

Visual and tactile displays

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Overview

- Visual displays
- Tactile displays
- Integrated displays
- Applications in medical simulation

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Color monitors

- CRT/LCD monitors
- Cheap, readily available, well understood technology
- Often sufficient in simulators
 - with minimal visual requirements
 - Minimally invasive procedures



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Stereoscopic Display

- Depth perception occurs when each eye sees a slightly different image of the same object.
- The brain fuses the separate images into a 3-dimensional representation



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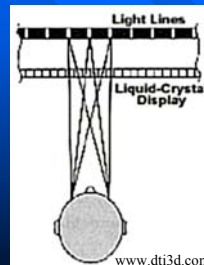
Stereoscopic eyewear

- Monitor alternately displays left/right image
- Display synchronized with LCD shutter glasses
- CrystalEyes
 - Wireless, requires emitter for synchronization, cost: about \$700 for eyewear, \$300 for emitter
- Vrex visualizer
 - Wired, cost: about \$30 retail, does not require emitter, works with any PC video display
 - <http://www.vrex.com>



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Stereoscopic flat panel display (Dimension Technologies)



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Stereoscopic flat panel display

- No eyewear required
- Perception of stereo effect is dependent on user's location
 - Easy to get left/right images crossed
 - Harder to get used to compared to monitor/stereo eyewear



www.dti3d.com

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Head mounted display

- CRT/LCD displays are worn on the head
- Immersive display of a virtual environment
 - Real-time tracking of head movements



- Augmented display of real-world environment
 - Need to align virtual and real-world environments

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Retinal scanning display [JOHNSTON95]

- Research by U. of Washington HITLab
- Developed by Microvision
- Coherent (laser) light scanned directly on retina
 - 800x600 (typical)
 - High contrast, daylight readable
 - Monochrome/color displays
- Applications
 - Mobile medical wireless display (TATRC)
 - Image guided surgery



www.mvvis.com

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CAVE: Cave Automatic Virtual Environment [CRUZ-NEIRA93]

- Stereo projectors display 3D images on each wall
 - Viewer(s) are immersed in 3D virtual environment
 - Head movement can be tracked
- Developed at Univ. of Illinois at Chicago
- Commercially available
- Applications
 - Medical readiness trainer



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Elumens VisionStation 800

- Immersive 3D space
- Low cost: \$10,000
- Elumens Corporation: hemispherical 3D visualization systems
- Other products: VisionDome
- Potential applications
 - Triage simulation



http://www.elumens.com/

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Haptic displays

Definitions

- Tactile (touch) feedback: sensed by receptors close to the skin (high bandwidth)
- Force feedback: sensed by receptors placed deeper in the body (low bandwidth)
- Haptic feedback: technically same as tactile feedback, but often extended to include both tactile and force feedback as in haptics
- Source: Force and Touch Feedback For Virtual Reality, Burdea

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Why Use Force Feedback?



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Phantom (Sensable Technologies)

- Sensors report movement in 6 degrees of freedom (dof)
- 3 dof force feedback
- Force feedback loop must be updated rapidly (1kHz refresh rate or better)
- Widely used for in surgical simulation research



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Virtual Laparoscopic Interface/ Laparoscopic Impulse Engine (Immersion)

- Interface device for simulated laparoscopic procedures
- Haptic and non-haptic version



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Haptic Catheter/Needle Insertion Simulator



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Endoscopy Simulator

- Flexible scope-like interface
- Computer generated imagery of anatomical structures
- Different procedures can be simulated
 - Bronchoscopy
 - Endoscopy



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400 Pin Tactile Array

- 400 individually controlled probes
– 0.5 mm apart
- Developed for research into the spatial-temporal response properties in fingertips.
- Reference: Pawluk et al.

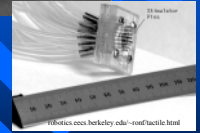


<http://www.med.jhu.edu/somlab/fah/research/methods/400pin/>

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Tactile displays

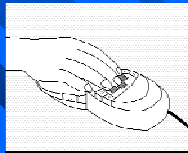
- 5 x 5 pin pneumatic display
 - 0.3N force per element
 - 3 bits of force resolution
- Tactile shape display [WELLMAN97]
 - Shape memory alloy based
 - 10 x 1 display
 - Heat dissipation a problem



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VirTouch: Virtual Touch System

- Designed to allow blind and visually impaired to navigate computer screen
- Provides tactile feedback to fingertips
- Allows user to recognize graphic shapes through touch

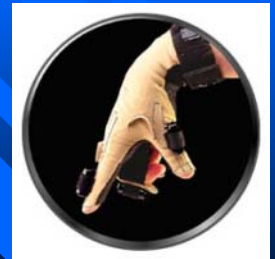


<http://www.virtouch.co.il/vts.htm>

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CyberTouch™ Tactile Feedback

- Tactile feedback option for instrumented glove
- Small vibrotactile sensors on each finger and the palm
- RS-232 interface

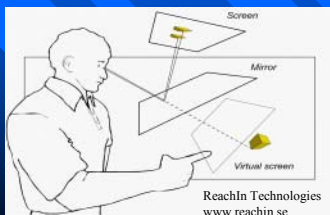


<http://www.immersion.com/products/3d/interaction/cybertouch.shtml>

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Virtual Workbench Environments [POSTON96]

- Combine 3D stereo display with haptic device.
- Virtual image is located within work volume of haptic device.



ReachIn Technologies
www.reachin.se

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<http://www.krdi.chi.berkeley.edu/ROB/BIOMED/virtual/>

www.reachin.se

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Reachin Display

- Components
 - PHANTOM force feedback
 - Stereo monitor
 - Semi-transparent mirror
- Swiss company: Reachin Technologies



<http://www.reachin.se/products/reachindisplay/>

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i.e.Med Reality Sculptor

- Components
 - Input device (such as PHANTOM or tracking system)
 - Windows PC with OpenGL graphics card
 - Mirror and stand
 - TDI software development kit



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Resources

- Head mounted displays
 - <http://www.vrnews.com/issuearchive/vra1001/vra1001tech.html>
 - <http://www.cs.unc.edu/~web/leadmounts.htm>
- Tracking
 - <http://www.cs.unc.edu/~trackerref/biblio/index.html>
- Stereoscopic displays
 - <http://www.stereographics.com/html/tp-paper.htm>

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