Virtual Reality

Introduction

Virtual reality (VR) is a computer interface that maximizes our natural perception abilities. Static two-dimensional images are often deceiving; it may be hard to reconstruct scales and distances between objects. Thus, it is important to implement the third dimension and to bring depth to objects.

There are two major components of three-dimensional virtual reality: movement and stereoscopy (http://www.ento.vt.edu/%7Esharov/3d/3dinsect.html). Our eye can easily reconstruct the third dimension if the object moves (movement). VR use separate images for the right and left eyes. Pre-determined movement is implemented using a movie or animated image. Arbitrary user-defined movement is implemented using the Virtual Reality Modeling Language (VRML) which is a standard language for describing interactive 3-D objects and worlds delivered across the Internet. VRML-images can be rotated and magnified interactively.

Best virtual reality implements both movement and stereoscopy. However, at this point you can view it only using special graphical computers (SGI). In the section about CAVE insects we describe one of the most sophisticated virtual environments, the CAVE, which runs on a SGI supercomputer.

Significance of the Topic

For reasons of pedagogy, economics, access and efficiency, an exponentially increasing amount of post-secondary, secondary and elementary curriculum is being offered over the Internet, the World Wide Web, or an Intranet. With the transition to electronically delivered curriculum the modalities of touch and tactile manipulation are not presently available. From an access perspective there are compelling reasons to add tactile manipulation and 3D audio to education delivered at a distance; luckily compelling reasons exist for all learners.

One of the major reasons is come from cognition and learning system of human being. A child's natural instinct is to touch, manipulate, see, smell and even taste a new object. Many new concepts and skills are better integrated when more than one sense or modality is engaged in the learning process. No teacher would question the value of hands-on learning or practical demonstration.

There are two major advantages to teaching using a computer simulation: students can practice in a risk free environment, students can obtain objective; simultaneous feedback regarding their actions (e.g., too much pressure is being applied, the probe is too far, etc.).

Virtual Reality in the Web

Virtual reality (VR) entails the use of advanced technologies, including computers and various multimedia peripherals, to produce a simulated (i.e., virtual) environment that users perceive as comparable to real world objects and events (Weiss & Kessel (1998), Virtual reality applications to work. http://www.utoronto.ca/atrc/rd/vrml/main.html)

Virtual reality has greatly changed the way in which people are able to interact with and manipulate information. The technology is, in fact, an outgrowth of earlier generations of computing, and some of its core components have been in use for some time. It is a natural outcome of the continued development of computer technology, including the availability of larger random access memory (RAM), faster processing speed, higher capacity storage media, diverse input interfaces, assorted multimedia peripherals such as digital cameras, sound and graphics cards and high speed CD-ROMs, and a burgeoning software industry that is scrambling to develop more realistic 3-D applications.

VRML (Virtual Reality Modeling Language)

If you want to draw 3D objects or develop VR programs, you need to use a specific language for them. Virtual Reality Modeling Language (VRML) is a standard language

for the animation and 3D modeling of geometric shapes. It allows for 3D scenes to be viewed and manipulated over the Internet in an interactive environment. Using a special *VRML browser*, the user can connect to an online VRML site, choose a 3D environment to explore and move around the '3D world'. It is possible to zoom in and out, move around and interact with the virtual environment (http://www.geom.umn.edu/software/weboogl/about.html).

There are two major versions of VRML. First one is VRML 1.0. Worlds are static environments where you can navigate and click on objects to link to information. The first version of VRML allows for the creation of virtual worlds with limited interactive behavior. These worlds can contain objects which have hyperlinks to other worlds, HTML documents or other valid MIME types. When the user selects an object with a hyperlink, the appropriate MIME viewer is launched. When the user selects a link to a VRML document from within a correctly configured WWW browser, a VRML viewer is launched. Thus VRML viewers are the perfect companion applications to standard WWW browsers for navigating and visualizing the Web.

Second, VRML97 is the informal name of the International Standard (ISO/IEC 14772-1:1997). It is almost identical to VRML 2.0, but with many editorial improvements to the document and a few minor functional differences. [VRML97 is also the name of the VRML Technical Symposium that took place in February 1997 in Monterey, CA.] It provides these extensions and enhancements to VRML 1.0: Enhanced static worlds; Interaction; Animation; Scripting; Prototyping. VRML 2.0 takes VRML and extends it with animation, behaviors, sensors and sounds. There are also some new geometry primitives as well as support for collision detection. The VRML 2.0 scene graph has also been modified to support PC rendering systems more efficiently.

The first release of the VRML 1.0 specification was created by Silicon Graphics, Inc. and based on the Open Inventor file format. The second release of VRML added significantly more interactive capabilities. It was primarily designed by the Silicon Graphics VRML team with contributions from Sony Research, Mitra, and many others. VRML 2.0 was reviewed by the VRML moderated email discussion group and later adopted and endorsed by many companies and individuals. In December 1997, VRML97

replaced VRML 2.0 and was formally released as International Standard ISO/IEC 14772 (http://www.stars.com/Authoring/VRML/).

Browser

Live 3d and WorldView 2.0 are most common browsers.

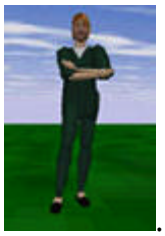
Live3d. The new Netscape Live3D VRML browser (built into Netscape V3.0) supports both the existing VRML 1.0 standard and the new 2.0 proposed standard. (http://home.netscape.com/eng/live3d/)

WorldView 2.0. The leader in three-dimensional (3D) technology for the Internet, produces WorldView 2.0, the fastest VRML 2.0 plug-in application for Netscape Navigator Web browsers. WorldView 2.0 for Microsoft Windows 95 and Windows NT is designed with the industry standard VRML 2.0. WorldView 2.0 empowers users to easily navigate 3D spaces with more animation, multimedia and interactive capabilities. WorldView 2.0 is available from the Intervista web site. (http://www.intervista.com)

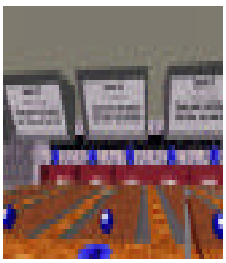
Applications

Virtual reality technology has a variety of applications. In home, school, navy, and any other places in the world, we can use a VR system for entertainment, simulation, and education.

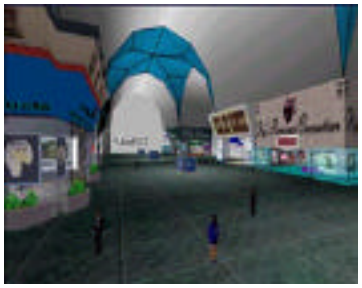
Entertainment

Chat   . We can meet and chat with people from all over the globe. Virtual chat site is filled with thousands of fun and interesting people to chat with. Generally, each person has his/her own avatar. An avatar is a 3D representation of you

that other people can see when you are chatting. Avatars even have the ability to run, jump, fly, dance, and express a whole host of emotions and actions.

Game  

. From marathon trivia games to league bowling nites, there are many sites to provide dozens of creative gaming environments such as soccer, hockey, bowling, chess, checkers, bingo, etc.

Shopping  . You can buy anything at a "real" 3D virtual mall in cyberspace, which is designed to resemble a modern shopping mall. The malls have a variety of vendors of both traditional and virtual products and services.

Build and Explore   . In a virtual reality site, you can build anything you want. A nice house in the country, an impenetrable fortress, or even a space ship. The only limit is your imagination.

Web sites for entertainment.

http://www.activeworld.com

http://vr-atlantis.com/

http://www.murdermystery.com/vrml/index.html

http://www.vr-mall.com

Education and Work

A collection of 3D VRML or other Web3D technology links to examples of educational uses of VRML or Web3D (http://web3d.about.com/compute/web3d/msub5edu.htm).

3D Insects . An extraordinary collection of VRML bugs by Alexi Sharov of the Dept. of Entomology, Virginia Tech (http://www.ento.vt.edu/%7Esharov/3d/3dinsect.html).

The 3D Sky. Galaxies and Stars in VRML based on accurate astronomy by Paul Houle (http://www.honeylocust.com/Stars/).

Accessibility and VRML. The work-related applications that appear to be most promising are those that employ virtual reality for (1) visualization and representation, (2) distance communication and education, (3) hands-on training, (4) orientation and navigation, and (5) workers with disabilities. Examples of each of these applications are provided in the following site (http://www.utoronto.ca/atrc/rd/vrml/main.html)

Alphabet Primer. From John Nikkel aka Ragtimer a most cool VRML alphabet teaching world. (http://www.matryx.net/vrml/AlphaB/alpha%5fpc.wrl/)

Avatardom.com. Cati Laporte's cool course about AvatarStudio. (http://www.avatardom.com)

Balloon Flight, Steve Fosset. A VRML view of Steve Fosset's around the world balloon flight attempt. (http://www.ojomagic.com/balloons/earth/)

BBC Education, History 2000. First class VRML historical reconstructions by the BBC. (http://www.bbc.co.uk/education/history/3d.shtml)

BioAnim. Tomaz Amon's VRML Biology site, expanded with literally dozens of high quality biological animations and worlds. (http://www.bioanim.com)

Brancusi's Mademoiselle Pogany. Experimental VRML gallery at the Philadelphia Museum of Art. (http://www.philamuseum.org/pogany/)

CADETTE. From the Franklin Institute in the city of brotherly love, CIMBLE a 3D educational environment. (http://www.cadett.fi.edu/)

Center for Electronic Communications. Some very accomplished work in an interesting educational environment at Florida Atlantic University. (http://www.animaster.com)

Centre for Advanced Spatial Analysis. An reasearch institution with several very interesting projects (urban design, GIS, information visualization), some using VRML. (http://casa.ucl.ac.uk/)

CitySpace. A collaborative city building project for kids. (http://cityspace.org)

Collaborative Design Studio. The use of Virtual Environments for urban planning and design is explored by these folks. (http://www.plamet.co.uk/olp/design.htm)

CollegeNet VRML Tour. A tour of Virginia Tech from a leading college info web site. (http://www.collegenet.com/vrml/)

Croatian VRML site. A polished site at the University of Zagreb. (http://vrml.zesoi.fer.hr/index2.html)

CyberAnatomy (vrml). A VRML anatomical tour-de-force led by Sam Chen of SGI for the O2 Out-Of-Box-Experience. (http://reality.sgi.com/sambo/oobe/cyberannatomy/intro.html)

CyberAstronomy. An interactive tour of the Solar System by that SGI wizard, Sam Chen. (http://reality.sgi.com/sambo/oobe/cyberastronomy/intro.html)

Considerations

The problems or shortcomings of commercially available products which address this function include:

- they are costly to produce, requiring either many hours of human labour or expensive, complex, and obscure hardware tools,
- they are costly to store and ship,
- many are fragile and easily damaged,
- they are not easy to share or duplicate and are therefore frequently used by only one student,
- they are not easily updated.

Reference

Weiss & Kessel (1998), Virtual reality applications to work (http://www.utoronto.ca/atrc/rd/vrml/main.html)

http://www.ento.vt.edu/%7Esharov/3d/3dinsect.html

http://www.geom.umn.edu/software/weboogl/about.html

http://www.stars.com/Authoring/VRML/

http://home.netscape.com/eng/live3d/

http://www.intervista.com

Resources

http://isdale.com/jerry/VR/index.html

This site is created by a technical writer for VR News Magazine, and is definitely the place to start if you are interested in learning more about VR.

http://www.dcs.ed.ac.uk/home/mxr/objects.html

This page offers a WWW interface to a collection of freely available 3D object files which have been compiled for their applicability to real-time graphics applications, and virtual reality (VR) in particular. All material here is freely-available.

http://www.mheim.com/index.html

This site is beautifully designed and is a source for books, seminars, articles and conferences on VR. Plus a groovy Tai Chi link!

http://www.inworldvr.com/products/index.html

InWorld specializes in providing custom 3D applications and content quickly and on budget. This site has many excellent demo's which my nine year old buddy found fascinating.

http://www.hitl.washington.edu/kb/onthenet.html

This is a comprehensive site of research and resources for VR technology.

http://www.apple.com/quicktime/

Apple's home page for QTVR. You can get downloads here.

Sites that use VR

http://www.apple.com/quicktime/qtvr/

Examples from Apple of sites that use VR. This is the cream of the crop! You must visit virtual Vancover!

http://www.conexus.si.edu/vrtour

A Virtual Tour of the National Museum of the American Indian Exhibitions Creation's Journey and All Roads Are Good.

http://www.worldserver.com/turk

Ken Turkowski's Web Page. He is one of the original QTVR programmers. His web site has some wonderful QTVR examples and links. It also offers some QTVR calculators that help you determine the QTVR lens parameters for a given camera and decide how manypictures to shoot with a given lens.

http://www.usexpo98.org/introvr.htm

Take a virtual tour of the U.S. pavilion at the Lisbon World Expo of 1998.

http://www.tourvision.com/qtvr/

View panoramic images of various areas including Old Sacramento, K Street and the Plaza.

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