Lecture 9

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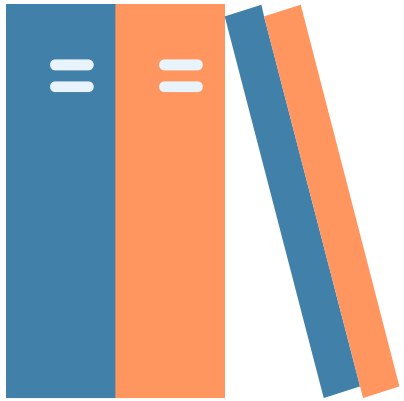
Unit 2

1. Augmented Reality Hardware – Displays – Audio Displays, Haptic Displays, Visual Displays, Other sensory displays, Visual Perception , Requirements and Characteristics, Spatial Display Model. Processors – Role of Processors, Processor System Architecture, Processor Specifications. Tracking & Sensors - Tracking, Calibration, and Registration, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors, Optical Tracking, Sensor Fusion.

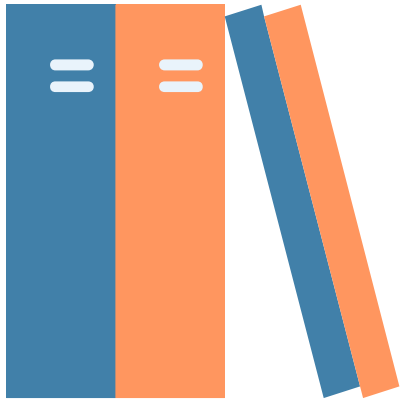


01 Displays

- **Audio Displays :**

- Sounds are part of our real-life experience and offer rich information about our environment. It has been shown that the combination of sound and graphics enhances the sense of presence. Auditory information can offer several benefits like:
  - perception ability of information that is outside of visual display,
  - alert or focus signals that attract the user or warn him/her, and
  - spatial orientation cues. It means that slight echoes and reverberation in the surrounding environment give the brain cues about the direction and distance of objects. The basic steps required for successful simulation of virtual sounds are: sound generation, spatial propagation, and mapping of parameters.

- Other than the three mentioned areas we need to consider another important factor that is portability. Due to system limitation the user may not be able to explore/go around much in detail. Thus, the portability becomes an issue.



01

Touch :

- The human haptic system, which involves the tactile and kinesthetic senses, is a very important perception channel. It has been shown that the ability to - “touch” virtual objects increases the sense of presence. The term haptic comes from the Greek word haptesthai, which refers to the sense of touch as the way in which the human body perceives objects and space.

- Haptic feedback has two modalities:
  - force- and
  - tactile- feedback

Force Feedback

- Force-feedback helps the user estimate the hardness, weight, and inertia of virtual objects. Haptic rendering is the process of computing and generating forces in response to user interactions with virtual objects.
- To increase the naturalness of interaction in VE some devices are equipped with force feedback. This includes a variety of manipulators from simple gloves to sophisticated and mechanically complex exoskeletal hand masters.
- **PHANTOM** (Personal HAptic iNTerface Mechanism) is a stylus-based haptic interface that was later commercialized and has since become one of the most commonly used force-feedback devices. Its applicability is due not only to its small size but also for the range of haptic feedback that is available.

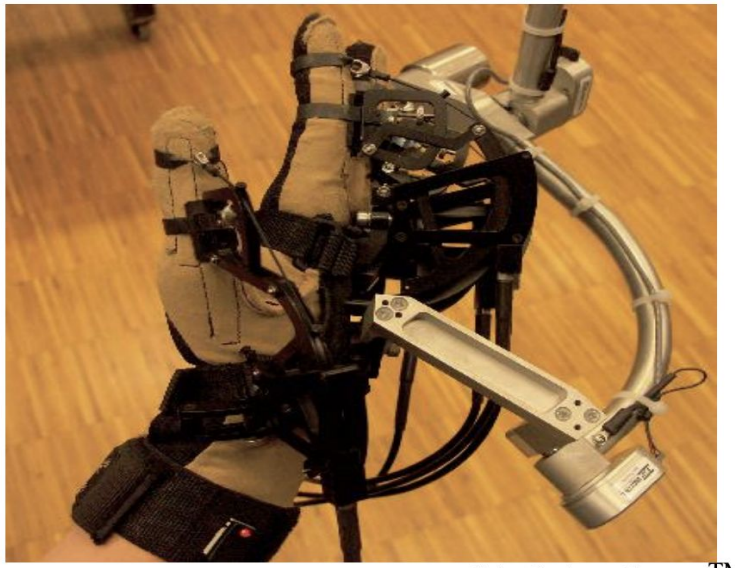
PHANTOM

Tactile Feedback

Tactile feedback provides a feel of the object‘s surface contact geometry, smoothness, temperature, etc. Tactile feedback is much more subtle than force-feedback and therefore more difficult to generate artificially. Tactile displays can be classified into three types of stimulation: **electro tactile, thermal, and mechanical.**

Some devices, like Immersion‘s CyberTouchTM (Fig. 9a) and CyberGraspTM, can also provide vibrotactile and force-feedback, respectively.

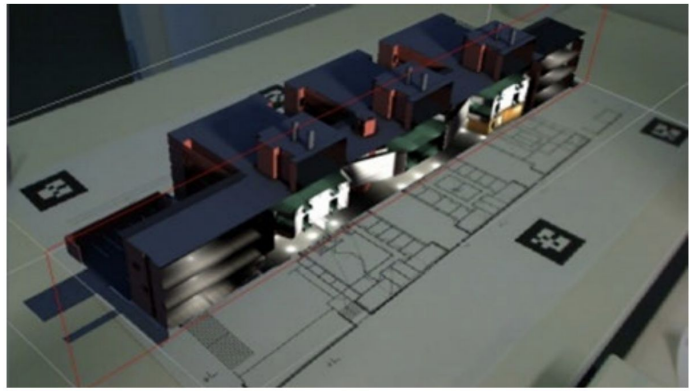
(a) CyberTouch™

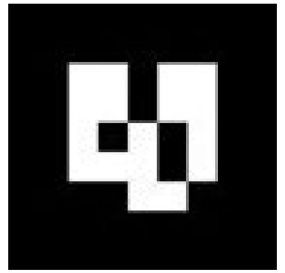


(b) CyberGrasp™

Display

- Based on the type we can classify them into four categor
  - Optical see-through Head Mounted Device
  - Video see-through Head Mounted Device
  - Virtual Retinal Systems
  - Monitor Based
  - Projection Displays



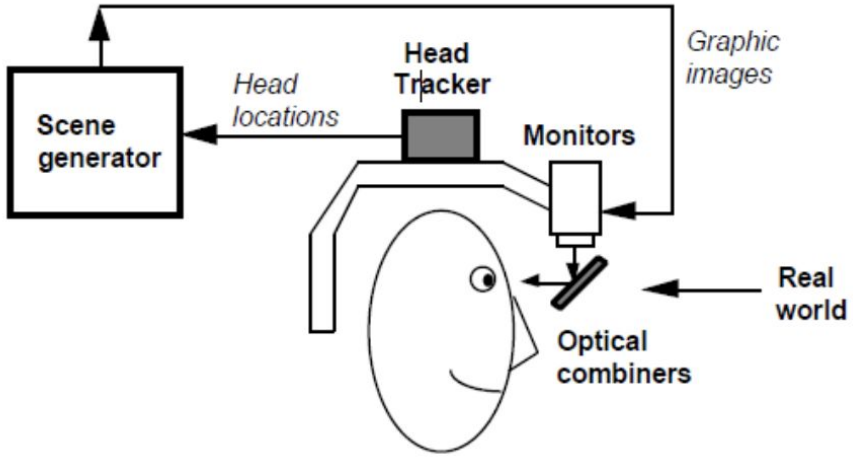


See-through HMD :

In contrast to the closed-view Head-Mounted Display (HMD) – which is used in VR applications – "see-through" designation comes from the need for the user to be able see the real world view. The HMD must be tracked because this allows for computing system to register the virtual information in its correct position in the physical world. HMD devices are mainly divided into two categories: optical see-through and video see-through.

OPTICAL SEE-THROUGH HEAD MOUNTED DEVICE

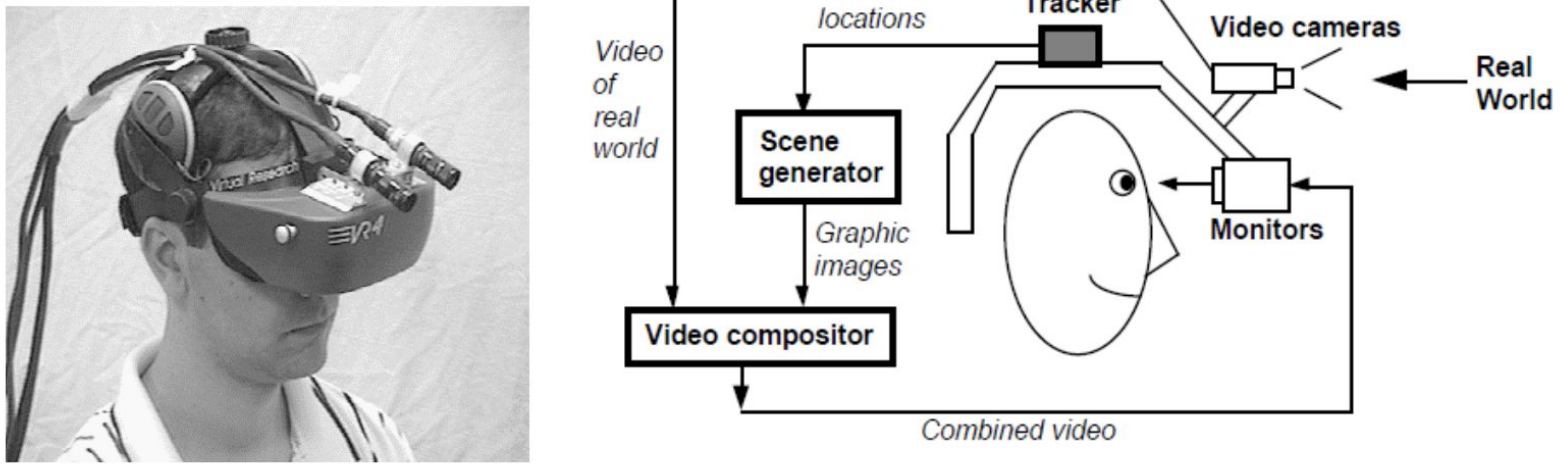
Optical see-through HMDs work by placing optical combiners in front of the user's eyes. These combiners are partially transparent, so that the user can look directly through them to see the real world. The combiners are also partially reflective, so that the user sees virtual images bounced off the combiners from head-mounted monitors. The optical combiners either reduce the amount of light that the user sees from the real world or might be set to reflect all light of a certain wavelength and none at any other wavelengths.



Optical see-through HMD and its conceptual diagram

VIDEO SEE THROUGH HEAD MOUNTED SYSTEM

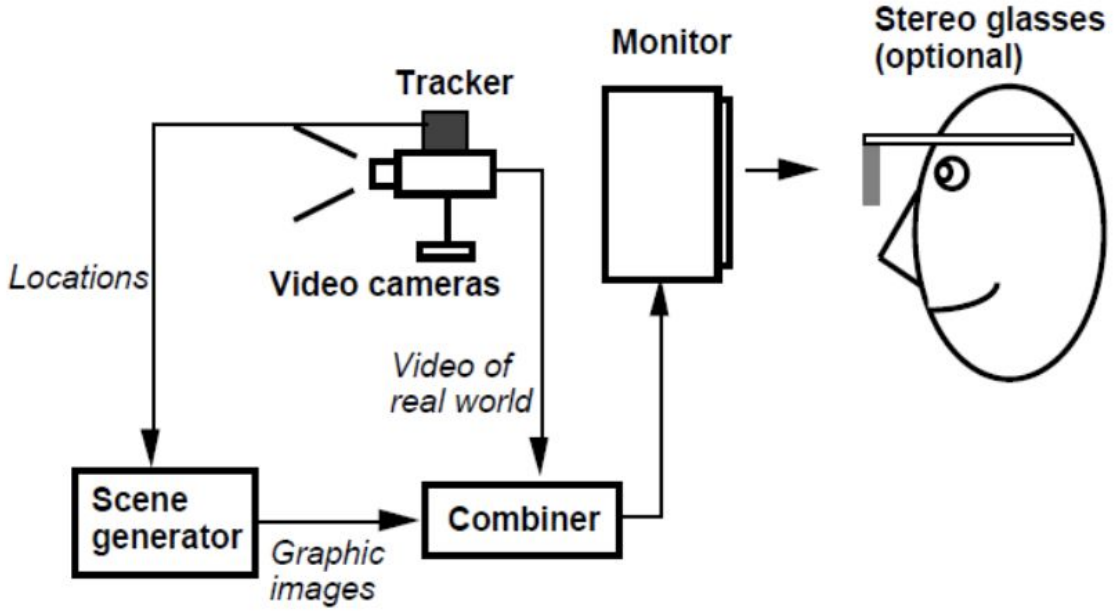
Video see-through HMDs work by combining a closed-view HMD with one or two head-mounted video cameras. The video cameras provide the user's view of the real world. Video from these cameras is combined with the graphic images created by the scene generator, blending the real and virtual. The result is sent to the monitors in front of the user's eyes in the closed-view HMD. Video composition can be done by either chroma-keying technique or depth-information technique.



Video see-through HMD and its conceptual diagram

Monitor-based Display

The simplest augmented reality system is the so called ―Window on the World‖ system (WoW). In this case, one or two video cameras view the environment. The video of the real world and the graphic images generated by a scene generator are combined, just as in the video see-through HMD case, and displayed in a monitor in front of the user. The user does not wear the display device. Optionally, the images may be displayed in stereo on the monitor, which then requires the user to wear a pair of stereo glasses. The user has little feeling of being immersed in the environment created by the display.



Monitor-based display and its conceptual diagram

Handheld Display

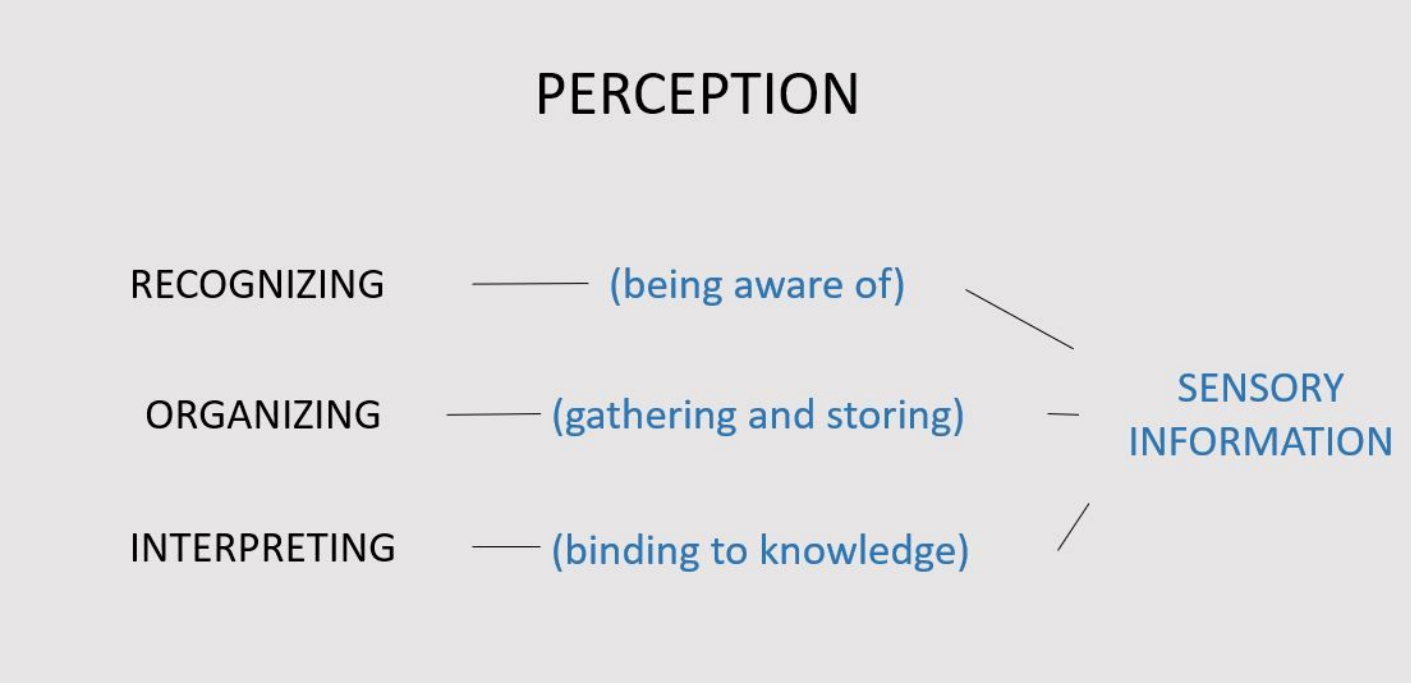
- Handheld devices represent a real alternative to head-attached devices for mobile applications. The experiment showed the feasibility of using a handheld display in AR applications.
- Handheld devices are getting popular for Mobile AR because of their relatively low cost, compact design, user mobility, light weight, wireless, powerful computing capability and intuitive way to interact with the computer.
- Such devices can be used as a window or a magnifying glass The video see-through approach is most promising to be used with this kind of devices. A camera captures a real time video stream of the environment and before displaying such video material to the user graphical augmentations are overlaid.
- The position and orientation of the camera are tracked so that result correct overlays. There are available different kinds of hand-held displays.
- Among those are Personal Digital Assistant (PDA), mobile phone hand-held mirror display and hand-held video projector.

Handheld Display

02 Visual Perception :

- **What is Perception?**
  Perception consists from three main processes called recognition, organizing, and interpreting. Recognition happens basically every day, we are aware of everything, such as sounds, lights, and colours. Then you are organizing everything that you perceive.
  Interpretation refers to the process by which we represent and understand stimuli that affect us.

Recognizing + Organizing+ Interpreting = Sensory Information



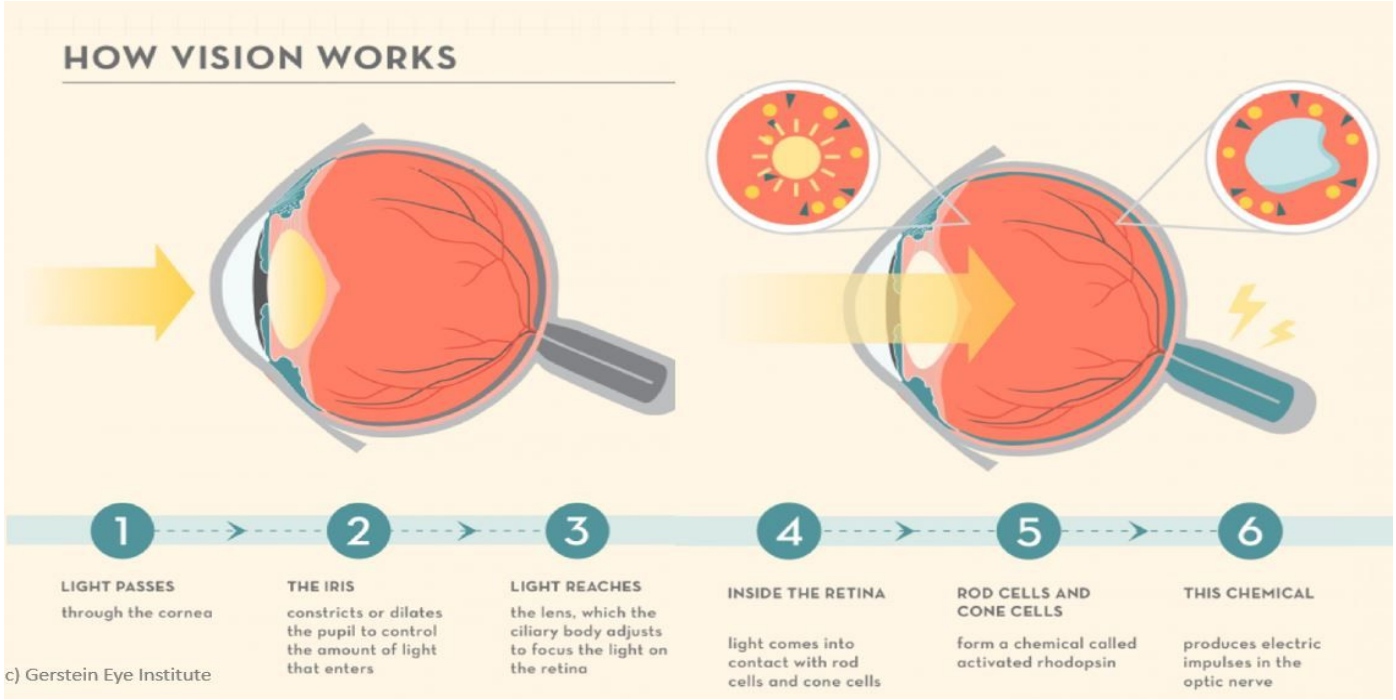
What is Visual Perception?

Visual perception is the end of product of vision.

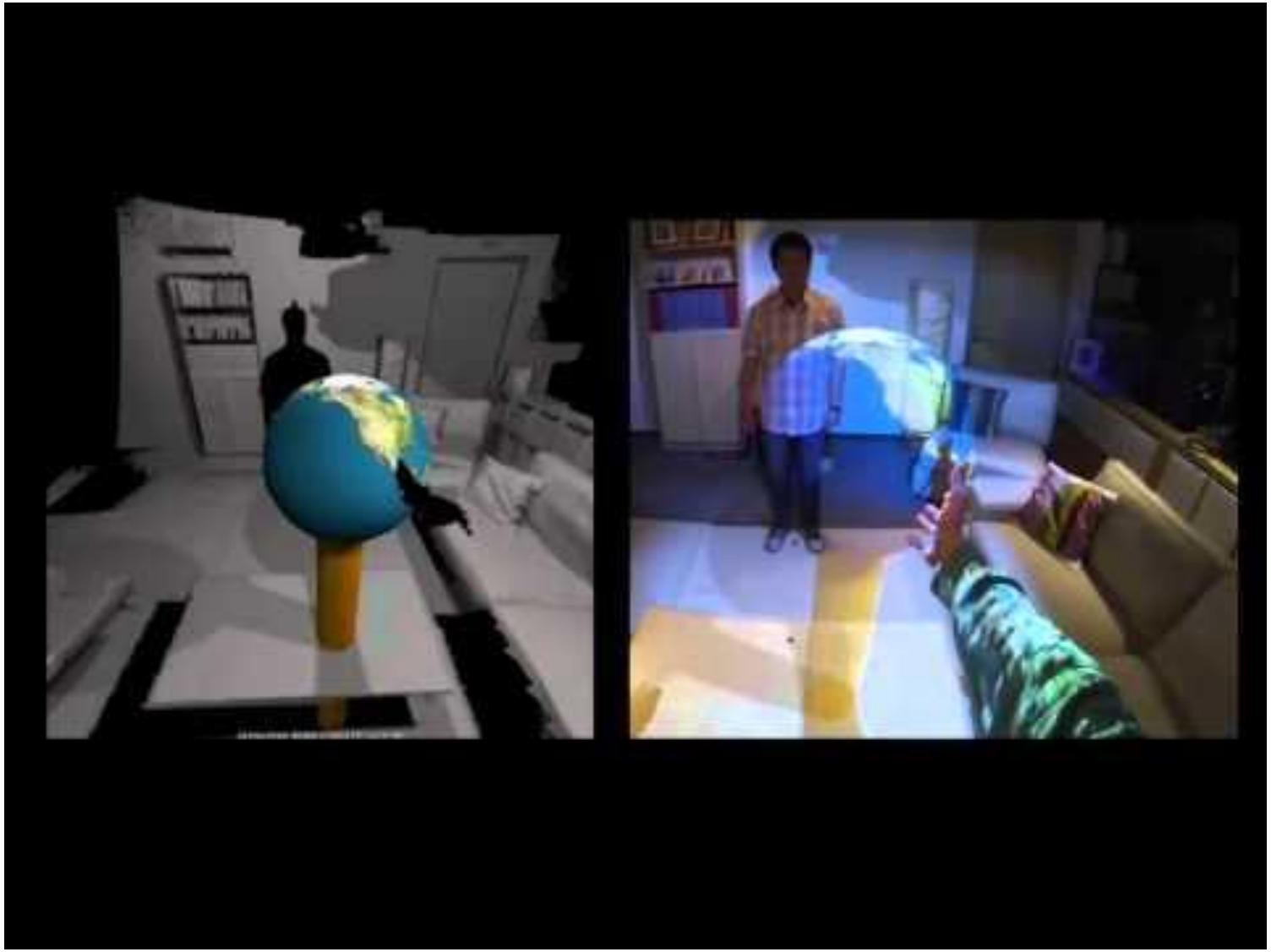
“Perception is not something that happens to us, or in us. It is something we do… Vision is a mode of exploration of the environment drawing on implicit understanding of sensorimotor regularities”

How Vision Works?

The eye passes through the cornea and go down to the iris. The light reflects and sort of vision is also a chemical reaction.



Spatial AR :



Processor in AR :

Just like your desktop, laptop, or smartphone, an AR system starts with a CPU.

The processor of an augmented reality system works hard to take in and send out information in the system, meaning that this unit is necessarily some heavy hardware—you can expect much more processing muscle than what's in your laptop.

Extensive AR systems use well-developed server farms to handle all incoming and outgoing data.

Thank You