CSE 165: 3D User Interaction

Lecture 8: Travel

Announcements

- Sunday, January 31st at 11:59pm:
  - Late deadline for project 1
- Monday, February 1st at 4pm:
  - Discussion Project 2
- Sunday, February 7th at 11:59pm:
  - Homework project 2 due

3D UI Presentations

- Jonathan Barnes
  - Real Haptics: Using Physical Manipulation to Control Virtual
- Matthew Zane
  - VR Skin
- Diego Gomez
  - Infinite Office

Navigation

Wayfinding – Cognitive Component

Travel – Motor Component

Travel

- Motor component of navigation
  - But good travel techniques integrate wayfinding aids
- Movement between two locations, setting the position (and orientation) of the user's viewpoint
- The most basic and common VE interaction technique, used in almost any large-scale VE

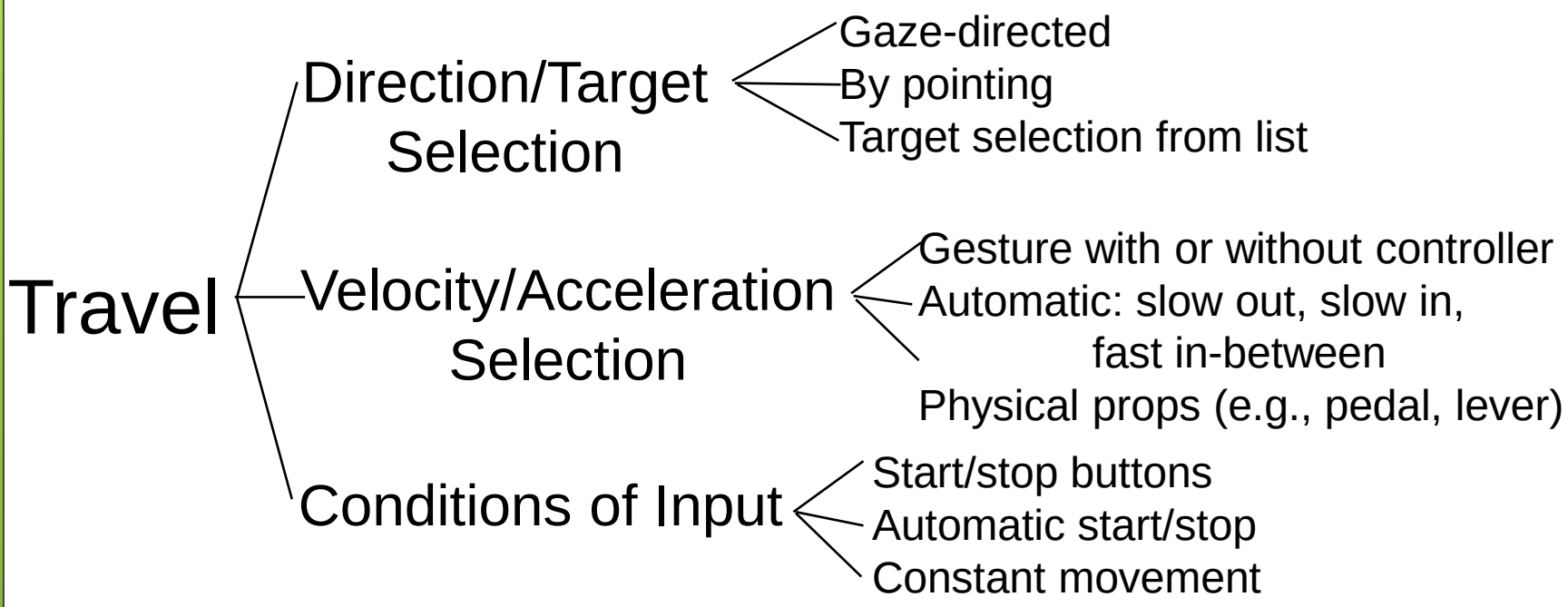
Travel Tasks: Why Travel?

- Exploration
  - travel which has no specific target
  - build knowledge of environment
- Search
  - naïve: travel to find a target whose position is not known
  - primed: travel to a target whose position is known
- Maneuvering
  - travel to position viewpoint for task
  - short, precise movements

Travel Parameters

- Travel distance
- Amount of curvature/number of turns in path
- Target visibility
- DOF required
- Accuracy required
- Other tasks to be done during travel
- Active vs. passive
- Physical vs. virtual

Travel Component Decomposition



From: Bowman, Koller, and Hodges, Travel in Immersive Virtual Environments. IEEE VRAIS '97

Travel Techniques

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

Physical Locomotion Techniques

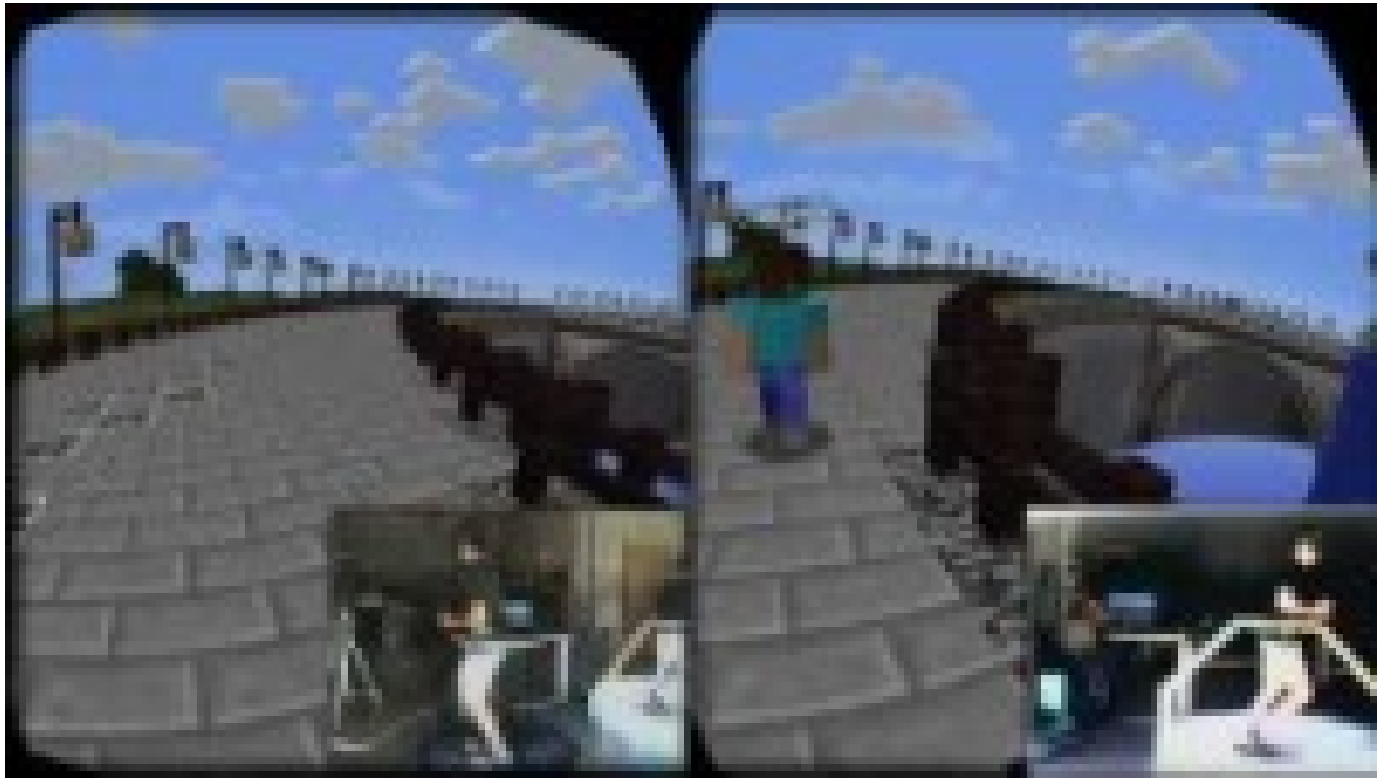
- Walking techniques
  - Large-scale tracking
  - Walking in place
- Treadmills
  - single-direction with steering (Gait Master)
  - omni-directional (Omni)
- Bicycles
- Other physical motion techniques
  - Magic carpet
  - Disney's river raft ride

Large Scale Tracking

Omni-Directional Treadmill

- Infinadeck VR

Virtuix Omni



Gait Master

String Walker

- Video from Emerging Technologies, SIGGRAPH 2007

Steering Techniques

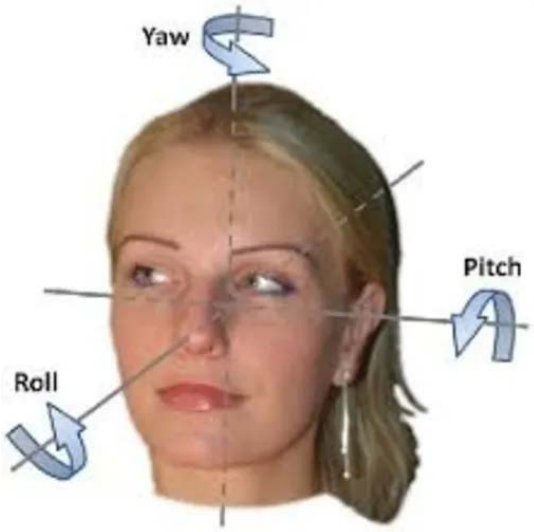
- Steering:
  - Continuous specification of direction of motion
- Techniques:
  - Eye gaze
  - Head direction
  - Hand pointing
  - Torso-directed
  - Physical device (steering wheel, etc.)

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

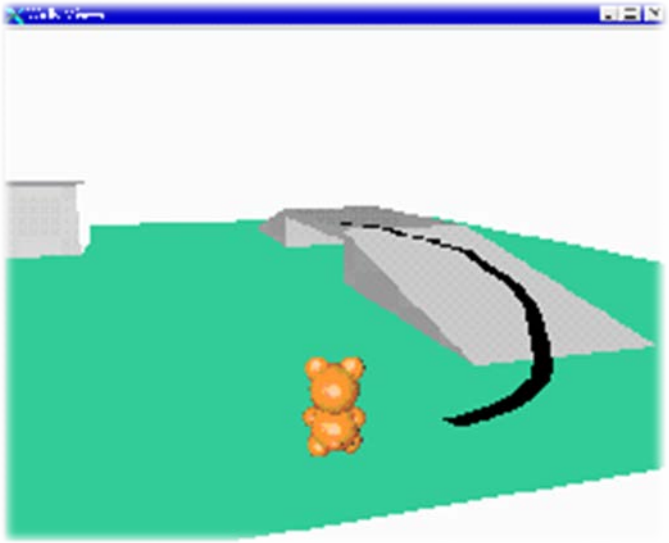


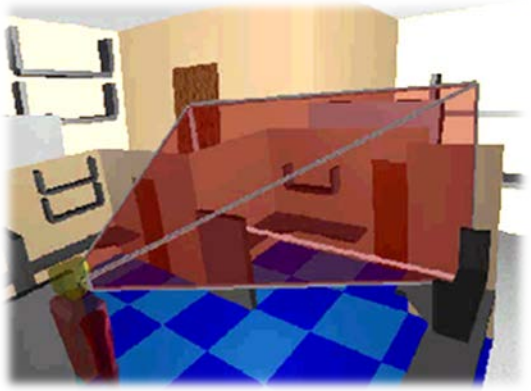
Steering by Pointing

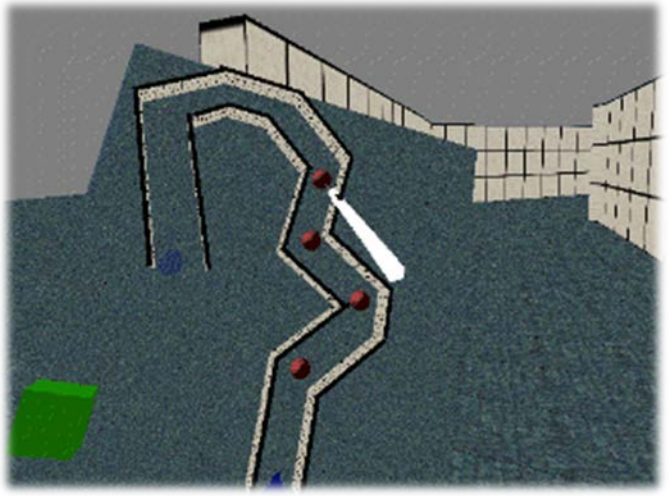
- Similar to steering by head orientation, but uses hand tracker instead of head tracker
- Cognitively slightly more complex than steering by eye/head
- Allows travel and eye gaze in different directions

Route-Planning

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

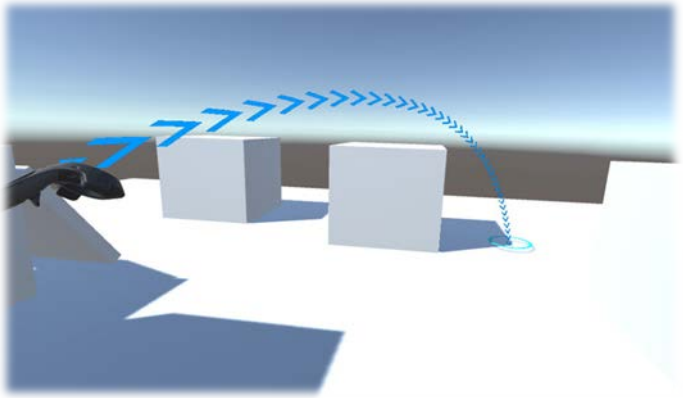






Target-Based Techniques

- 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

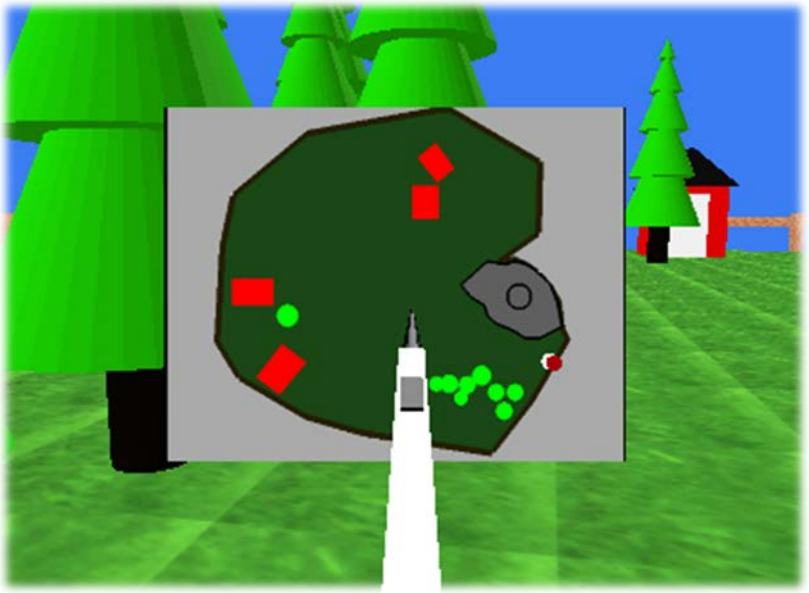
Teleportation Pros/Cons

- 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