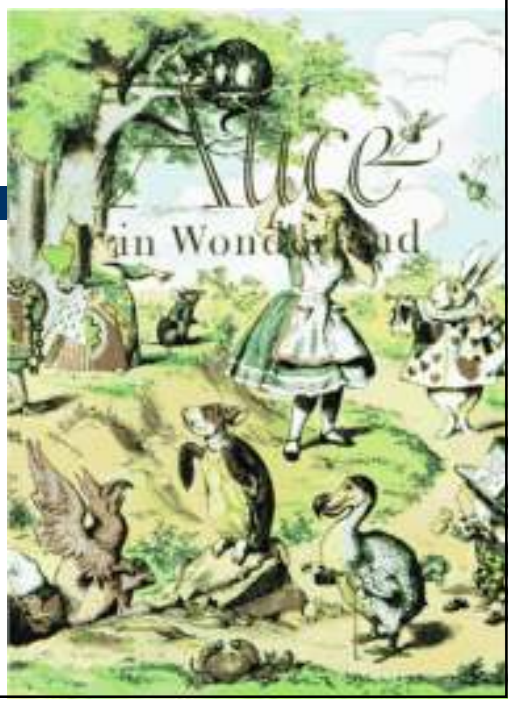
ENSF 545
Introduction to Virtual Reality

Introduction

What is Virtual Reality?



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What is VR?

- Advanced computer technologies
- High-end human-computer interface
- Real-time simulation and interactions through multi-sensory modalities
- VR == VE

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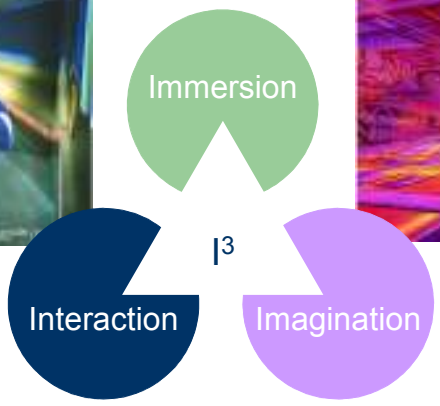
What is VR?



* Burdea, 1993

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Response Domain

- Reading a novel
- Movie
- 3D movie
- Game

- **Immersive VR** -> + total body movement

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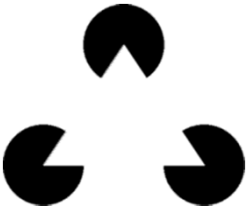
Presence and Hypotheses

- Perceptual theories:
  - (Gregory:) Perceptual system selects between competing hypotheses.
  - (Stark:) Perceptual system is top-down driven.
- Hypotheses relating to the fundamental question:
  - Where am I?



Presence ←→ Immersiveness

- A ‘good’ immersive VR (*e.g.* CAVE -- Computer Automated Virtual Environment)
- What we ‘see’ is
  where we are …
  and
  where we act

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Perceptual Augmentation

- (Stark:) “Virtual reality works because reality is virtual.”
- Very simple cues required to trigger presence

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Why Learning VR Technologies?

- Successes in industry
  ➔ a need for VR professionals
  - Examples – military simulations, medical rehabilitation, oil industry, games
  - Advantages – significant cost savings, saving lives, and fun ...
- Help VR development efforts in other industries
- Understand what VR can and cannot do

Example - Military Simulations

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Example – Medical Rehabilitation

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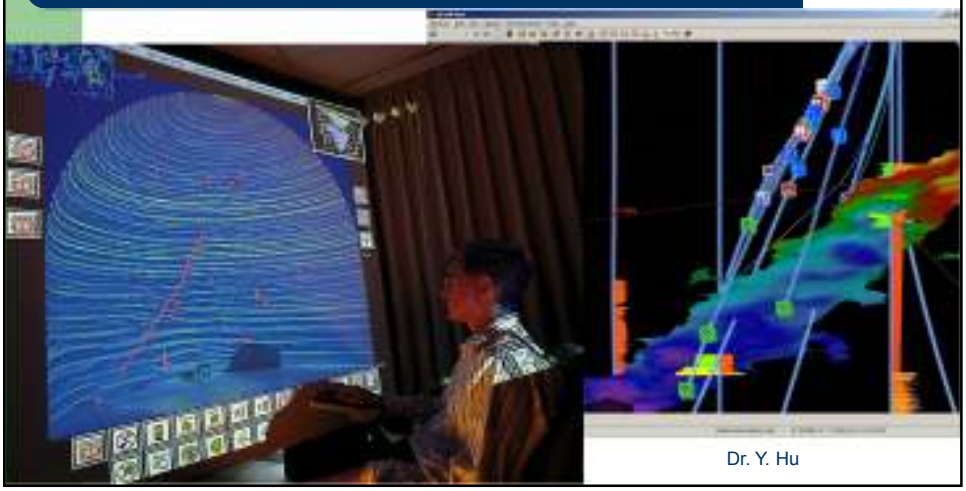
Example – Oil Industry



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Example – Games with WII

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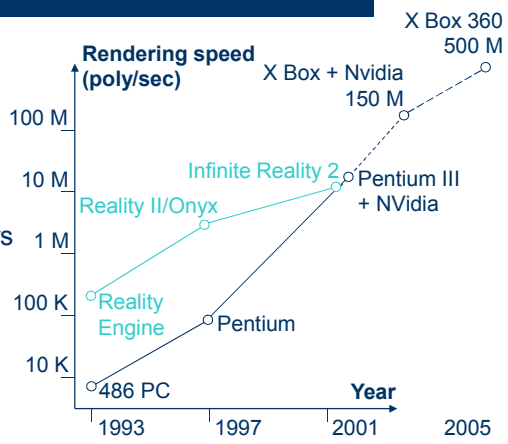
VR History

- 1962, Morton Heilig, Sensorama
- 1981, NASA, LCD-based HMD (VIVED)
- 1985, NASA (Scott Fisher, Thomas Zimmerman, Jaron Lanier), Sensing glove
- **1989**, Jaron Lanier coined the term "**Virtual Reality**"
- 1993, IEEE organized the first VR conference in Seattle

➔ VR is part of the scientific and engineering community.

VR Industry

- Silicon Graphics Inc. (SGI) – Reality Engine, 1993
- Late 1990s, rebirth of VR
  - Large volume displays
  - PC graphics
  - VR I/O interfaces
- VR market:
  - $50 million, 1993
  - $3.4 billion, 2005



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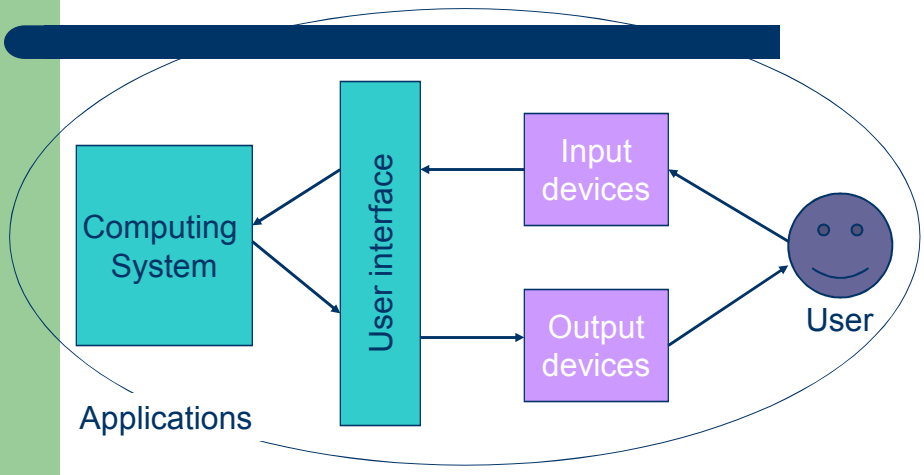
VR Systems

Situation



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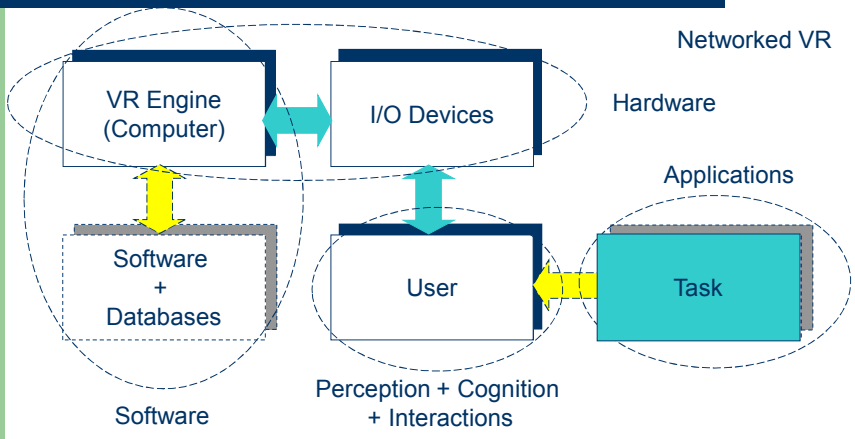
Key Components of a VR System



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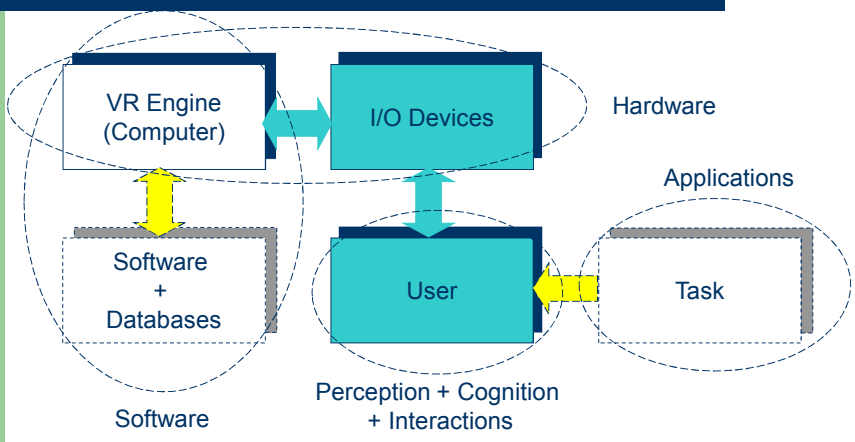
Applications - Define

- What are the users of a specific application?
  (experiences, aptitude, motivations, needs…)
- What is the task and what is required to do it?
- What is the environment for the application?
- What are the basic perceptual, cognitive, motor, and affective capabilities of humans?

Key Components of a VR System



Senses vs. Devices

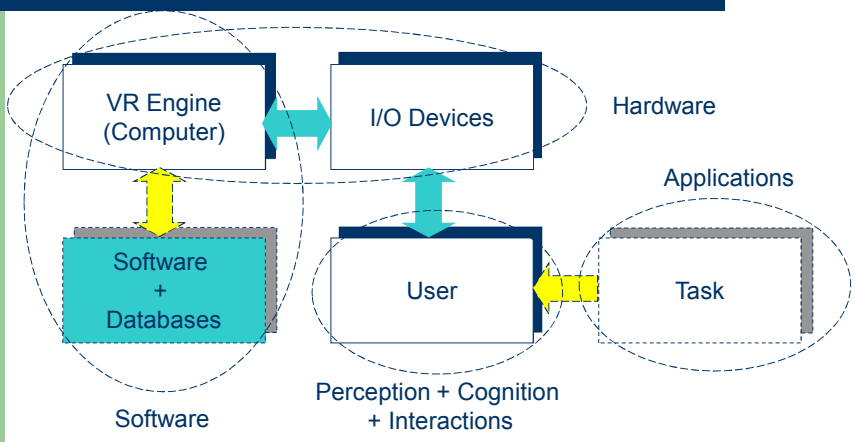
	Humans	VR Systems
Vision	Eyes	3D stereo graphics
Touch	Hand	Force feedback
Hearing	Ears	3D speaker system
Smell	Nose	Fragrance
Taste	Tongue	N/A

Senses vs. Devices (cont'd)

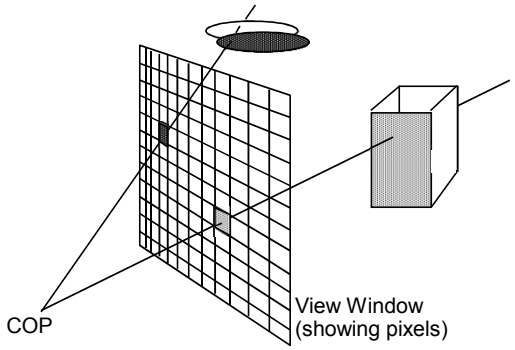
	Humans	VR Systems
Location	Cues + Landmarks	Tracking device
Interaction	Language + Gesture	Wand, Gloves, etc.
Thermo	Skins	Temperature feedback gloves

What do You Recognize?

Five Components of a VR System



Painting Through a Window



COP = Centre of Projection

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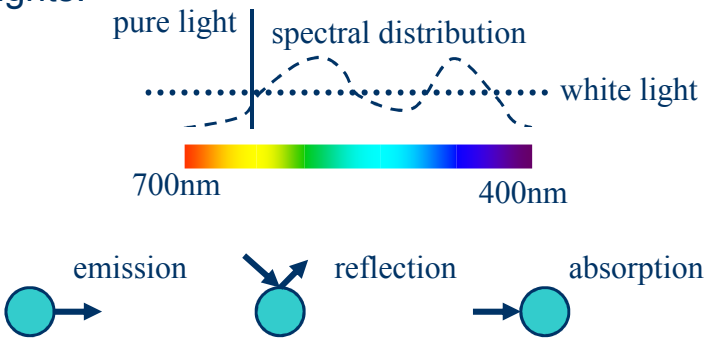
Light in an Environment

- Lights:



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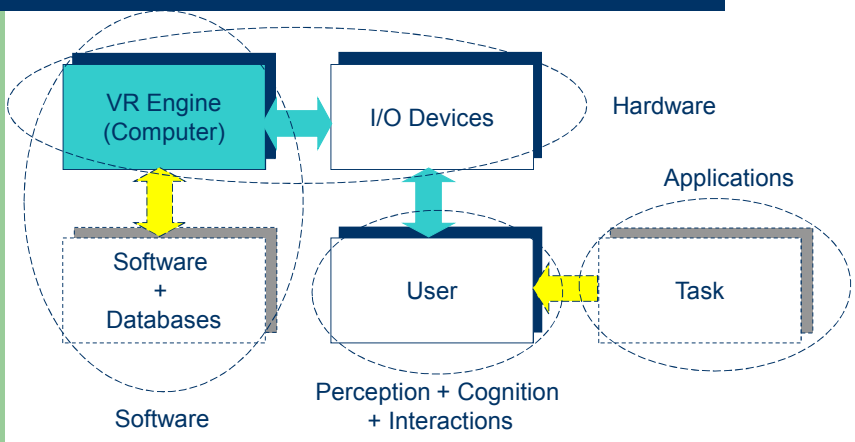
Key Components of a VR System



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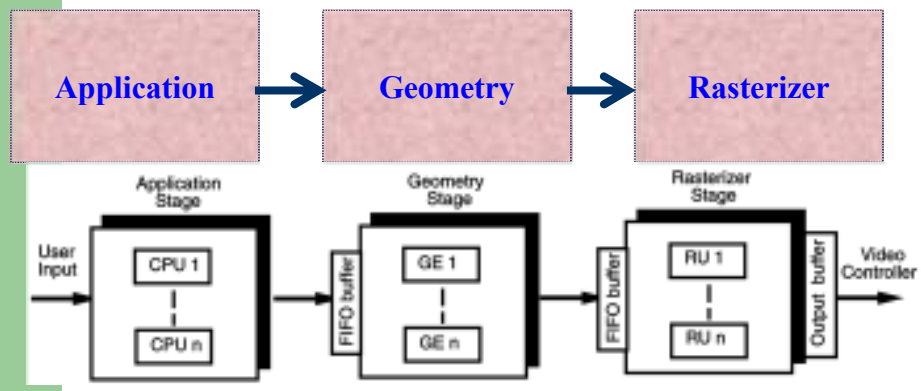
The Graphics Rendering Pipeline



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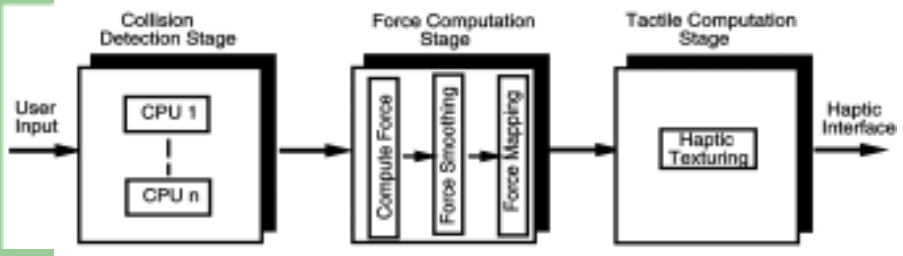
The Haptic Rendering Pipeline



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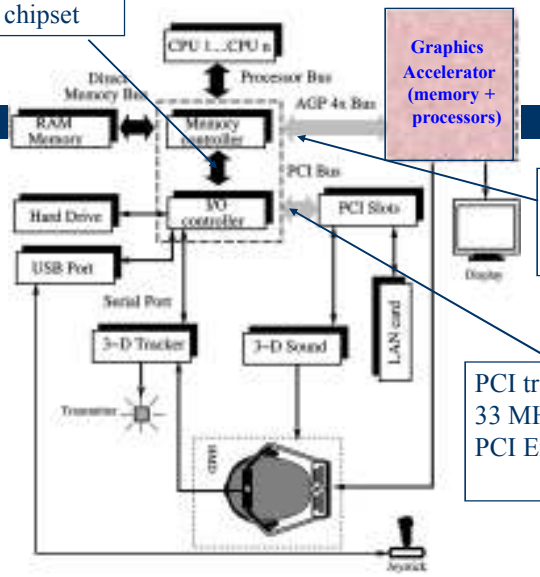
PC Architecture

Intel 820/850 chipset



AGP 8x rate ~ 2 GBps
unidirectional
533 MHz x 32 bit/sec

PCI transfer rate ~ 133 MBps
33 MHz x 32 bit/sec
PCI Express rate ~ 4 GBps
bidirectional

Workstation - SGI InfiniteReality

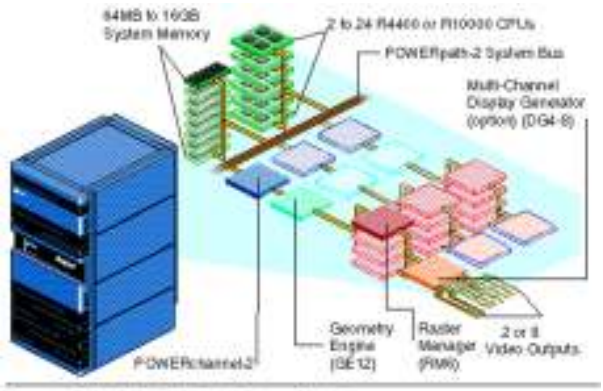
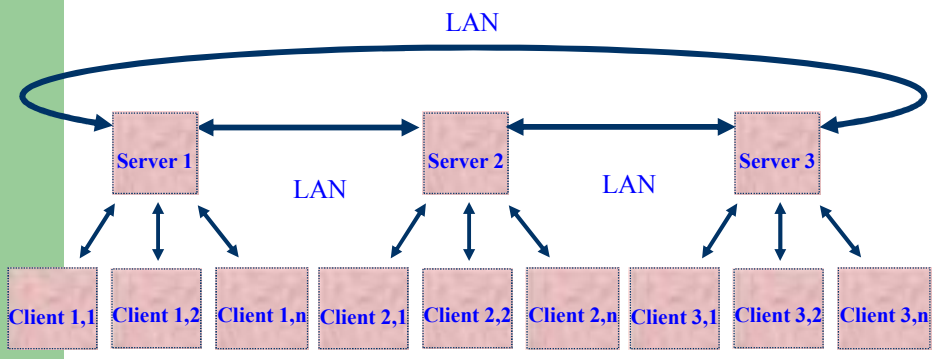


Figure 2. InfiniteReality Rack System Block Diagram

Networked VR



Recap

- Five key components of a VR system
  - VR Engine (computer)
  - Software and database
  - Input / output devices
  - User
  - Task (application)