CS-525V: Building Effective Virtual Worlds

What Makes Good VR?

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Plan for Tonight

☐ Effective VR
☐ Talk about Project Ideas
What Makes Good VR?

☐ Physical immersion
  ■ VR world presented based on user location and orientation
  ■ Sensory stimuli in response to user actions
  ■ *Synchronized* video, audio, etc.
    ☐ Not so easy!
  ■ User-movement tracking

☐ Mental immersion
  ■ The level of *engagement* of the user
Two Schools of Thought

- Experience must be extremely realistic
  - No "point to fly" abilities
  - Excludes anything that demonstrates you are not in the real world

- Experience may contain "magical" properties
  - Can actually increase presence
  - Also, in realistic systems, breaks in realism can kill presence
Components of Immersion

- User is immersed to the point of suspension of disbelief

- Key elements
  - Personal meaningfulness
  - Interactivity
  - Sufficient resolution
    - Spatial resolution
      - Units vary by sensory modality
    - Temporal resolution
      - Update-rate varies by sensory modality
  - System latency/lag
    - Each component introduces latency
What do we Actually Need to do?

- A typical "render loop" might look something like this:

```c
for( ;; ) {
    GetInput( );
    UpdateScene( );
    RenderScene( );
}
```
What does `UpdateScene` look like?

- Contains everything that needs to be done at each frame, like:
  ```
  UpdateScene() {
    DoAI();
    DoPhysics();
    ...
  }
  ```

- What order should these be done in?
- How will they be synchronized?
What does **RenderScene** look like?

- Must trigger output for each sensory modality, like:
  ```c
  RenderScene( ) {
    RenderGraphics( );
    RenderAudio( );
    ...
  }
  ```

- But these run at different update rates, so what should we do?
  - Wait for the slowest one?
  - Use shared memory with last "good" state?
  - Double buffer?
Good Rules to Follow

☐ Relax dependencies as much as possible
  ■ If using mutex, keep the window small

☐ Design for multi-core processing as much as possible
  ■ This is the future!

☐ Get away from the linear-nature of the preceding example render loop
  ■ Just set things up at the beginning, and only communicate to synchronize
Transference of Permanence

- If some objects are of high fidelity, users will assume all are
  - Physical object registered with a virtual one
Levels of Immersion

- None
- Minor Acceptance
- Engaged
- Full Mental Immersion

- Some people have sensory dominance
  - Visual
  - Audio
  - Haptically

- User study on user descriptions

- Physiological measures
Points of View

- First person
  - Pretty common

- Second person
  - Gives more context

- Third person
  - Like a movie

- Inside-out vs. outside-in
  - User can switch to give focus+context
Rules in the VR World: Physics

- Static-world physics
- Cartoon physics
- Newtonian physics
- Choreographed physics
- Do all objects need to follow the same laws?
  - Drop something

- Do you need to follow the same laws?
  - How can you fly?
Rules in the VR World (cont.)

- What should happen when I push on a virtual wall?