

CSE 165: 3D User Interaction

Lecture 8: Travel

Announcements

- Sunday, February 7th at 11:59pm:
 - Homework project 2 due
- Monday, February 8th at 4pm:
 - Discussion Project 3
- Sunday, February 14th at 11:59pm:
 - Homework project 2 late deadline

3D UI Presentation

- Qing Wei:
 - Introducing SenseGlove Nova

Travel Techniques

- Physical locomotion (“natural” metaphors)
- Steering techniques
- Route planning
- Target-based techniques
- Manual manipulation
- Viewpoint orientation techniques

Physical Locomotion Techniques

- Walking techniques
 - Large-scale tracking
 - Walking in place
- Treadmills
 - single-direction with steering (Gait Master)
 - omni-directional (Omni)
- Bicycles
- Other physical motion techniques
 - Magic carpet
 - Disney's river raft ride



Large Scale Tracking

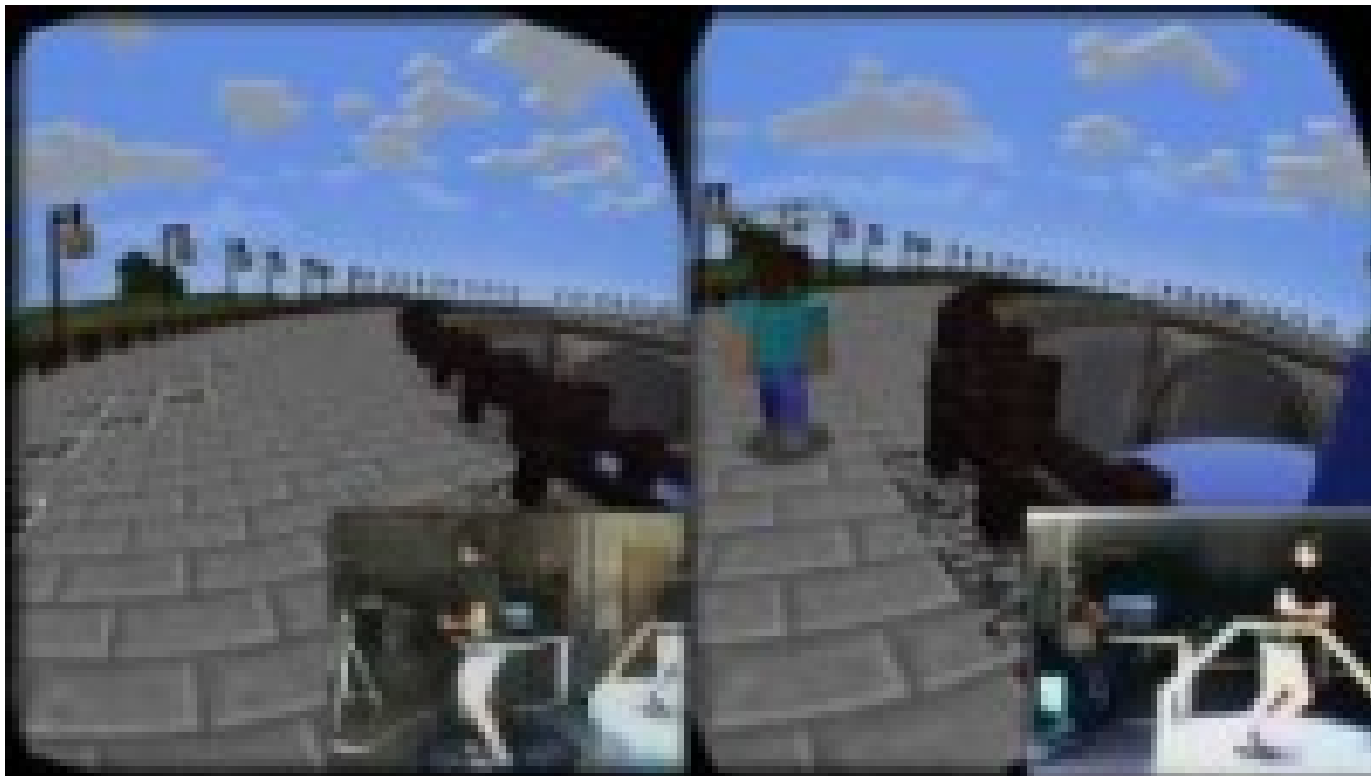


Omni-Directional Treadmill

- Infinadeck VR



Virtuix Omni



Gait Master



String Walker

- Video from Emerging Technologies, SIGGRAPH 2007



3D-Printed VR Shoes

- Made by Youtuber “Finally Functional”



VR Shoes: Components

- 2 motors, \$50 each
- 2 VESC's, \$65 each
- 2 ESP32s, \$10 each
- 2 anti spark switches, \$30 each
- 2 batteries, \$25 each
- safety harness, \$30
- ceiling hook, \$20
- bearings, \$20
- plastic, \$20
- various screws, metal rods, connectors, \$20

Steering Techniques

- Steering:
 - Continuous specification of direction of motion
- Techniques:
 - Eye gaze
 - Head direction
 - Hand pointing
 - Torso-directed
 - Physical device (steering wheel, etc.)

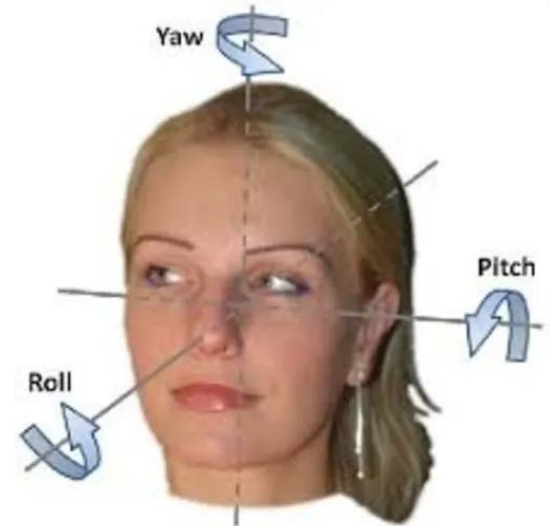
Steering by Eye Gaze

- Move viewpoint in direction of eye gaze
- Gaze direction determined from eye tracker
- Cognitively simple
- Doesn't allow user to look to the side while traveling



Steering by Head Orientation

- Move viewpoint in direction head is pointed
- Direction determined from head tracker
- Cognitively simple
- Allows user to look to the side while traveling, but hard to decouple eye gaze and head direction



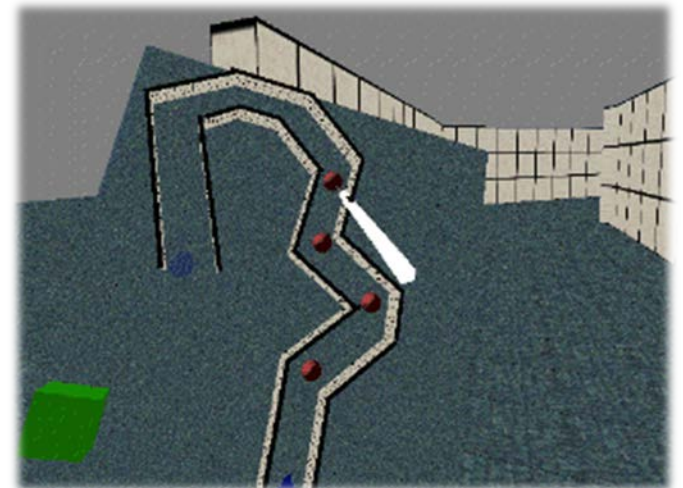
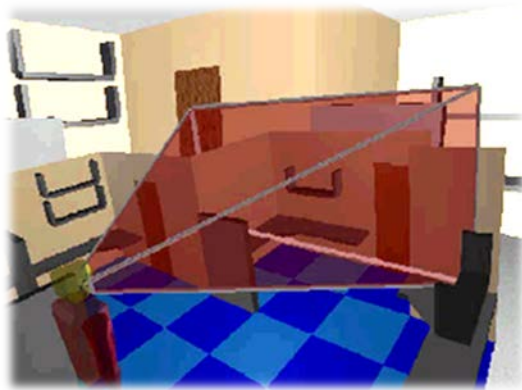
Steering by Pointing

- Similar to steering by head orientation, but uses hand tracker instead of head tracker
- Cognitively slightly more complex than steering by eye/head
- Allows travel and eye gaze in different directions



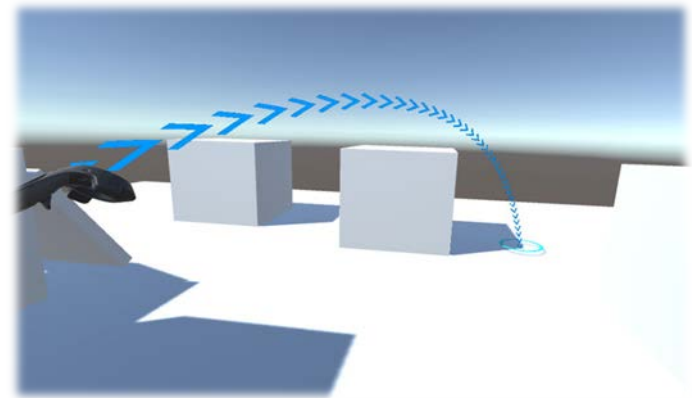
Route-Planning

- One-time specification of path
- Implementation:
 - Draw entire path
 - Specify points along path
 - Manipulate user representation



Target-Based Techniques

- Direct specification of destination
- A.k.a. Teleportation
- Techniques:
 - Point at target location on ground
 - Point at target object
 - Choose target from list
 - Enter coordinates
 - Use Map/WIM
- Visualization as straight line or arc



VR Arc Teleporter Unity Asset

Teleportation Implementation

- User points at target location with controller
 - Straight line: simpler implementation
 - Curved line: allows teleporting to higher spots
- Specification of target orientation:
 - Nothing specified: orientation doesn't change
 - Orientation specification possible: allows more flexibility
- Transition animation:
 - No animation: immediate switch to destination
 - Fade to black: very short fade to black during transition
 - Gradual transition to destination: defeats purpose of reducing motion sickness, but helps with orientation

Teleportation Pros/Cons

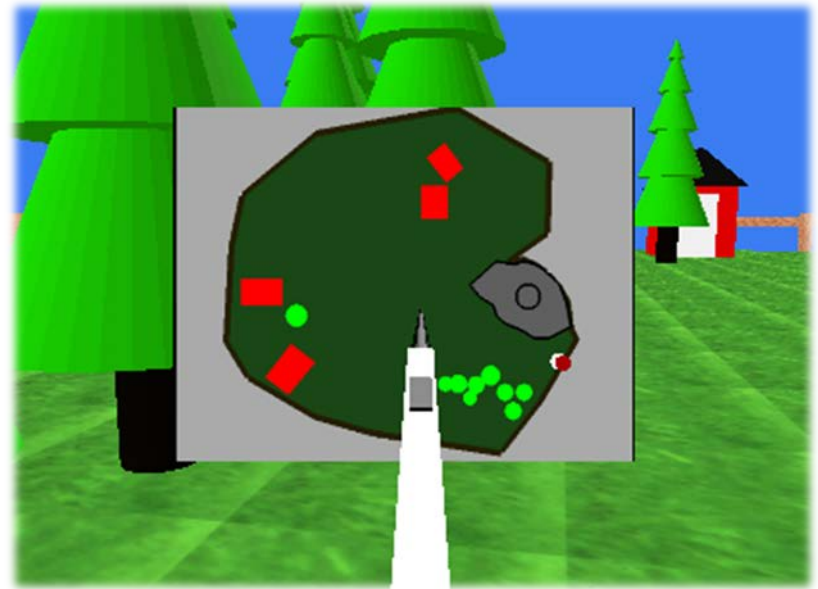
- Advantages:
 - Reduces motion sickness compared to continuous walking
 - Allows quicker movement through spaces
 - Gives programmer control of where user can go (especially when teleport destinations are limited)
- Disadvantages:
 - Disorienting: no intuition for movement to new location
 - Can jump over obstacles that would have blocked motion with continuous motion techniques
 - Destination orientation specification is cumbersome

Teleportation in Unity



Map-Based Travel Techniques

- User represented by icon on 2D map
- Drag icon with stylus to new location on map
- When released, viewpoint moves smoothly to new location



Manual Manipulation – Grabbing the Air Technique

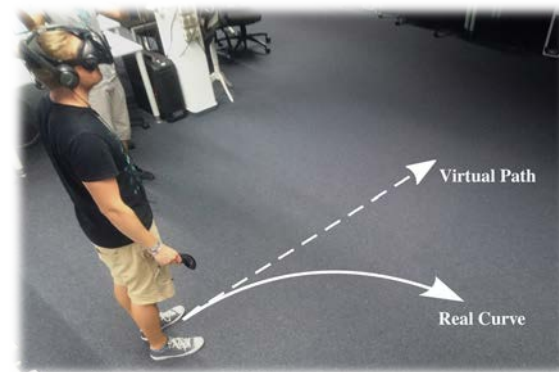
- Use hand gestures to move yourself through the world
- Metaphor of pulling a rope
- Can be one-handed, but often a two-handed technique
- Works well with tracked gloves or 3D tracked controllers

Viewpoint Orientation Techniques

- Head tracking
- Non-isomorphic rotation
- Virtual sphere (trackball)

Redirected Walking

- VR users wear HMDs
- Experience the illusion of walking in any direction for an infinite distance
- In reality they are walking a curvilinear path in physical space
- Accomplished by introducing unnoticeable rotations to the virtual environment



Redirected Walking: Video



Video: Comparison of Selection and Travel Techniques

