

Interfaces:
Input and Display Technologies

Part I

INPUT TECHNOLOGIES

Input Technologies

- Position Tracking
- Gesture Tracking
- Facial Tracking
- Biosignal
- Haptic Input
- Locomotion
- Speech

Input Technologies

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Position Tracking:

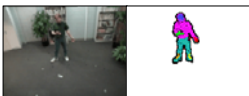
General

- Permits users to experience being “in” the environment.
- Associated with HMD to provide Head-Coupling.
- **Active** (uses emitters) vs. **Passive** (no emitters).
- Active: **Inside-out** (sensor inside) vs. **Outside-in** (sensor outside).

Position Tracking:

Optical

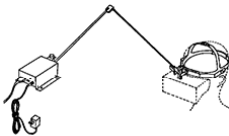
- Tracking light emitters (active)
or image shape (passive)



Position Tracking:
Magnetic



Position Tracking:
Mechanical



Position Tracking:
Acoustical



Position Tracking:
Inertial



Input Technologies

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Gesture Tracking:
Gloves



Dataglove



CyberGlove

Gesture Tracking:
Gloves



PowerGlove (1989)

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Facial Tracking:
Markers vs. No Markers



Input Technologies

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Biosignal: Many Different Possibilities

- Myoelectric
 - Muscular movement
- Cerebroelectric
 - Brain signals (EEG)
- Skin Conductance
- Heart Rate



Biosignal: Bio Feedback Games



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Haptic Input: 6 DOF Manipulation



Haptic Input: Single Point Pressure



Haptic Input:
Hand Motion



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- **Locomotion**
- Speech

Locomotion:
Steppers



Locomotion:
Cycles



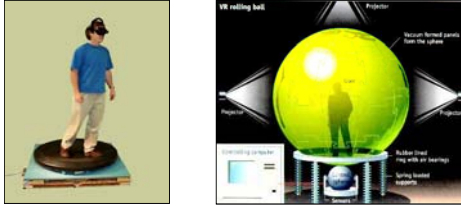
Locomotion:
Omnidirectional Treadmills



Locomotion:
Rollers



Locomotion:
Giant Pad and Trackball!



Locomotion:
Robot Floor



Input Technologies

- Position Tracking
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- Haptic Input
- Locomotion
- **Speech**

Part II

DISPLAY TECHNOLOGIES

Display Technologies

- Path of perception
 - **Distal Stimulus**: the source
 - **Proximal Stimulus**: what hits the receptor
 - **Perceptual Hypothesis**: inference about distal from proximal
 - **Percept**: mental representation of world
 - **Perceptual Constancy**: maintaining hypothesis
- Display technologies can start with reproducing proximal stimuli

Display Technologies

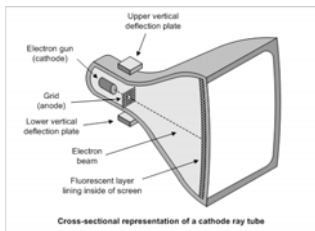
- Visual Displays
- Acoustic Displays
- Haptic Displays
- Motion Displays

Display Technologies

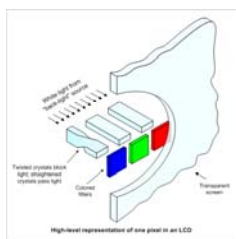
- Visual Displays

- Acoustic Displays
- Haptic Displays
- Motion Displays

Visual Displays - Image Sources: Cathode Ray Tubes



Visual Displays - Image Sources: Liquid Crystal Displays



Visual Displays - Image Sources:
Retinal Scan Displays



Visual Displays - Optical Systems:
Head-mounted Displays

- Reflective can support see-through, but lose brightness.
- Refractive are bright but unwieldy.



Visual Displays - Optical Systems:
BOOM Technology



Visual Displays - Optical Systems:

Shutter Glasses



- Block out one eye at a time in synchrony with alternating images on a monitor.
- Full monitor resolution.
- Needs tracking for viewpoint dependent images.

Visual Displays - Optical Systems:

Polarized Glasses

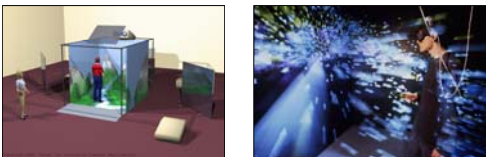
- Images from two sources are combined, each with a different polarization.
- Polarized glasses separate them again.



Visual Displays - Optical Systems:

CAVEs

- Large displays on more than one side.

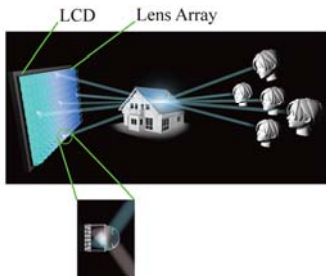


Visual Displays - Optical Systems:
CAVEs



CAVEUT 2004

Visual Displays - Optical Systems:
Autostereoscopic Displays



Visual Displays:
Performance

- Orthostereoscopy
 - Depth perception tricks
- Resolution
 - Pixellation
- Responsiveness
 - Refresh and update rates
- Field of View
 - Should be at least 60°

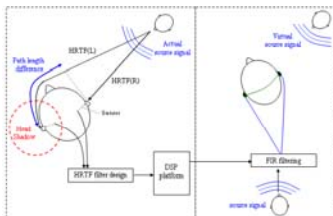
Display Technologies

- Visual Displays
- Acoustic Displays
- Haptic Displays
- Motion Displays

Acoustic Displays: Generally

- Virtual acoustic displays present virtual auditory worlds (VAWs).
- Synthesize the cues that are used by humans in localizing sounds.
- Still some controversy regarding what cues are required to produce externalization.
- Both visual and acoustic displays require rendering and presentation.

Acoustic Displays: Head-Related Transfer Function



- HRTF are measured by fitting human subjects (or mannequin heads) with probe microphones, deep within their ears, and then by measuring the signals that reach them when sounds from a large number of locations are played in an anechoic chamber.
- From this filters are created to process sound before it is presented to the user.

Acoustic Displays:
Additional 3D Cues

- Distance effects
 - Attenuation
- Field patterns
 - Directionality
 - Occlusions
- Doppler effect
- Early echoes
- Reverberation



Display Technologies

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Haptic Displays:
Tactile Feedback

- Vibro-tactile
 - Motorized vibration or rumble
- Pneumatic
 - Jets of air
- Electrocutaneous
 - Pulses of electricity
- Shape-memory alloys
 - Bending alloys press on skin
- Functional neuromuscular stimulation
 - Direct stimulation of neuromuscular system

Haptic Displays:
Force Feedback

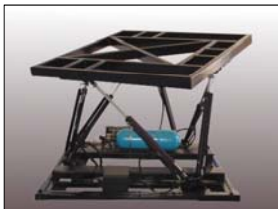
- Joystick or wheel
- Motorized Arm
- Exoskeleton



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Motion Displays:
Inertial Platforms



Motion Displays:
Locomotive Platforms