CS-525V:
Building Effective Virtual Worlds

What Makes Good VR?

Robert W. Lindeman

Worcester Polytechnic Institute

Department of Computer Science

gogo@wpi.edu

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:

```
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:

```
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
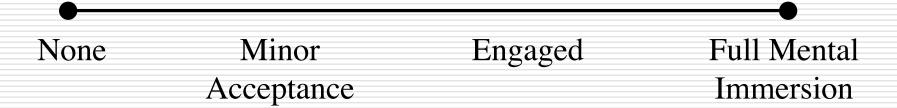   - Just set things up at the beginning, and only communicate to synchronize

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   Engaged   Full Mental
Acceptance   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?