Wheel-Based Attachable Footwear for VR: Challenges and Opportunities in Seated Walking-in-Place Locomotion

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Motivation

- Virtual locomotion is an essential task in VR
- Among many locomotion techniques, **seated walking-in-place (sWIP)** offer optimal balance of immersion, user comfort, physical space efficiency, and practicality
- Traditional VR controllers lack sWIP feature
- Most sWIP devices are in research prototype stage
- Commercial sWIP devices lack through end user evaluation

- *We study the effects of a commercial sWIP device,* **Cybershoes**, *on user comfort, presence, motion sickness, and overall experience during sightseeing tasks.*

Bindings for Stability · Grips for better turning traction · Roller Accurate tracking · USB Charging Port Firmware Update · Removable Top for changing batteries · IMU Inertial Measurement Unit for Orientation

Methodology

- We conducted a study with 12 participants (8 men, 4 women, aged 25-30)
- Participants performed sightseeing tasks in two VRChat worlds
- They used sWIP with Cybershoes and teleportation with handheld controllers
- We used think-aloud protocol and qualitative coding analysis

VRChat world 1 · VRChat world 2 · Receiver for Cybershoes · A participant performing sightseeing tasks · Swivel chair with adjustable height · Cybershoes

Key findings

- Cybershoes generally led to reduced motion sickness compared to handheld controllers
- Most participants (10 out of 12) reported slower perceived speeds with Cybershoes
- Majority experienced more natural maneuvering by combining foot, head, and body movements
- Physical fatigue was more pronounced with Cybershoes, particularly in lower extremities
- VR novices found Cybershoes more intuitive than handheld controllers

Design Implications

- Incorporate force feedback and adjustable wheel resistance based on virtual terrain
- Explore applications in professional training scenarios (e.g., firefighter training)
- Design exertainment apps leveraging Cybershoes' physical engagement (e.g., virtual marathons)
- Potential of Cybershoes in enhancing remote work experiences, particularly for roles requiring physical movement
- Investigate methods to calibrate movement speed to individual users' preferences and physical capabilities