Virtual Reality and Augmented Reality

VR Technology

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Interacting in VR

Universal 3D Interaction Tasks in VR

The core types of tasks users typically perform VR:

1. **Object Interaction**

   Selection: Choosing or picking objects

   Manipulation: Changing object properties such as position, size, or orientation.

2. **Navigation**

   Travel: Physical movement through the space *(Example: Walking through a VR world.)*

   Wayfinding: Cognitive process of understanding and deciding how to get from one place to another. *(Example: Using signs or maps in VR to plan a route.)*

3. **System control**

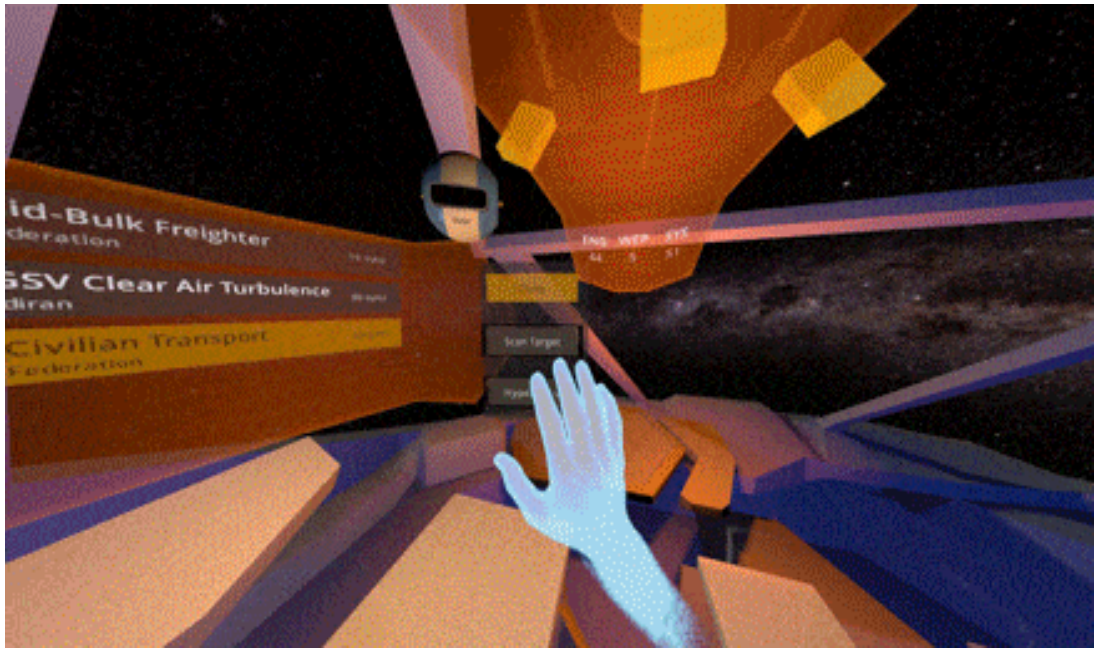
   Issuing a command to change system state or mode *(Example: Opening a menu with voice commands.)*

Object Interaction

Selection and Manipulation

Common Selection Techniques

1. Simple virtual hand



Process

- One-to-one mapping between physical and virtual hands
- Object can be selected by “touching” with virtual hand

Limitation:

- Only select objects in hand reach

Selection and Manipulation

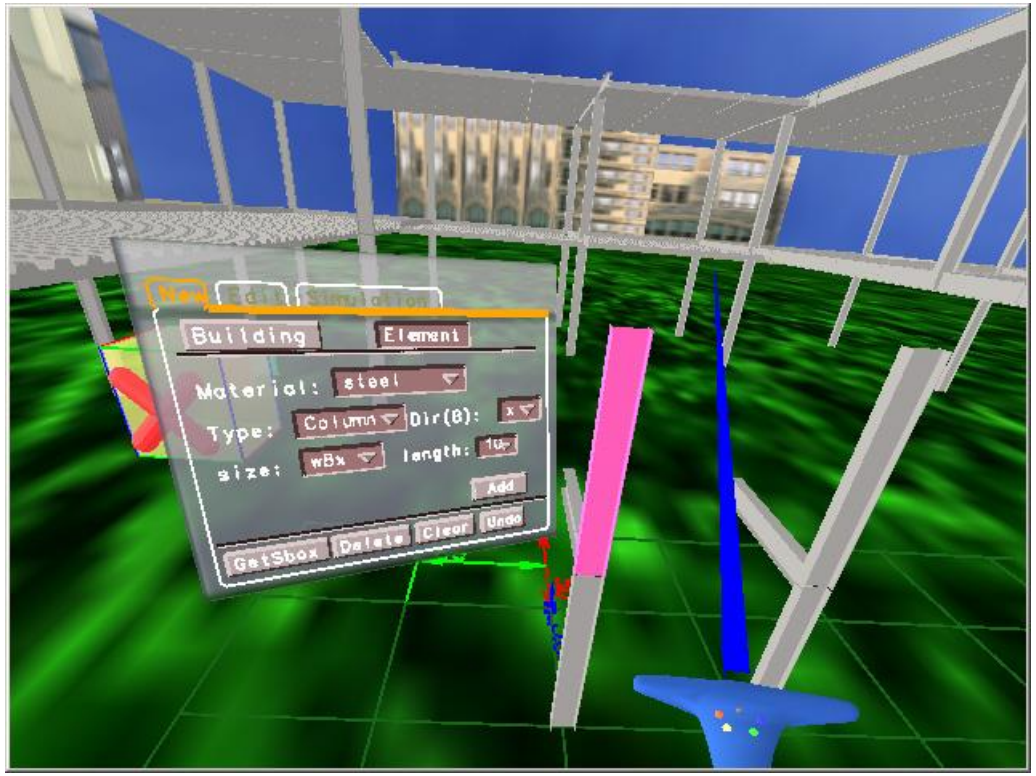
Common Selection Techniques

2. Ray-casting technique

“Laser pointer” attached to virtual hand

- First object intersected by ray may be selected
- User only needs to control 2 DOFs (pitch and yaw of the wrist)

Proven to perform well for remote selection

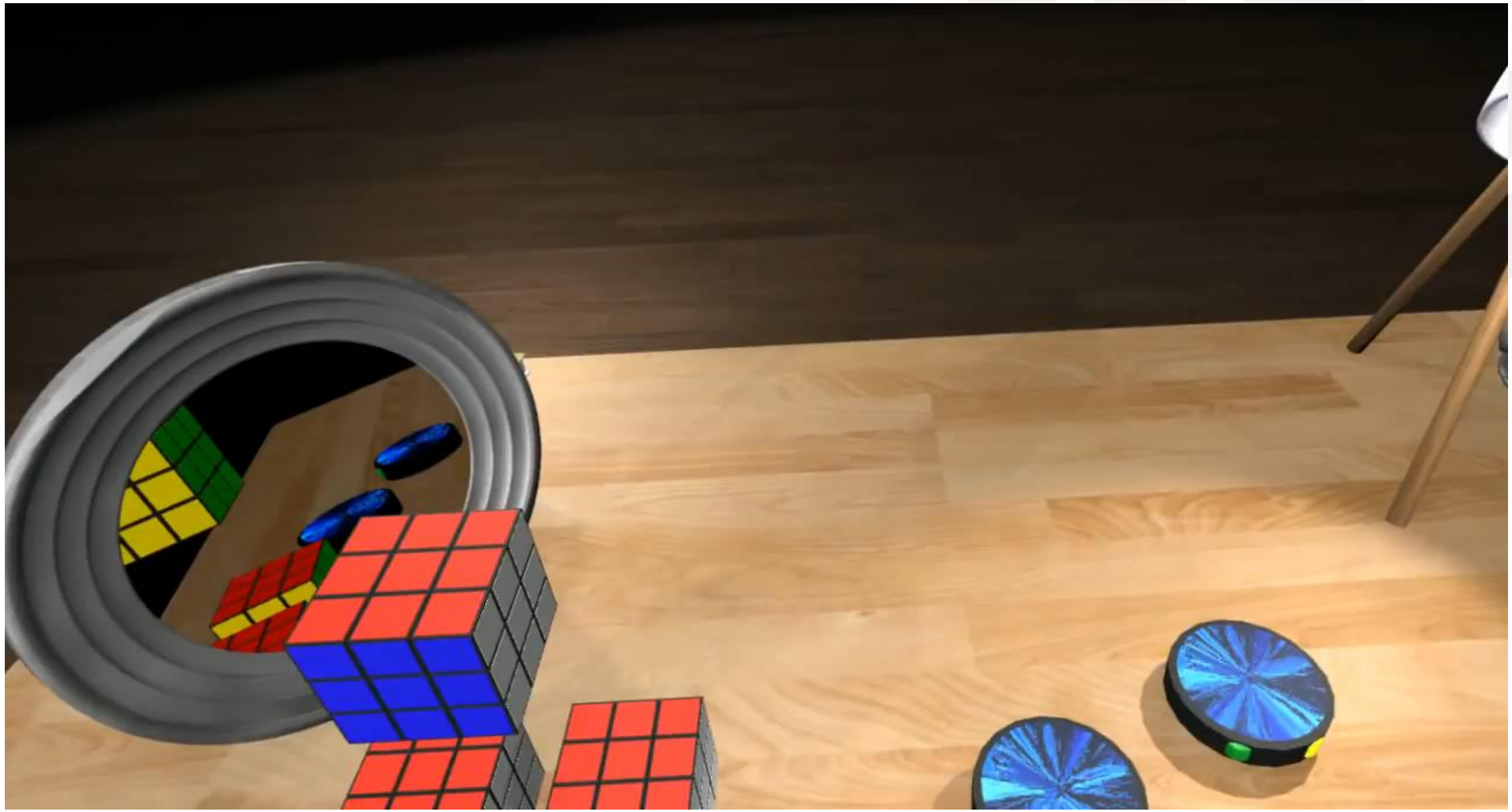


Example Ray Casting

https://www.youtube.com/watch?v=KGC8vFpRDko

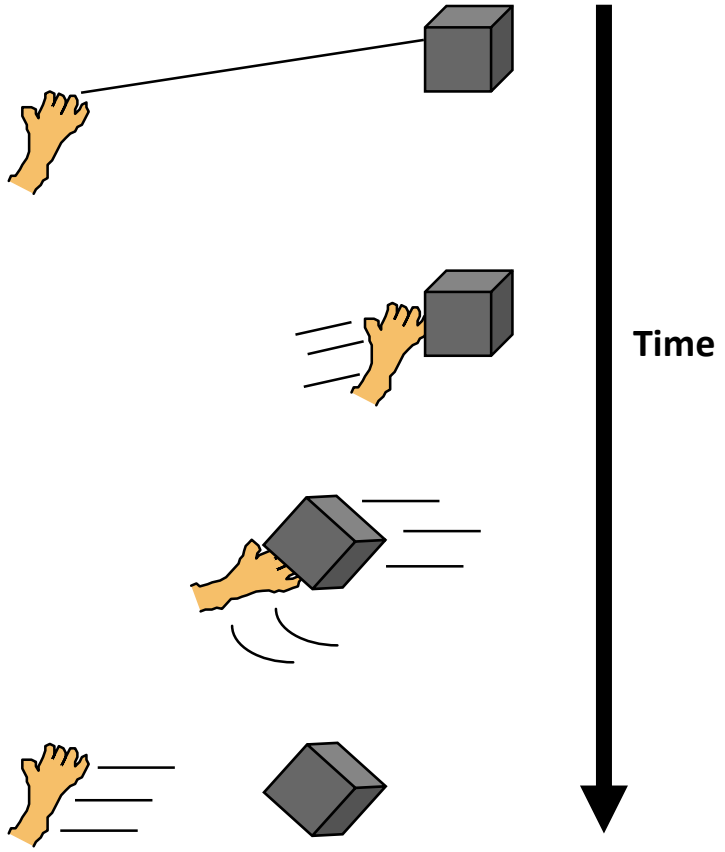
Common Manipulation Techniques

1. Simple virtual hand



Common Manipulation Techniques

2. HOMER technique

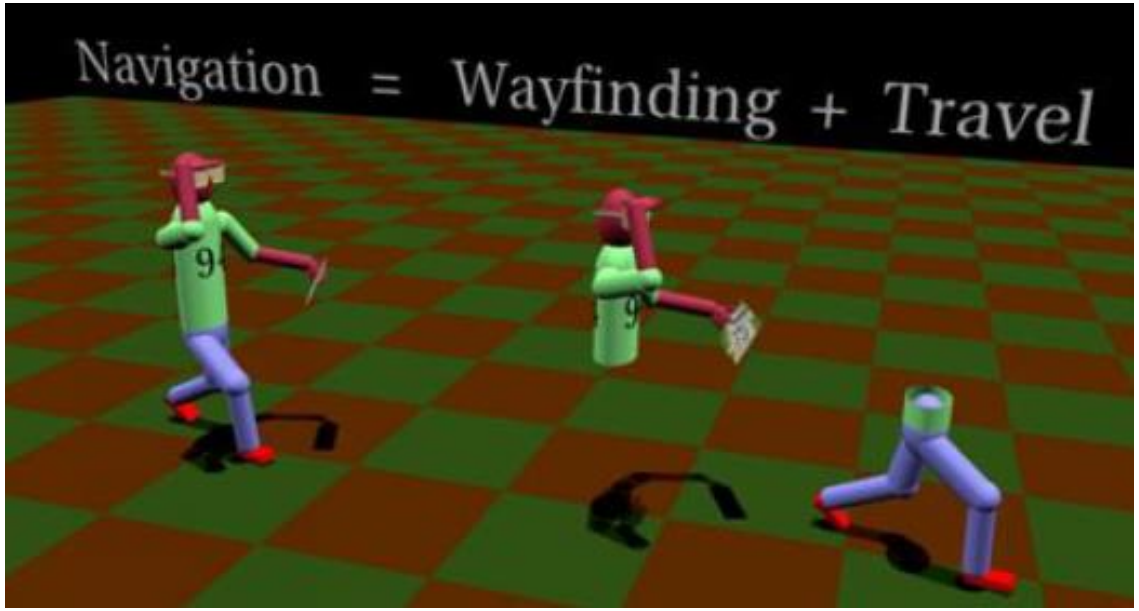


Hand-Centered
Object
Manipulation
Extending
Ray-Casting

- **Selection:** ray-casting
- **Manipulate:** directly with virtual hand
- Include **linear mapping** to allow wider range of placement in depth

Navigation

Navigation



How we move from place to place within an environment

Navigation: The combination of **wayfinding** with **travel**

Wayfinding: cognitive component of navigation

Travel: motor component of navigation

Types of Travel

1. Exploration

- No specific goal for the movement. *(Example: Walking around a virtual forest just to enjoy the view, without looking for anything specific.)*

2. Search

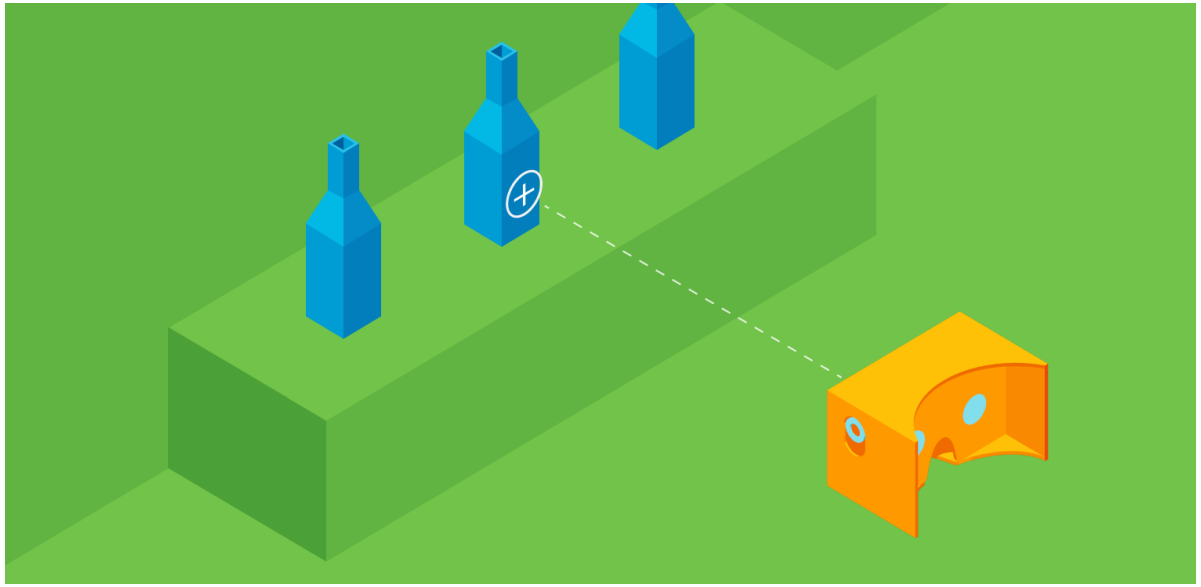
- Moving to specific target location, but the way you move depends on what you know about it.

Naïve – target position not known. *(Example: In a VR escape room, you're looking for a hidden key but don't know where it might be.)*

Primed – position of target known. *(Example: A marker on the map tells you exactly where the treasure chest is - so you go straight to it.)*

Travel Techniques

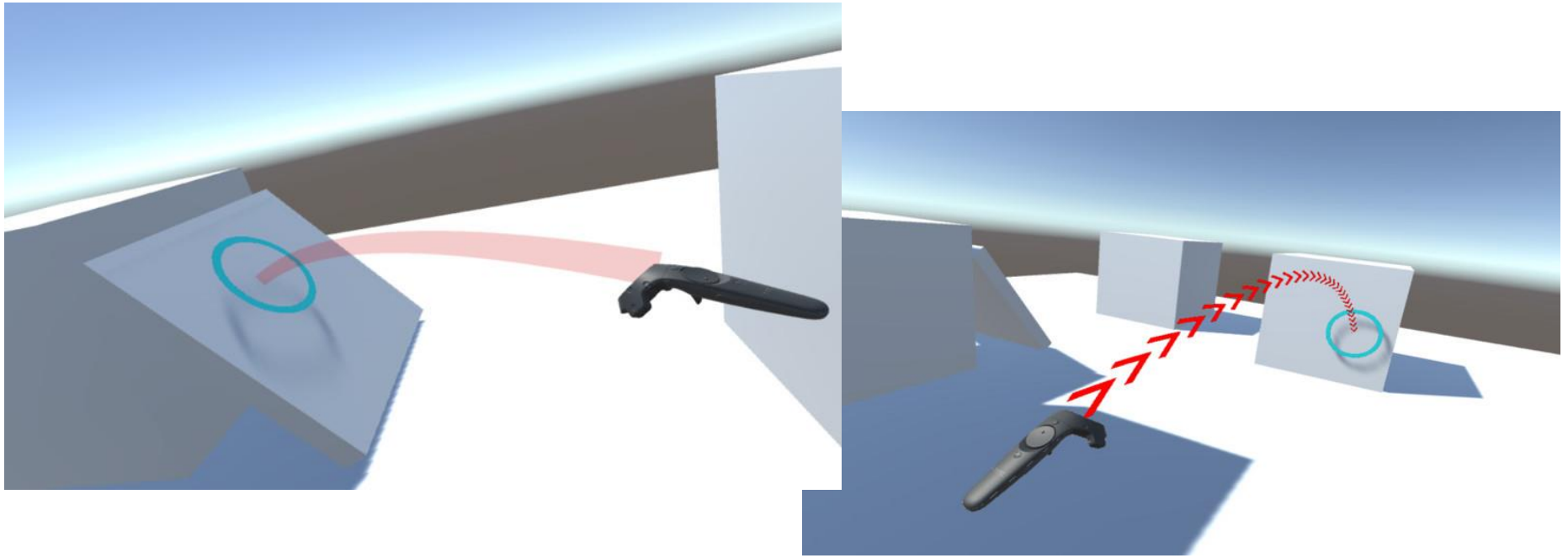
1. Gaze Directed Steering



- The system detects where the **user is looking** and moves in the direction that you are looking.
- Very natural navigation
- Can be used on simple HMDs (e.g. Google Cardboard)

Travel Techniques

2. Teleportation



- Use **controller** to select end point
- Jump to a fixed point in VR

System Control

System Control

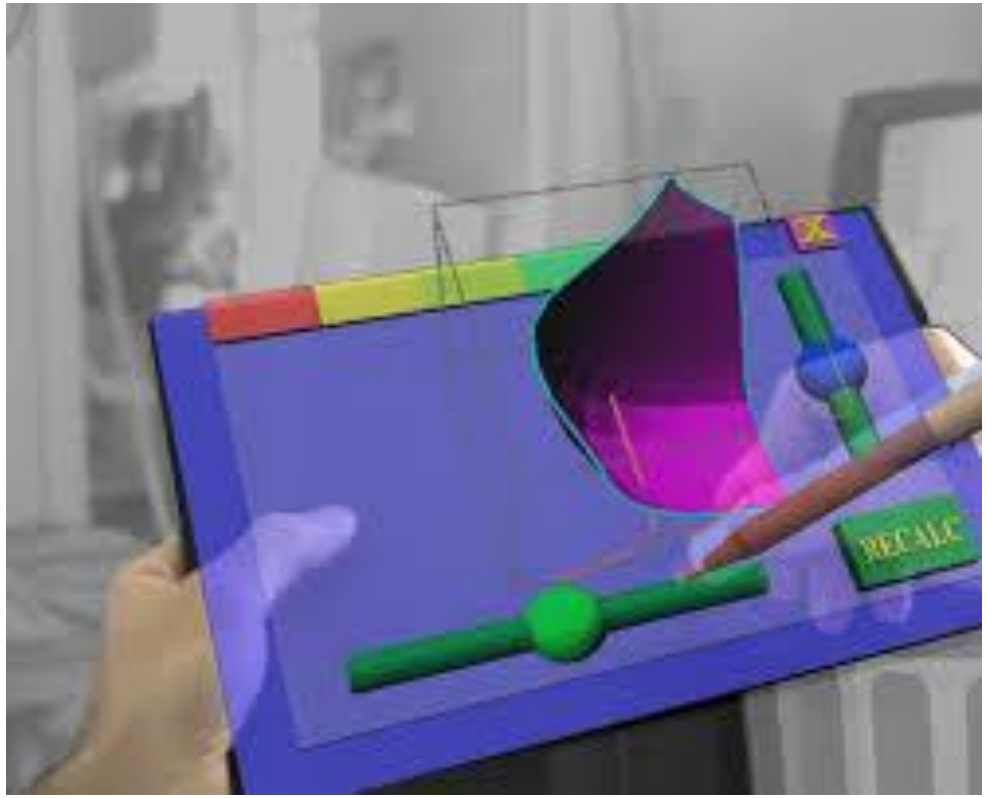
Issuing a command to change system state or mode

Examples

- Launching application
- Changing system settings
- Etc.

Key points

- Make commands visible to user
- Support easy selection



System Control

Tools

Use tools for system commands

1. Tangible user interfaces (real tools)
2. Virtual tools (3D objects)

Example: Gear VR Interface

- 2D Interface in 3D Environment

Audio Displays

Audio Displays

Definition: Computer interfaces that provide synthetic *(artificial)* sound feedback to users interacting with the virtual world.

The sound can be:

- **Monaural:** both ears hear the same sound, or
- **Binaural:** each ear hears a different sound

Motivation

- Sound can significantly enhance realism
  Example: Mood music in horror games
- Sound can provide valuable user interface feedback
  Example: Alert in training simulation

Audio Displays

Spatialization vs. Localization

Spatialization

- Is the processing of sound signals to make them release from a point in space
- This is a technical topic

Localization

- Is the ability of people to identify the source position of a sound
- This is a human topic, *(i.e., some people are better at it than others).*

Creating/Capturing Sounds

Sounds can be captured from nature (*sampled*) or synthesized computationally

High-quality recorded sounds are:

- Cheap to play
- Easy to create realism
- Expensive to store and load
- Difficult to manipulate

Synthetic sounds are:

- Cheap to store and load
- Easy to manipulate
- Expensive to compute before playing
- Difficult to create realism

THANK YOU