Virtual Reality

CS60-520 Presentation
Instructor: Dr. Aggarwal
Student: Yang Gao
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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.

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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 word.
  - 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.
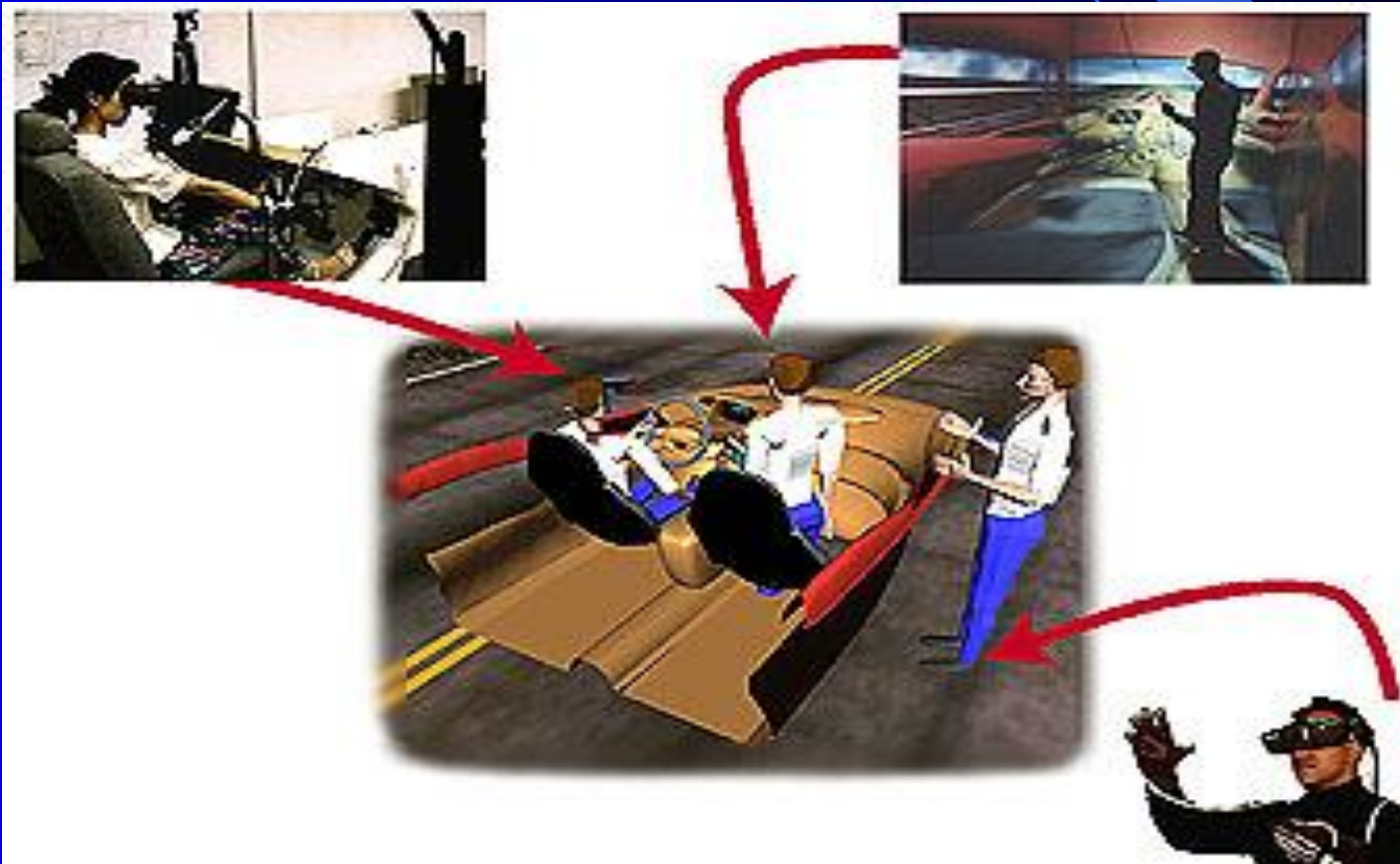
VR Examples (Cont'd)

- Telepresence VR
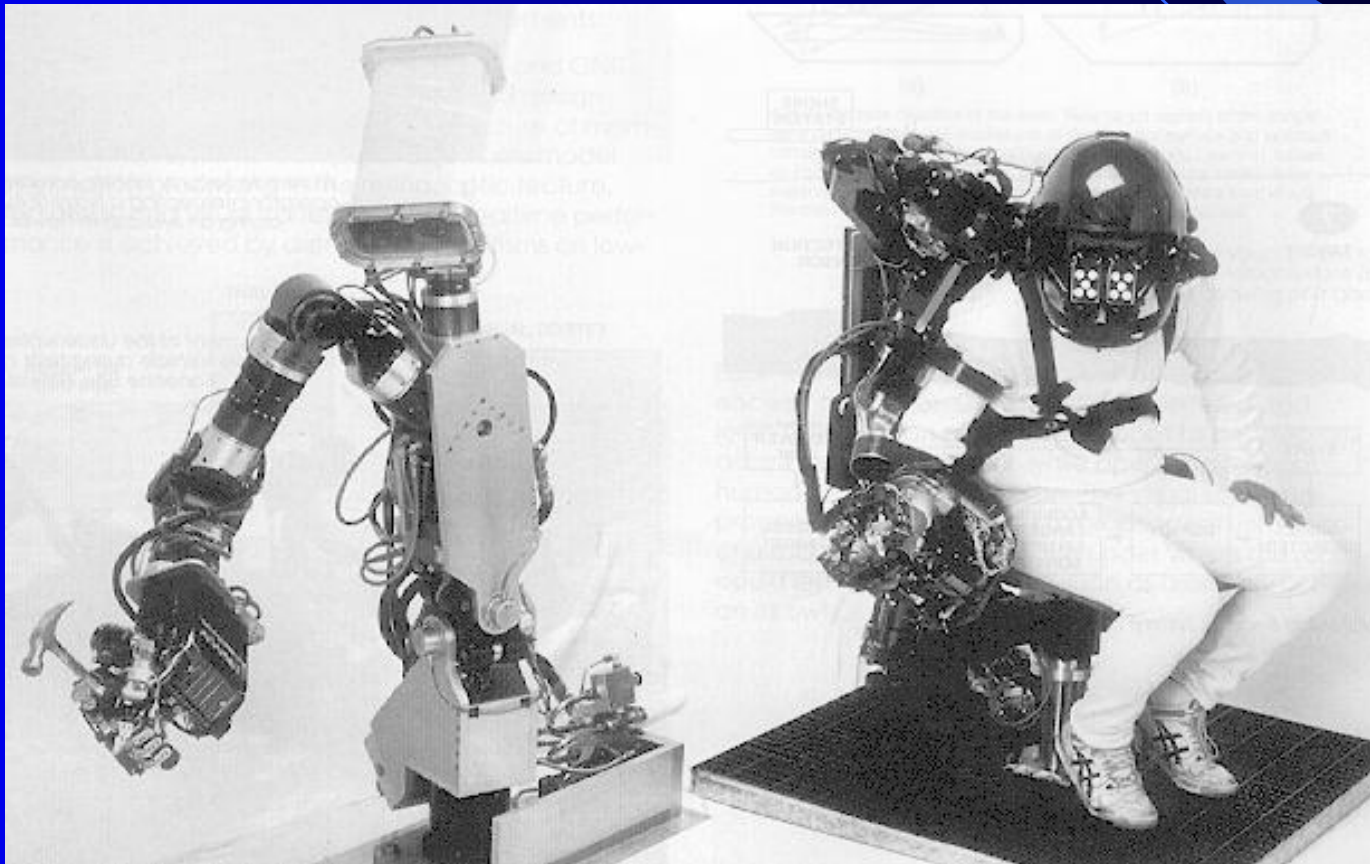
VR Examples (Cont'd)

- Augmented VR

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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.
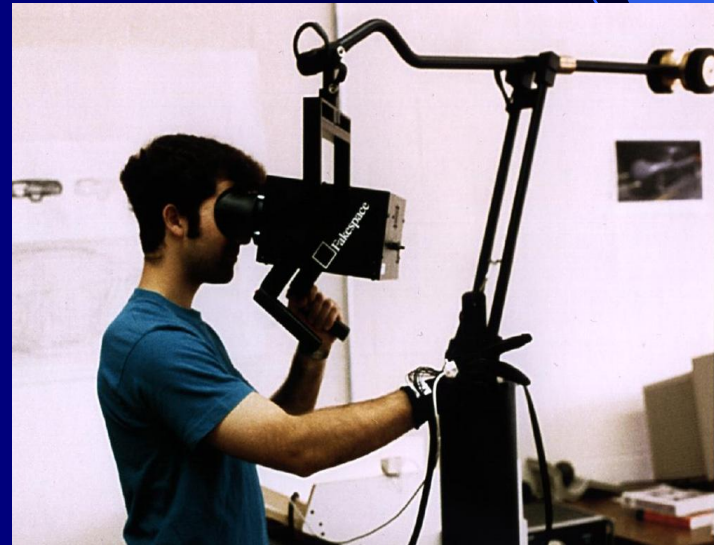
Technologies of VR--Hardware

- **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.

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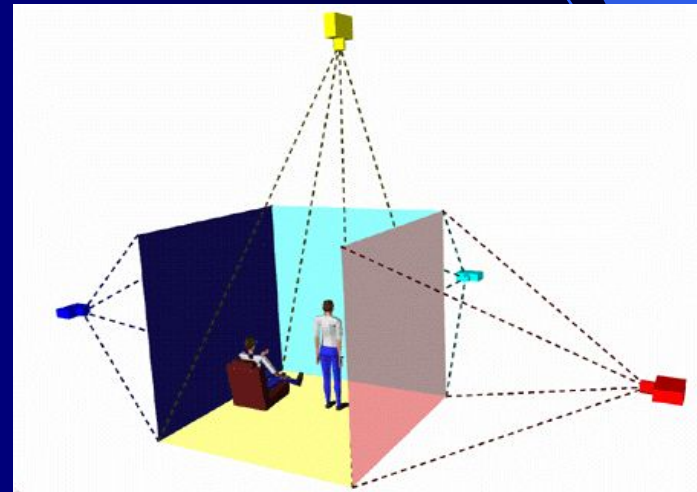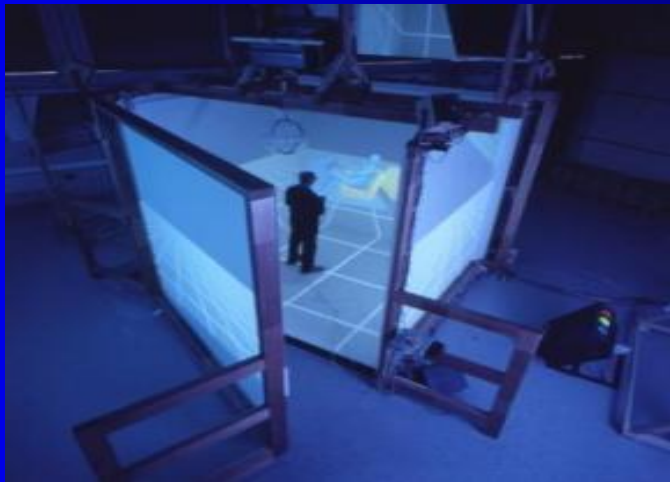
Technologies of VR--Hardware

- ## 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)

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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.

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Architecture of VR System

- Input Processor, Simulation Processor, Rendering Processor and World Database.
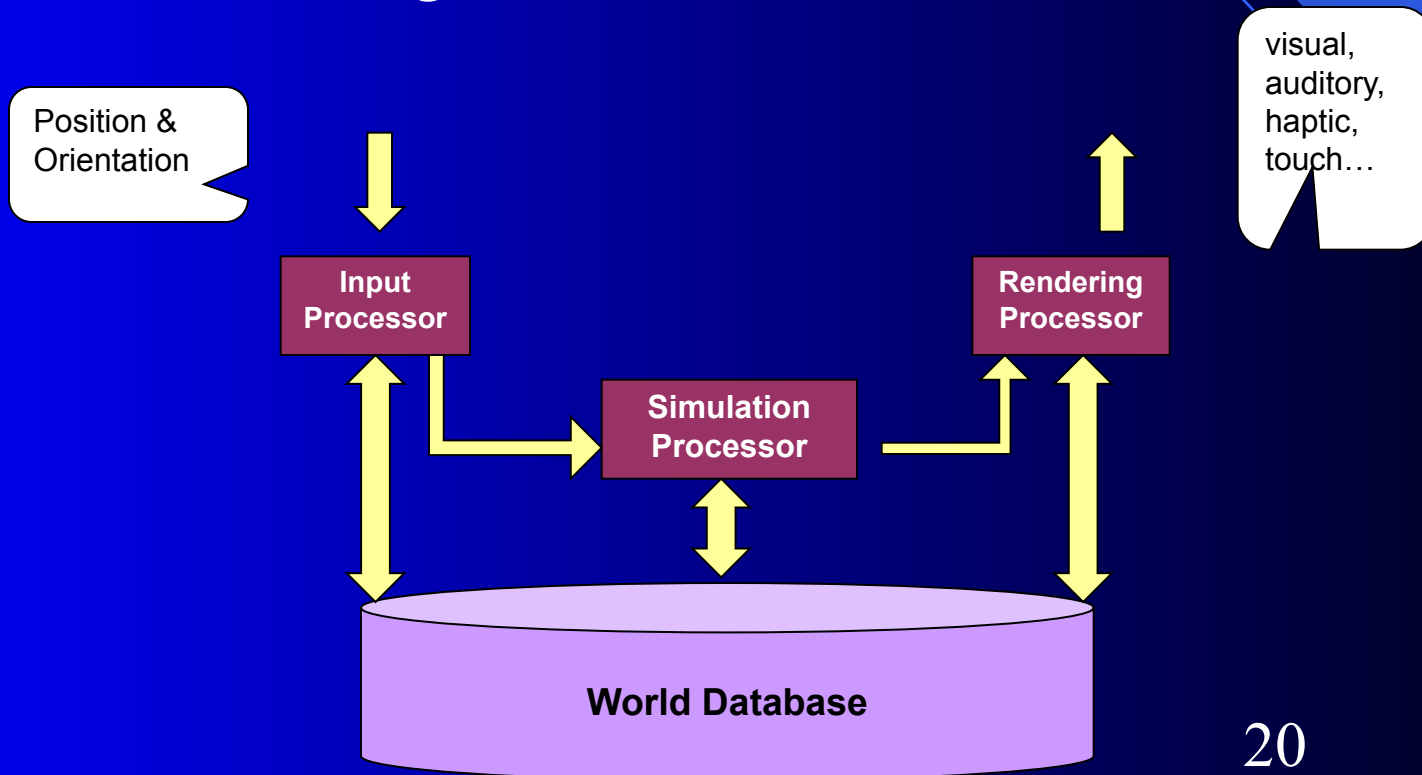
Components of VR System (Cont'd)

- 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.

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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.
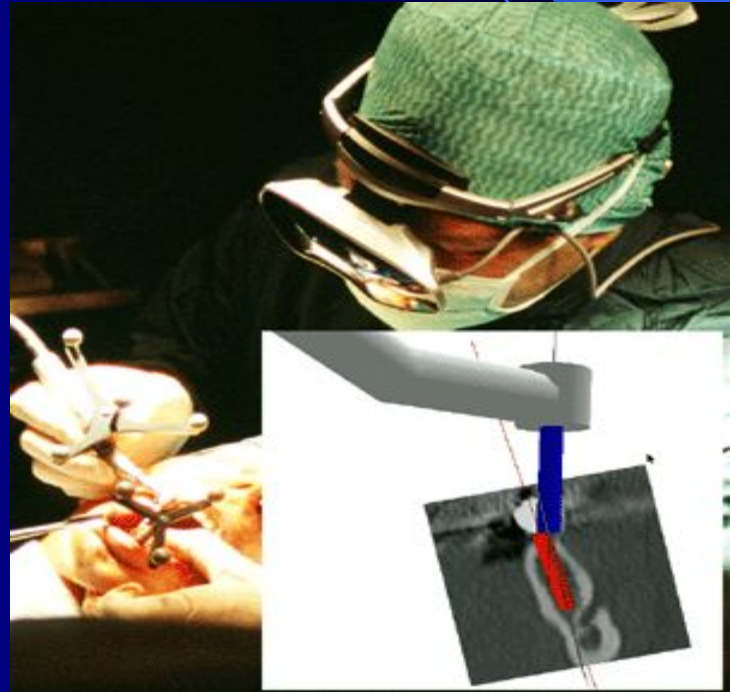
Applications

- **Entertainment**
  - More vivid
  - Move 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.

Reference

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Comments & Questions?