Visual Displays

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Overview

- Purpose
- Requirements
- Categories
- Applications in medical simulation

Visual Displays

- To provide visual feedback
- To simulate medical displays
  - Should be familiar
  - Should not distract




Classification

- By immersiveness
  - CRT/LCD screens
  - Head mounted displays
  - Domes
  - Rooms

Color Monitors

- CRT/LCD monitors
- Cheap, readily available, well understood technology
- Sufficient for simulators
  - with minimal visual requirements
  - of minimally invasive procedures

Stereoscopic Display

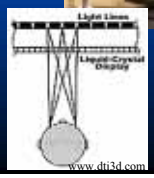
- Depth perception occurs when each eye sees a slightly different image of the same object.
- The brain fuses the separate images into a 3-dimensional representation

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

Stereoscopic Flat Panel Display Raster Barrier Technology

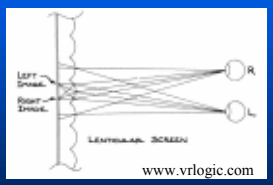
- Dimension Technologies [EICHENLAUB91]
- Pros
  - 3D without glasses
  - Compact display
- Cons
  - Not light efficient
  - Banding effect
  - Bi-plano display
  - Small "sweet spot"



www.dti3d.com

Stereoscopic Flat Panel Display Lenticular Screen

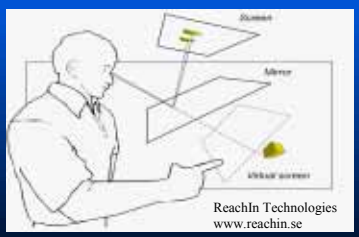
- VRLogic SynthaGram
- Pros
  - Brighter (more light efficient)
  - Multi-plano
  - "Look around"
- Cons
  - Still need to be properly oriented (but not so critical)



www.vrlogic.com

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

http://www.krdl.org.sg/R&D/biomed/virtual/

www.reachin.se

Applications

http://cs.millersville.edu/~webster/Haptics/

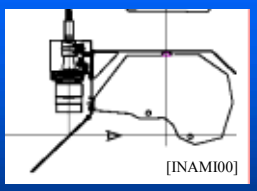
Head Mounted Displays

- 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

Head Mounted Projective Displays

- Light projector on headmount
- Retro-reflective display returns light to eye
- Retro-reflective material can be on any surface
  - Walls, tables, patients
- Superimpose CGI on real-world images



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

Elumens VisionStation 800

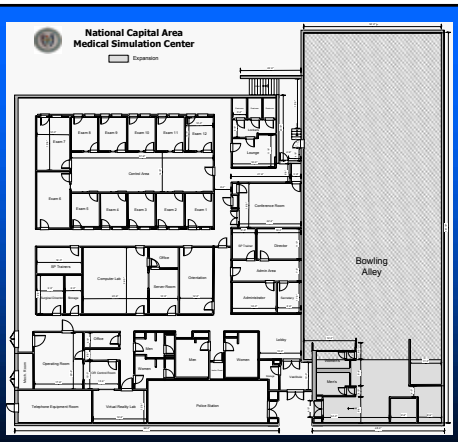
- Immersive 3D space
- Low cost: $10,000
- Elumens Corporation: hemispherical 3D visualization systems
- Other products: VisionDome
- Potential applications
  - Triage simulation

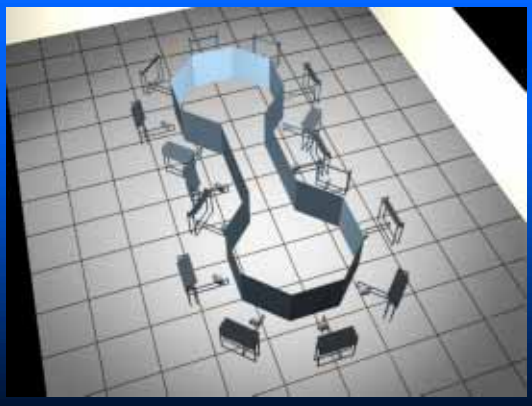
CAVE

- Cave Autonomous Virtual Environment
- Total immersion VR environment
- Scientific Visualization

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



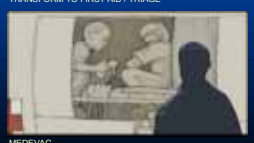


URBAN TERRORIST ATTACK – MASS CASUALTY

BOMB BLAST ON A BUS

TRANSFORM TO FIRST AID / TRIAGE

TRANSFORM TO AIRCRAFT / CLINICAL CARE TRANSPORT



MEDEVAC

SimCen CAVE Project Challenges

- More than 98 renderers
  - Backprojected walls and floor
  - Passive stereo
  - Distributed rendering solution
  - Low cost Linux-based PCs
  - Low cost LCD projectors

Meeting the Challenges

- Distributed rendering
  - Chromium [HUMPHREYS02], 36 node rendering cluster has been implemented
  - potentially scalable "to hundreds"
- Tiled projectors
  - Maintainability, alignment, color correction [MAJUMDER03]
  - The experience of others
    - » Livermore Computing Powerwalls (at least 3), including a 15 projector 19.6 Mpixels Powerwall.

SimCen CAVE Project Challenges

- Head-tracking for projection correction is not feasible
  - Multiple viewers
  - Use curved screens and digital warpers.
- Tracking of multiple individuals/objects
  - People
  - Equipment
  - Relatively low resolution required, but large numbers of trackers

SimCen CAVE Project Challenges

- Ceiling (IR) trackers
  - Smoke effects can cause problems
- Sound localization
- Need to blend virtual and actual actors convincingly
- Combine HMD (projective) with CAVE

Resources

- Head mounted displays
  - **http://www.vrnews.com/issuearchive/vrn1001/vrn1001tech.html**
  - **http://www.cs.unc.edu/~us/web/headmounts.htm**
- Stereoscopic displays
  - http://www.stereographics.com/html/hp-paper.htm

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