User Experience with Semi-Natural Locomotion Techniques in Virtual Reality: The Case of the Virtuix Omni

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Motivation

The benefits of real walking for locomotion in virtual reality (VR) have been well documented. Prior studies have shown that semi-natural VR locomotion techniques can produce an inferior user experience compared to both real walking and non-natural locomotion techniques, but it is not known whether all semi-natural VR locomotion interfaces suffer from the same problems.

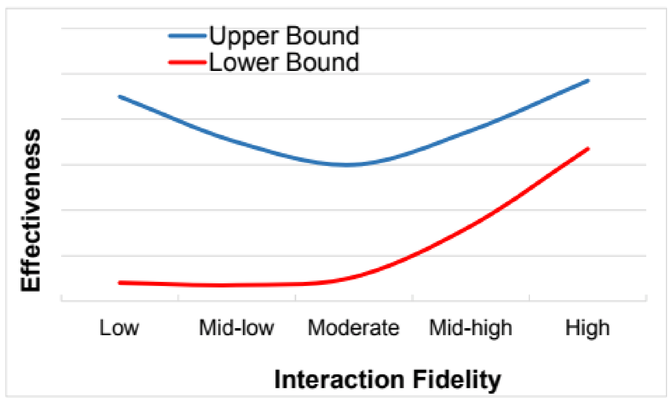
FIFA Analysis

	Game Controller	Virtuix Omni
Biomechanical Symmetry		
Kinematic Symmetry	Move thumb to translate	Move thighs, legs, feet and to translate entire body
Kinetic Symmetry	Apply force in movement direction by thumb	Large vertical and low shear ground forces
Anthropomorphic Symmetry	Thumbs	Thighs, legs, and feet
Control Symmetry		
Dimensional Symmetry	x + y	x + y
Transfer Function Symmetry	Tilt-to-velocity	Motion-to-Δ position
Termination Symmetry	Stop tilting joystick	Stop taking steps
System Appropriateness		
Input Accuracy	Standard Joystick	Inertial foot sensors
Input Precision	Standard Joystick	Inertial foot sensors
Latency	Standard Joystick	Inertial foot sensors
Form Factor	Handheld	Curved surface with a harness

Low Fidelity — High Fidelity

Research Questions

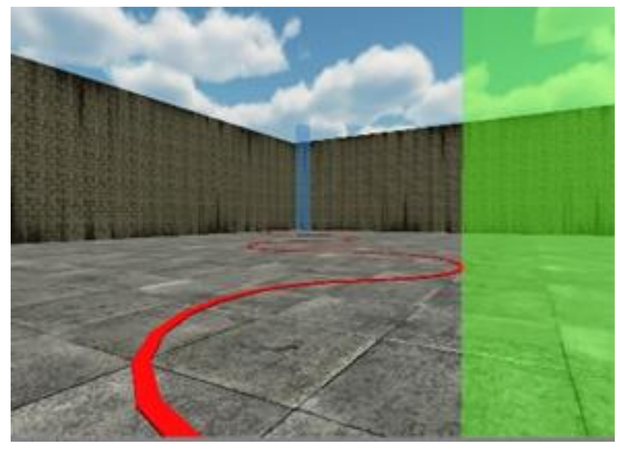
1. How does the user experience (including speed, accuracy, spatial orientation, game experience, simulator sickness, presence, and user preference) with the semi-natural Virtuix Omni compare to a traditional non-natural VR locomotion interface?
2. Do these results support the uncanny valley hypothesis of McMahan et al.?
3. Compared to earlier semi-natural VR locomotion techniques, does the Omni provide higher interaction fidelity and correspondingly higher levels of user experience?



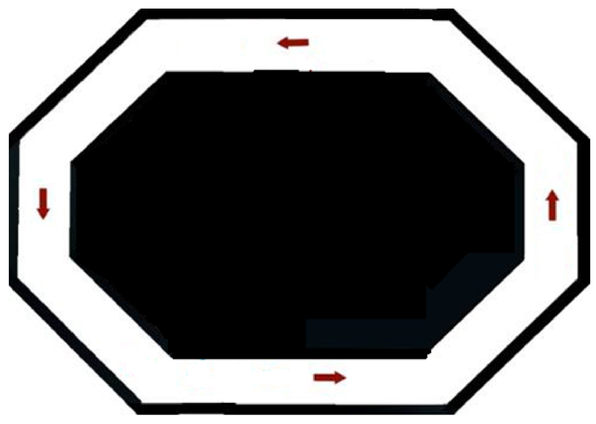
Visual Representation of the Uncanny Valley

Experiment

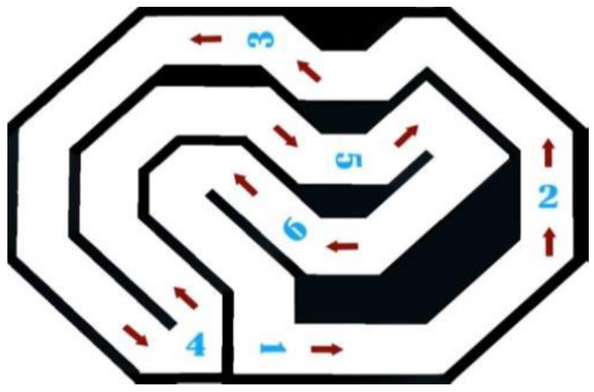
The experiment compared two different locomotion interfaces: the Virtuix Omni and a game controller technique. We used the tasks from an existing locomotion testbed. The testbed includes tasks emphasizing accuracy, speed, and spatial orientation, and uses a variety of measures to get a comprehensive view of locomotion user experience.



A view of the 2m half circle path following task. Users needed to accurately walk along the red line between the checkpoints.

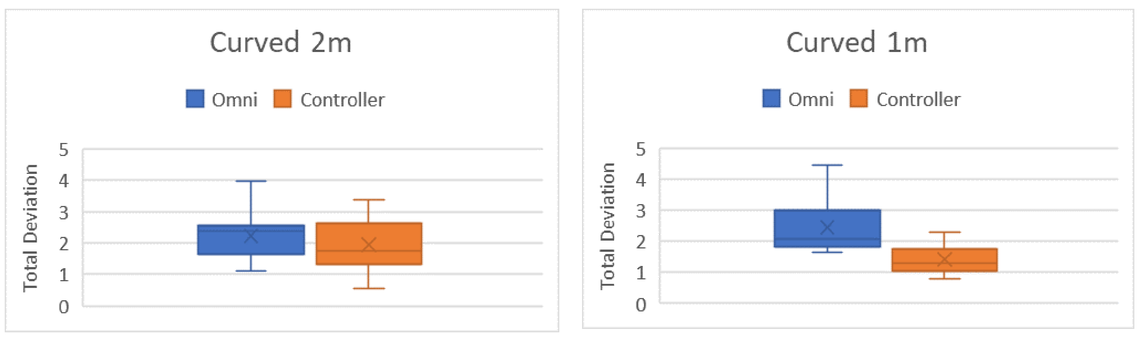


Top down view of the speed path. Users needed to quickly “run” 2 laps while avoiding walls.



Top down view of the spatial orientation task. Users walked in a virtual maze and were asked to locate obstructed markers from previous positions in the world.

Key Findings



Total deviations for two path following tasks. The line inside each box represents the median, while the “x” marks the mean.

- Overall, we found few objective differences in task performance
- Only the most difficult path following task resulted in significantly more deviation
- The relationship between the level of interaction fidelity in a technique and its effectiveness is not a simple “more is better.”
- Our results suggest that newer semi-natural devices with increased fidelity have the potential to climb out of the uncanny valley.

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