Body-based Interaction for Desktop Games

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Abstract
Interaction for desktop games is mostly limited to keyboard and mouse input. We are investigating the benefits of adding body-based interaction to complement keyboard and mouse interaction in desktop gaming. We present a proof-of-concept implementation of body-based navigation for the game World of Warcraft, and a formative evaluation to test the feasibility of this kind of interaction. Our observations provide evidence that body-based interaction in addition to keyboard and mouse can help players perform more tasks at the same time and can be especially attractive and helpful to new players. Our study also revealed design consideration for this type of interaction.

Keywords
Body-based interaction, games, desktop games, navigation, World of Warcraft.

ACM Classification Keywords
H.5.2. [Information interfaces and presentation]: User Interfaces – Input devices and strategies; Interaction styles.

Introduction

As video game technology evolves and game design becomes more sophisticated, players have more options and higher levels of expression. However, game interfaces have not evolved at the same pace, so new features in a game often means that it will be harder to learn and master this added complexity. Game interfaces need to explore new directions in order to become easy to learn while delivering the same levels of control and expression [3].

Currently there are three basic approaches for 3D video game interaction [3]. The first is the traditional one: keyboard, mouse, joystick, and game controllers. The second uses physical props that simulate the real world (i.e., steering wheels, guitars, and tennis rackets). The third approach uses "true spatial tracking of the user's motion and gestures, where users interact in and control elements of the 3D gaming world with their bodies" [3].

This third approach, which we call *body-based interaction*, is a good candidate to evolve game interfaces. The use of real-world movements to control virtual actions can make use of players' physical skills from previous experiences with the world (e.g., muscle memory). Body movements allow players to utilize input modalities beyond the hand and fingers. Body-based interaction has been used in immersive virtually reality (VR) and console games. In VR, body-based interaction has promoted benefits such as better spatial understanding [5], and higher sense of presence [7]. Body-based interaction in console games has lead to increased levels of engagement [4]. Examples are the use of cameras (Sony EyeToy) or controllers with motion sensors (Nintendo Wii), which enables the player's body movement to control game interaction. For the desktop, most games still mostly rely on the keyboard and mouse.

Our research is investigating body-based interaction in the desktop environment, since we believe that many of the benefits seen in VR and console games will transfer to the desktop. We do not want to replace keyboard and mouse, but instead we want to enhance desktop interaction using body-based interaction. Other researchers have investigated this topic. On a first-person-shooter game players sitting on a stool tilted and rotated their bodies to control navigation, while shooting using a gun-like input device [1], which resulted in a more enjoyable experience and better game flow. When using a gesture interface to control an avatar in Second Life [6], many players find easier to remember gestures than the text commands provided by Second Life. Neither of these projects, however, made use of body-based interaction combined with keyboard and mouse input.

Our hypothesis is that in compound tasks, which are composed of two or more smaller tasks, if one part of the interaction is taken away from the keyboard and placed on the body, it will be easier for the player (especially new players) to concentrate on the remaining keyboard actions. In order to investigate this hypothesis we implemented a prototype that allows body-based navigation in the game World of Warcraft (WoW) [2], and conducted a formative evaluation.

Prototype

We implemented body-based navigation for the desktop game World of Warcraft (WoW), a popular online game, currently with more than 10 million players. We chose

Figure 1 - Bars on the side and bottom of the screen give feedback to users about their tracking position. The green mark represents the player's position. For the vertical bar, if the green mark reaches the yellow area the character walks, and reaching the red area makes the character run. The top yellow and red areas represent moving forward, while the bottom area represents moving backward. The horizontal bar on the bottom of the screen represents the amount of rotation applied to the character, based on the distance from the center (position control).

WoW because of its high complexity of interaction. As players achieve new levels and gain more skills, these are mapped to different keys on the keyboard. It is common for high-level characters to have almost every key on the keyboard mapped to different actions. Players have to become good enough to gain more skill, and also need to learn how to access these skills quickly while playing. Often, players have to perform more than one task at a time – for example, navigate and fight, or navigate and communicate with other players in the guild. Thus, our goal was to offload some of the actions from the keyboard onto the body, allowing the player to use both body-based and keyboard input simultaneously.

Designing body-based interaction for a desktop game presents different challenges than designing for a console game. Console games can assume players have space to move around, probably standing in their living rooms. For a desktop game, we must assume that players are sitting in chairs, and that their hands are busy with the keyboard and mouse. This assumption limits the amount of movement available for body-based interaction.

In our implementation we use leaning to control navigation. By leaning their bodies forward or backward players move their characters forward in the same direction. Starting from a neutral body position, a small amount of forward or backward movement makes the character walk, and leaning farther forward makes the character run (rate control). There is a "dead zone" surrounding the neutral point in which the character stands still. Leaning to the side rotates the character with the amount of rotation proportional to the distance the player leaned (position control). We also experimented with rate control for rotation, but found this to be difficult to control. A foot pedal is used to activate and deactivate movement. Bars on the side and bottom of the screen give feedback about the user's body position, as shown in figure 1.

Players can customize the amount of movement necessary to activate running and walking, set the direction of rotation, reset their neutral position, and choose if pressing the foot pedal activates or deactivates the movement. To track players' movement a Wii remote pointing down is placed above the player's chair. Its infrared camera is used to track infrared LEDs that players wear on top of their heads. Players still use the keyboard to perform all other tasks, such as selecting targets and attacking. Figure 2 illustrates this setup.

Although we refined the design concept and implementation details through several iterations, our goal was not to find the optimal body-based navigation technique. Once we felt that the technique was usable and fairly robust, we wanted to perform a study to investigate the feasibility of this approach.

Formative evaluation

The goal of this formative study was to determine if players are able to use their bodies to interact while also using the keyboard and mouse, and to investigate possible benefits of this approach. A total of twelve participants took part in the study. Three did not play desktop games, three were experienced WoW players (all had 63+ level characters, out of 70 levels) and six had never played WoW but played other desktop games. Participants' ages ranged from 22 to 41; two were female.

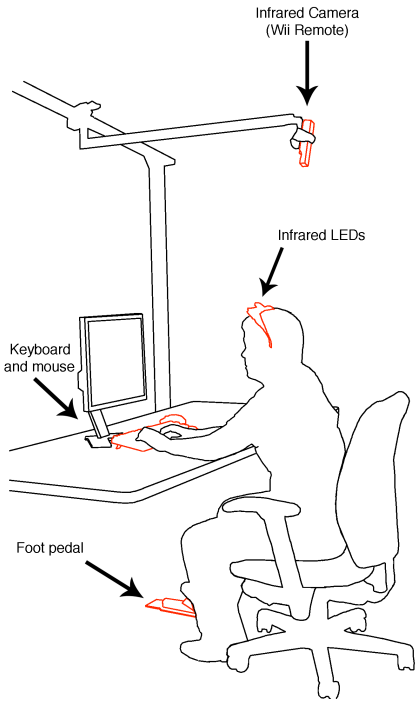

Figure 2 - Prototype setup

The study started with background questions about computer usage and familiarity with desktop games. We asked the WoW players additional questions about their playing habits. Participants then received a tutorial on how to play WoW using the keyboard and mouse, followed by an experimental session where they completed a series of tasks. This first part of the study ended with a questionnaire collecting opinions about the tasks and the standard WoW interaction. In the second part of the study, players learned how to use the body-based technique, and then completed the same experimental tasks as in part one. Another questionnaire collected opinions and impressions about playing using body-based interaction, comparisons with traditional interaction, and suggestions about how to make body-based interaction better. Since we were investigating feasibility and possible benefits, we did not measure task performance.

Tasks

The first set of tasks involved navigation only, and the goal of these tasks was to gain insight on participants' opinions of traditional and body-based navigation. Outdoor navigation tasks were easier, since they involved smooth turns and few obstacles. Indoor tasks were harder, and required going in and out of several rooms, climbing stairs, and maneuvering around objects in tight spaces.

The second set of tasks involved performing two tasks at the same time: navigation and attacking. These tasks were design to test our hypothesis that body-based interaction would have benefits for compound tasks. The first task was to attack and kill wolves using a weapon that could be fired from a distance, so navigation was minimal. The same task was repeated using a weapon that requires close contact and more navigation. Finally, players had to duel with another character, which was controlled by one of the researchers. During the duel players could choose any weapon and skill that they wanted. This task required more navigation than before, since the opponent character was constantly moving to avoid strikes and to find good positions to attack.

Observations and User Feedback

Here we discuss the two most important findings, related to the general use of body-based interaction, and its use in multitasking.

General Body-Based Interaction

Ten out of 12 participants (including all of the novice players) liked the idea of using body movement to control the character in the game. Some of the comments were that it was "fun," "interesting," "natural," and "more intuitive," while another subject responded that he "didn't have to think too much." Subjects that did not like body-based interaction mentioned that "it is too much energy to do everything that needs to be done," and that they couldn't play for more than 10 or 15 minutes using body-based interaction due to fatigue. Based on their experience with our technique, participants were asked whether they would use a hypothetical "perfect" body-based navigation technique to play WoW in the long term. Seven of 12 participants (including all of the novice players) said that they would use it in the long term. Some said that it would be easier to multitask, that keys are easy to forget, and that body movement gives a stronger feeling of involvement with the game itself. Subjects that would not use body-based interaction in the long term mentioned that they did not think the

technique is suitable for a fast-paced game like WoW, and that body movement makes it hard to keep their eyes fixed on the desktop screen.

Multitasking

During attacks and the duel participants had to multitask, navigating and attacking at the same time. We asked them if using the body to navigate made it easier or harder to concentrate on the attack. It was easier for five of the 12 participants, who justified their answers by saying that they didn't have to think about how the character was moving and only had to concentrate on the attack. Four participants said it was harder, and that they had to concentrate more to move the character. They mentioned that they know how much they need to hold down a key to back up, turn around, or strafe, and to do that with the body was much more difficult. Others commented that they keyboard offers discrete control, while the body-based technique provides continuous movement, so it was harder to have fine control. Three participants did not have a direct answer to the question; two of these were novice players. One mentioned that he had to concentrate a little more, but it was not overwhelming, and that using body-based interaction during the attack was the task where he had the most fun. The other novice player said that he did have to concentrate a little more during the attacks, but it was still easier than using the keyboard and mouse.

Design insights

The interviews and our observations also gave us insights about how to design body-based interaction for desktop games.

- Keyboard: Since it is not our intention to replace the keyboard, it is important to point out what subjects like about using it. Control over fine movements and discrete actions were generally better with keyboard. This was visible on the indoor navigation tasks, where character had to navigate through narrow spaces and make sharp turns. Body-based interaction seems to be most appropriate for continuous, coarse-grained actions.
- Naturalness of interaction: For body-based interaction, many participants like the naturalness of the mapping between their body and the character's movement. When part of the interaction did not have that direct mapping, some players had difficulties. The foot pedal, for example, did not have this direct correspondence. Some participants would forget to take the foot off the pedal to stop their movement, which caused undesired navigation. Some players also did not like the sideways movement of the torso to control rotation. For them, the most intuitive movement was to rotate their heads, but by doing this the player's head would not face the screen. As much as possible, body-based interaction should support natural, direct mappings.
- Fatigue: this was a concern for some participants, since navigation required constant movement of the body, and/or constant muscle tension to hold the body in a particular position. They mentioned that they could not use our interaction technique for many hours. When designing body-based interaction, care should be taken to keep the amount of movement to a minimum, to avoid requiring users to maintain a constant position, and to ensure that users can rest at regular intervals in the game.

Conclusions and Future Work

Our formative study demonstrated the feasibility of combining body-based interaction with keyboard input for desktop games. We observe possible benefits in multitasking, enjoyment of the game, and learnability.

During the attacking tasks, the resemblance of the body movement to the character movement made it easier for some players to concentrate only on the keys they needed to press to attack. This supports our hypothesis about benefits for multitasking.

Interactions that support a correspondence to real-world actions can also provide a different kind of game experience than that delivered by keyboard and mouse only. Some players felt more involved in the game because the character was mimicking their body movements.

Experienced WoW players told us that when they first learned to play the game (prior to our experiment) it was easy to learn the basic game, but it took longer to master the mapping between keys and actions. We argue that the reason is that there is no relation between the key pressed and how the action is performed in the real world. Body movements that resemble the real-work action can help novice players learn the game easier and faster.

Future work

Given the positive feedback and suggestions received from our participants, and from our own experience, we are continuing to explore the possibilities of combining body-based interaction with keyboard and mouse.

We intend to use the design insights to refine our navigation technique. We will minimize fatigue by reducing the muscle tension needed to activate and control movements. We want to use foot interaction, since this is a resource not used in most desktop games, but we will find a better mapping to the action that the foot will control. We will investigate more intuitive mappings between players' movements and character rotation. We will expand the scope of the interaction by offloading additional tasks onto the body.

We are designing a formal study to quantify the benefits of this approach on learnability, performance, and engagement with desktop games.

References

[1] Beckhaus, S., Blom, K., Haringer, M. A new gaming device and interaction method for a first-person-shooter. *Computer Science and Magic 2005*, (2005).

[2] Blizzard Entertainment. World of Warcraft. http://www.worldofwarcraft.com.

[3] LaViola, J., Bringing VR and Spatial 3D Interaction to the Masses through Video Games. *IEEE Computer Graphics and Applications*, 28(5), 10-15, 2008.

[4] Lindley, S. E., Le Couteur, J., and Berthouze, N. L. Stirring up experience through movement in game play: effects on engagement and social behaviour. In *Proc. CHI 2008,* ACM Press (2008), 511-514.

[5] Schuchardt, P., Bowman, D. The Benefits of Immersion for Spatial Understanding of Complex Underground Cave Systems. In *Proc. VRST 2007,* ACM Press(2007), 121-124.

[6] Sreedharan, S., Zurita, E. S., and Plimmer, B. 3D input for 3D worlds. In *Proc. OZCHI '07*, 227-230, 2007

[7] Usoh, M., Arthur, K., Whitton, M.C., Bastos, R., Steed, A., Slater, M., Brooks, F. P., Jr. Walking > Walking-in-Place > Flying, in Virtual Environments. In *Proc. SIGGRAPH 99*, ACM Press (1999), 359-364.