

Virtual Reality

CPS592 – Visual Computing and Mixed Reality

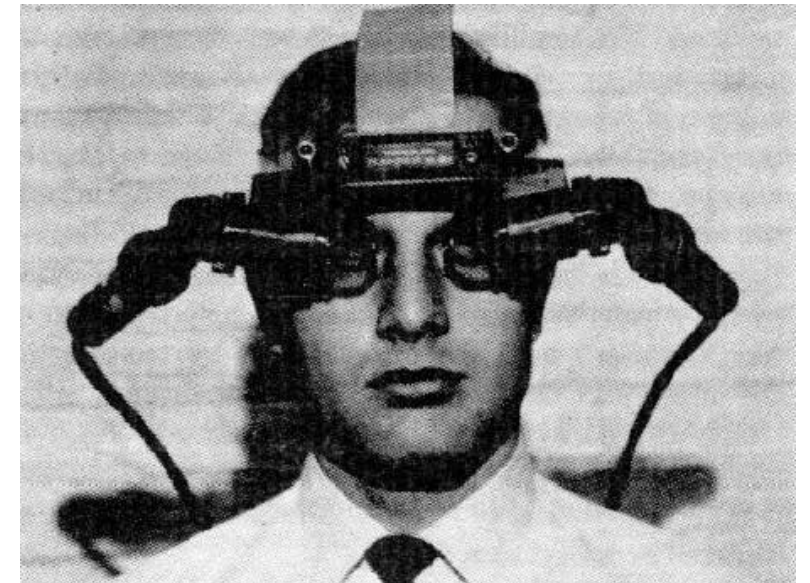
What is Virtual Reality?

Virtual Reality (VR) is the **illusion** of a three-dimensional, interactive, computer-generated reality where **sight**, **sound**, and sometimes even **touch** are simulated to create pictures, sounds, and objects that actually **seem real**.



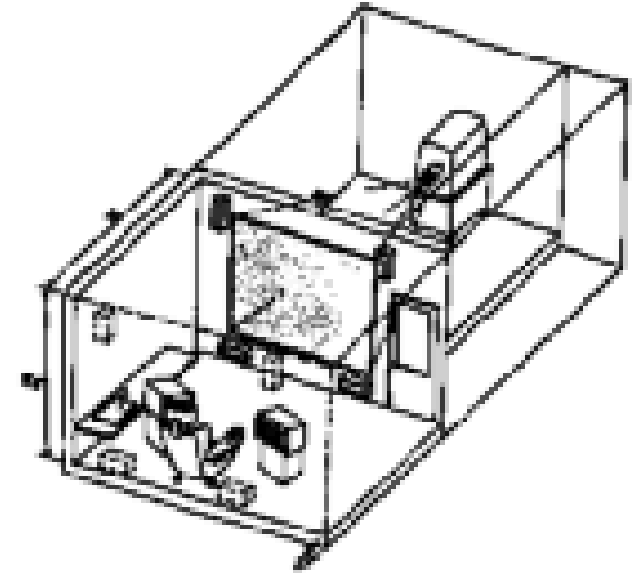
History

- Morton Heilig (1957-62)
 - Sensorama
- Ivan Sutherland (1960)
 - First head mounted display and head tracking system



History

- MIT (1983)
 - *“Put That There”*
 - *“The Aspen Movie Map”*
- UNC (1986)
 - *Using “virtual world” term*
 - *Walkthrough, Pixel Flow & Nanomanipulator systems*



History

- NASA Ames Research Center
 - *HMD, VPL Datagloves and BOOM*
 - *Spatial (3D) Sound*
 - *Super Cockpit*
- *VPL*
 - *First Commercial VR Hardware & systems*
 - *“Reality Build for Two” (RB2)*
 - *“Body Electric”*



History

- Myron Krueger
 - *GlowFlow, Meta play, Psychic space & Videoplace*
- *Naval Postgraduate School*
 - *SIMNET*
 - *NPSNET*



History

- New generations (2010s)
 - Oculus



- HTC Vive



Why VR? Applications

■ Entertainment

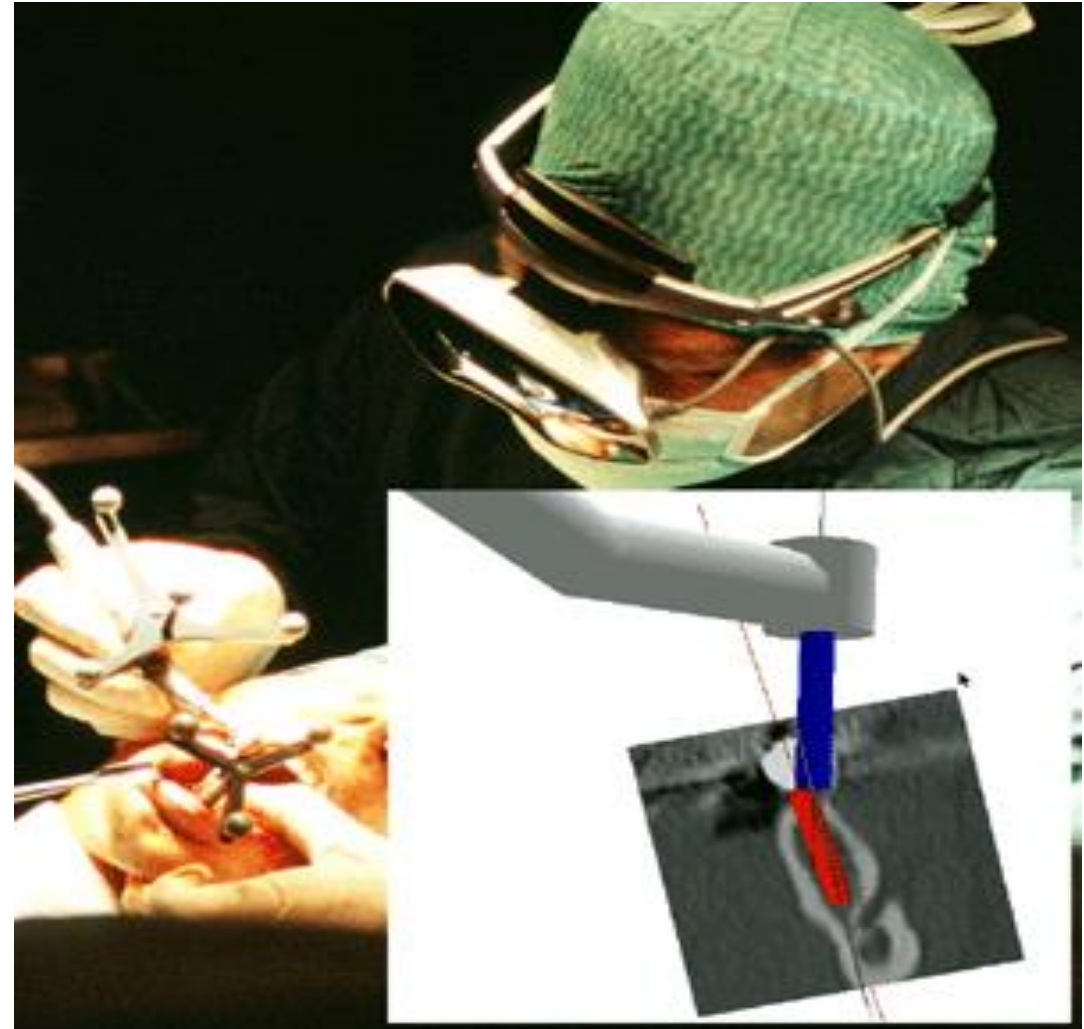
- More vivid
- More exciting
- More attractive



Why VR? Applications

■ Medicine

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



Why VR? Applications

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



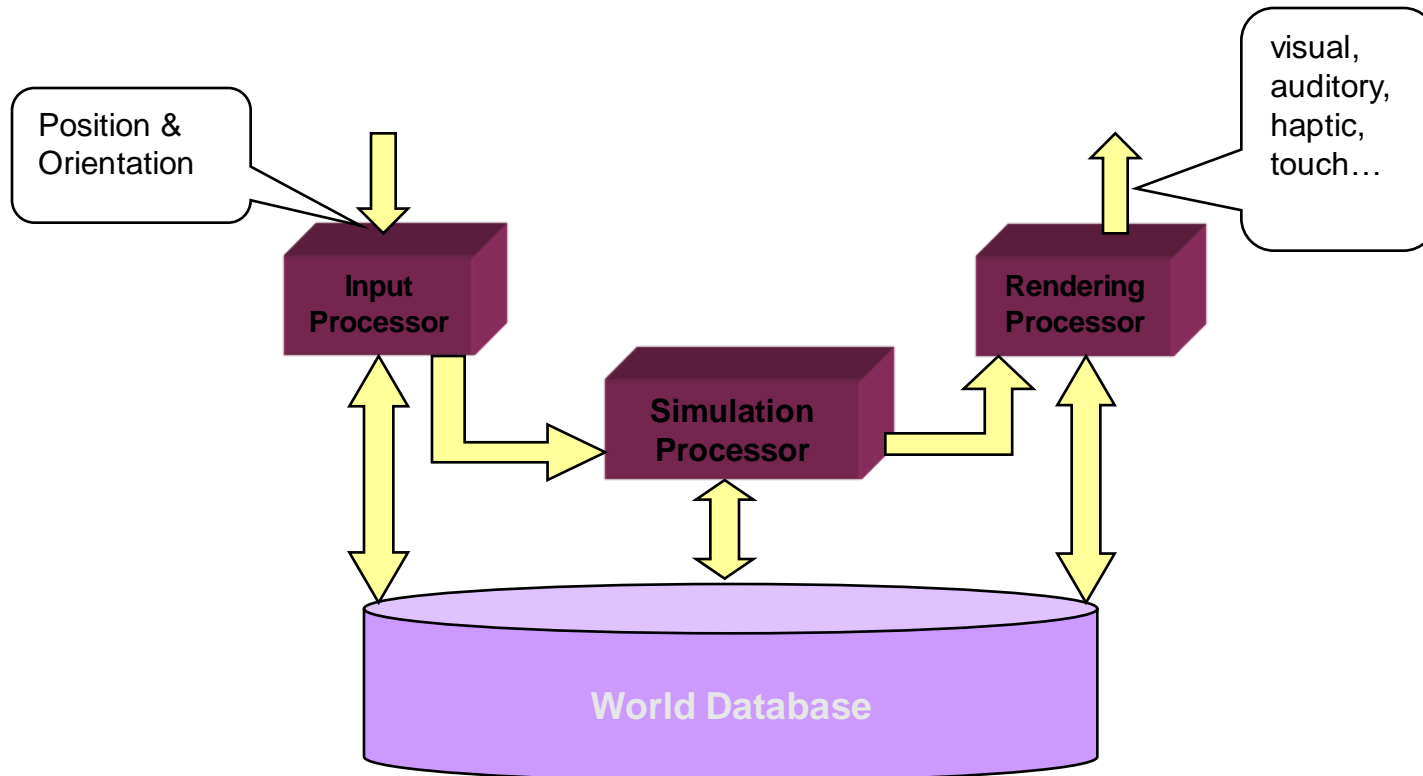
Why VR? Applications

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



Architecture of VR System

- Input Processor, Simulation Processor, Rendering Processor and 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.

■ 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

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

Head mounted display - early

- Head-Mounted Display (HMD)

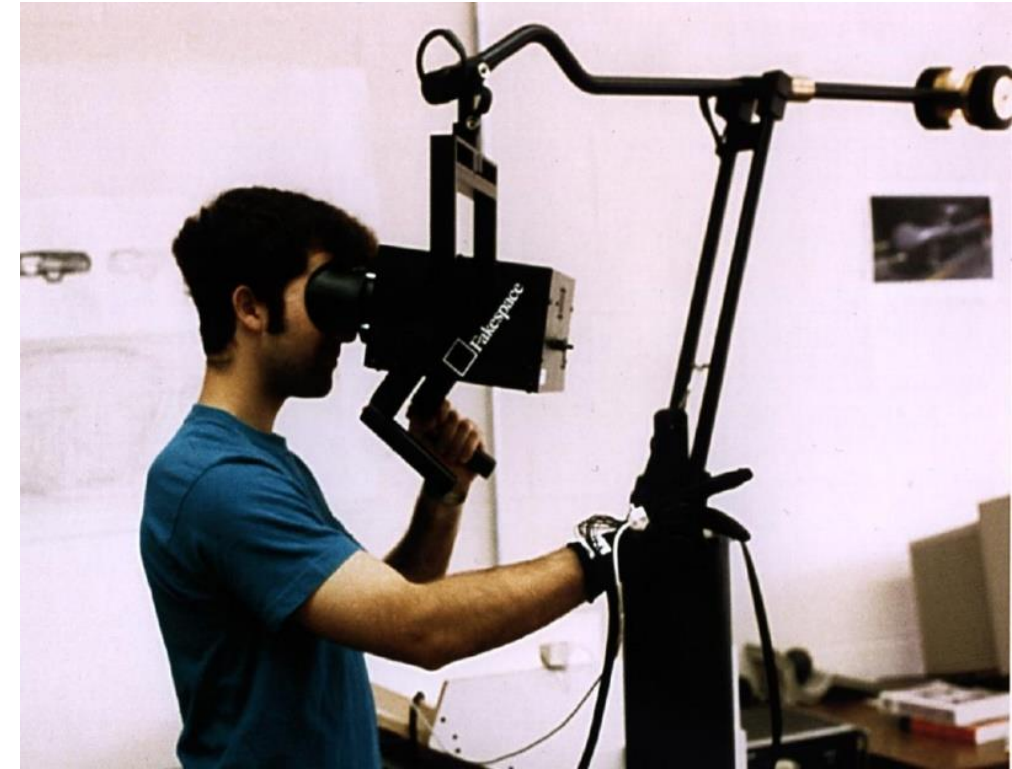
- A Helmet or a face mask providing the visual and auditory displays.
- Use LCD or CRT to display stereo images.
- May include built-in head-tracker and stereo headphones



Head mounted display - early

■ Binocular Omni-Orientation Monitor (BOOM)

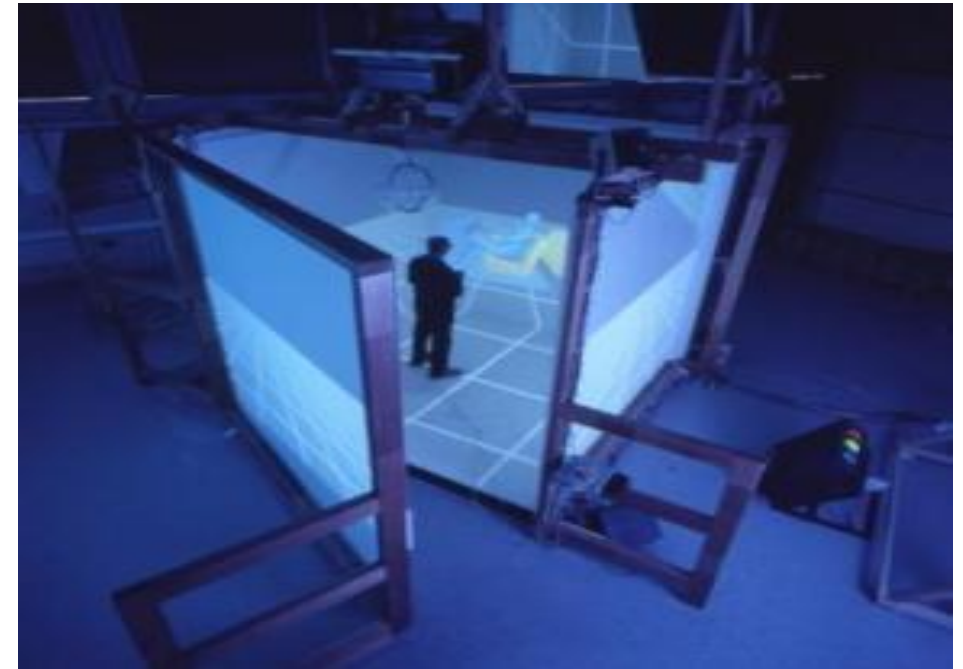
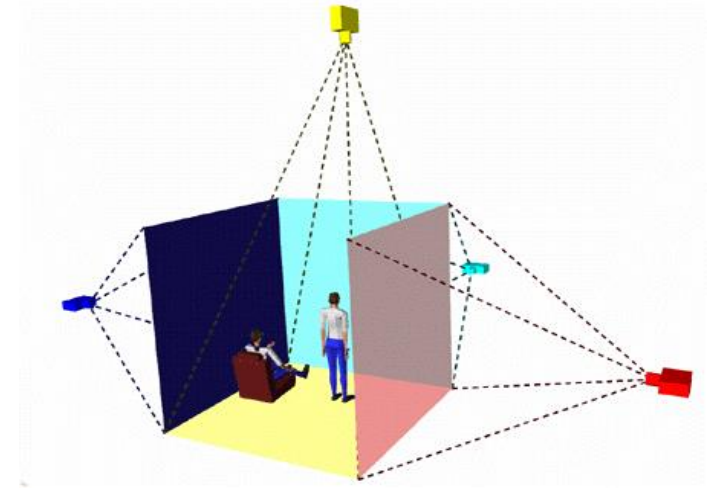
- Head-coupled stereoscopic display device.
- Uses CRT to provide high-resolution display.
- Convenient to use.
- Fast and accurate built-in tracking.



Head mounted display - early

■ 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.



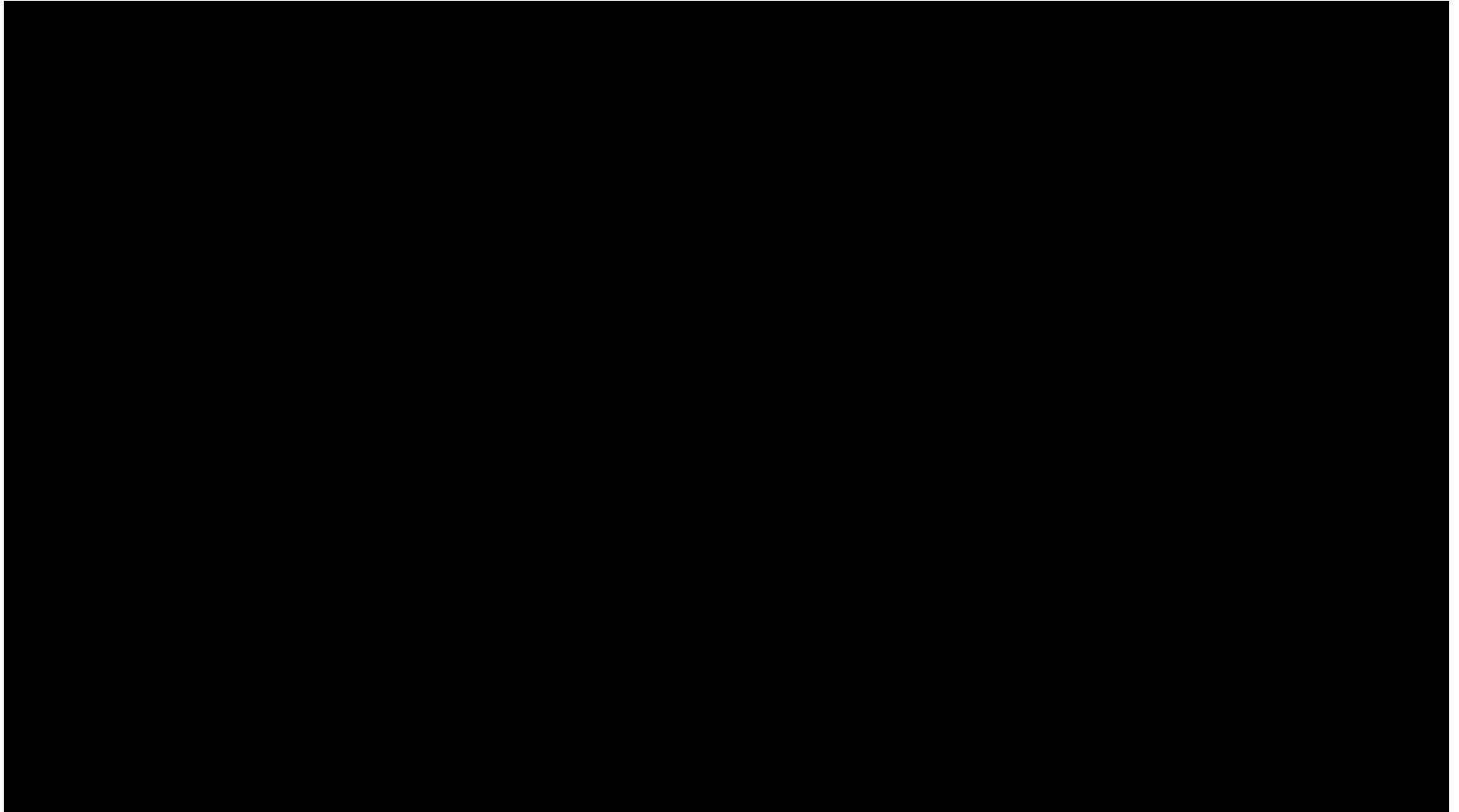
Head mounted display

- Oculus Rift



Head mounted display

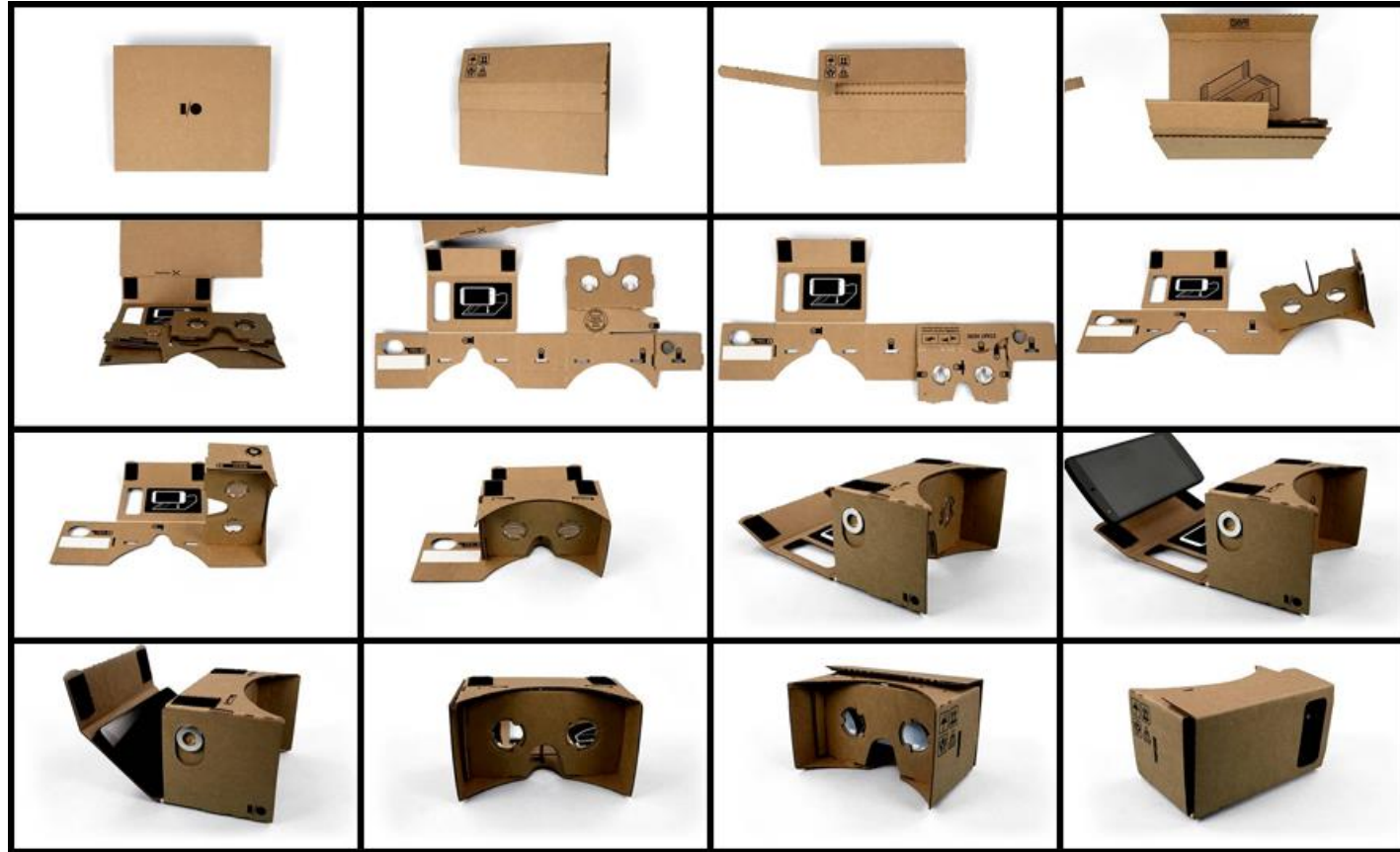
- HTC Vive



Google Cardboard



Google cardboard kit



Google cardboard kit



Control in VR system - early

■ Control Devices

- Control virtual objects in 3 dimensions.



Control in VR system - early

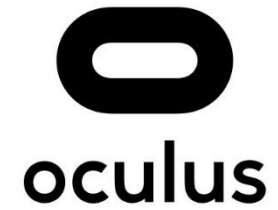
■ Data Glove

- 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.



Control in VR system

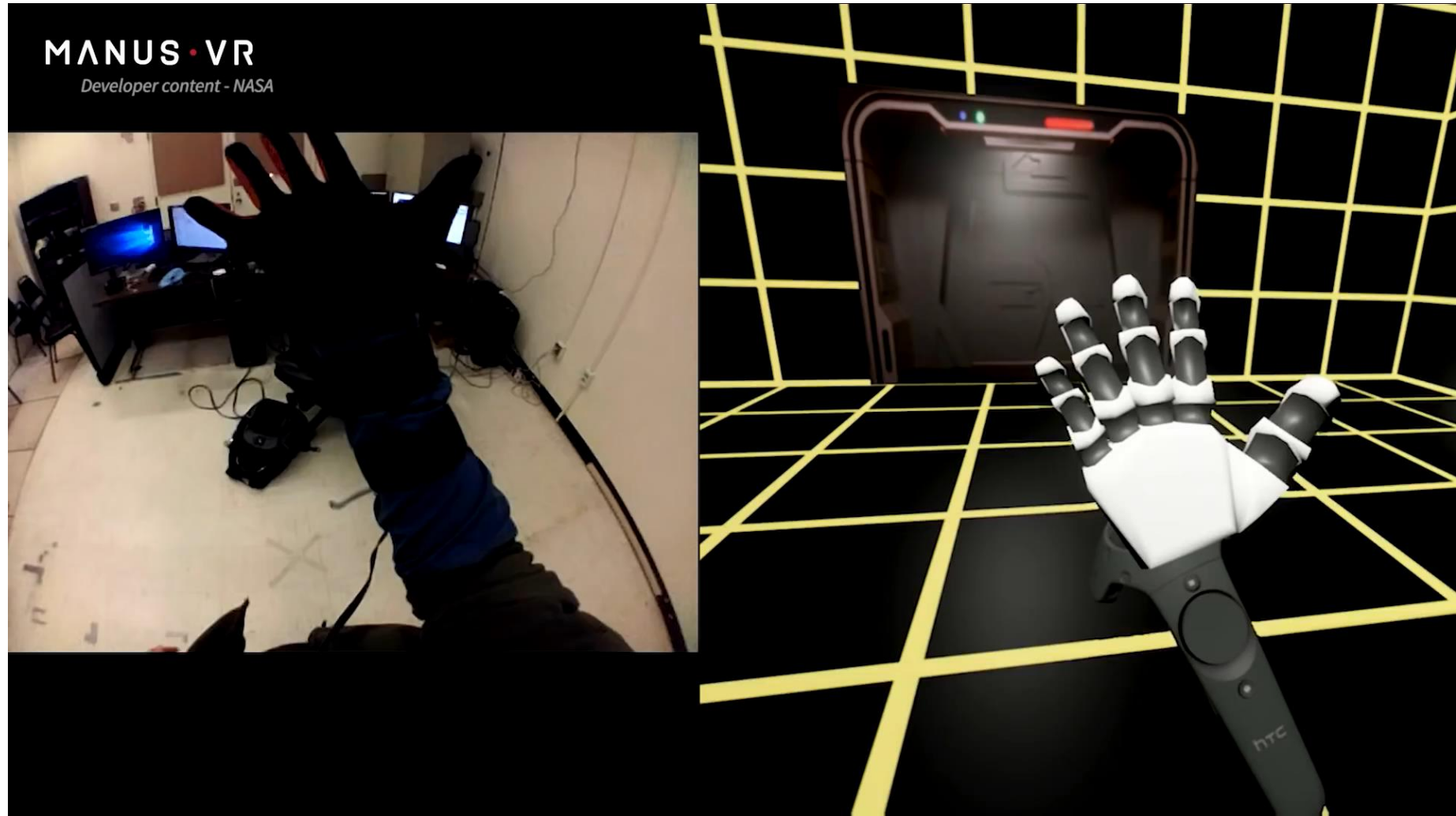
- Oculus vs. Vive controllers



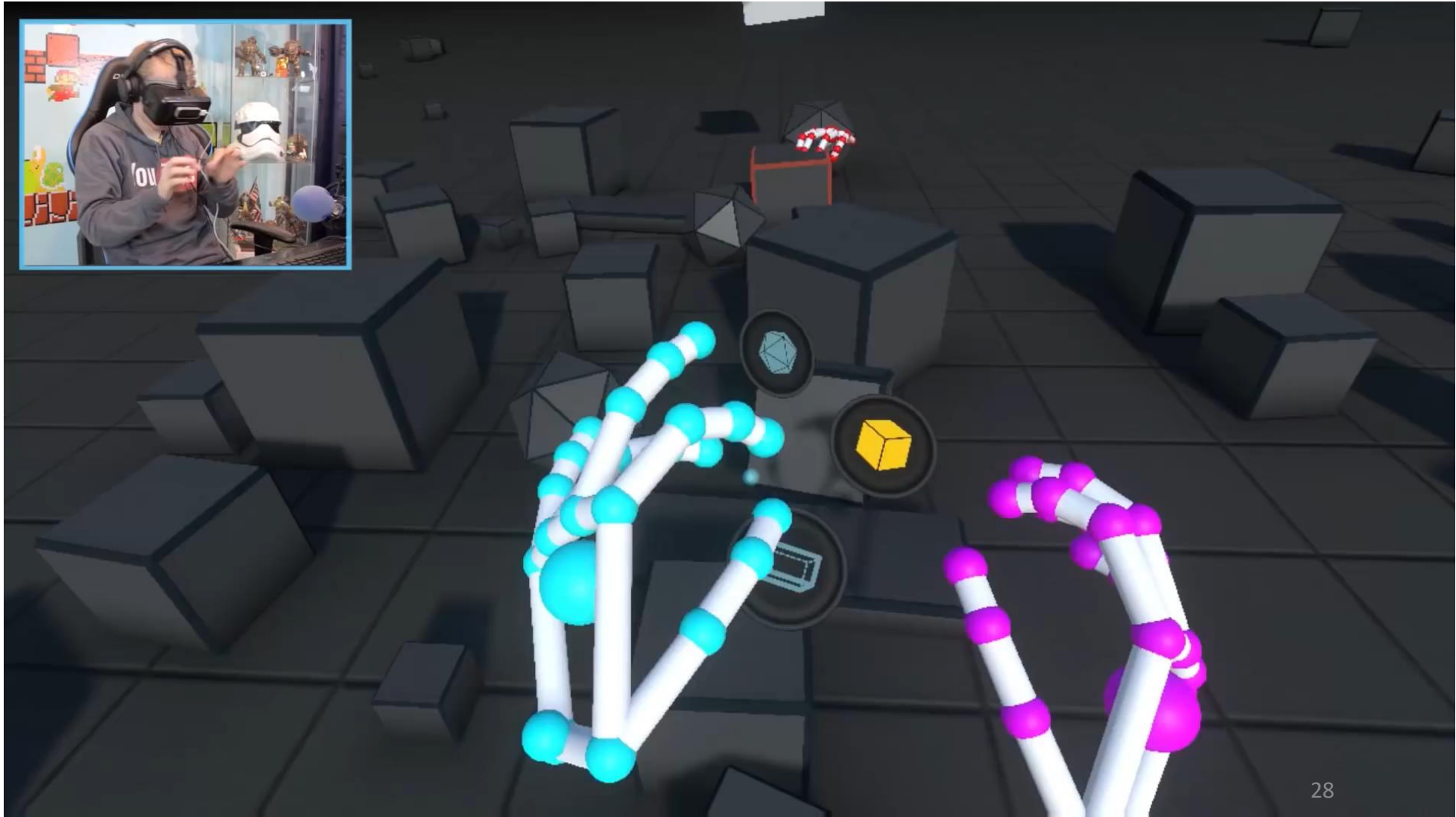
Control in VR system



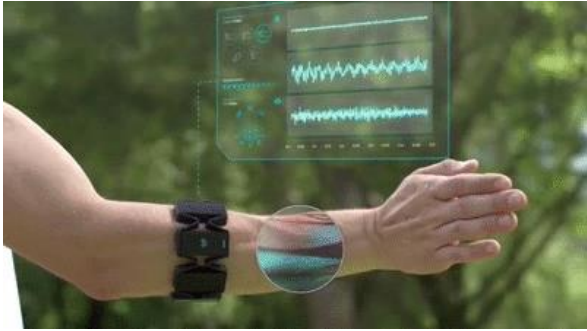
Control in VR system



Control in VR system



Control in VR system



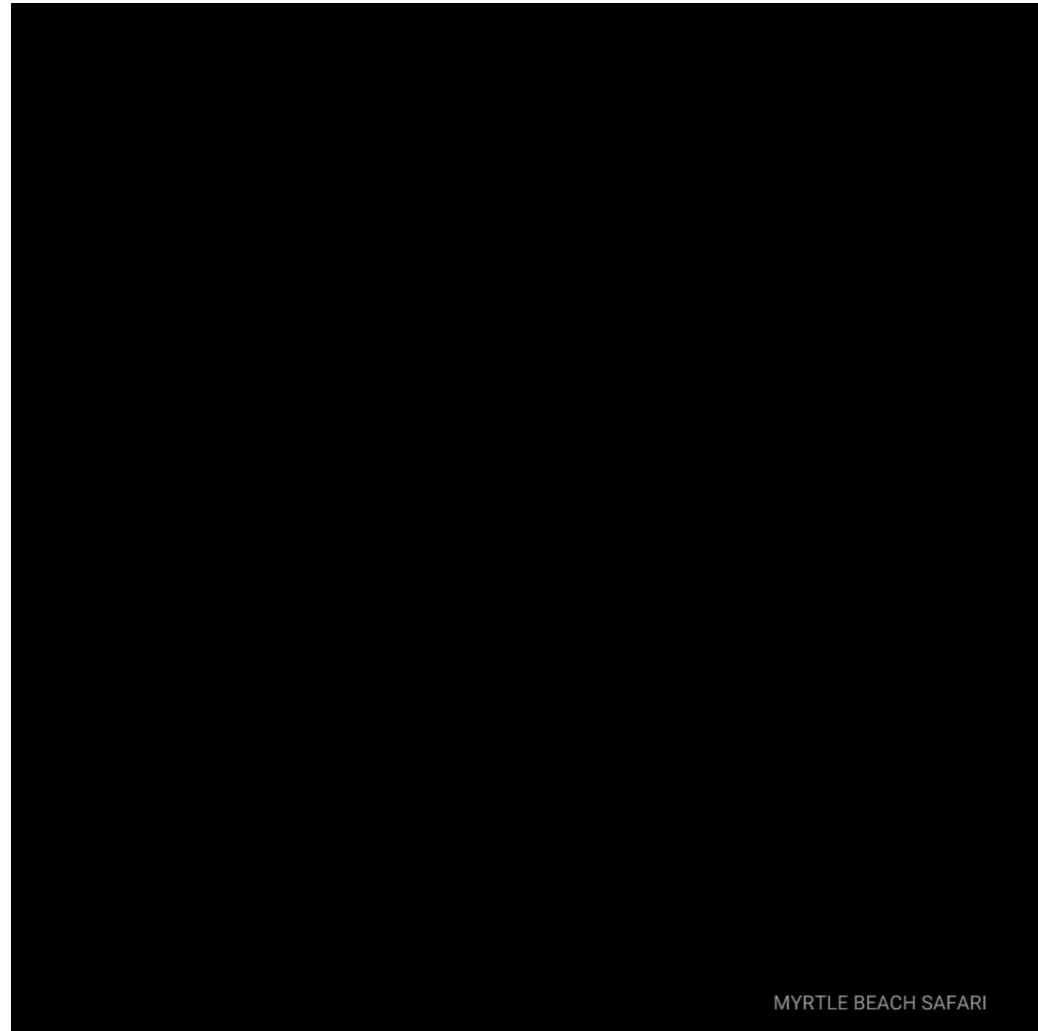
Haptic feedback



VR in reality



VR in reality



Current problems

- ☹️ Cybersickness / simulator sickness
- ☹️ Feedback is limited
- ☹️ Low-fidelity
- ☹️ Expensive
- ☹️ Lack of integration between application packages

Problems



Conclusion and Summary

- Virtual Reality is defined as:
 - Simulated environment
 - Interaction with human senses
 - Reactive to input from person
- What can be VR
 - Just about any simulated environment



Conclusion and 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.

Q&A