A Cure for Neuromancers: Developing Software Solutions to Cyber Sickness with Tunneling and Predictive Rail Systems

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This summer's project was aimed toward developing and improving software-based accessibilities for virtual reality experiences, specifically to address issues of motion/cyber sickness during locomotion. Typically, cyber sickness will occur in VR users when a mismatch occurs between their real life movement and their virtual movement. This sickness can be incredibly prohibitive for those new to using VR, and as such, limit their experiences to stationary ones. In the past few years, multiple software solutions have been developed for this locomotion problem. Specifically, in natural locomotion (where a user can control exactly where/how fast they move using a controller, without teleportation), a popular solution has been to use tunneling. Tunneling involves restricting the user's field of view (FOV) with an obscuring "blinder", typically in the form of a black vignette effect. This helps limit the amount of periphery data a user has to process, and better focuses them on their movement goal, reducing the dissonance between their virtual and real-life movement. Our work this summer strove to improve and build upon these methods in three distinct ways: a) merging current tunneling with other VR comfort methods for improvement, b) developing a new, predictive virtual rail system to help continue grounding user movement, and c) implementing quantitative methods of measuring cyber/motion sickness. Each of these were implemented using the Unity game engine, and developed/tested on the Oculus Rift, and its associated API in Unity.

The first part of this was accomplished by merging the methodology of tunneling with another VR comfort mechanic: foveated rendering. Foveated rendering aims to recreate parts of natural vision, in which humans don't naturally have their entire FOV in focus. This is implemented by blurring or rendering the edges of a VR screen in lower resolution/fidelity, where user eyes aren't focused. As a middle step between a static foveation and a dynamic, eye-tracking one, I decided to implement tunneling that used blurring rather than an opaque blinder, and added the ability for the blinder to follow the direction of player movement, tilting in whatever direction they may be moving to further account for possible dissonance between virtual and real-life locomotion. In early testing, this has made for a less intrusive/more immersive experience, but further testing is required to determine possible tradeoffs.

The second branch, the rail system, iterates and expands on an idea presented in Luk ' thesis, "Examim B 0.005 Tc 45 0 0 45 0 0Tmmn 0.005 Tc 45 0 0 45 0 0Tes Un 0.005 Tmavigation mesh system (fo nd uam o52 (ı pathfinding) to attempt to predict the location the player wants to be in next, and renders a clearly visible line, or rail, from the player's location, to their predicted location. This predicted location changes dynamically, based on the direction the user is moving. This system provides a visually stabilizing element to a user's FOV, that simultaneously guides their focus directly toward whatever direction they may be walking in, so long as the rail is in view. While less immersive, this method can be integrated into a variety of settings and while apparent, is immediately intuitive for users as to its purpose.

The third element was developed to help assist in testing the effectiveness of the two previous comfort measures. It uses the formulae and methods described by Weech et al.'s research into the sensorimotor components of cyber sickness[1], and adapting an implementation using solely the sensors in the Oculus Rift by Kim et al.[2]. This method of cyber sickness detection will be used in conjunction with qualitative user surveys when testing expands to the student body this fall semester, as part of an independent study.

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[1] "Sensory Processing: Estimating the Sensorimotor Components of Cybersickness," accessed August 12, 2019, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6295542/.
[2] Sehoon Kim et al., "An Effective FoV Restriction Approach to Mitigate VR Sickness on Mobile Devices," Journal of the Society for Information Display, June 1, 2018, https://doi.org/10.1002/jsid.669.