

Virtual & Augmented Reality



What is VR?

- Virtual Reality (VR) means feeling the imaginary(virtual) world as real that is a simulation running in a computer. Virtual reality is the term used for computer generated 3D environments that allow the user to enter and interact with alternate realities.
- The definition of 'virtual' is near and 'reality' is what we experience as human beings.
- Virtual Reality refers to a high-end user interface that involves real-time simulation and interactions through multiple sensorial channels.

VR Experience: <https://www.youtube.com/watch?v=qYfNzhLXYGc>

VR Tool: <https://www.youtube.com/watch?v=jnqFdSa5p7w>



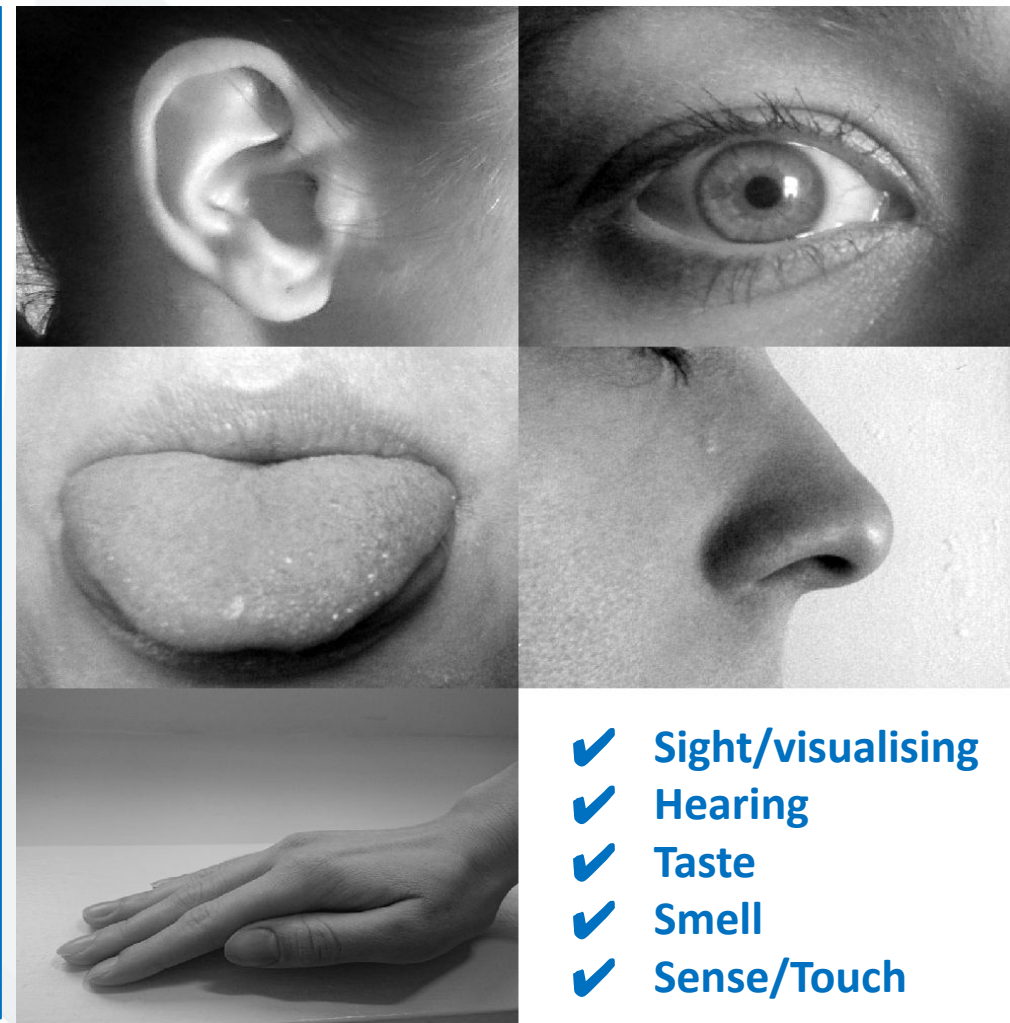
How do we perceive reality?

We understand the world through our senses:

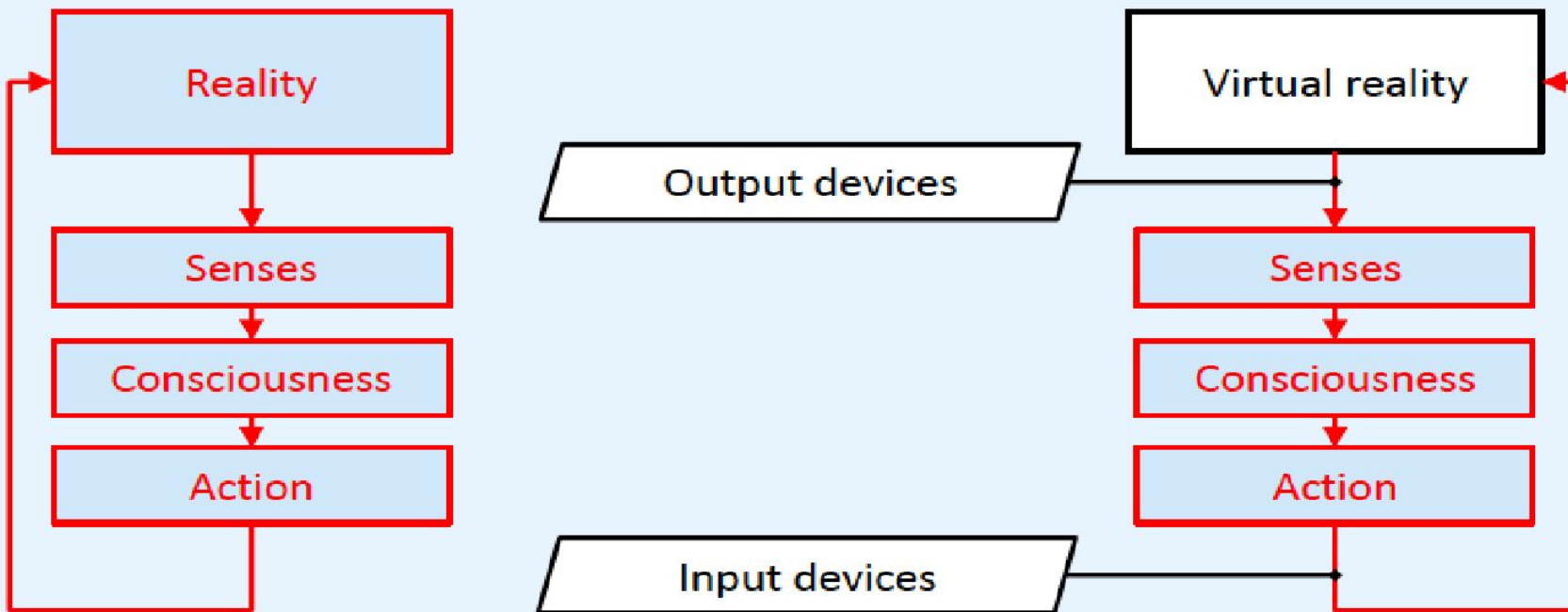
- Sight, Hearing, Touch, Taste, Smell (and others..)

Two basic processes:

- Sensation – Gathering information
- Perception – Interpreting information



Reality vs. virtual reality

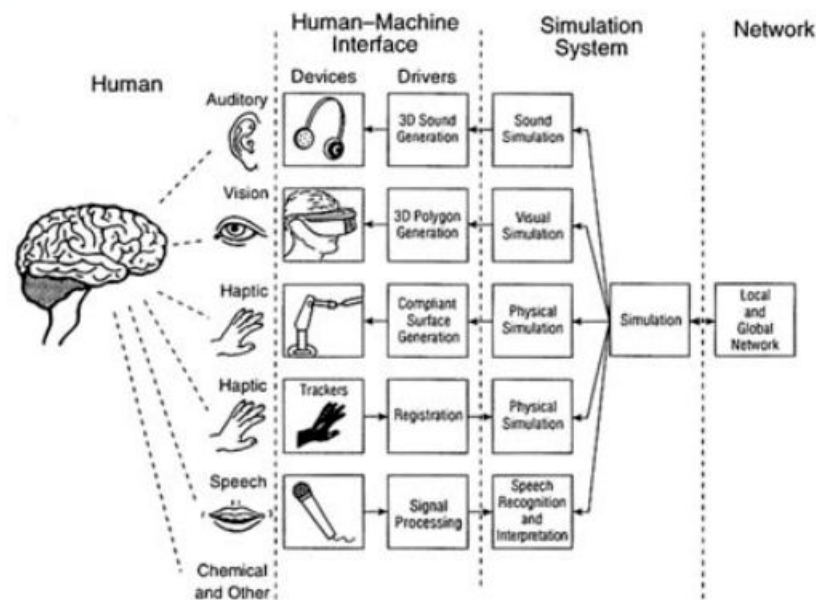


- ✓ In a VR system, there are input and output devices between human perception and action

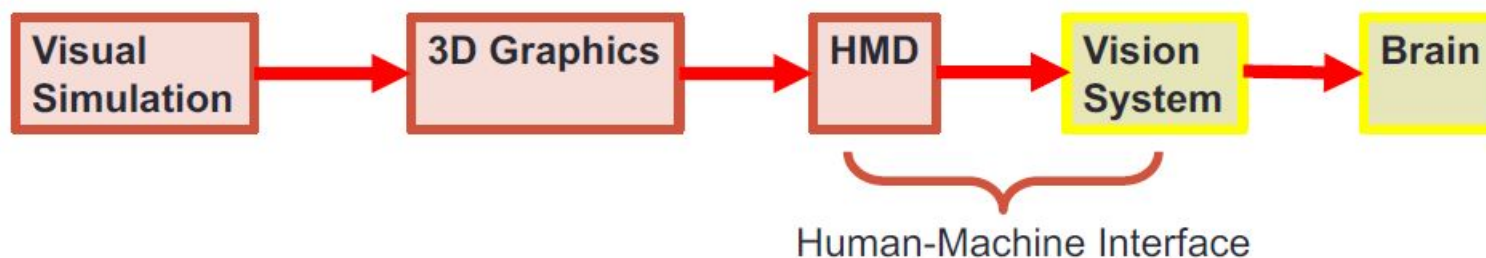
Use of technologies to simulate senses

Using Technology to Stimulate Senses

- **Simulate output**
 - E.g. simulate real scene
- **Map output to devices**
 - Graphics to HMD
- **Use devices to stimulate the senses**
 - HMD stimulates eyes



Example: Visual Simulation



Creating an Immersive Experience:

- ✓ Head Mounted Display
- ✓ Immerse the eyes
- ✓ Projection/Large Screen
- ✓ Immerse the head/body

Future Technologies:

- ✓ Neural implants
- ✓ Contact lens displays, etc

HMD Display Principles

Principle of Stereo image generation and illusion on brain

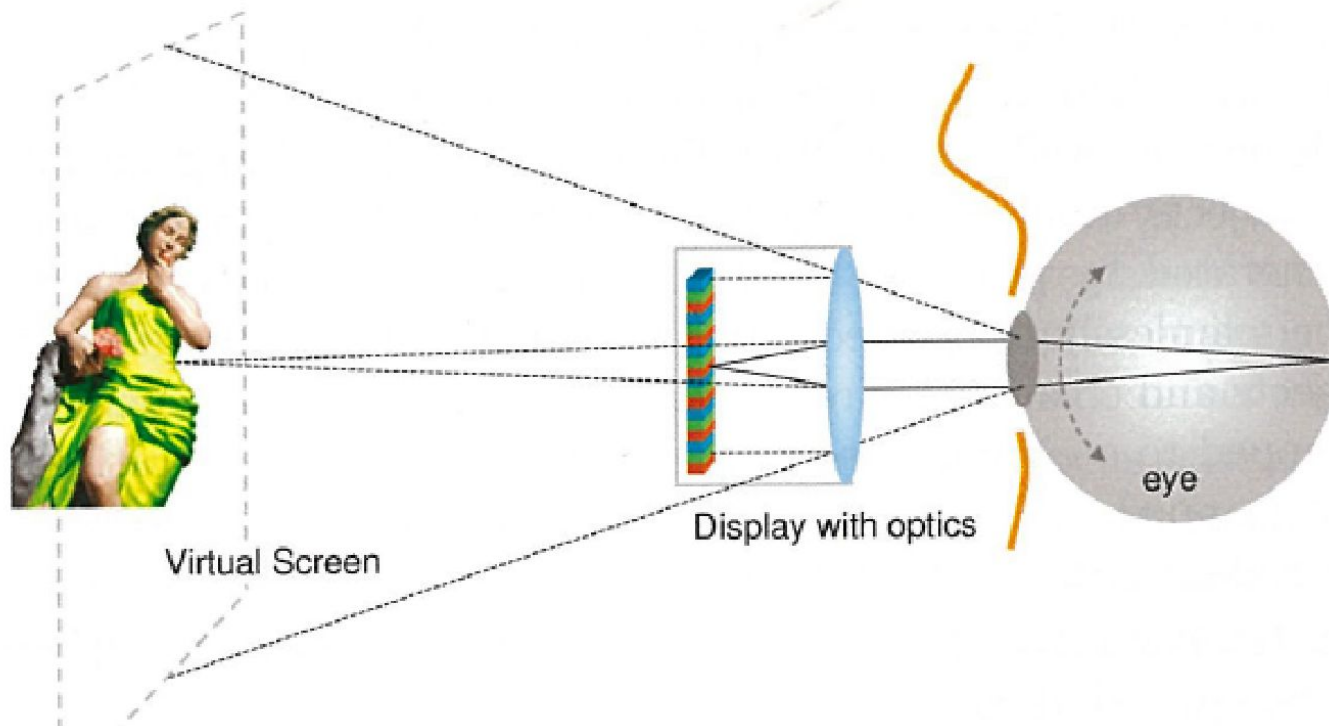


Fig. Principle of display with optics to create illusion of virtual screen

VR Stereo images



Left-eye image

Right-eye image



History of virtual reality



- ✓ In mid 1950s, a visionary cinematographer, Morton Heilig developed the **Sensorama** (patented 1962) which was an arcade-style theatre cabinet that would stimulate all the senses, not just sight and sound.
- ✓ It featured stereo speakers, a stereoscopic 3D display, fans, smell generators and a vibrating chair. The Sensorama was intended to fully immerse the individual in the film.
- ✓ He also created six short films for his invention all of which he shot, produced and edited himself.
- ✓ The Sensorama films were titled, Motorcycle, Belly Dancer, Dune Buggy, helicopter, A date with Sabina and I'm a coca cola bottle!.

Types of virtual reality

- Immersive Virtual Reality
- Non-immersive Virtual Reality
- Window on world Virtual Reality



Immersive Virtual Reality:

Immersion into virtual reality is a perception of being physically present in a non-physical world.

Elements of virtual environments that increase the immersiveness of the experience:

- ✓ Continuity of surroundings
- ✓ Conformance to human vision
- ✓ Freedom of movement
- ✓ Physical interaction
- ✓ Physical feedback

Types of virtual reality (cont.)

Non-Immersive Virtual Reality:

Large display, but doesn't surround the user.



Types of virtual reality (cont.)

Window on world Virtual Reality:

Desktop- based Virtual Reality involves displaying a 3-dimensional virtual on regular desktop display without use of any specialized movement tracking environment.



Architecture of a VR System

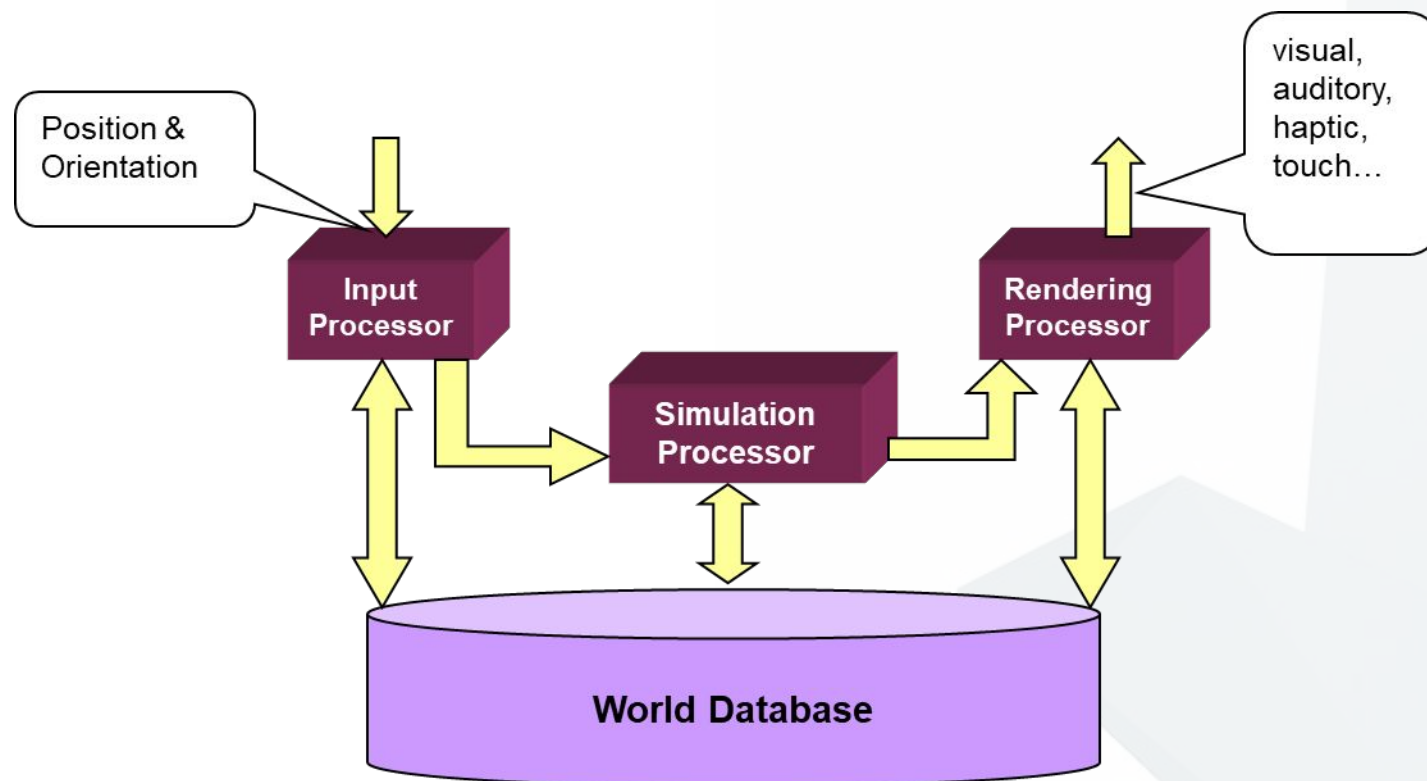


Fig. Architecture of a VR System

Components of a VR System:

- Input Processor
- Simulation Processor
- Rendering Processor
- World Database

Components of VR System

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.

Input Devices



Prio VR



Razer Hydra



Stem



Control VR

Components of VR System (cont.)

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.

Output devices



VR headset



3D Audio



Sensing Gloves



Helsinki

Components of VR System (cont.)

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 takes a description of the world starts from the simulation process or derive it directly from the World Database for each time step.

Components of VR System (cont.)

World Database (World Description Files):

- Store the objects that inhabit the world, scripts that describe actions of those objects.

Applications of VR

VR in Military



VR in Healthcare



Applications of VR (cont.)

VR in Education



VR in Scientific Data Visualization



Applications of VR (cont.)

VR in Environment



Advantages and Disadvantages of VR

Advantages

- Virtual reality creates a realistic world.
- It enables user to explore places.
- Through Virtual Reality user can experiment with an artificial environment.
- Virtual Reality makes the education more easy and comfortable.

Disadvantages

- The equipment used in virtual reality are very expensive.
- It consists of complex technology.
- In virtual reality environment, we can't move by our own like in the real world.

What is Augmented Reality(AR)?

<https://www.youtube.com/watch?v=T5O3vijPGUw>



<https://www.youtube.com/watch?v=d3YT8j0yYl0>

□ Augmented Reality:

- A combination of a real scene viewed by a user and a virtual scene generated by a computer that augments the scene with additional information.
- An AR system adds virtual computer-generated objects, audio and other sense enhancements to a real-world environment in real time.

Augmented Reality vs. Virtual reality?

Comparison of AR & VR:

- Augmented reality system:
 - ✓ Augments the real world scene with computer generated objects
 - ✓ User maintains a sense of presence in real world
 - ✓ Needs a mechanism to combine virtual and real worlds
- Virtual reality system:
 - ✓ Totally immersive environment
 - ✓ Visual senses are under control of system

How does AR work?

- ✓ Pick a real world scene.
- ✓ Add your virtual objects in it.
- ✓ Delete real world objects if needed.
- ✓ Not virtual reality since environment real.



Displays used in AR

☐ Head-mounted Display(HMD)



- ✓ Device paired to a headset such as a harness or helmet



☐ Eye Glasses



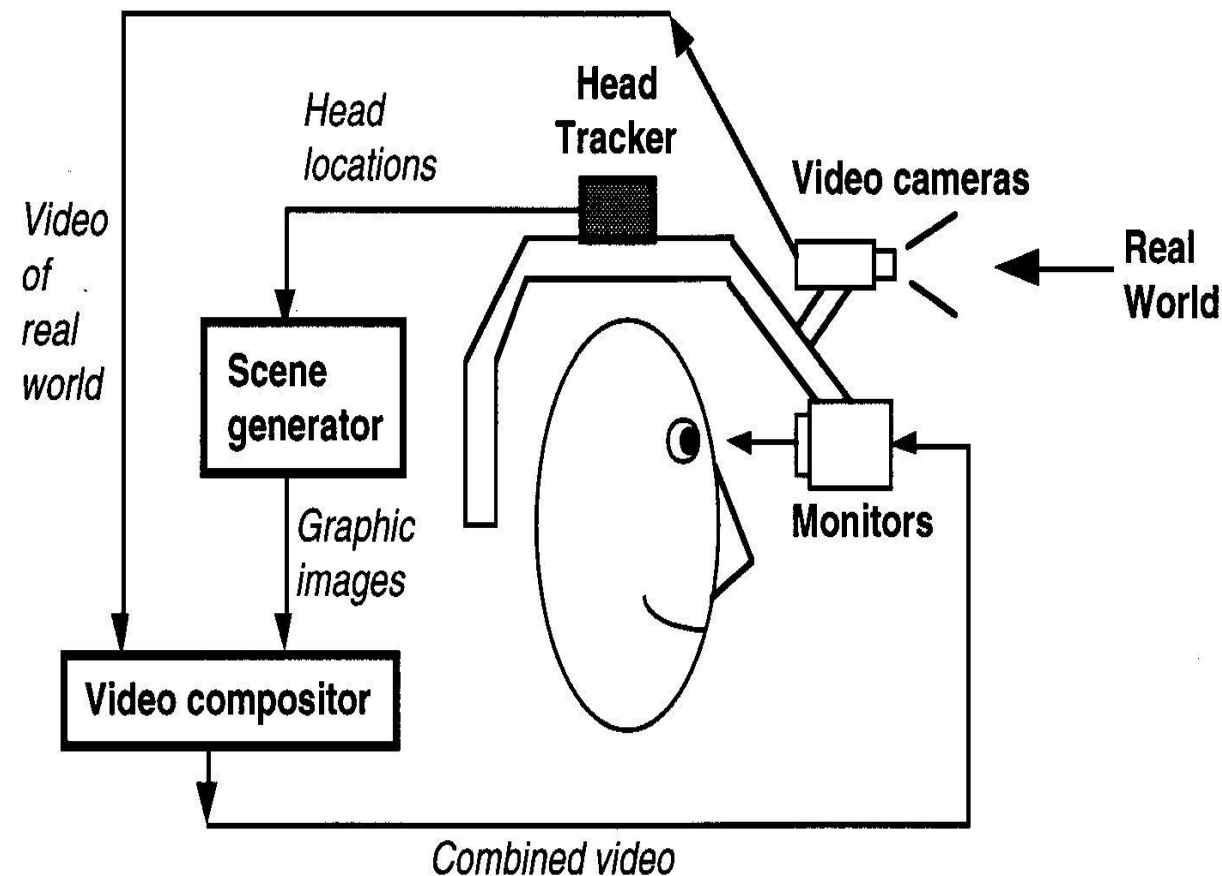
- ✓ Eye wear that employs cameras to intercept the real world view and re-display it's augmented view through the eye pieces



Architecture of an AR System

❑ Video see-through HMD based AR System

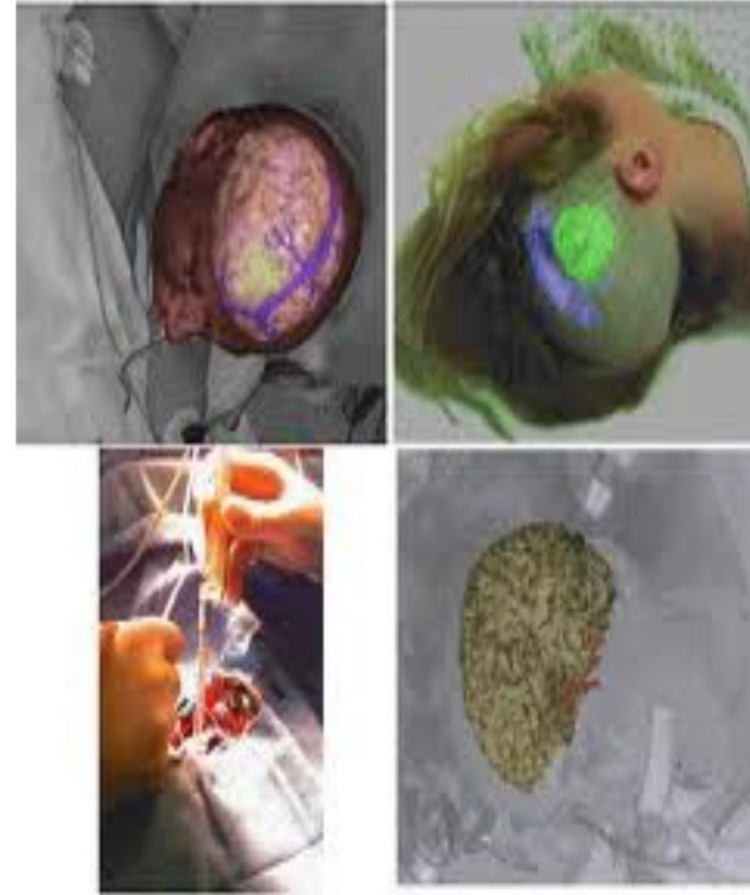
- ✓ Capturing of real world scene
- ✓ Head tracking
- ✓ Generation of graphical/artificial objects
- ✓ Combining the real world scene and computer generated objects/ scene
- ✓ Displaying the combined video through a head mounted display



Applications of AR

- ✓ Medical
- ✓ Entertainment
- ✓ Military Training Engineering
- ✓ Design
- ✓ Robotics and Telerobotics
- ✓ Manufacturing, Maintenance, and Repair
- ✓ Consumer Design Hazard Detection Audio

Medical Applications of AR



AR in Entertainment



