

SM 14/15 – T7

Virtual and Augmented Reality

LCC, MIERSI

Miguel Tavares Coimbra

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"WILLIAM GIBSON IS ONE OF THE MOST
EXCITING NEW WRITERS TO HIT SCIENCE
FICTION IN A LONG WHILE.
HIS FIRST NOVEL IS AN EVENT
I'VE BEEN EAGERLY AWAITING."

—ROBERT SILVERBERG

EDITED BY TERRY CARR

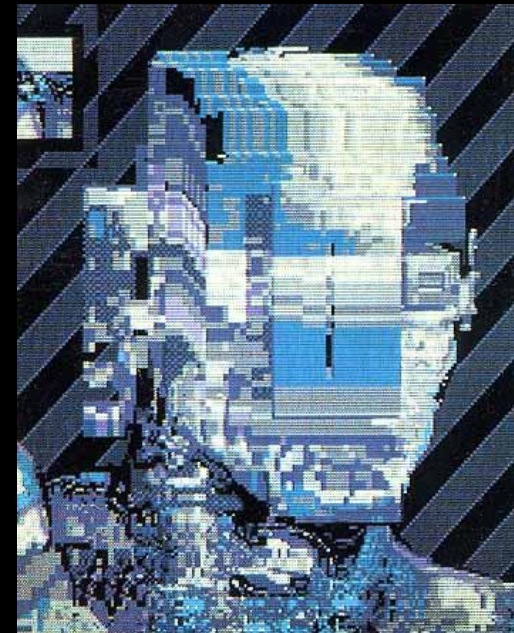
THE NEW ACE SCIENCE
FICTION SPECIALS

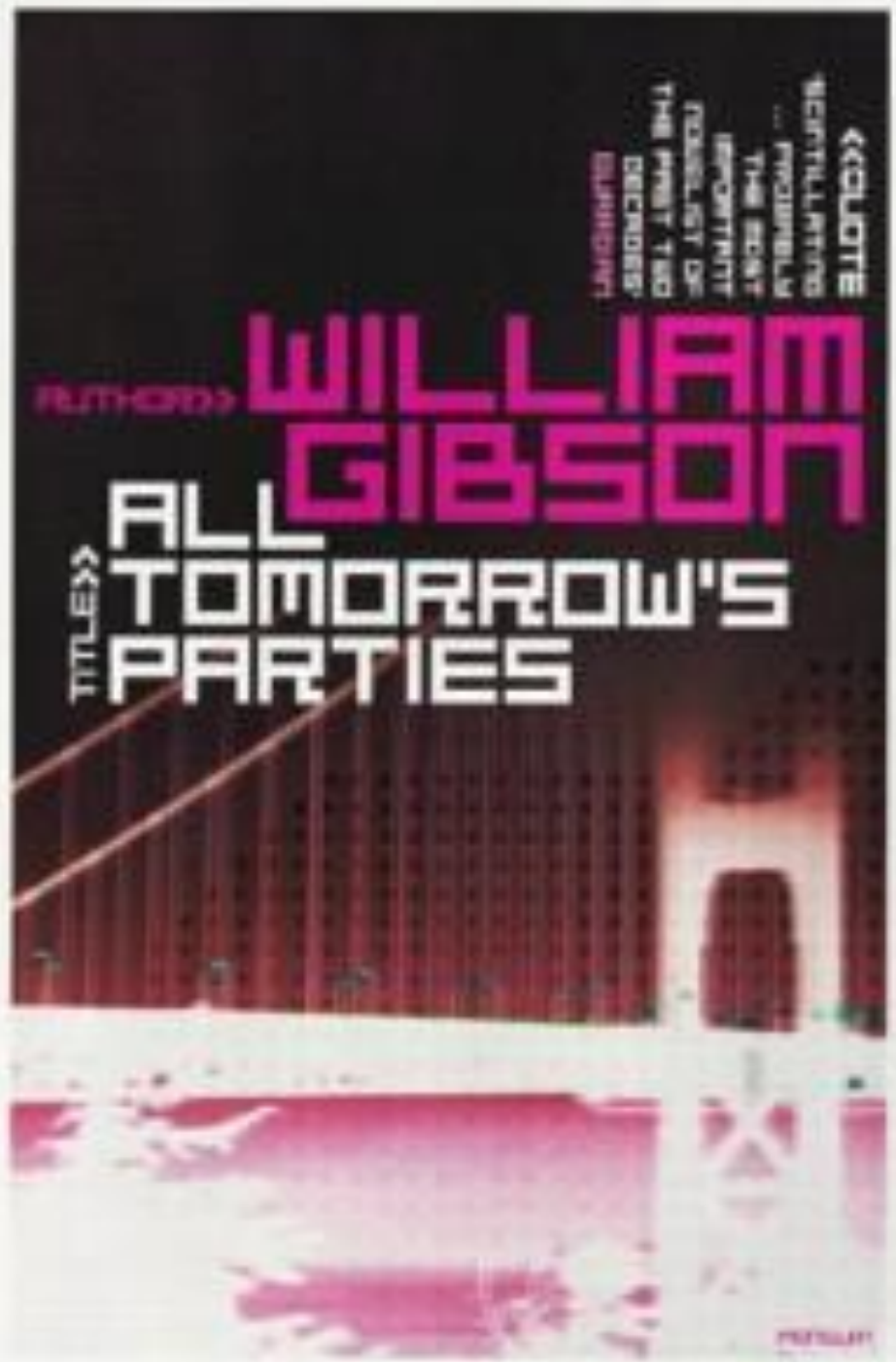
NEUROMANCER

WILLIAM GIBSON



1982 - Coins the
term 'cyberspace'
(in another book...)





1999 – Makes me look cool in London when I read in coffee shops

(many other inspirations for virtual reality but I have a soft spot for Gibson...)

Augmented....
something

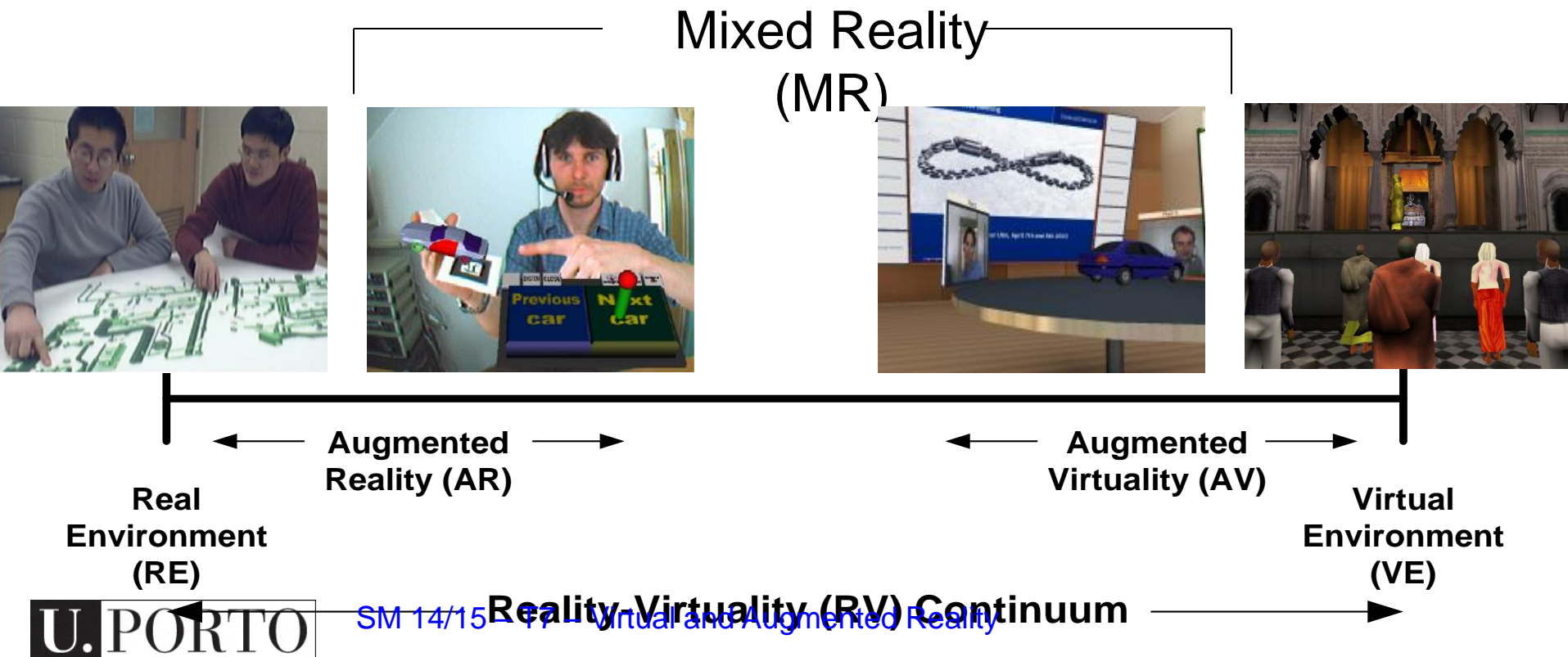


Mixed Reality

Mixed Reality (MR) is a term that has been used to refer to the entire spectrum of situations that span the continuum between virtual reality and actual reality

Mixed Reality Continuum

- Mixed reality includes augmented reality, augmented virtuality, and other mixed configurations



Virtual Reality

- What is “Virtual Reality”?
 - Brooks (1999) defines it as: “[an] experience .. in which the user is effectively immersed in a responsive virtual world” ...
 - Sherman and Craig (2003) defines it as a medium composed of interactive computer simulations that sense the participant’s position and actions and replace or augment the feedback to one or more senses, giving the feeling of being mentally immersed or present in the simulation (a virtual world)
 - Immersive, Semi-immersive, Non-immersive

Virtual Reality

- Four Key Elements in Experiencing Virtual Reality
 1. A virtual world
 2. Immersion
 3. Sensory feedback
 4. Interactivity

Key Element 1 – Virtual World

A virtual world an imaginary space, often (but not necessarily) realized through a medium (rendering pipeline, display, etc.)

Key Element 2 – Immersion

Immersion (physical and mental) having a sense of “presence” within an environment; this can be purely a mental state, or can be accomplished through physical means.

- Mental Immersion: a state of being deeply engaged, with suspension of disbelief.
- Physical Immersion: bodily/physically entering into a projected area

Key Element 3 – Sensory Feedback

Sensory feedback: visual/aural/haptic
feedback to a participant

Key Element 4 - Interactivity

Interactivity: in a virtual reality experience, participants are able to move around and change their viewpoint, generally through movements of their head

Virtual Reality Technology

- Head Mounted Displays: Tiny displays, mounted on the head, fully immersive, needs tracker to track the position and orientation of user's head.



Virtual Reality Technology

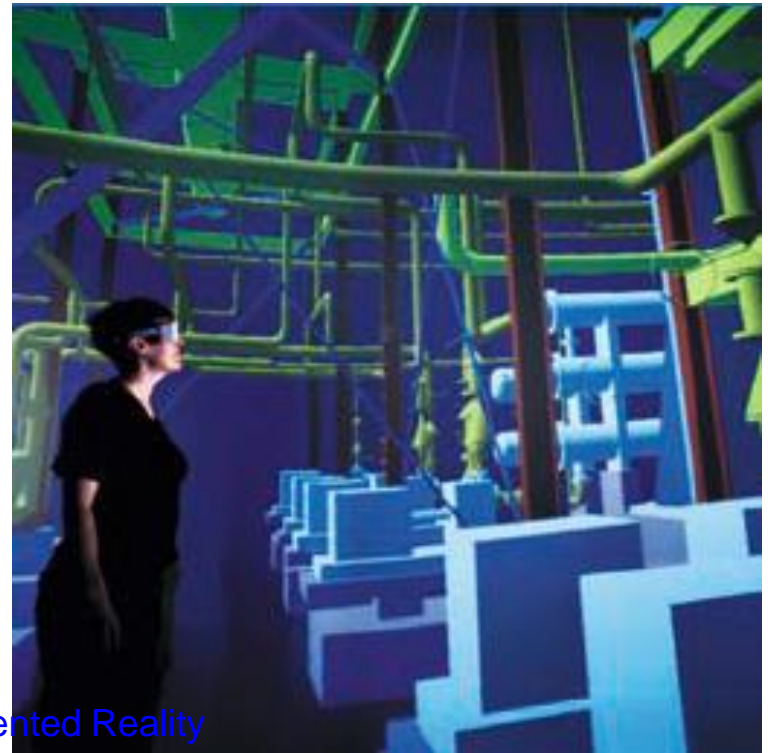
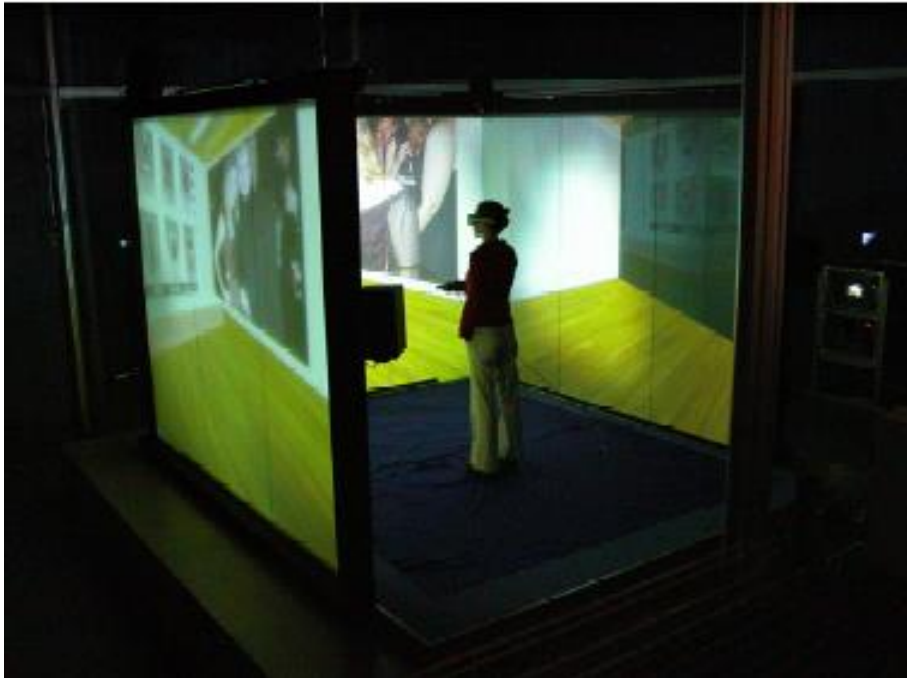
- **Projection-Based Systems:** A front-projected or rear-projected system in which the user is surrounded by images, projected onto large screens, create high immersion sense.



CAVE™ at NCSA

Virtual Reality Technology

- Blue-c system by ETH institutes: collaborative virtual reality



Virtual Reality Technologies

- Workbenches: flat, rear-projection screens that display images in stereo, and can be set up in a horizontal or tilted position, create partially immersion and high object presence.



Responsive
Workbench,
developed by
Wolfgang
Krueger at
Stanford

Virtual Reality

- **Hot Open Challenges:**
 - Interactive more effectively with virtual worlds:
 - Manipulation
 - Wayfinding
 - Measuring the illusion of presence



What Zuckerberg Sees in Oculus Rift

Facebook acquired Oculus Rift because it believes virtual reality could be the next big thing after mobile.

By Simon Parkin on March 26, 2014



New reality Attendees

Facebook moved quickly to acquire Oculus VR – creator of the forthcoming Oculus Rift virtual reality headset – for approximately \$2 billion. Discussions between the two companies opened less than two weeks ago, according to Oculus VR’s CEO Brendan Irebe. “We locked ourselves in the Facebook HQ and just got the deal done really fast,” Irebe told the *Wall Street Journal*. “We don’t want to disrupt the team and go through months of negotiations.”

Facebook’s founder and CEO Mark Zuckerberg reportedly instigated the deal. “Strategically we want to start building the next major computing platform that will come after mobile,” he said on a conference call on Tuesday night. Zuckerberg sees the acquisition as part of Facebook’s mission to



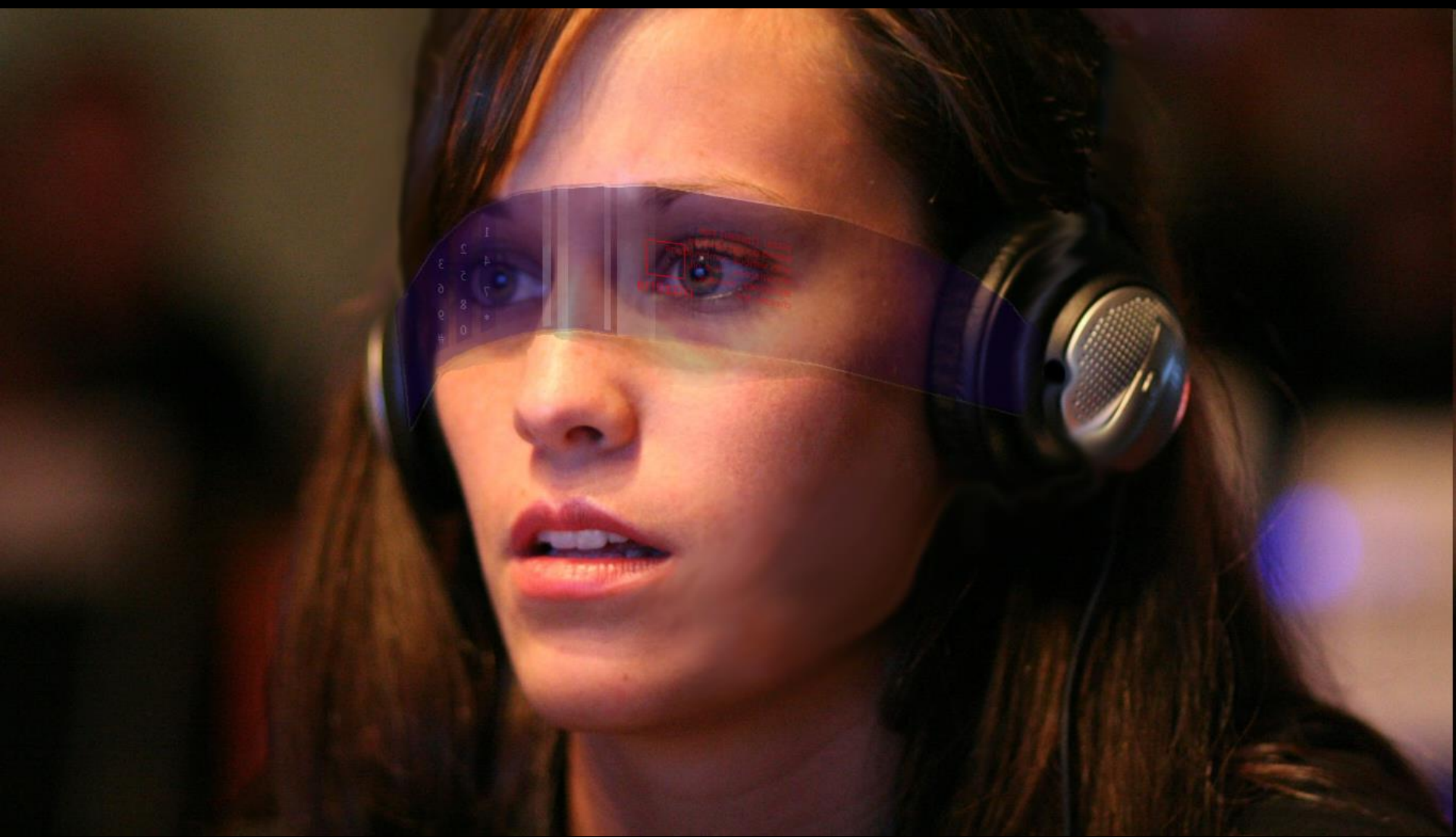
WHY IT MATTERS

Facebook’s interest could introduce millions

Augmented Reality

How do we define this?

Is this Augmented Reality?



Is this Augmented Reality?



Is this Augmented Reality?



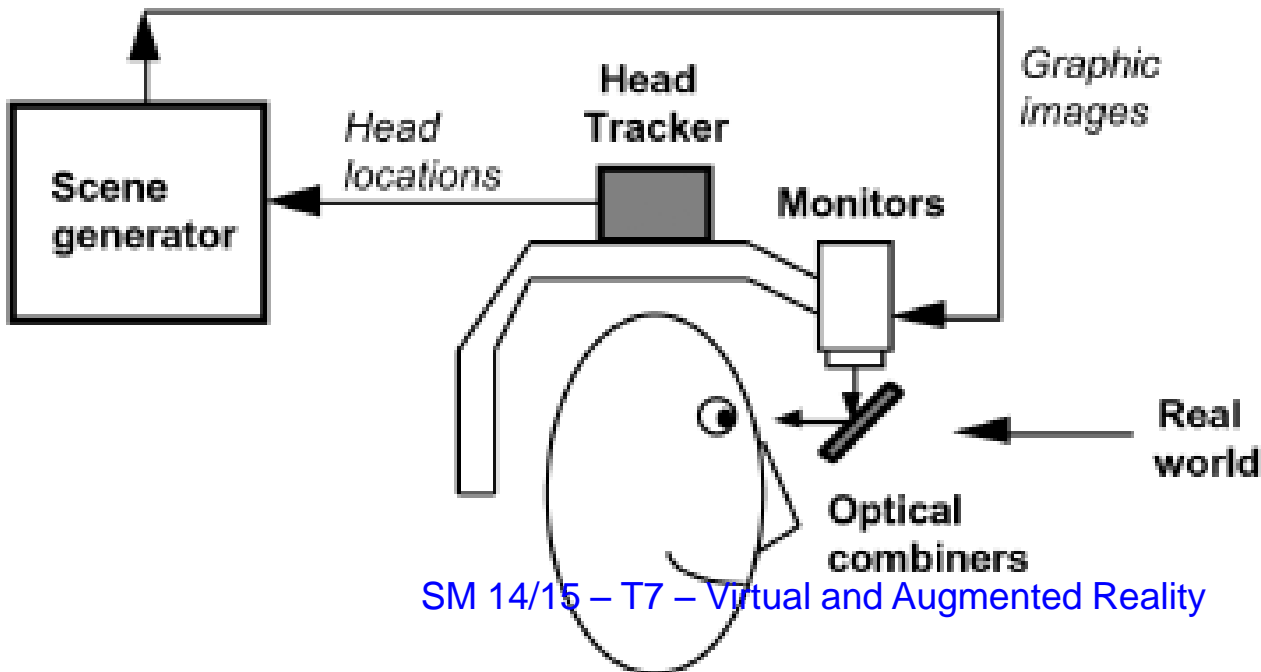
Audio yes, visual map no (representation not augment), directions yes

Augmented Reality

Augmented Reality (AR) is a technology or an environment where the additional information generated by a computer is inserted into the user's view of real world scene

Augmented Reality

- Optical see-through: Partly transmissive optical combiners are placed in front of the user's eyes, allowing the user to see in them the reflection of virtual images portrayed on miniature displays in their line of sight.



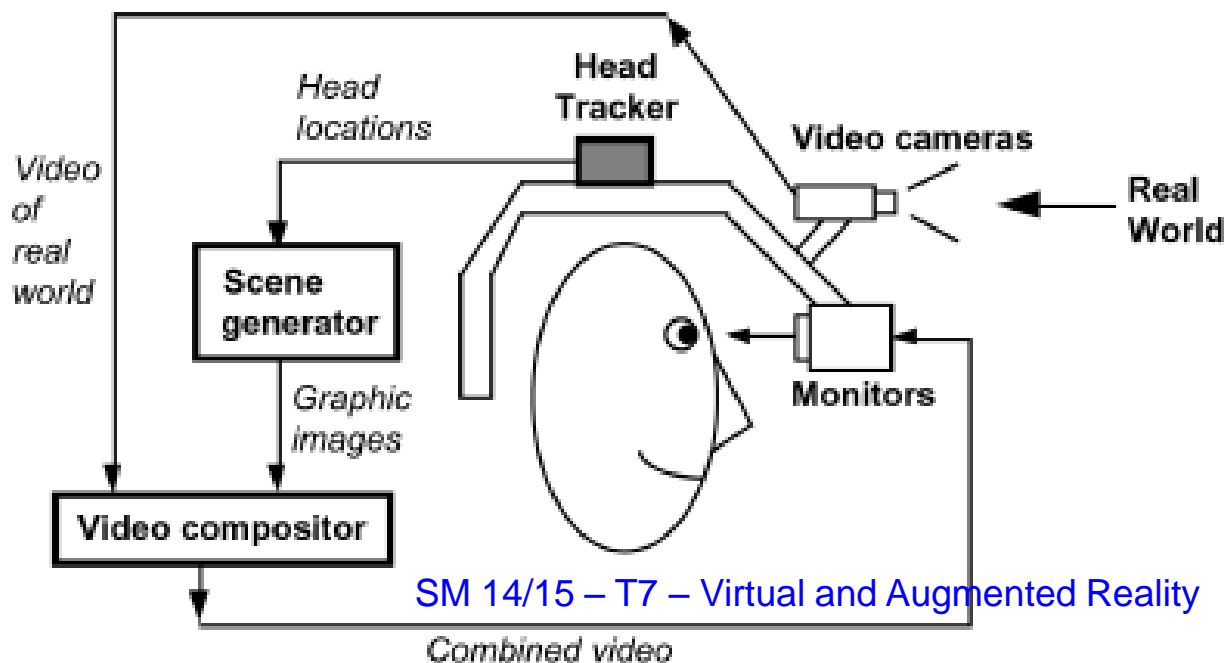
AddVisor 150

GLASS



Augmented Reality

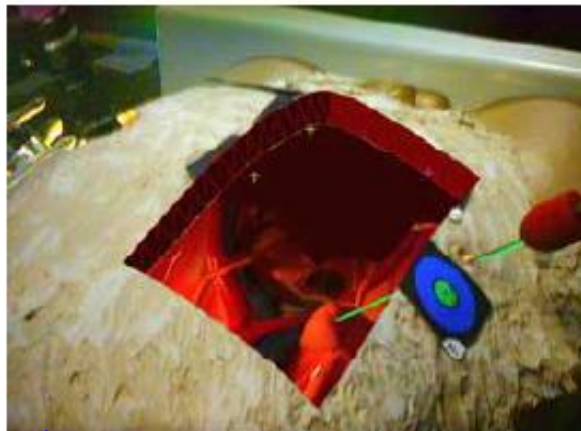
- Uses miniature cameras to capture the view of the world that would be seen by each eye. The video images of the real world are then combined with the computer-generated images of the virtual world, to create augmented-reality images that can be displayed on a traditional (non see-through) HMD



ARVision 3D HMD (commercial system)
(cameras mounted over the eyes)

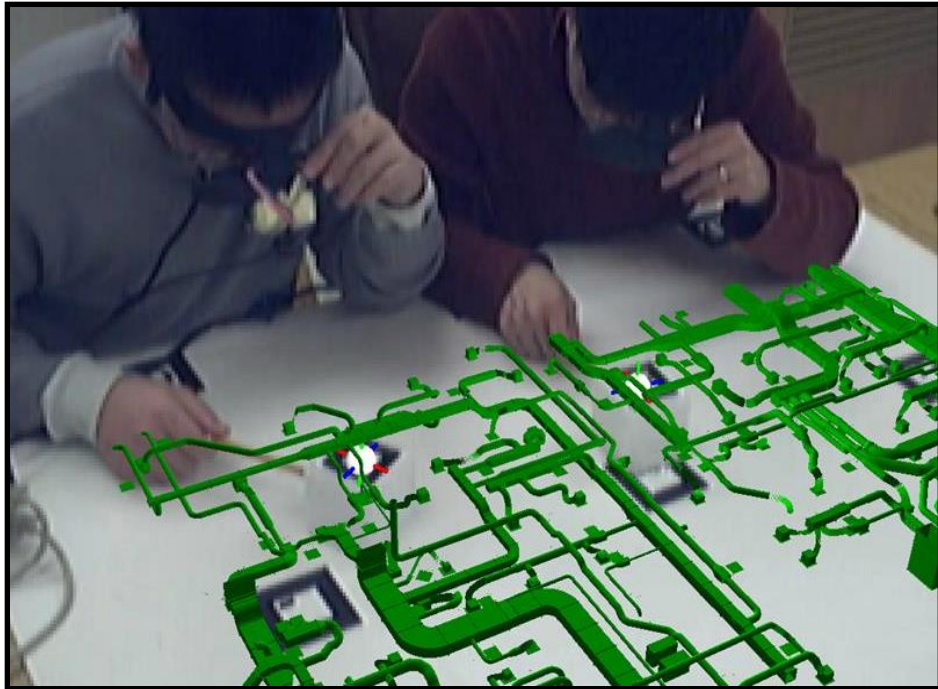
AR Applications

- **Applications of Augmented Reality**
 - Medical: Display of acquired data from ultrasound, superimposed over the live patient
 - Goal - to facilitate minimally invasive operations such as fine needle biopsies, and laproscopic surgeries

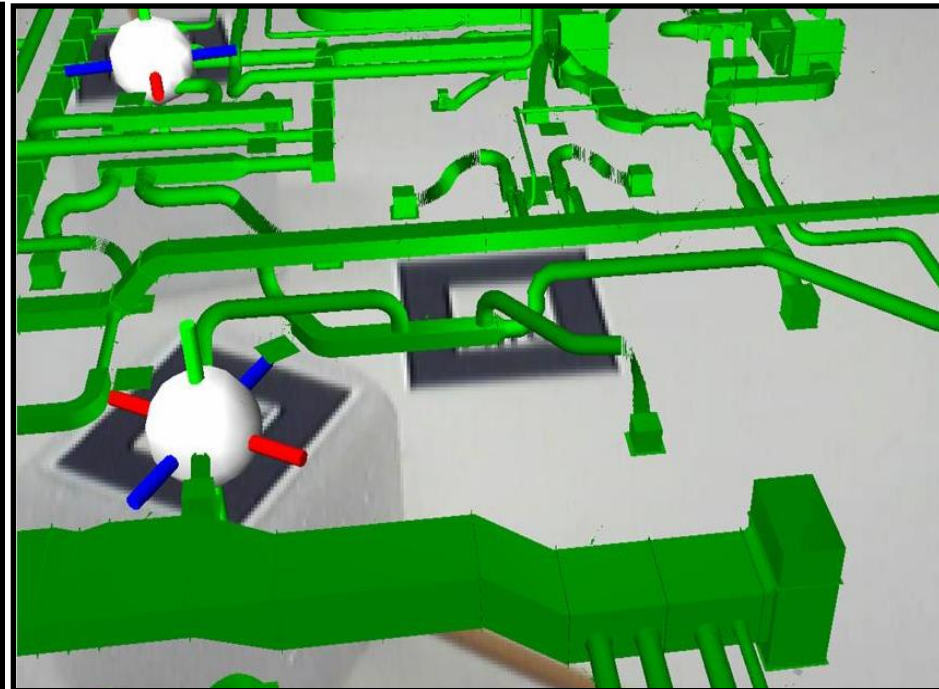


Augmented Reality in Cooperative Design

- Collaborative Virtual Environment



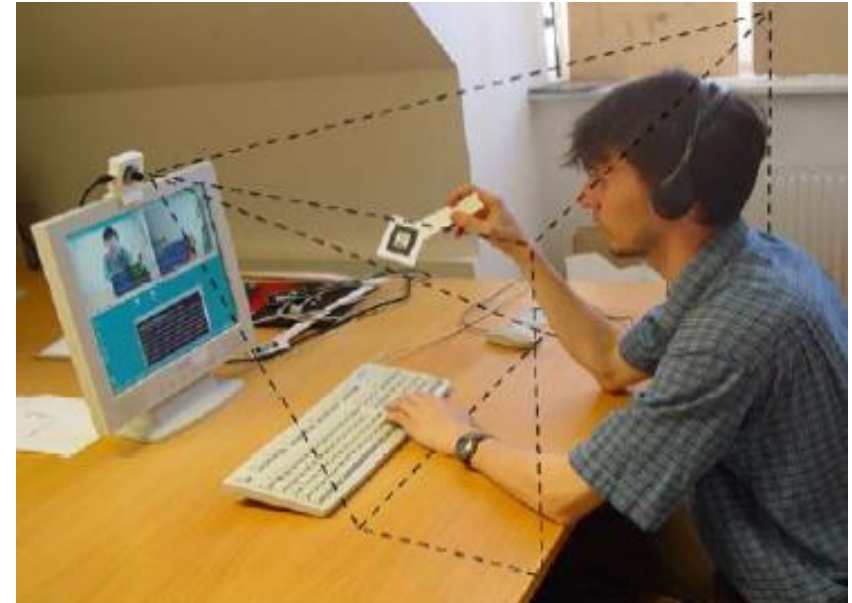
MRCVE collaboration scenario



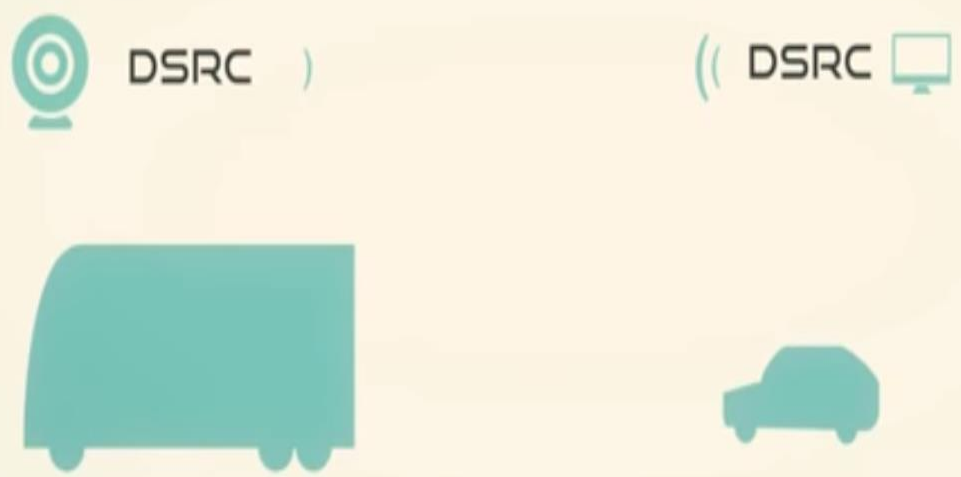
Mixed Reality view through head-mounted display

Augmented Reality in Cooperative Design

- AR-based Videoconferencing



LOW LATENCY VIDEO STREAMING



ENHANCED REALITY WITH DEPTH PERCEPTION



Jaguar Virtual Windscreen



4th 00:45.32 5th

S. Gordon 3rd

Last Lap 02:12:34
Fastest 02:09:22



Making it work

- Where do I place the cameras?
- Do I project or do I use glasses?
- Need strong computer vision to quantify real parameters

Still learning in 2015!

Augmented Virtuality

AV describes all the cases where the real object is inserted into a computer-generated environment

Augmented Virtuality

- A system in which real multi-sensory input is provided, which supplements the visually presented virtual environment.
- Examples of AV
 - Visual example
 - Insert real video stream (e.g., video conferencing) into virtual environment
 - Olfactory example
 - Directing the smell of coffee grounds to a user when s/he passes near a virtual coffee maker in the virtual environment
 - Haptic example
 - Turning on a heat lamp over the user when s/he approaches a spot in the virtual environment that is exposed to full sun
 - Turning on a fan in front of the user when s/he approaches a spot in the virtual environment that is exposed to wind



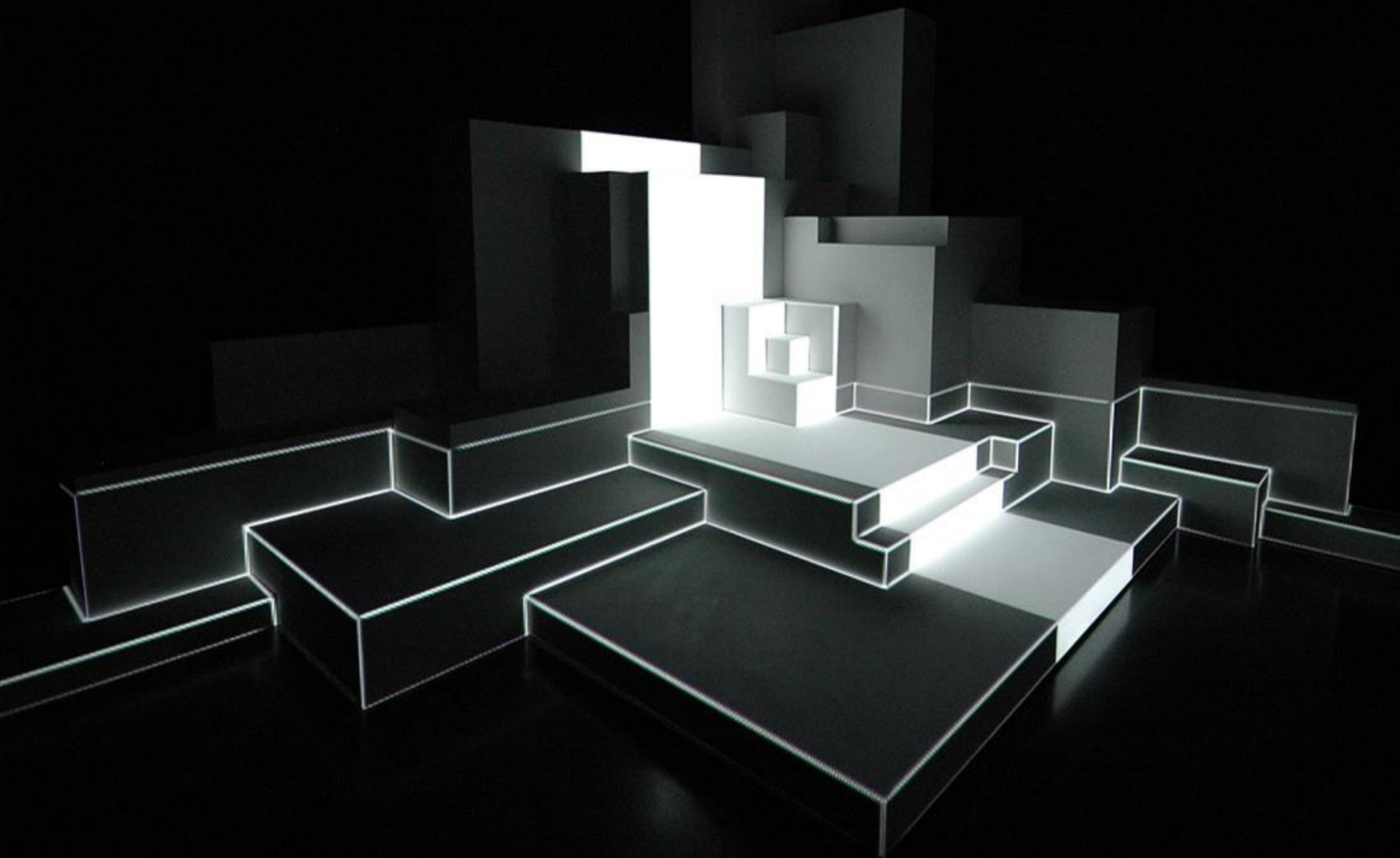
AV-based videoconferencing

Still....
Augmented....
Something....



Get Creative!

Virtual? Augmented? Real? Inspirational!





Go visit PIC!!

Our equipment includes:

Facial and Body Motion Capture (Optitrack) // Markerless Motion Capture (Organic Motion) and Motion Monitor SW (innsport), Head Tracker (Organic Motion) // 3D TV (Samsung) // 42" TV (Sony) // Head Mounted Display (Nvis nVisor SX111) // 4 Xbox Kinect (Microsoft) // 4 Xbox 360 (Microsoft) // 4 3D projectors (DELL) // Digital Table // Play Station 2 (Sony) // Game pads (Wii Remote) // CG Workstation for each student // 4 Active Glasses (Crystal Eyes 5) // 3D Wall (XVR) // 6 DSLR Camera (Canon EOS 1100D) // EEG System - Electroencephalography (Emotiv EPOC) // 2 Ipad 3 - Wifi - Celular - Retina - (Apple) // 1 GoPro Headcam Kit Faceware // 1 Oculus Rift Development Kit 2

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