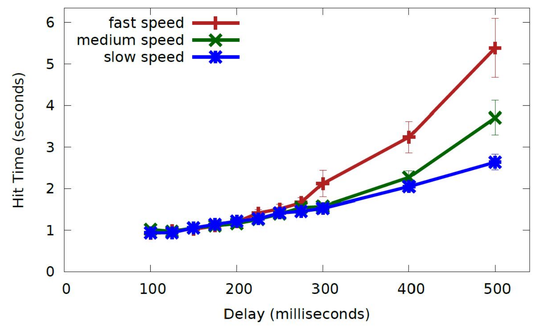


Figure 4: Player performance – Hit time versus delay, grouped by puck speed.

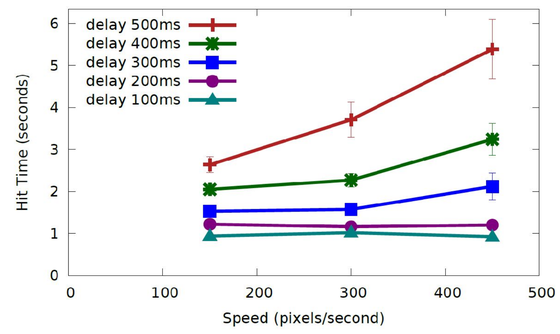


Figure 5: Player performance – Hit time versus speed, grouped by added delay.

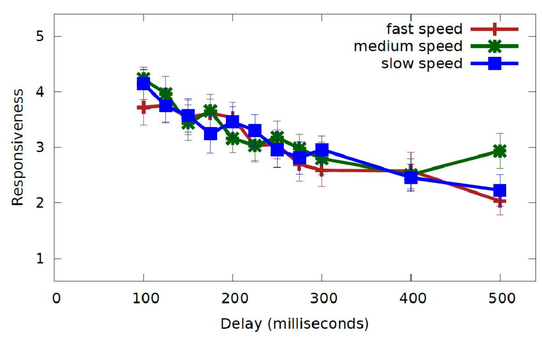
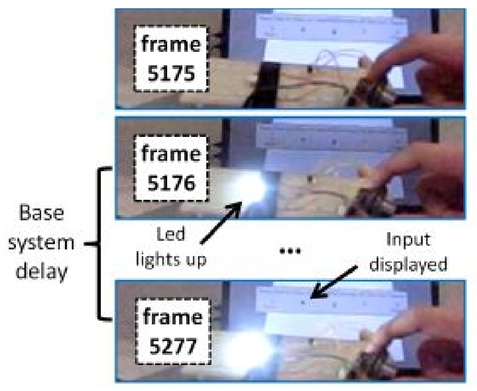


Figure 6: Quality of Experience – Responsiveness versus delay, grouped by puck speed.

Measuring Base Delay



- A bread board with an led was connected via a wire soldered to a mouse
- A high frame rate camera (a Casio EX-ZR200) filmed the player clicking on the QoE prompt
- The frame number when the light appeared with the button click is subtracted from the frame number when the QoE prompt shows the input, giving the base delay.

Base system delay
=
frame with input and light displayed
-
frame with light and without input

Conclusion

- Increase in the time it takes to select a moving target for all delays
- A sharper increase in time taken is measured for higher delays and fast targets
- Subjective opinions show that users are sensitive to modest amounts of delay
- Analytic model derived to provide a fit for the mean time to select a moving target using terms for delay and interaction

Future Work

- Models and analysis for mouse clicks and quality of experience
- Study target selction with a wider range of speeds and screen sizes
- Study different types of physical delay within other forms of player input involving target selction