# VR Hardware

Class 3

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## Industrial Engineer

- IE's goals in any organization is to
  - study the process
  - improve the process
    - Faster
    - Cheaper
    - Effective
    - Reliable
    - of Quality
    - Easy to use

## IE and Training

- The Process in hand is Training
- IE's job in this case is how to make Training:
  - Faster
  - Cheaper
  - Effective
  - Reliable
  - of Quality
  - Easy to use

## IE and Int. Sim.

- The class intend is to provide IEs (and others) with the base knowledge of Interactive Simulation Technology
- This technology can be applied to training systems design

## Interactive Simulation Systems

- Can be divided into five basic subsystems:
  - Simulation Software
  - Computer Processor
  - Output
  - Input
  - Communications

## Simulation Software

- Is the core simulator component that enables the other components to perform their functions within the simulation system
- Collects data from the user via the input devices
- Processes this data and updates the simulation state

## Simulation Software

- Presents this simulation state to the user via the output devices
- Shares the local state with other simulators via the communications pipeline

## Computer Processing

- Interactive simulation must satisfy the requirement of real-time performance
- It integrates a diverse collection of technologies into a single complex system
- Until recently it was used in costly applications only using custom components, and high end machines…

## Computer Processing

- Recently:
  - Advances in computer processing power
  - Advances in communications capabilities
  - Maturation of many VR related technologies (above version 1.0 alpha)
- The good news is:
  - Availability
  - Low cost
  - Variety
  - Commercial Off-The-Shelf (COTS) components

## Computer Processing

- Processing and storage capability of VR system must adequate to:
  - process all inputs through the simulation software
  - generate all necessary output in real time
- The simulation cycle uses processing by the CPU, as well as memory and disk access.
- The simulation cycle share these resources with other subsystems
- The better the performance of the input, output, and communications software, the more of the cycle is left for simulation processing.

## Computer Processing

- Other key points:
  - Interface compatibility (serial, parallel, SCSI…)
  - Affordability
  - Maintainability (easy to install, maintain, and repair)
  - Expandability (future needs and upgrades)

## Output Subsystem

- In VR simulation, the most important type of output subsystem is the visual subsystem
- It is divided into two elements:
  - Visual Generation
  - Visual Representation

## Output Subsystem

- The visual generation element is responsible for generating the visual imagery from databases of 2 and 3 dimensional data
- It can configured in a variety of ways
  - Host Computer with Image Generator (2 connected computers, sometimes not designed to work together)

## Output Subsystem

- Multipurpose Graphics Workstation (everything in one high-end computer), Central Processing and the graphics subsystems designed to work together
- Host computer with integrated graphics Accelerators (most recent configuration), a computer enhanced by a third-party three dimensional graphics board

## Output Subsystem

- Once graphic imagery has been generated, it must be presented to the user…the job of the visual presentation element…also called displays
- Displays in VR applications can be classified into two main categories based on their physical relationship to the user
  - Fixed position displays
  - Close-eye displays

## Fixed-Position Displays

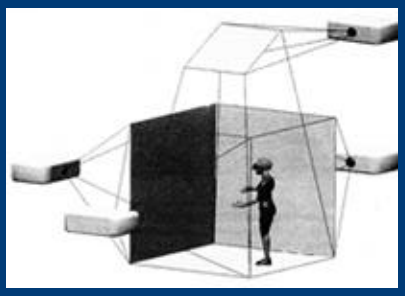
- Standard Monitor
  - Cathode Ray Tube (CRT), desktop
  - Liquid Crystal Display (LCD), laptop
  - Widely available and easy to implement
- Projection screen
  - Large size
  - large field of view
  - Better immersion than CRT or LCD
  - Lower picture quality than CRT
  - Brightness and contrast diminish with oblique viewing angle

## Fixed-Position Displays

- Multiple monitors
  - Combined and synchronized
  - Behave as a single larger monitor
  - High-resolution
  - The higher the resolution, the bigger the imagery generation cycle
  - Sometimes discontinuity between adjacent monitors

## Fixed-Position Displays

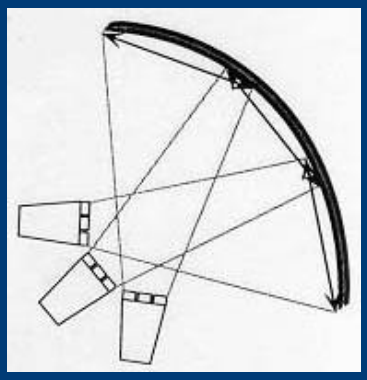
- Multiple Projection Screens
  - Similar to combining monitors
  - Provides extremely large and immersive display
  - Large field of view (what is seen), and large field of regard (what is viewable)
  - More processing time
  - Discontinuity problems on edges



# Interactive Simulation: UCF EIN5255

## Fixed-Position Displays

- Curved displays
  - The most sophisticated implementation of fixed-position displays
  - Two or more projectors to direct adjacent, overlapping images at different region of a large, seamless curved screen



## Fixed-Position Displays

- Curved displays
  - No seems between adjacent portions of the image, when properly implemented
  - Large field of view, large field of regard
  - All regions are viewed at close to their normals
  - Therefore the perceived brightness and contrast are very good across the entire display
  - The most significant processing demand
  - Needs sophisticated optical correction (distortion purposes.
  - Expensive
  - Frequent maintenance and calibration

## Close-Eye Displays

- Close enough to the user's eyes, and move in tandem with the user's head
- Head Mounted Displays (HMD)
  - Is a device worn on the user's head
  - configured to display imagery directly in front of the eye
  - Offer individual images for each eye (stereoscopy)
  - Good visual immersion

## Close-Eye Displays

- Offer small field of view
- Tendency to induce simulator sickness
- Encumbrance by wearing itself, plus cables from computer processing subsystem

## Close-Eye Displays

- Booms (page 77) is an armature that is attached to a fixed location
  - The user places the supported display up to his eyes and moves it together with his head
- Binoculars (page 85)
- Others variations of the HMD

## Close-Eye Displays

- Direct Retinal Laser Display is a device tha uses one or more lase to scan an image directly onto the retina of the human eye
- High Resolution and a large field of view
- Could replace CRTs and LCDs for close-eye displays

## Next week

- Output Subsystem
  - Audio output
  - Haptic output
- Input Subsystem
  - Locomotion
  - Sensor Technology
  - Gesture Recognition
  - Natural Language Recognition