

Interfaces:
Input and Display Technologies

Input Technologies

Input Technologies

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

Position Tracking:

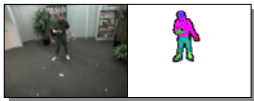
General

- Permits users to experience being “in” the environment.
- Associated with HMD to provide Head-Coupling.
- Active vs. Passive.
- Inside-out vs. Outside-in vs. Neither.

Position Tracking:

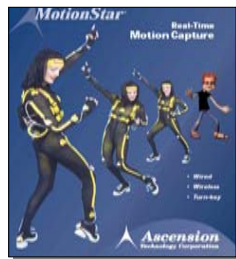
Optical

- Tracking light emitters (active) or reflectors (passive)
- Pattern recognition.

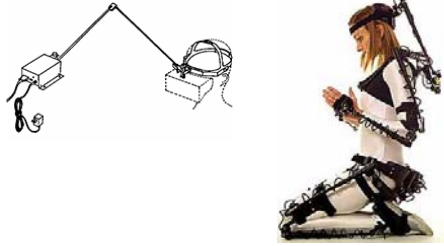


Position Tracking:

Magnetic



Position Tracking:
Mechanical



Position Tracking:
Acoustical



Position Tracking:
Inertial



Gesture Tracking:
Gloves



DataGlove



CyberGlove

Gesture Tracking:
Gloves



PowerGlove (1989)

Facial Tracking:
Markers vs. No Markers



Biosignal:

Many Different Possibilities

- Myoelectric
 - Muscular movement
- Cerebroelectric
 - Brain signals
- Skin Conductance
- Heart Rate



BBCI - EEG

Biosignal:

Bio Feedback Games



Haptic Input:

6 DOF Manipulation



Haptic Input:
Single Point Pressure



Haptic Input:
Hand Motion



Locomotion:
Steppers



Locomotion:
Cycles



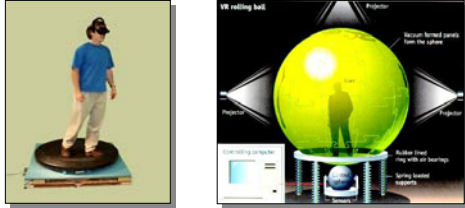
Locomotion:
Omnidirectional Treadmills



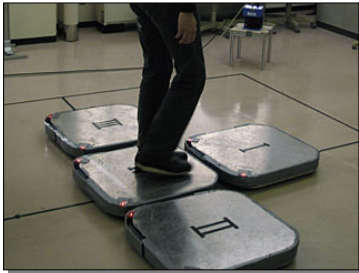
Locomotion:
Rollers



Locomotion:
Giant Pad and Trackball!



Locomotion:
Robot Floor



Display Technologies

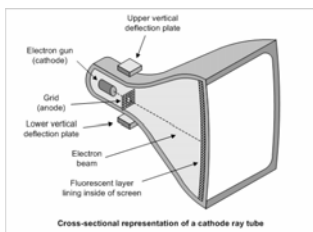
Display Technologies

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

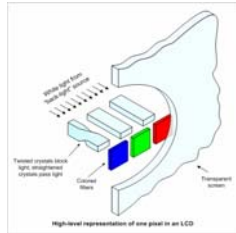
Display Technologies

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

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 loose 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

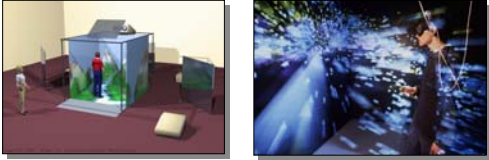
- Images from two sources are combined, each with a different polarization.
- Polarized glasses separate them again.



Visual Displays - Optical Systems:

CAVEs

- Large displays on more than one side.



Visual Displays - Optical Systems:

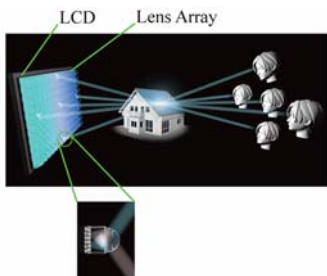
CAVEs



CAVEUT 2004

Visual Displays - Optical Systems:

Autostereoscopic Displays



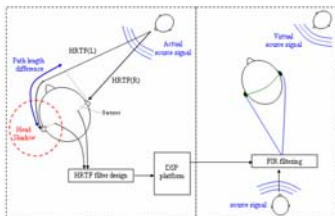
Visual Displays:
Performance

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

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
 - Frequency dispersion
- Field patterns
 - Directionality
 - Occlusions
- Doppler effect
- Early echoes
- Reverberation



Haptic Displays:
Tactile Feedback

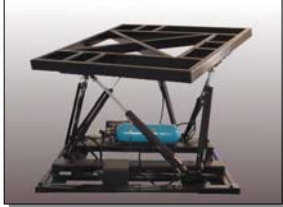
- Vibro-tactile
 - Motorized vibration or rumble
- Pneumatic
 - Jets of air
- Electrocutaneous
 - Pulses of electricity
- Shape-memory alloys
 - Bending alloys press on skin
- Functional neuromuscular stimulation
 - Direct stimulation of neuromuscular system

Haptic Displays:
Force Feedback

- Joystick or wheel
- Motorized Arm
- Exoskeleton



Motion Displays:
Inertial Platforms



Motion Displays:
Locomotive Platforms