Introduction to Immersive Display Systems

AERSP, CSE, MATH, BUS  597
Fall 2004

George Otto
george-otto@psu.edu
What do we mean by VR?

The phrase *virtual reality* was coined by Jaron Lanier in the mid 1980s to describe a specific configuration of software and devices – effectively computerized clothing – and a user’s experiential engagement with computer simulated graphical worlds displayed and interacted therewith.

There are media traditions within which VR can be placed.

At its core, VR can be thought of as the adaptation of computing and media technologies to create systems with formal characteristics that maymore fully engage human perceptual processes in order to enable more experientially compelling media encounters.
Binocular Disparity and Stereo Vision

http://www.vision3d.com/stereo.html
Stereoscope and Viewmaster

http://www.chicagohs.org/fire/media/pic0470.html

http://www.cinti.net/~vmmasell/
Anaglyph and Polarized Passive Stereo

Adapted from: http://unmuseum.mus.pa.us/stereosc.htm
Stereoscopic 3D Cinema
Anaglyph (1922) and Polarized (1950s)

Wide Field of View Immersive Projection Formats
Morton Heilig – Sensorama, 1962

“Experience Theater”

http://www.artmuseum.net/w2vr/timeline/Heilig.html
Ivan Sutherland

Sketchpad, 1963;
The Ultimate Display, 1965;
Head Mounted Display, 1968

Myron Krueger – Artificial Reality – 1970s

Responsive, video based, human scale, graphical environments

Unencumbered, body centered, tracked interfaces

Presages CAVE's and other contemporary surround screen projection-based systems

http://portal.acm.org/citation.cfm?id=317463
HMD and Data Glove - "Virtual Reality" – late 1980s
HMD and dataglove
Jaron Lanier, VPL Research
NASA Ames, VIEW Project, Scott Fisher
UNC Chapel Hill, GROPE, Fred Brooks
University of Washington, HIT Lab
http://portal.acm.org/citation.cfm?doid=328798
Electronic Visualization Lab – CAVE - 1992

Carolina Cruz-Neira, Dan Sandin, Thomas DeFanti

http://portal.acm.org/citation.cfm?id=166134&coll=GUIDE&dl=GUIDE&C
FID=29550332&CFTOKEN=25231313
Penn State Applied Research Laboratory
SEALAB

5 sided projection based (four walls + floor) CAVE™ like system

http://www.arl.psu.edu/capabilities/ins_sealab_facilities.html
Iowa State’s C6 Virtual Reality Applications Center (VRAC)

http://www.vrac.iastate.edu/c6.php
“ Canonical” VR System Attributes

• Wide field of view “immersive” display (projection based or HMD)
• Stereoscopic display
• User interaction with simulated graphical objects or worlds
• Tracked viewer position to allow for richer interaction and viewer centered projection
• Spatial or contextual audio
• Tactile or haptic feedback
Virtual Reality Applications Design

Using interactive, experiential, multimedia simulations to achieve a purpose through the effective use of the computing, display and interactive affordances of the systems at hand.
The MIST System  
(Mentice Medical Simulation AB, Gothenburg, Sweden)

The MIST system's training interface is based on modified laparoscopic instruments. Simple real time 3D computer graphics accurately track and represent the movements of the virtual instruments within a virtual operating volume. In this volume, geometric shapes that approximate those faced during actual operations on organs are displayed on the computer screen and subsequently manipulated by a surgical trainee via the surgical instrument interface.

http://bmj.bmjjournals.com/cgi/content/full/323/7318/912
MolDRIVE: a VR system for visualization and steering of remotely running real-time MD simulations.

The VR Spring Manipulator is used for particle steering of an atom from MD simulation of a protein and a carbon polymer resp. (right upper image) More about MolDRIVE:

Some Obstacles to the Widespread Acceptance of First Generation Projection Based VR Systems (CAVEs, C2, Immersadesks, etc.)

- Relatively expensive to acquire and maintain
- Fragile devices requiring supervision by support staff
- Challenging computing environment for many end users
- Facilities often are cloistered with limited access for general use
- VR workflow often is distinct from other discipline-specific processes

All of which lead to VR being treated as a separate activity that exists outside of established workflows
The VR Desktop Approach
(if we are having difficulty bringing desktop users to VR, perhaps we can bring VR to desktop users)

Leverage price performance improvements in personal computer graphics to deliver much of the VR experience, affordably and accessibly, given the audience and tasks under consideration

- Affordable cost
- Ease of use
- Physical accessibility
- Within existing workflows

“Lowering the bar and extending the reach”
Immersive Environments Two Screen
Hardware Description

“Workstation” class PC (2 x Xeon, 2.2 GHz, 2 Gb ram) with Wildcat III 6210 graphics card (up to two screens in stereo)

For each projection screen:
2 Proxima Ultralight X350 DLP XGA Projector
Cvyiz xpo.2 stereo converter
6 x 8 foot, rigid rear-projection screen
Two Screen IEL – Spring 2002
Student Defined Multimodal Immersive Presentation Environment

Immersive Information Space in Addition to Immersive Virtual Space

Students use commercial 3D modeling tools and multimedia applications, in conjunction with navigable 3D VR viewers developed locally.

i.e. we are trying to fold VR into the students’ existing workflow and repertoire of digital media tools
ITS/SALA Immersive Environments Lab (IEL)
http://gears.asct.psu.edu/viz/facilities/iel

3-screen windows Desktop – 3D VR plus commercial applications support

Clustered, Linux, multi-CPU approach for 3-screen VR application (C++, OpenSG, VRPN, QT) – OpenGL enabled Linux desktop (DMX/Chromium)

Telecollaborative 3D display in conjunction with Access Grid functionality
Immersive Environments Display Configurations

For each projection screen:
2 Proxima Ultralight X350 DLP XGA (1024x768) Projector
Cyviz xpo.2 stereo converter
6 x 8 foot, rigid rear-projection screen

Users may switch select from 3 video sources for each screen
Two-screen Windows Desktop / Windows Display

For each projection screen:
- 2 Proxima Ultralight X350 DLP XGA (1024x768) Projector
- Cyviz xpo.2 stereo converter
- 6 x 8 foot, rigid rear-projection screen

Switch select from 3 video sources for each screen
Linux Console / Three Screen Linux Display

Switch select from 3 video sources for each screen

For each projection screen:
2 Proxima Ultralight X350 DLP XGA (1024x768) Projector
Cyviz xpo.2 stereo converter
6 x 8 foot, rigid rear-projection screen
Recent developments in the IEL / Coming Attractions

The bigger picture:

• 3-screen Windows desktop for application compatibility and end-user familiarity

• Clustered, Linux, multi-CPU approach for 3-screen VR applications – application development in process

• Independent video switching for each screen allows selective presentation from multiple computer graphic sources – e.g. Windows console, Linux clustered rendering, external laptops

• Access Grid enabled – telecollaborative, multimodal, immersive workspace

Ongoing application “nuts and bolts”

• Improve handling of complex surfaces and lighting solutions – ongoing workflow evaluation, development and documentation

• Develop data rich models and application workflow for viewing and manipulating the same

• Continue to seek opportunities for useful merging of VR like applications with other building design, analysis and presentation tools as appropriate

• Develop use in other data rich disciplines for which immersive visualization may be beneficial