

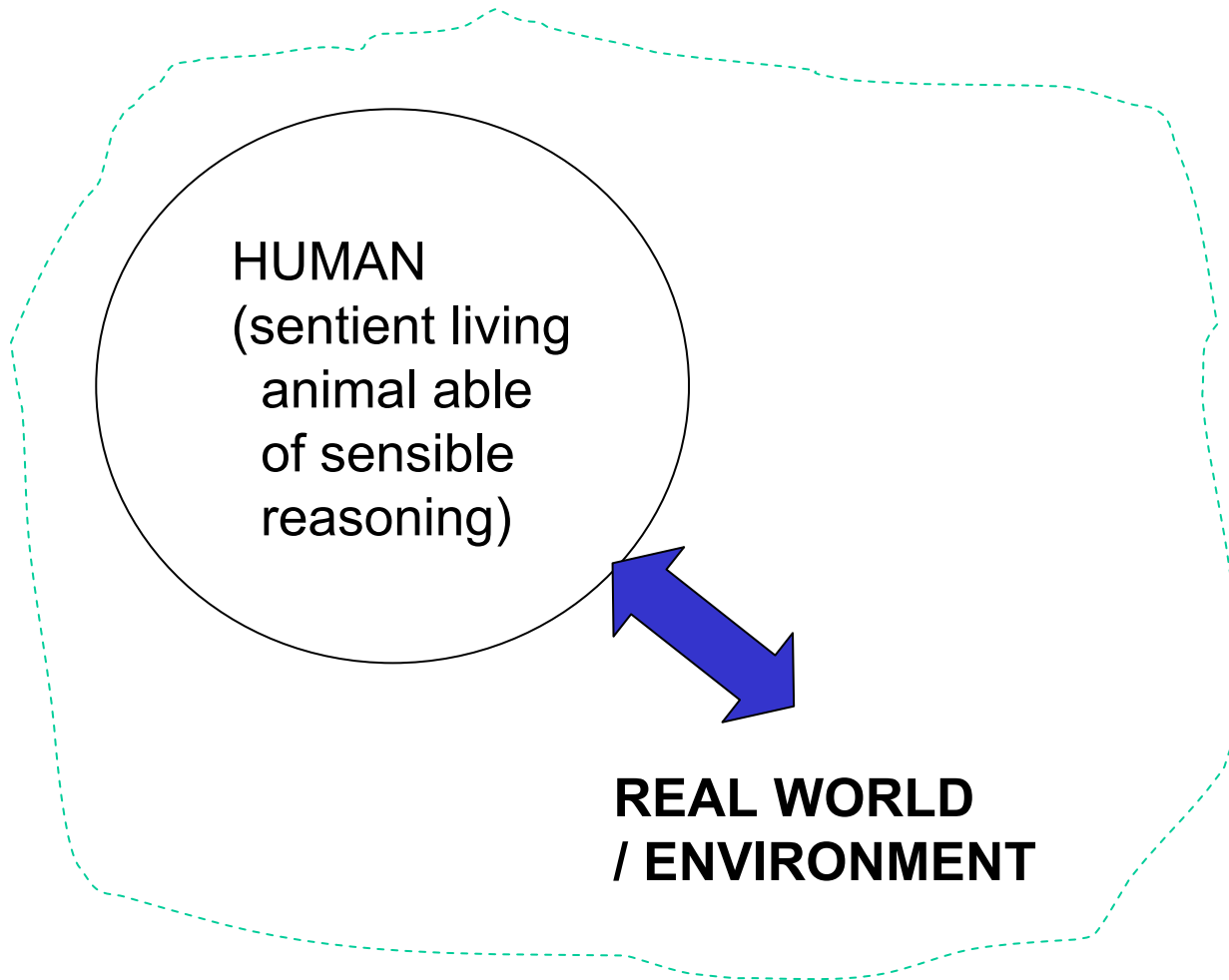
VIRTUAL REALITY

Introduction

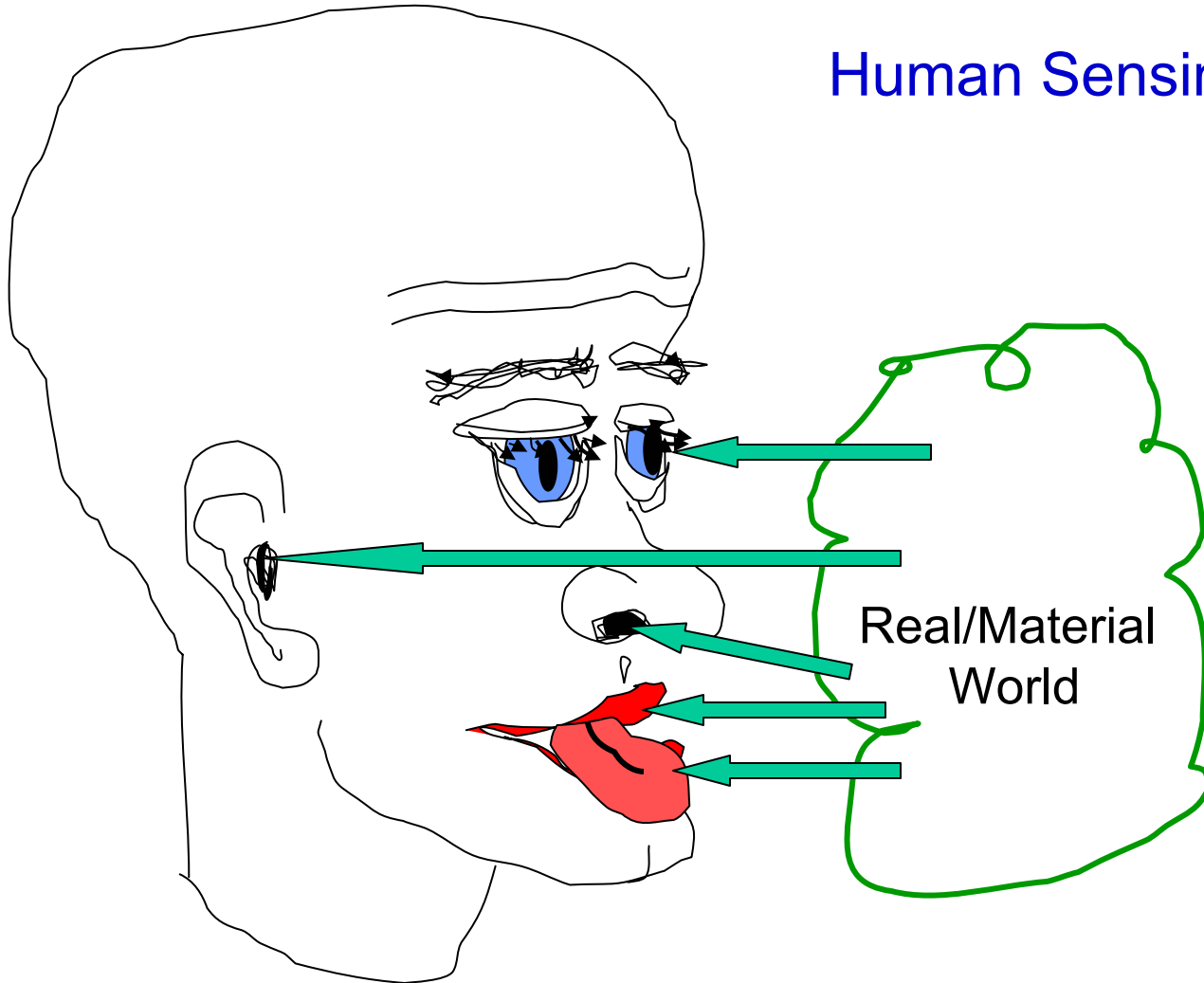
Emil M. Petriu
SITE , University of Ottawa

- ❑ Natural and Virtual Reality
- ❑ Virtual Reality
- ❑ Interactive Virtual Reality
- ❑ Virtualized Reality
- ❑ Augmented Reality

HUMAN PERCEPTION OF REALITY

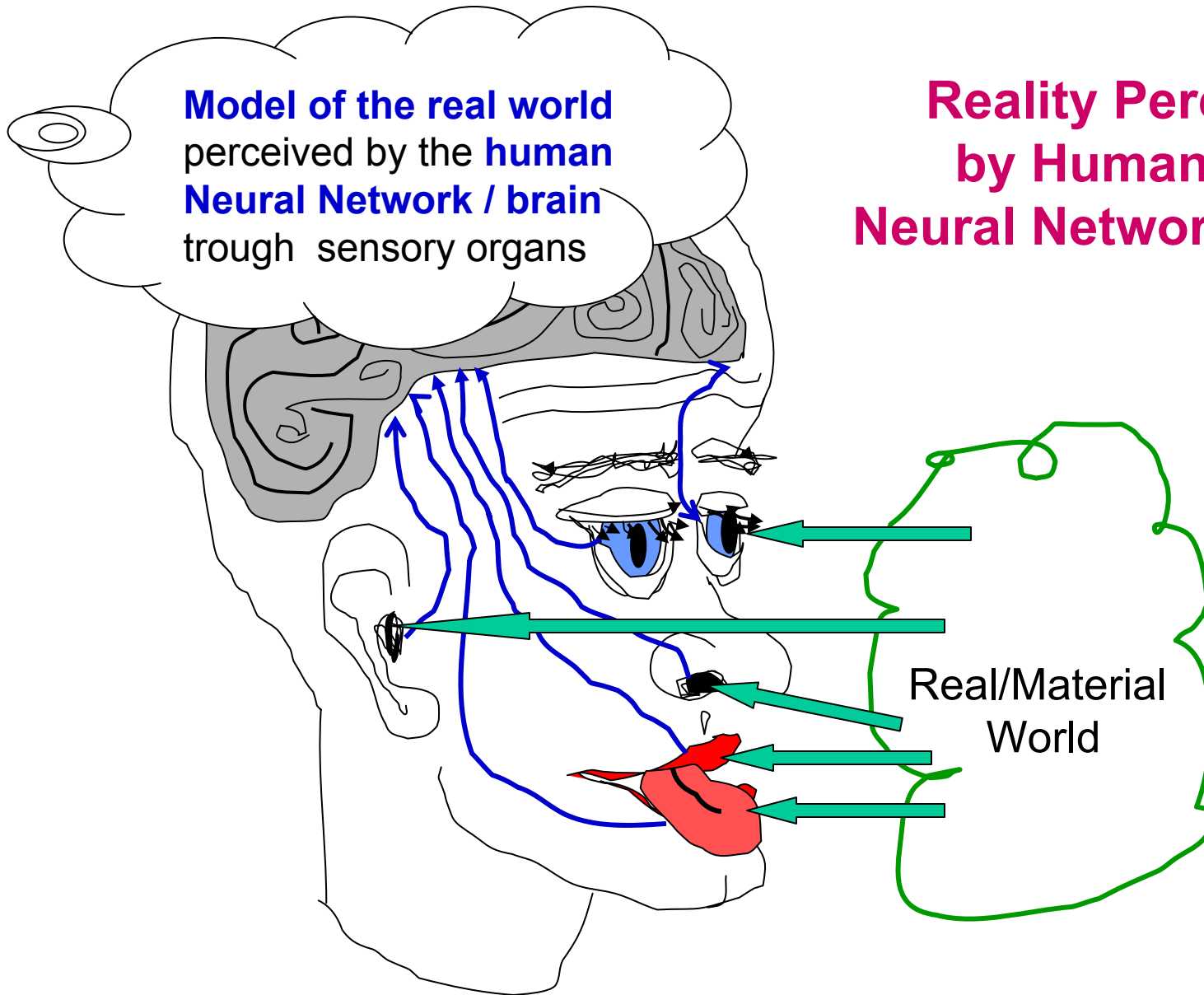


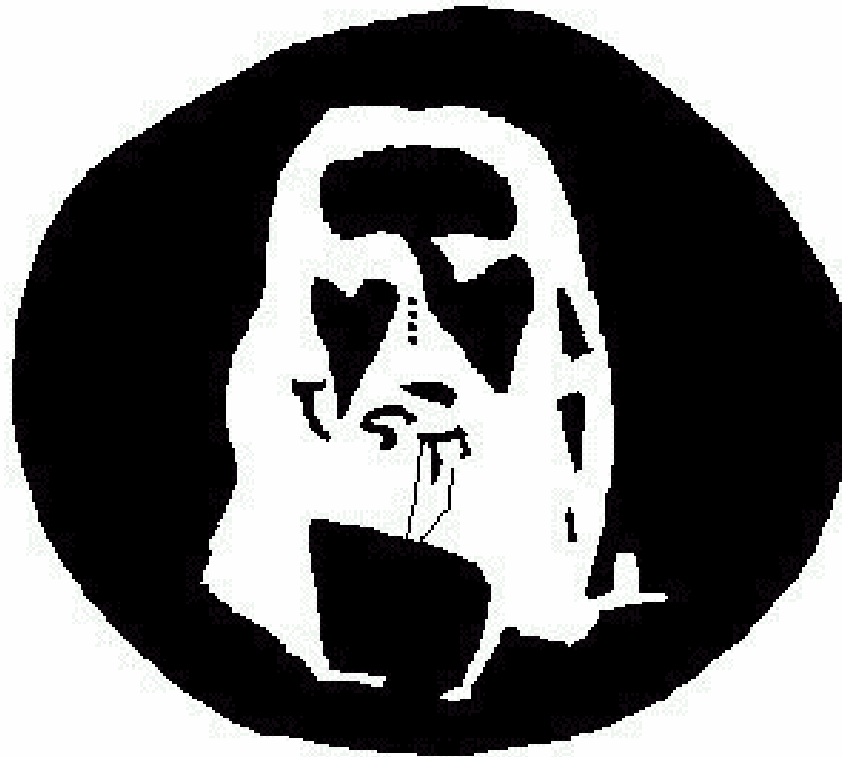
Human Sensing



Reality Perception by Humans as a Neural Network Process

Model of the real world
perceived by the human
Neural Network / brain
through sensory organs





- 1) Relax and concentrate on the 4 dots in the middle of the picture for aprox. 30-40 secs.
- 2) Then, take a look at a wall near you (resp. any smooth, single coloured surface)
- 3) You will see a circle of light developing
- 4) Start blinking your eyes a couple of times and you will see a figure emerging.

What Is Virtual Reality?

**A Web-Based Introduction
Version 4 – Draft 1,
September, 1998**

Jerry Isdale

<http://www.isdale.com/jerry/VR/WhatIsVR.html>

>>> *What Is Virtual Reality? -A Web-Based Introduction, by Jerry Isdale*

1. Overview
2. A Taxonomy of Virtual Reality
3. Types of VR Systems
4. VR Hardware
5. Levels of VR Hardware Systems
6. VR System Technical Approaches
7. Available VR Software Systems
8. Aspects of A VR Program
9. Other Senses
10. World Space
11. World Database
12. World Authoring versus Playback
13. World Design
14. Fiction Books Related to VR

Virtual Environments allow humans to visualize, manipulate and interact with computer models and extremely complex data. Computer generated visual, auditory, force or other sensory outputs to the human user can be mixed with the sensor based models of the real world to generate a virtual world within the computer.

- ❑ This *virtual environment* (VE) may be a CAD like model, a scientific simulation, or a view into a database.
- ❑ The *users can interact and directly manipulate objects within VE.* Some virtual environments are animated by other processes, simulations, or simple animation scripts.
- ❑ VE technology has already found *applications* in industrial design, communications, telerobotics, scientific research, medicine, training & education, and entertainment.

Types of VR Systems ... according to [Isdale]

- ❑ **Window on World Systems (WoW)**, or Desktop VR.
- ❑ **Video Mapping** variation of the WoW approach where the user watches a monitor that shows his body's silhouette interaction with the world.
- ❑ **Immersive Systems** completely immerse the user's personal viewpoint inside the virtual world. These "immersive" VR systems are equipped with *Head Mounted Displays (HMD)*, or a 'Cave' or room in which the viewer stands. The "Holodeck" used in the "Star Trek: The Next Generation" is an extrapolation of this technology.

Types of VR Systems... according to [Isdale]

- ❑ **Telepresence** links remote sensors in the real world with the senses of a human operator. *Applications* => remote sensors might be located teleoperated robots for fire fire fighting, space or undersea operations. Surgeons are using instruments on cables having a video camera at the point of operation.
- ❑ **Mixed Reality**, or Seamless Simulation,...mixes the Telepresence and Virtual Reality systems. The computer generated inputs are merged with telepresence inputs and/or the users view of the real world. *Applications* => surgeon's view of a brain surgery is overlaid with images from earlier CAT scans and real-time ultrasound. A fighter pilot sees computer generated maps and data displays inside his HMD.



G. Burdea and Ph. Coiffet, ***Virtual Reality Technology***, (second edition with CD-ROM), Wiley, New Jersey, 2003, (ISBN 0471360899).

Virtualized Reality

- ❑ **Prof. Takeo Kanade**, Robotics Institute,
Carnegie Mellon University, Pittsburgh, PA, USA
<http://www.cs.cmu.edu/~virtualized-reality/>

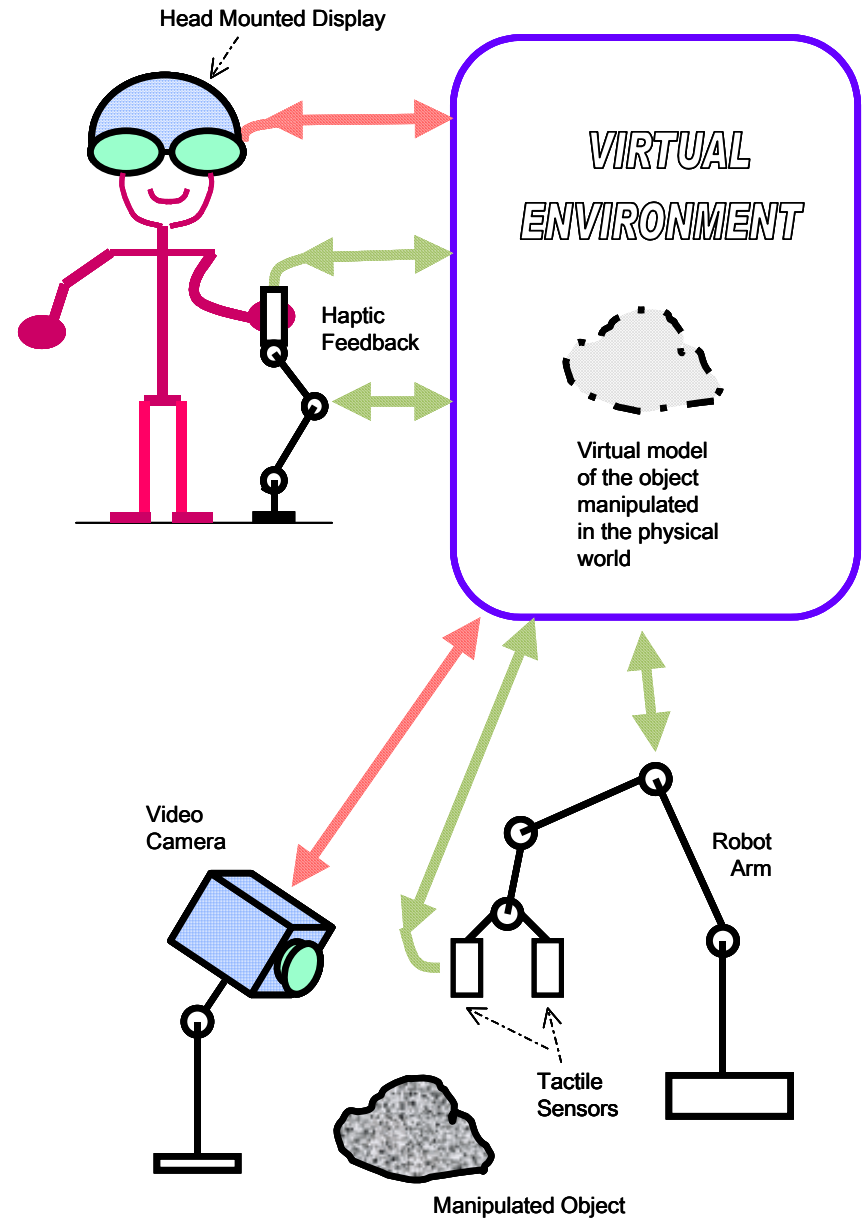
“In contrast to virtual reality, in which synthetic environments are created, Virtualized Reality is based on events taking place in the real world, which are captured and processed by computer manipulation”,

>>> Virtualized Reality

- ❑ **Prof. Pierre Boulanger**, Canadian Working Group on Virtualized Reality Systems, NRC-IIT, Ottawa, ON, Canada
<http://www.virtualizedreality.org>

“Virtualized reality is a generalization of the standard visual simulation paradigm where the model and the actions used in the simulated world are extracted from various sensors and information retrieval systems. The resulting visual simulation aims at an exact representation of the real world allowing for photo realistic rendering, telepresence, remote control, and intuitive information queries”.

Distributed wireless network of sensor agents deployed in the environment. The human operator monitors the environment from a remote location using interactive **virtualized reality**

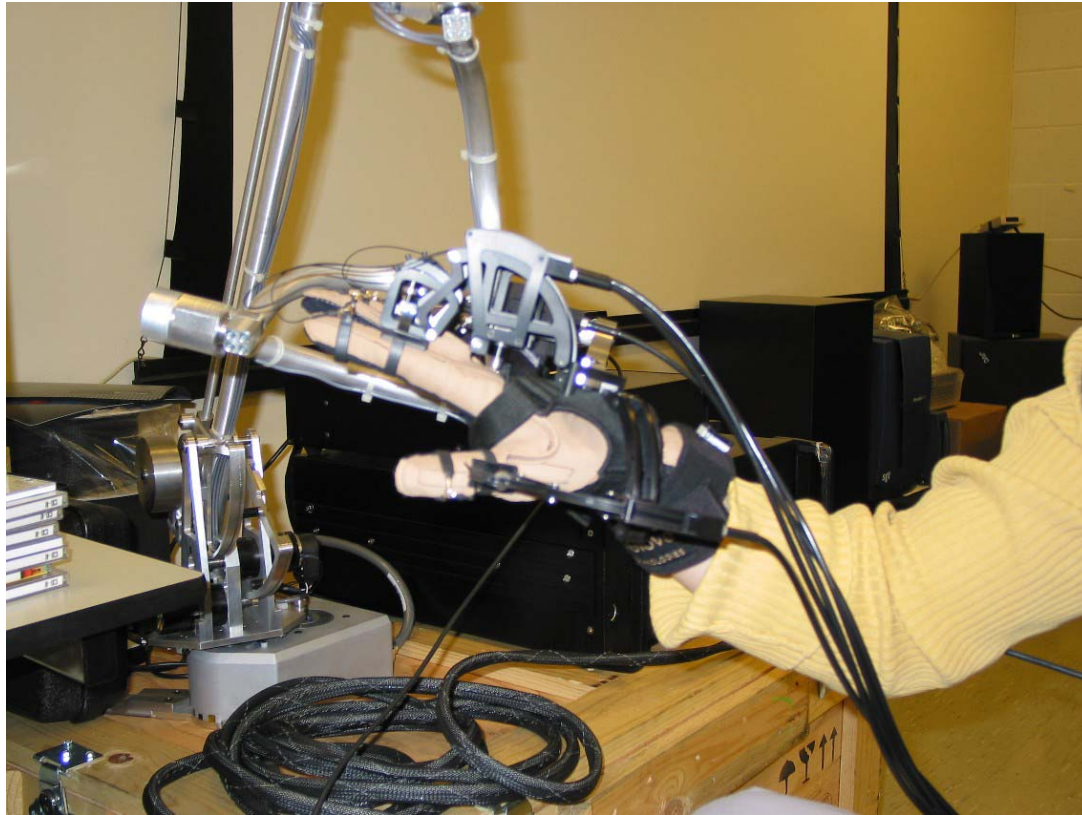




Head Mounted Display



Monocular Display



Commercial “Virtual Hand Toolkit for CyberGlove/Grasp”
providing the kinesthetic human-computer interface

Augmented Reality & Computer Augmented Environments

- **Prof. Jim Vallino**, Departments of Computer Science and Software Engineering Rochester Institute of Technology, Rochester, USA, <http://www.se.rit.edu/~jrv/research/ar/>

“The basic difference between the Augmented Reality and the Virtual Reality is the immersiveness of the system. Virtual reality strives for a totally immersive environment. The visual, and in some systems aural and proprioceptive, senses are under control of the system. In contrast, an augmented reality system is augmenting the real world scene necessitating that the user maintains a sense of presence in that world. The virtual images are merged with the real view to create the augmented display. There must be a mechanism to combine the real and virtual that is not present in other virtual reality work”

>>> Augmented Reality & Computer Augmented Environments

- ❑ **SONY Links on Augmented Reality Projects**

<http://www.csl.sony.co.jp/project/ar/ref.html>

- ❑ **US Department of the Navy, Office of Naval Research, “Battlefield Augmented Reality System (BARS)”**

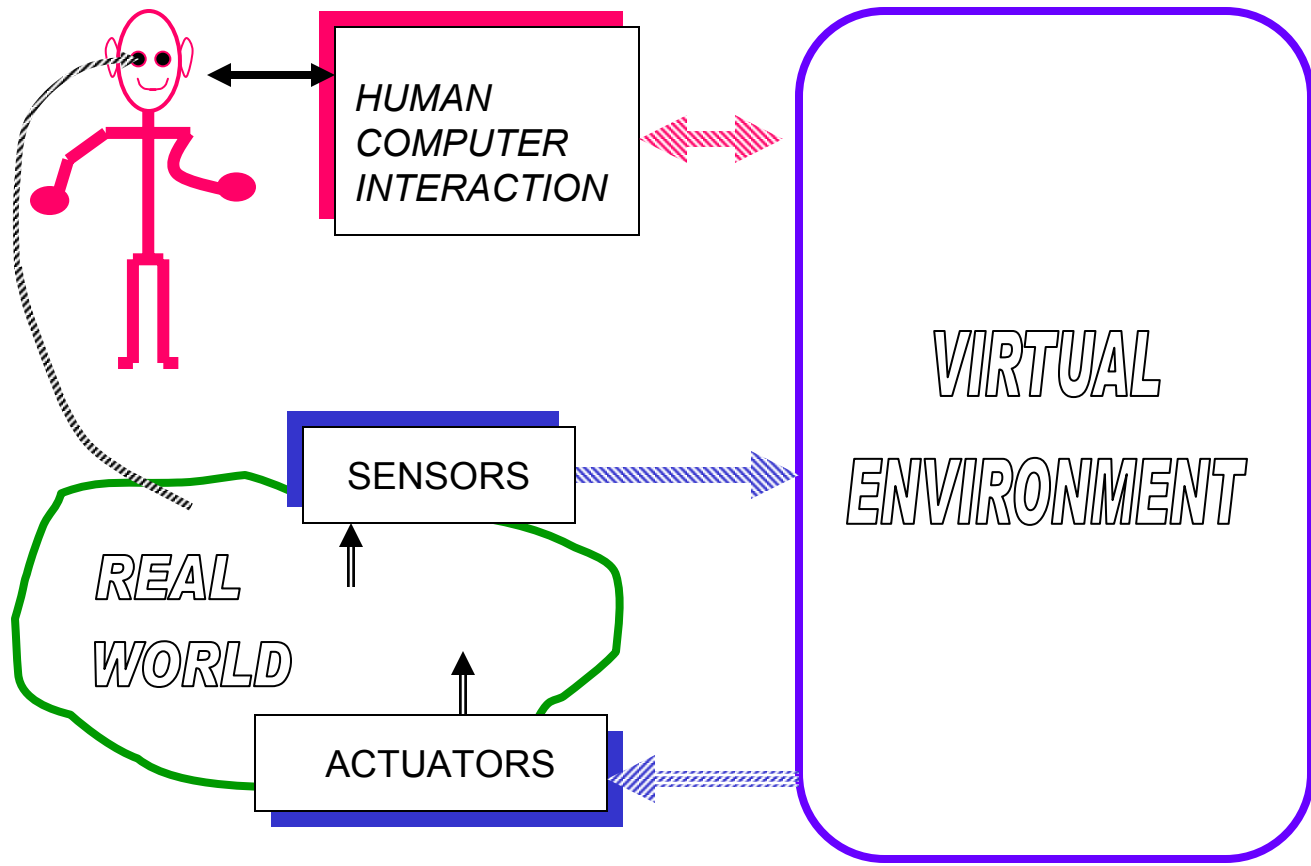
- ❑ **US National Tele-Immersion Initiative**

<http://www.advanced.org/teleimmersion.html>

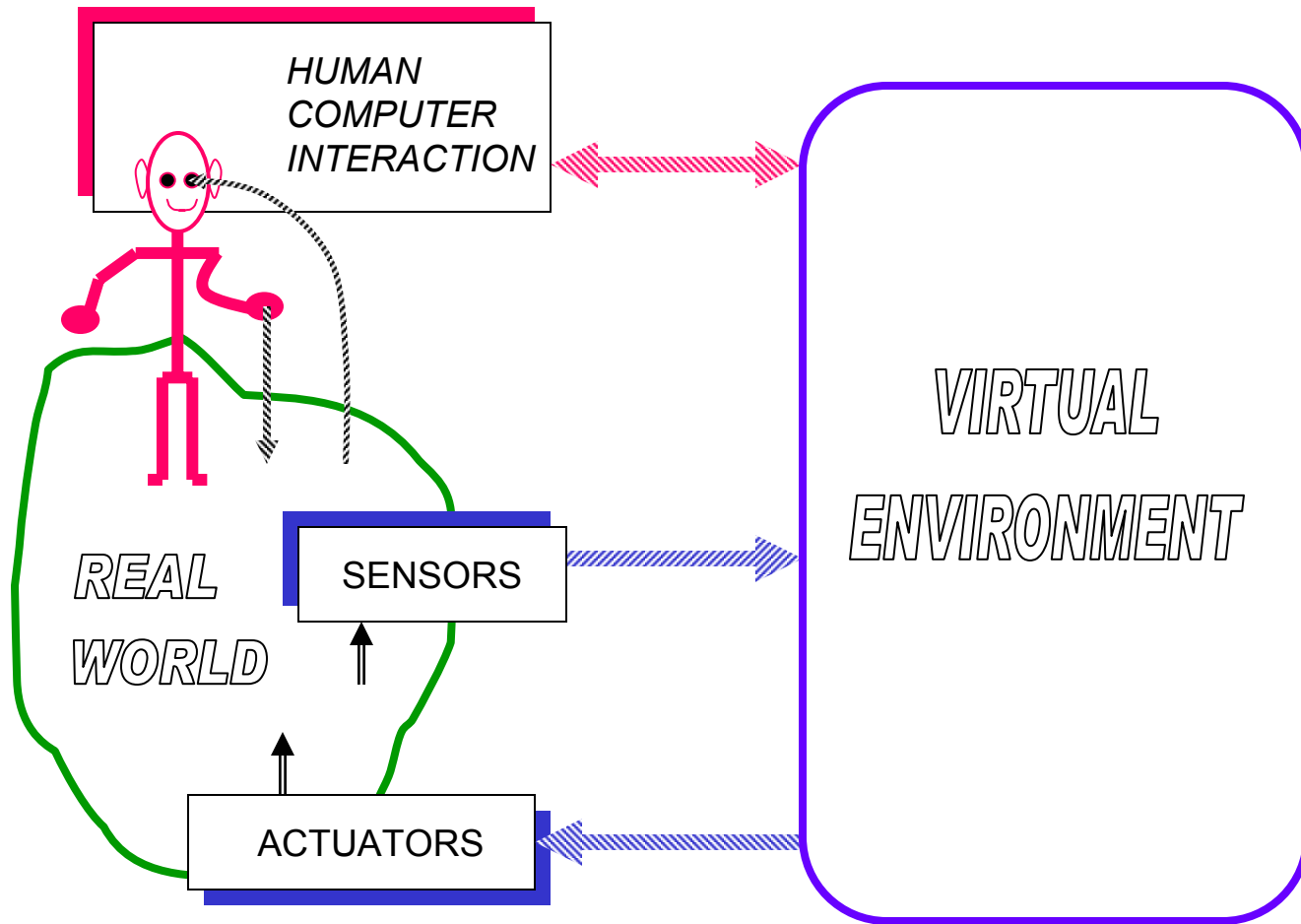
“Tele-Immersion (National Tele-immersion Initiative - NTII) will enable users at geographically distributed sites to collaborate in real time in a shared, simulated environment as if they were in the same physical room. This new paradigm for human-computer interaction is the ultimate synthesis of networking and media technologies and, as such, it is the greatest technical challenge for Internet”.



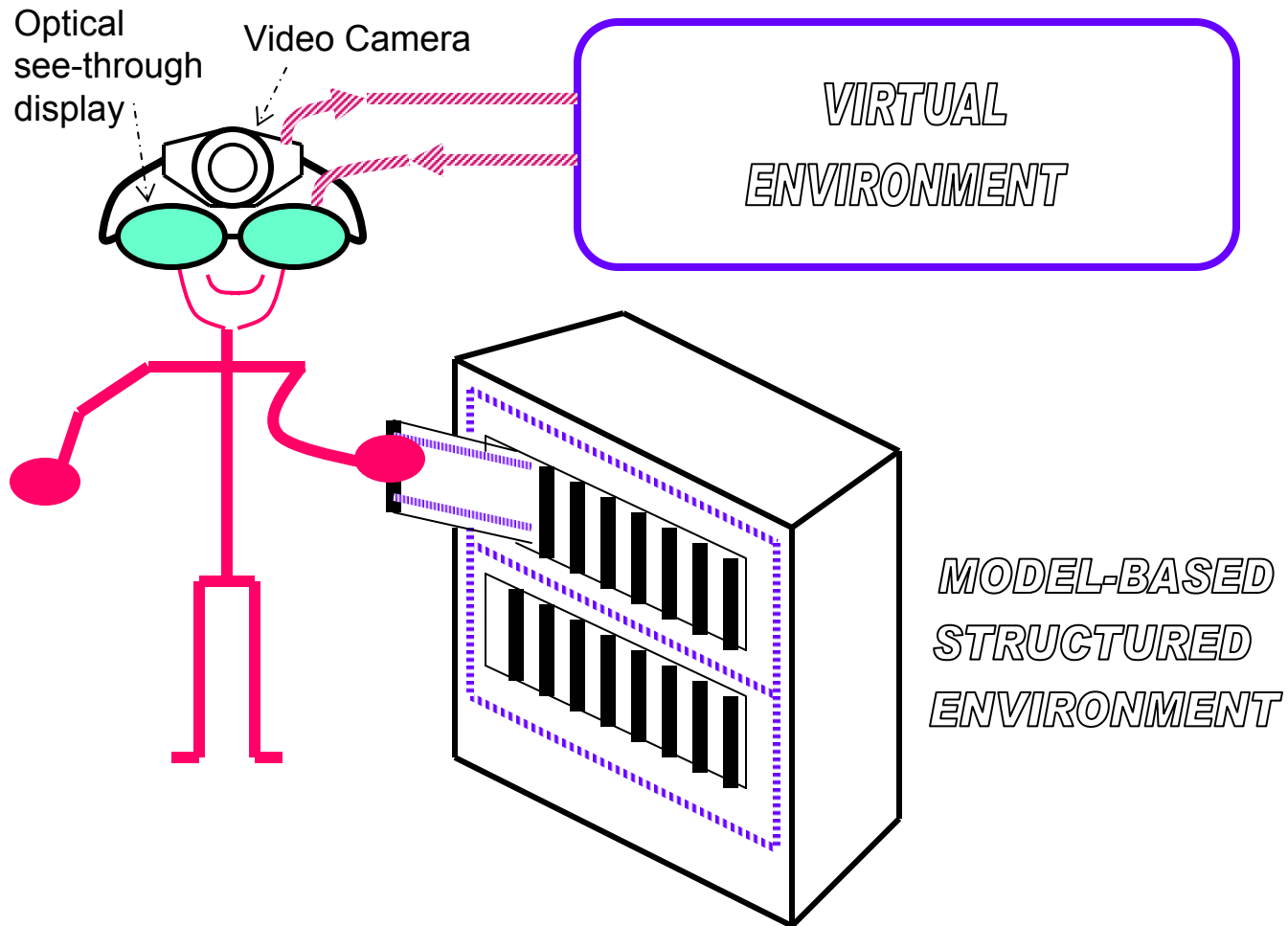
E.M. Petriu and T.E. Whalen, " Computer-Controlled Human Operators,"
IEEE Instrum. Meas. Mag., Vol. 5, No. 1, pp. 35 -38, 2002



Interfacing virtual environments with the real world and human operators



Human interaction with the real world and in augmented virtual reality



Human operator using augmented virtual reality in a structured real world.



Computer vision recognition of the pseudo-random binary code, which is then used as augmented reality information.