CSE 165: 3D User Interaction

Lecture #3:
Selection and Manipulation

Announcements

- Sign up for video presentation
  - Deadline: Sunday, Jan 17, 11:59pm
  - Only need to pick a date now – you can choose the video later
- Homework Assignment 1 is due Sunday, Jan 24 at 11:59pm
- Late deadline: Jan 31 at 11:59pm

Independent Research

- Opportunity for this quarter:
  - Development of AR application with Unity for the Hololens
  - Collaboration with SPAWAR (Navy research lab)

3D UI Presentations

- Baichuan Wu:
  Introducing the Rain Blender Rig

Selection and Manipulation

On 2D Desktop

- Location selected with mouse cursor
- Action triggered with mouse button
  - 1-3 (sometimes more) buttons for different functionality
- Mouse wheel as shortcut for scroll bar interaction

On Touch Screens

- Examples: smart phone, tablet, laptop display
- Finger touches target location directly
  - Triggers action on touch
- Multi-touch and swiping for added functionality
  - E.g., pinch to zoom

Triggering an Action in 3D

With Controllers

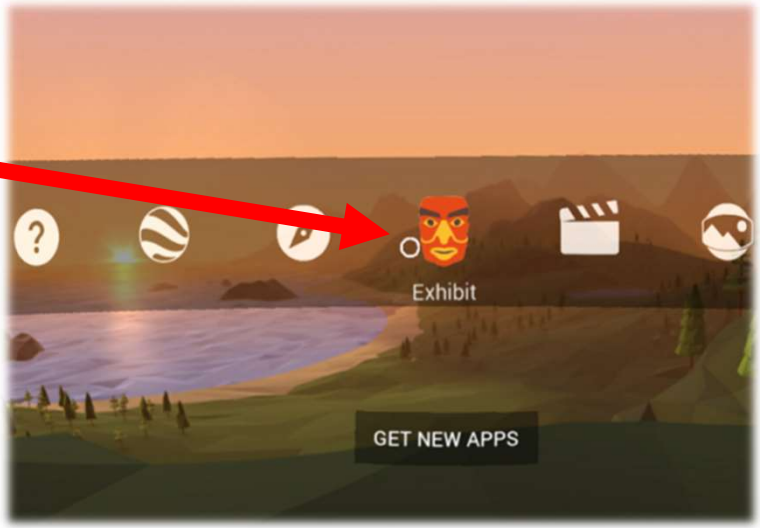
- If a VR/AR system comes with controllers, actions can be triggered with the buttons on the controllers
- Challenge:
  not to overburden the user with memorizing button assignments

Without Controllers

- Some VR headsets do not come with controllers:
  - Google Cardboard
  - Other smartphone VR
  - Early Oculus (DK1 and DK2)

Selection by Gaze or Head Direction: Hover and Wait

- Crosshairs in center of screen
- Turn head in direction of selection location (Hover)
- Action triggers after specified amount of time (Wait)



Examples for Visual Indicators

- Radial widgets

- Slider widgets

- Hexagon fill
  - https://www.youtube.com/watch?v=uTH9NCxNvZI

Why are Selection and Manipulation Important?

- Major methods of interaction with
  - physical environments
  - virtual environments
- Affect the quality of entire 3D interface
- Design of 3D manipulation techniques is difficult

Selection vs. Manipulation

- Selection: specifying one or more objects from a set
- Manipulation: modifying object properties (position, orientation, scale, shape, color, texture, behavior, etc.)

Goals of Selection

- Indicate action on object
- Query object
- Make object active
- Travel to object location
- Set up manipulation

Selection Performance

- Variables affecting user performance
  - Object distance from user
  - Object size
  - Density of objects in area
  - Presence of occluding objects

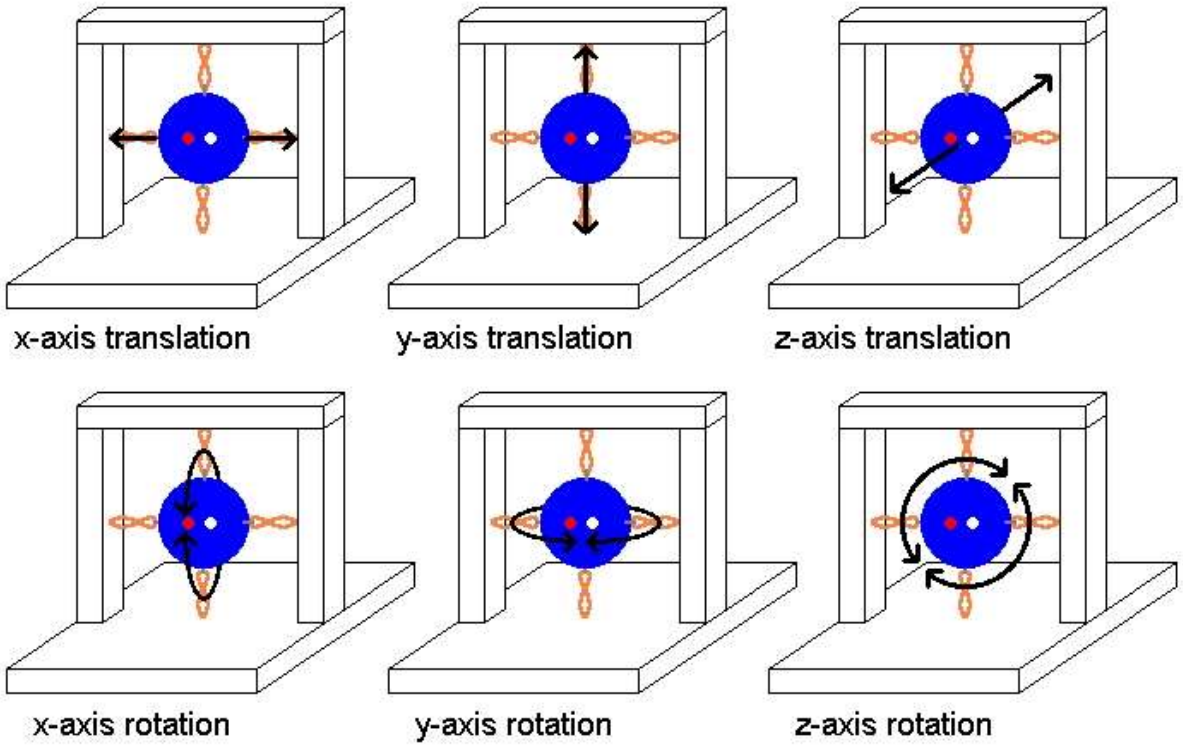
Canonical Parameters

- Selection
  - distance and direction to target
  - target size
  - density of objects around the target
  - number of targets to be selected
  - target occlusion
- Manipulation
  - Positioning
    - distance/direction to initial position
    - distance/direction to target position
    - translation distance
    - required precision of positioning
  - Rotation
    - distance to target
    - initial orientation
    - final orientation
    - amount of rotation

Degrees of Freedom (DOF)

- DOF: Set of independent displacements that specify completely the displaced or deformed position of a body or system.
- 3 DOF for position:
  - Moving up and down (heaving)
  - Moving left and right (swaying)
  - Moving forward and backward (surging)
- 3 DOF for orientation:
  - Tilting up and down (pitching)
  - Turning left and right (yawing)
  - Tilting side to side (rolling)

6 Degrees of Freedom



Input Device Parameters

- Number of control dimensions
- Control integration: how many DOF are controlled simultaneously
- Force or incremental direction vs. position control (relative vs. absolute location)
- Form factor: impact on accuracy

Sensor attached to hand

Isomorphic vs. Non-Isomorphic View

- Isomorphic
  - Geometrical one-to-one correspondence between hand motions in physical and virtual worlds
  - Natural interactions
- Non-Isomorphic
  - "Magic" virtual tools (laser beams, rubber arms, etc.)