Kinect

Implications of Kinect Sensor Latency to User Interaction in Virtual Reality

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Since the release of the Microsoft Kinect in 2011, there has been increased interest in markerless body-based interaction for virtual reality (VR). The Kinect and similar sensors enable users to interact with VR in a natural method, while costing substantially less than other user tracking system. However, the use of these low-cost sensors comes at the expense of increased system latency, which can adversely affect the user's experience in VR. To better understand the advantages and limitations of these low-cost markerless sensors, this research will develop a method to measure the latency of the Kinect 1 and Kinect 2 sensors for skeletal tracking, voice recognition, and gesture recognition. Furthermore, the impact of latency on different methods of user interaction will be investigated.

Previous research has shown that latency between a user's movements and the corresponding visual changes in a virtual environment have a substantial impact on both the user's immersion and comfort level in the environment (Friston & Steed, 2014). To improve immersion and comfort, virtual reality systems are built with hardware that minimizes system latency. However, with the release of the Microsoft Kinect in 2011, there has also been a push towards non-contact body-based interaction in virtual environments, at the cost of added latency (Livingston, Sebastian, Ai, & Decker, 2012). Therefore, we propose an REU group investigates these tradeoffs by:

1. Developing a method to determine the latency of non-contact body-based sensors, such as the Microsoft Kinect 1 and Kinect 2, for skeletal tracking, voice recognition, and gesture recognition modalities.
2. Examine user tolerance of latency in different tasks (object manipulation, travel, system control)
3. Examine user tolerance of latency for different interaction modalities (voice, gesture, skeleton tracking)

By examining these questions, a better understanding of the physical limitations of the Kinect 1 and Kinect 2 sensors will be ascertained. Furthermore, by understanding the user perceptions of latency for non-contact body-based sensors, virtual environment designers will be able to build interactions that minimize the disruptive effects of the sensors latency.

Friston, S., & Steed, A. (2014). Measuring latency in virtual environments. *IEEE Transactions on Visualization and Computer Graphics*, *20*(4), 616–625. doi:10.1109/TVCG.2014.30

Livingston, M. A., Sebastian, J., Ai, Z., & Decker, J. W. (2012). Performance Measurements for the Microsoft Kinect Skeleton. In *2012 IEEE Virtual Reality (VR)* (pp. 119–120). Costa Mesa, CA: IEEE. doi:10.1109/VR.2012.6180911