CSE 190: 3D User Interaction

Lecture #15: 3D UI Design

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Announcements

- Homework assignment #4 due Friday, March 8th at 1pm in Sequoia lab 142
  - Grading starts at 12:30
- CAPE
  - Web site open March 4 to March 17
- Please return borrowed webcams, Hydras, Kinects by end of quarter
  - After homework presentation
  - After class
  - During my office hour (Mon 2pm)
  - Drop off in my office – leave note with your name, I will send confirmation email

Paper Presentations Next Lecture

- Bryan: Impossible Spaces: Maximizing Natural Walking in Virtual Environments with Self-Overlapping Architecture
- Arick: TBD

Paper Presentations Today

- Kevin: Piivert: Percussion-based interaction for immersive virtual environments
- Nico: Increasing Agent Physicality to Raise Social Presence and Elicit Realistic Behavior
- Justina: Breaking the status quo: Improving 3D gesture recognition with spatially convenient input devices

3D UI Design Strategies

Thus far…

- 3DUI hardware
  - Output
  - Input
- Universal 3DUI tasks
  - Selection
  - Manipulation
  - Navigation
  - System control
  - Symbolic input

But: The combination of techniques and devices alone does not guarantee an enjoyable experience!

3DUI Design

- Microlevel: implementation
  - 3D interaction programming: hard!
  - Testing: difficult and hard to automate
  - Tweaking UI parameters: important but time consuming
- Macrolevel: guidelines
  - Strengths and limitations of human psychology/physiology
  - Common sense
  - Rules of thumb
  - Example: people naturally use 2 hands, so using 2 hands in a 3D UI might improve usability/performance

3DUI Design

- Two main strategies
  - Designing for humans
    - Match design to human strengths
  - Inventing 3D interaction techniques
    - Creative exploration of 3D UIs

Designing for Humans - Feedback

- Feedback is critical to usable 3D interfaces
  - User feedback is any information conveyed to the user to help understand
    - system state
    - result of operation
    - status of task
- Feedback control mechanism
  - Example: turning a knob produces feedback by
    - External sources: the knob
    - Internal sources: user's body
- Want to have appropriate feedback levels
- Ensure compliance (agreement) between different levels/types of feedback

Designing for Humans – Feedback in Multiple Dimensions

- Sensory dimensions
  - Visual, auditory, tactile, olfactory
  - Proprioceptive: relative position of neighboring parts of the body
  - Kinesthetic: bodily motion
- Want to try to give multi-dimensional feedback
  - Can be difficult due to technology (e.g., haptic devices)
  - Sensory feedback substitution
    - Example: visual/audio cues compensate for missing haptic feedback
- System-based feedback
  - Reactive – from sensory dimensions
  - Instrumental – generated by devices
  - Operational – changes in virtual world

Designing for Humans – Compliance

- Main principle in design feedback
- Want different feedback dimensions in sync
  - Maintain spatial and temporal correspondence between multiple feedback dimensions
- Feedback displacement is bad!
  - Example: hand and virtual object move in different directions

Designing for Humans – Spatial Compliance

- Directional compliance – virtual object should move in the same direction as manipulated by input device
- Nulling compliance – when user returns device to initial pose, virtual object returns to corresponding initial pose
- Instrumental and operational feedback also require spatial compliance
  - Example: real and virtual hand should be aligned

Designing for Humans – Temporal Compliance

- Latency – typical problem
  - Temporal delay between user input and sensory feedback
  - Incompliance with internal feedback
- Variable latency can be even more problematic
- Solutions?
  - Reduce scene complexity
  - Faster hardware
  - Predictive tracking