

Virtual Reality

CS60-520 Presentation

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Outline

- Introduction
- The history of VR
- Types of VR
- Technologies of VR
- Architecture of VR system
- Applications of VR
- Current problems & Future work
- Summary
- Reference

Introduction



- What is Virtual Reality(VR)?
Virtual Reality refers to a high-end user interface that involves real-time simulation and interactions through multiple sensorial channels.

Introduction (Cont'd)

- Why VR?

VR is able to immerse you in a computer-generated world of your own making: a room, a city, the interior of human body. With VR, you can explore any uncharted territory of the human imagination.

Brief History

- In 1950s, flight simulators were built by US Air Force to train student pilots.
- In 1965, a research program for computer graphics called “The Ultimate Display” was laid out.
- In 1988, commercial development of VR began.
- In 1991, first commercial entertainment VR system “Virtuality” was released.

Types of VR System

- Windows on World(WoW)
 - Also called Desktop VR.
 - Using a conventional computer monitor to display the 3D virtual world.
- Immersive VR
 - Completely immerse the user's personal viewpoint inside the virtual 3D world.
 - The user has no visual contact with the physical world.
 - Often equipped with a Head Mounted Display (HMD).

Types of VR System(Cont'd)

- Telepresence

- A variation of visualizing complete computer generated worlds.
- Links remote sensors in the real world with the senses of a human operator. The remote sensors might be located on a robot. Useful for performing operations in dangerous environments.

Types of VR System(Cont'd)

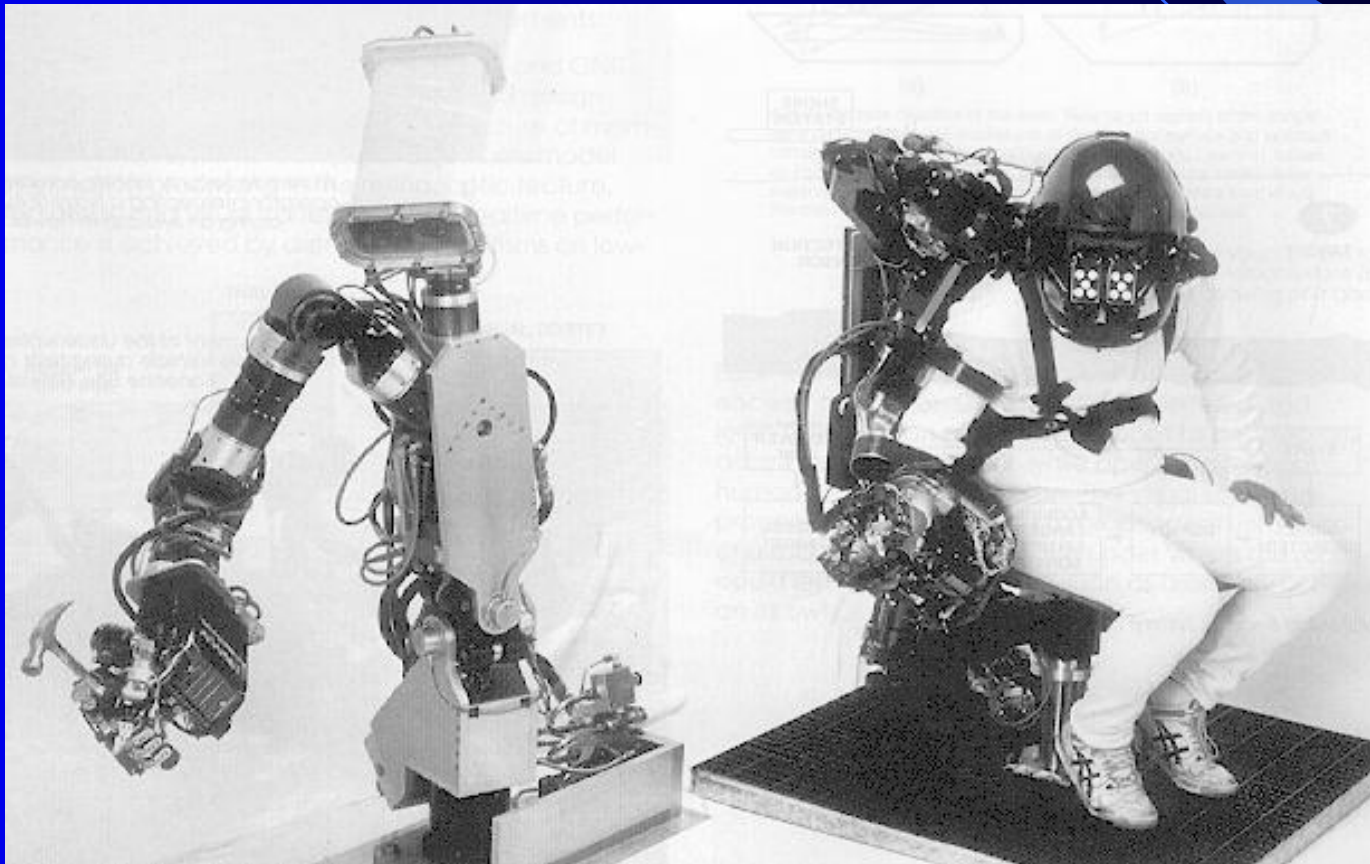
- **Mixed Reality(Augmented Reality)**
 - The seamless merging of real space and virtual space.
 - Integrate the computer-generated virtual objects into the physical world which become in a sense an equal part of our natural environment.

Distributed VR

- A simulated world runs on several computers which are connected over network and the people are able to interact in real time, sharing the same virtual world.

VR Examples (Cont'd)

- Telepresence VR



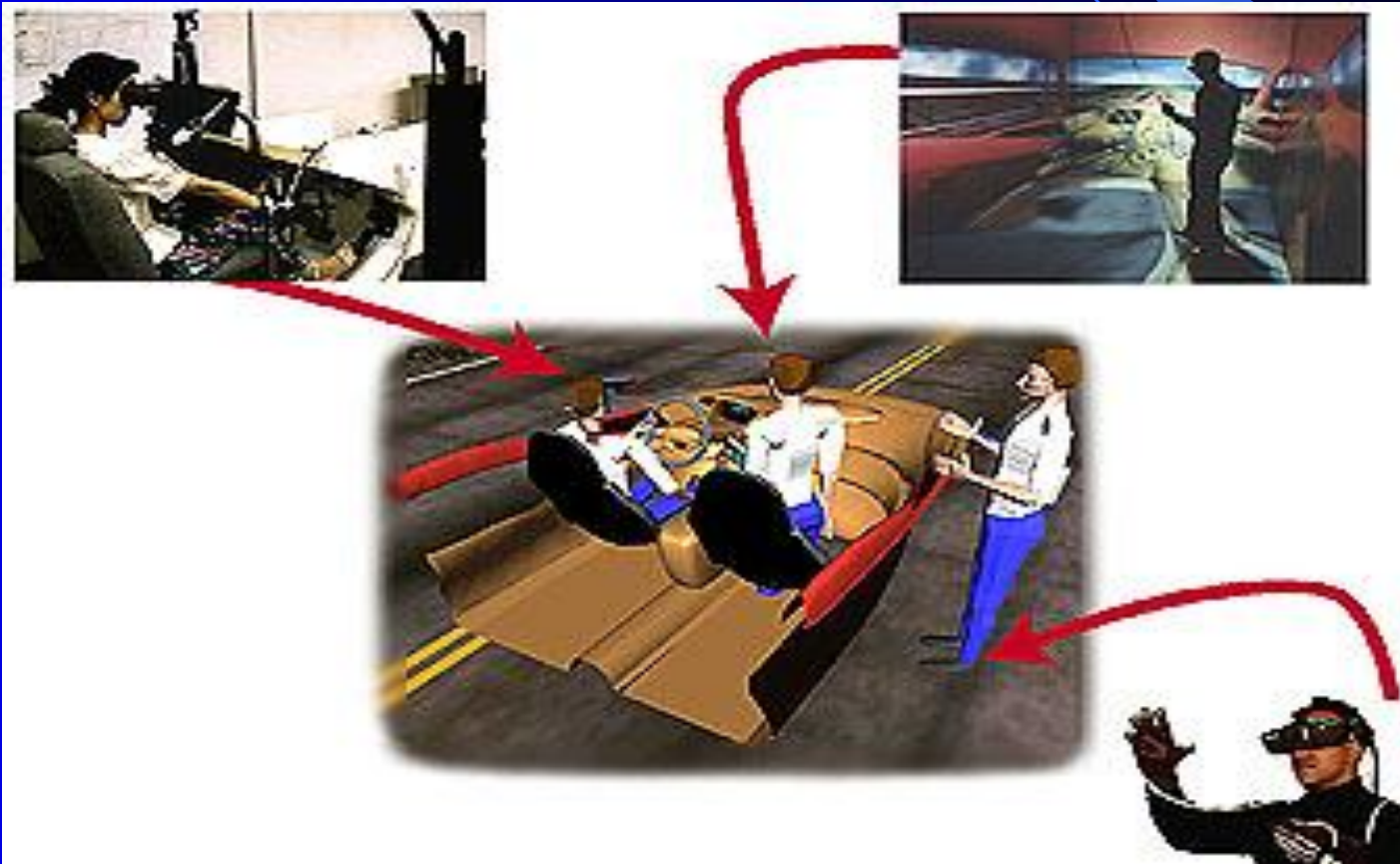
VR Examples (Cont'd)

- Augmented VR



VR Examples (Cont'd)

- Distributed VR



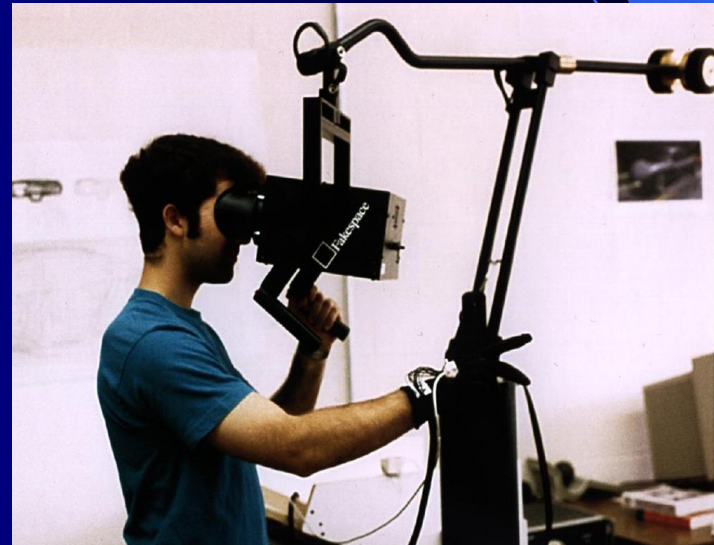
Technologies of VR--Hardware

- Head-Mounted Display (HMD)
 - A Helmet or a face mask providing the visual and auditory displays.
 - Use LCD or CRT to display stereo images.
 - May include built-in head-tracker and stereo headphones



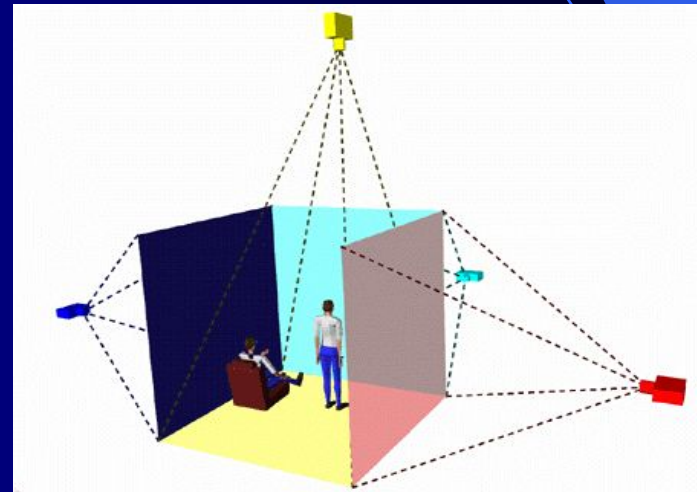
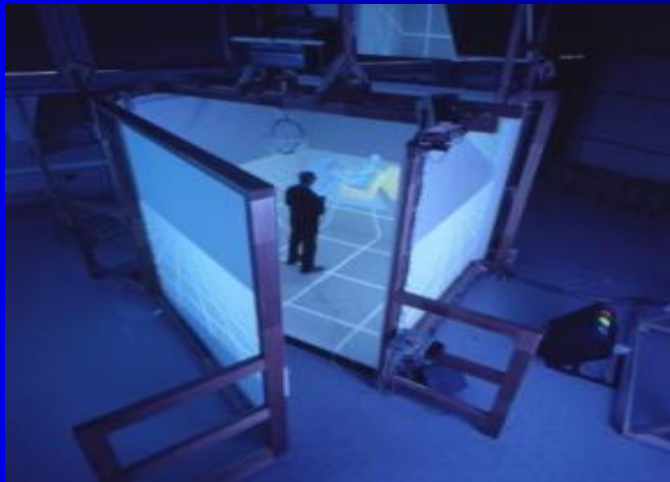
Technologies of VR--Hardware

- Binocular Omni-Orientation Monitor (BOOM)
 - Head-coupled stereoscopic display device.
 - Uses CRT to provide high-resolution display.
 - Convenient to use.
 - Fast and accurate built-in tracking.



Technologies of VR--Hardware

- **Cave Automatic Virtual Environment (CAVE)**
 - Provides the illusion of immersion by projecting stereo images on the walls and floor of a room-sized cube.
 - A head tracking system continuously adjust the stereo projection to the current position of the leading viewer.



Technologies of VR--Hardware

▪ Data Glove

- Outfitted with sensors on the fingers as well as an overall position/orientation tracking equipment.
- Enables natural interaction with virtual objects by hand gesture recognition.



Technologies of VR--Hardware

- Control Devices
 - Control virtual objects in 3 dimensions.



Technologies of VR--Software

- Toolkits

- Programming libraries.
- Provide function libraries (C & C++).

- Authoring systems

- Complete programs with graphical interfaces for creating worlds without resorting to detailed programming.

Technologies of VR--Software

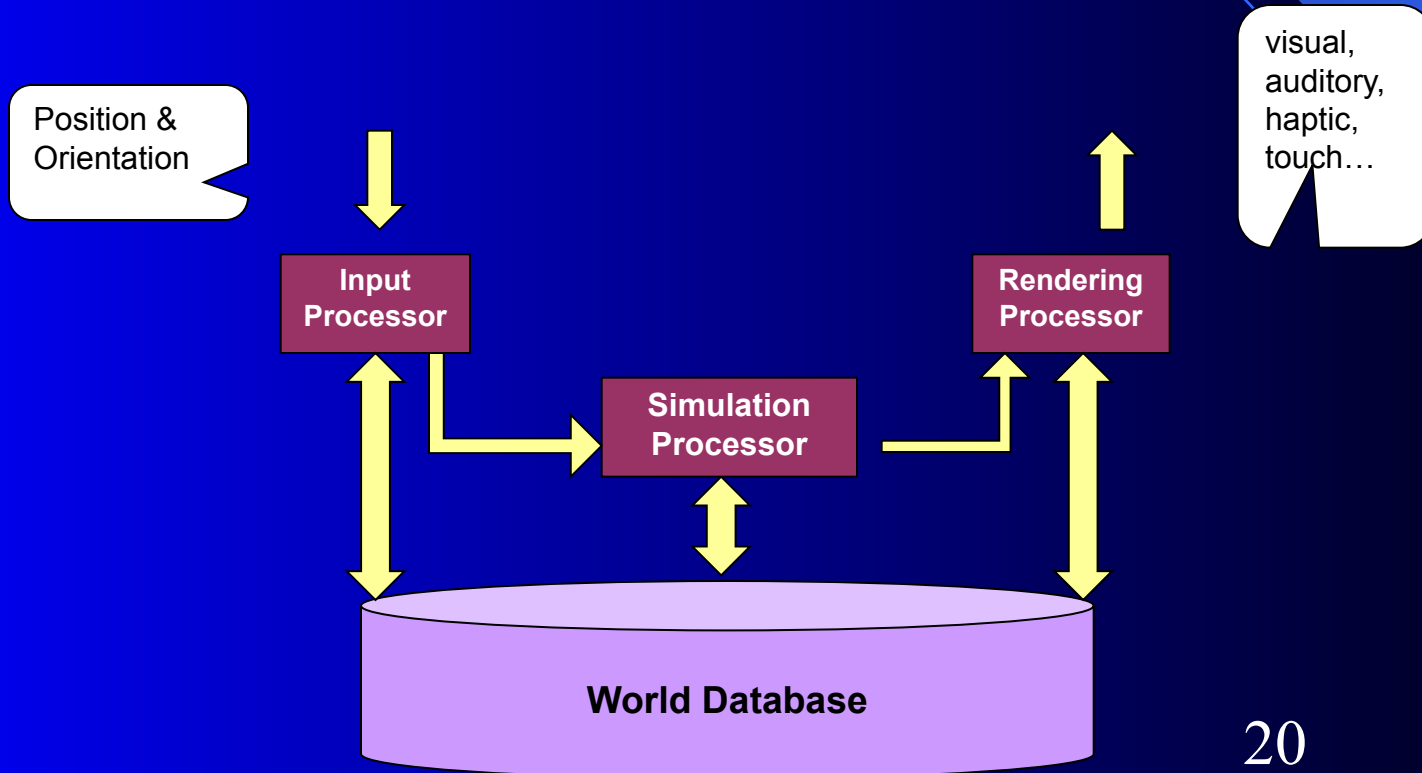
- Software packages available in market
 - Multiverse (Freeware)
 - Virtual Reality Studio (\$100)
 - Sense8 World Tool Kit (WTK) (over \$1000)
 - Autodesk Cyberspace Development kit (over \$1000)

Technologies of VR--Software

- VRML(Virtual Reality Modeling Language)
 - Standard language for interactive simulation within the World Wide Web.
 - Allows to create "virtual worlds" networked via the Internet and hyperlinked with the World Wide Web.
 - Aspects of virtual world display, interaction and internetworking can be specified using VRML without being dependent on special gear like HMD.
 - VR models can be viewed by Netscape or IE with a browser plug-in.

Architecture of VR System

- Input Processor, Simulation Processor, Rendering Processor and World Database.



Components of VR System (Cont'd)

- Input Processor

- Control the devices used to input information to the computer. The object is to get the coordinate data to the rest of the system with minimal lag time.
- Keyboard, mouse, 3D position trackers, a voice recognition system, etc.

Components of VR System (Cont'd)

- Simulation Processor
 - Core of a VR system.
 - Takes the user inputs along with any tasks programmed into the world and determine the actions that will take place in the virtual world.

Components of VR System (Cont'd)

- Rendering Processor
 - Create the sensations that are output to the user.
 - Separate rendering processes are used for visual, auditory, haptic and other sensory systems. Each renderer take a description of the world stat from the simulation process or derive it directly from the World Database for each time step.

Components of VR System (Cont'd)

- World Database (World Description Files)
 - Store the objects that inhabit the world, scripts that describe actions of those objects.

Applications

- **Entertainment**

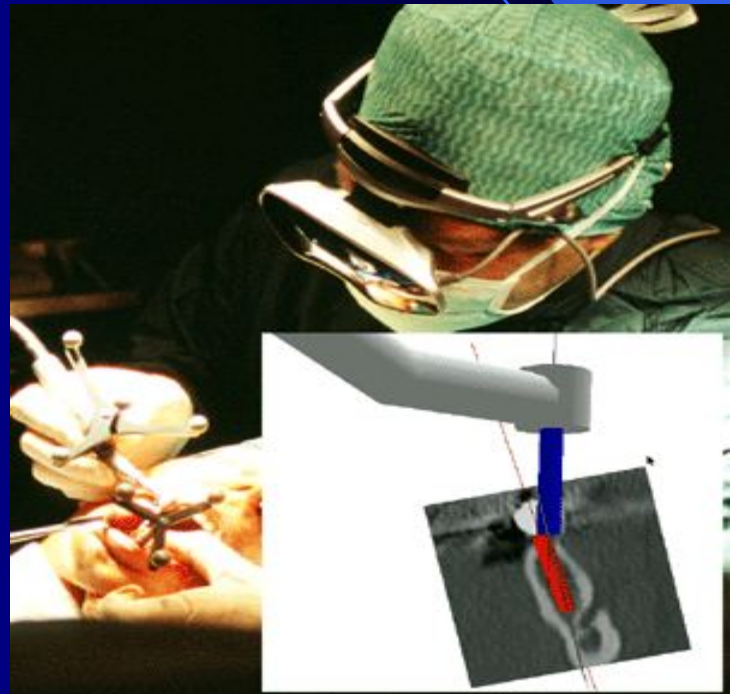
- More vivid
- More exciting
- More attractive



Applications (Cont'd)

■ Medicine

- Practice performing surgery.
- Perform surgery on a remote patient.
- Teach new skills in a safe, controlled environment.



Applications (Cont'd)

- Manufacturing
 - Easy to modify
 - Low cost
 - High efficient



Applications (Cont'd)

- Education & Training
 - Driving simulators.
 - Flight simulators.
 - Ship simulators.
 - Tank simulators.



Current problems & Future work

- ☹ Cybersickness / simulator sickness
- ☹ Low-fidelity
- ☹ Expensive
- ☹ Lack of integration between application packages
- ☺ High-fidelity system
- ☺ Cost-saving
- ☺ Collaborative
- ☺ High-level contact between participants in distributed VR

Summary

- Visualization of complicated, large data is helpful for understanding and analysis.
- VR offers us a new way to interact with computer.
- VR enables us to experience the virtual world that is impossible in real world.
- VR is changing our life, eventually VR will increasingly become a part of our life.

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Comments & Questions?