Course Outline

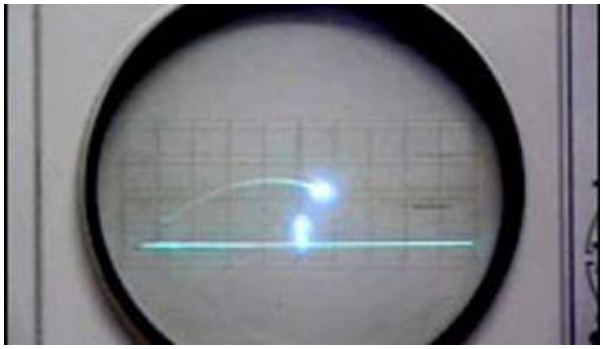
- What is Virtual Reality? ✓
- Scientific and industrial applications of Virtual Reality ✓
- The history of (Computer Graphics &) Virtual Reality
- (Output channel) Representation of virtual worlds
  - Visual
  - Aural
  - Haptic
- (Input channel): Interaction in virtual worlds
  - Motion tracking
  - Interacting with virtual objects
  - Navigation in virtual worlds
- Dynamic virtual worlds:
  - Collision Detection
  - Modeling of deformable objects
- Immersive Visualization

Course on Virtual Reality

History of Computer Graphics & Virtual Reality

History

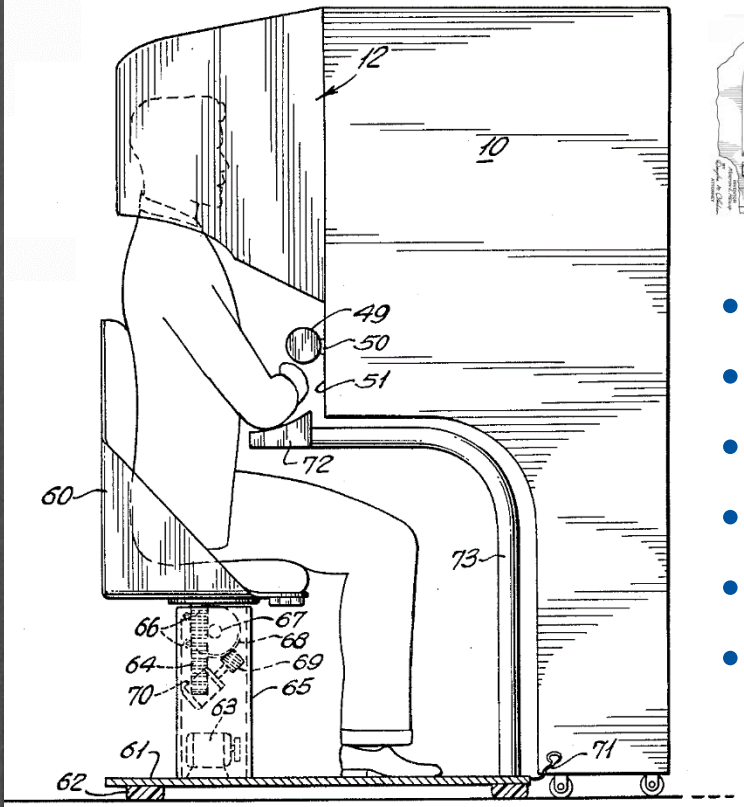
- 1949: First CG on Whirlwind Computer at MIT (Bouncing Ball)

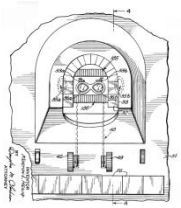


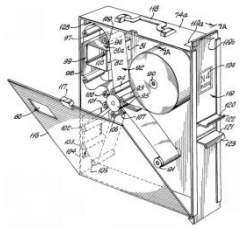
- 1952: CG for recognition of aircrafts on a radar screen (SAGE Computer)

History (contd.)

- 1956: Sensorama (Morton Heilig)







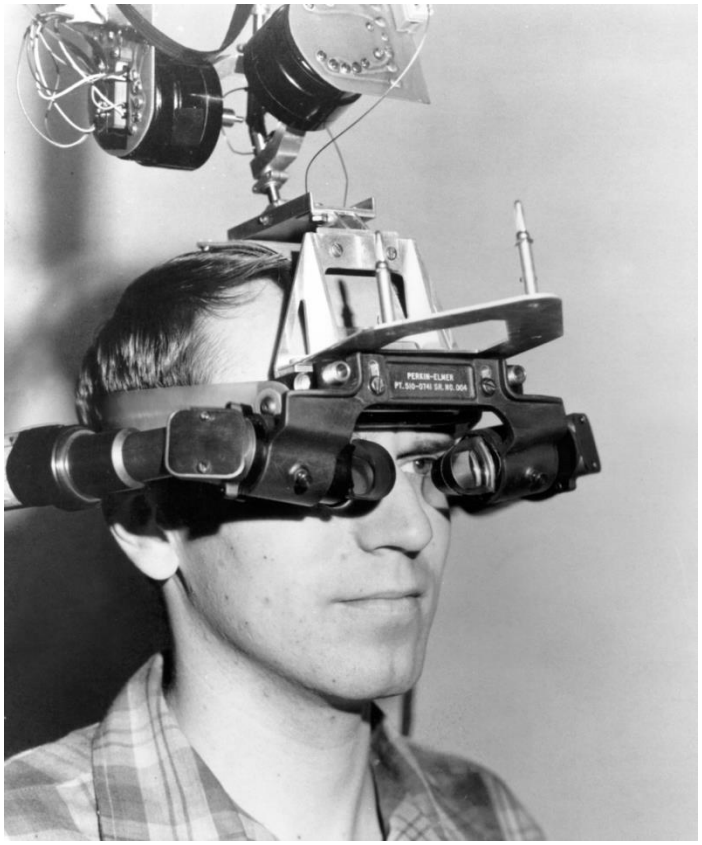
- Stereo vision
- Stereo sound
- Motion
- Wind
- Aroma
- Vibrations

History (contd.)

- 1963: Sketchpad: First interactive CG system with light pen (I. Sutherland)

History (contd.)

- 1965: First commercial vector display (IBM, $100K)
- 1965: The Ultimate Display (I. Sutherland)



History (contd.)

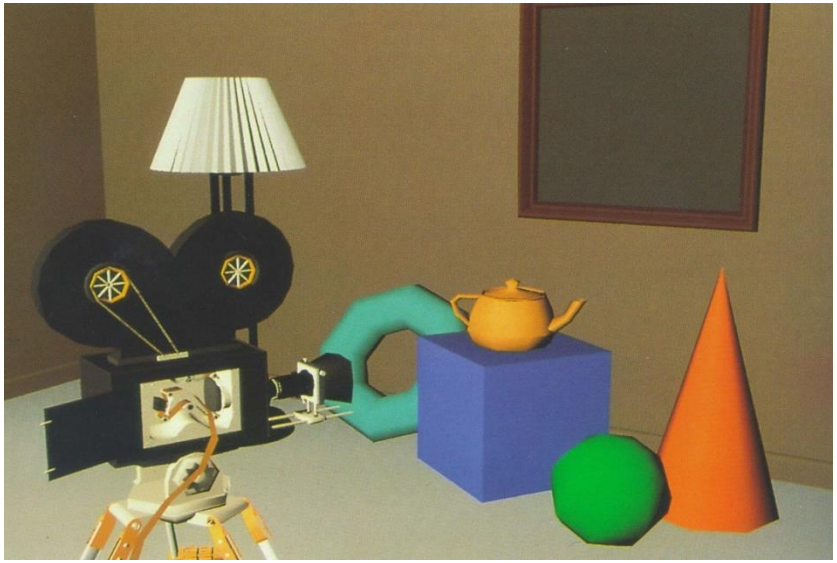
- 1967: First haptic display: GROPE project (Brooks, UNC)

Picture: Kalawski

(Picture shows later project status)

History (contd.)

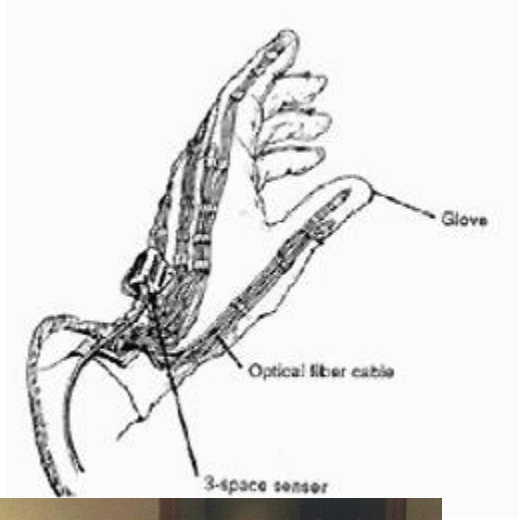
- 1971: Raster Scan Principle
- 1971: Gouraud Shading

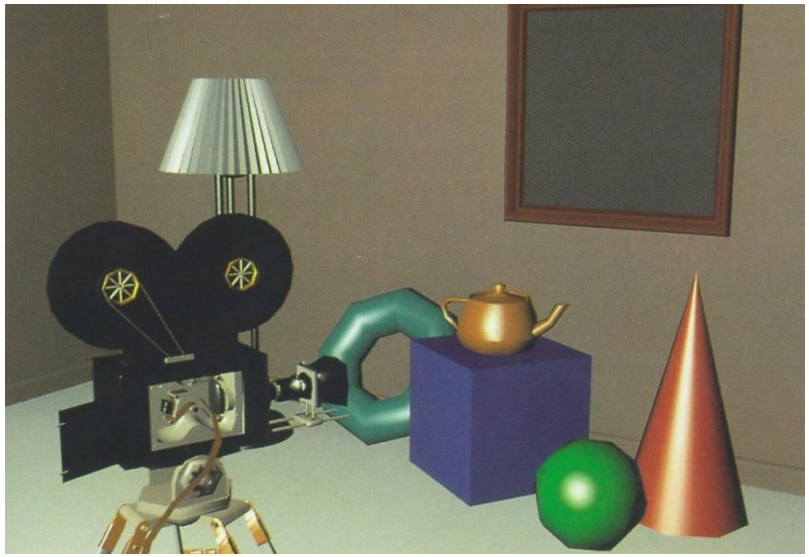


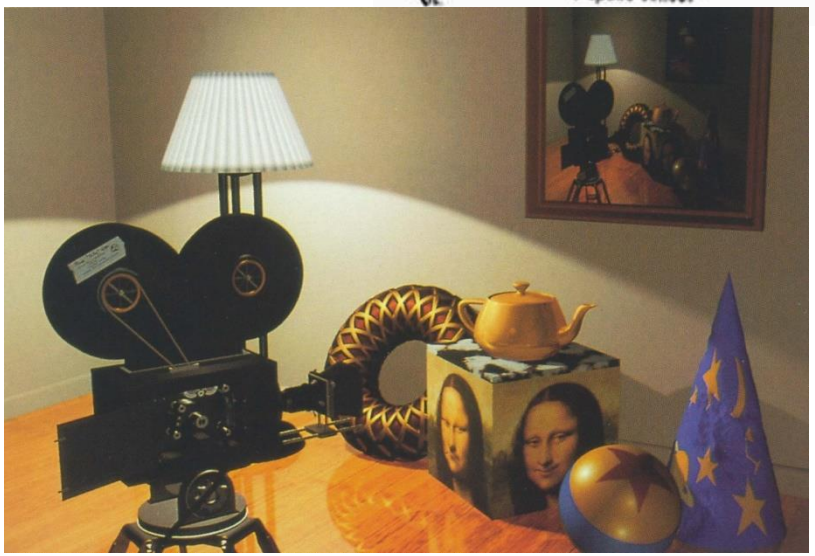
Pictures: Foley et al.

History (contd.)

- 1974: Texture Mapping (Catmull)
- 1975: Phong Shading
- 1977: First instrumented glove (Sandin & Sayre)
- 1979: Ray Tracing







History (contd.)

- 1979: Polhemus Tracking System (Raab et al.)

- 1984: Radiosity

VR pioneer Thomas A. Furness III

- 1982: Visually Coupled Airborne Systems Simulator (Darth Vader helmet)
- 1986: Super Cockpit Program

- 1989: Founder of the Human Interface Technology (HIT) Lab at the University of Washington
- 2016: Life Time Award

History (contd.)

- 1986 – 1989: Super Cockpit Program

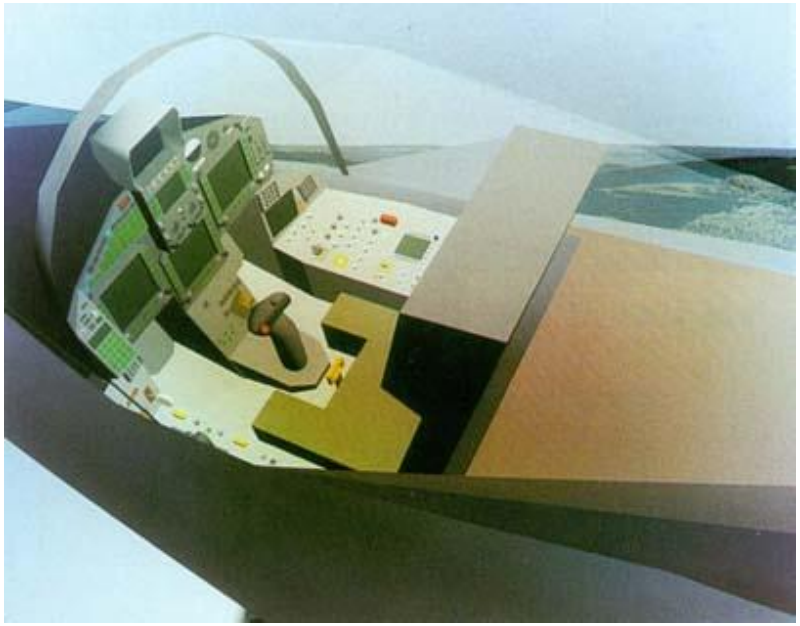
History (contd.)

- 1984: Jaron Lanier creates the term “Virtual Reality” and founds VPL Research
- Late 80’s: First VR products by VPL-Research (DataGlove and EyePhone)

Jaron Lanier
(WWW pic)

History (contd.)

- 1987: British Aerospace Virtual Cockpit



Pictures: Kalawski

History (contd.)

- 1989: NASA VIEW System (Virtual Interface Environment Workstation)
  First complete VR system, project started in the early 80's

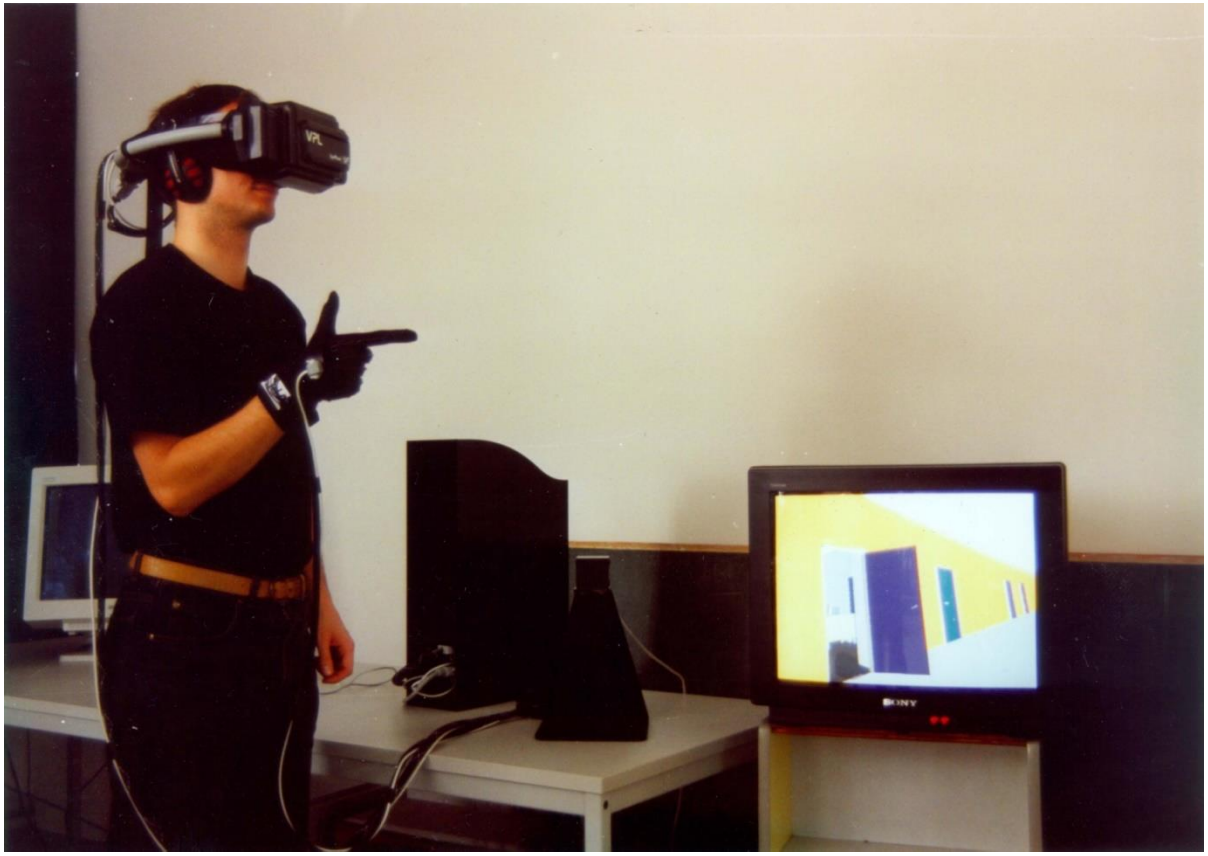
Pictures: Burdea et al.

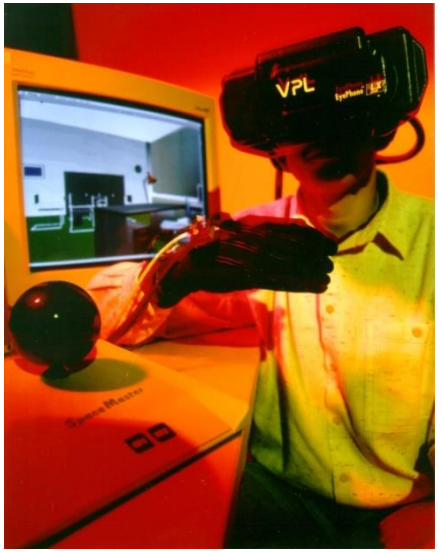
1989

1992

History (contd.)

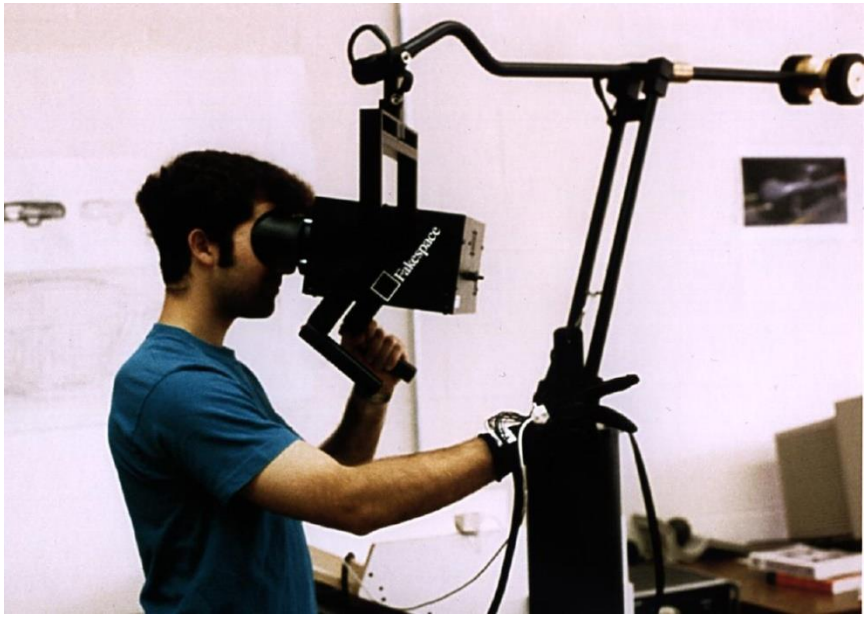
- 1992: First VR system (VPL Research) @ RWTH





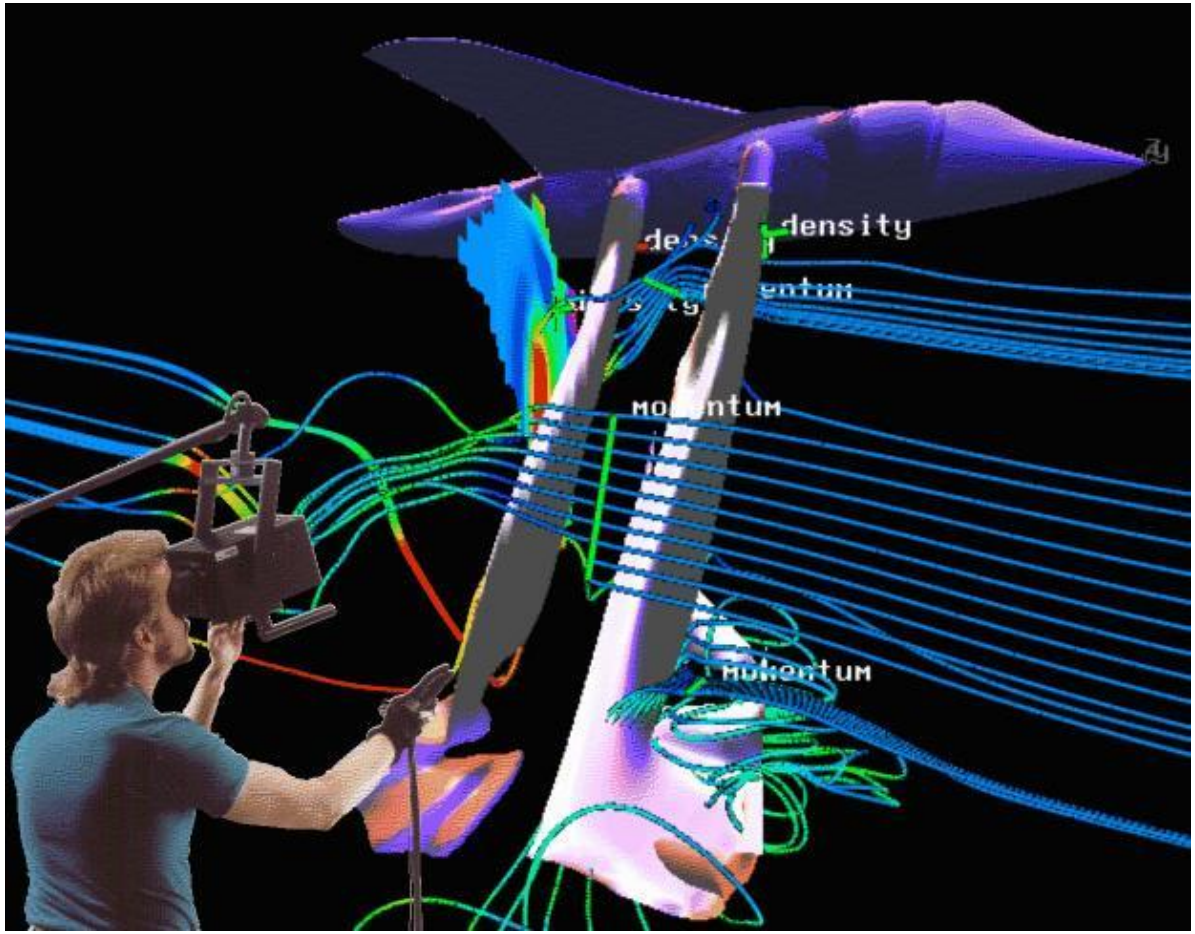
History (contd.)

- 1993: BOOM – Binocular Omni-Orientation Monitor
  - Head-coupled stereo display attached to counterbalanced multi-link arm
  - Head tracking via sensors in the links of the arm
  - U.S. patent held by Mark Bolas, manufactured by Fakespace Systems Ltd.
  - Driven by Silicon Graphics VGX380 workstation
    - 1280 x 1024 resolution, 800.000 shaded triangles/s



History (contd.)

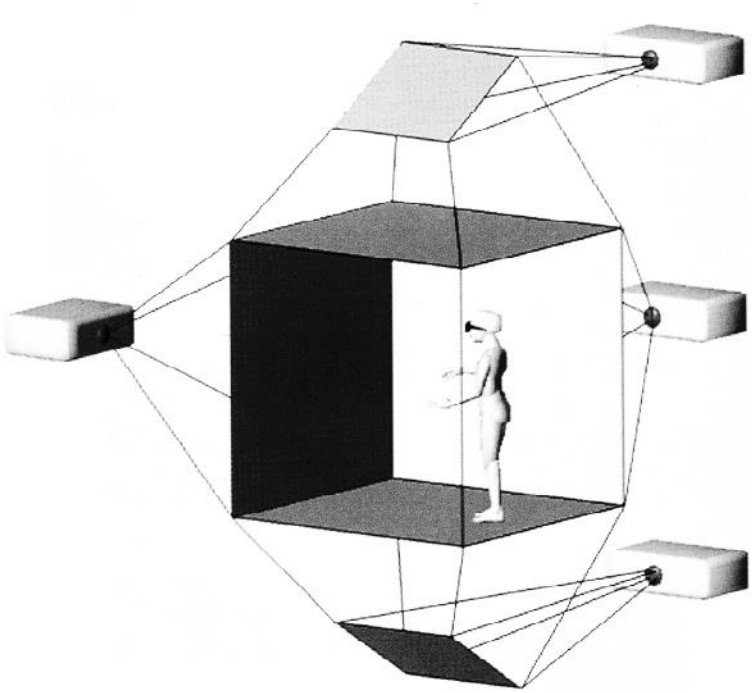
- 1993: NASA Virtual Windtunnel by Steve Bryson

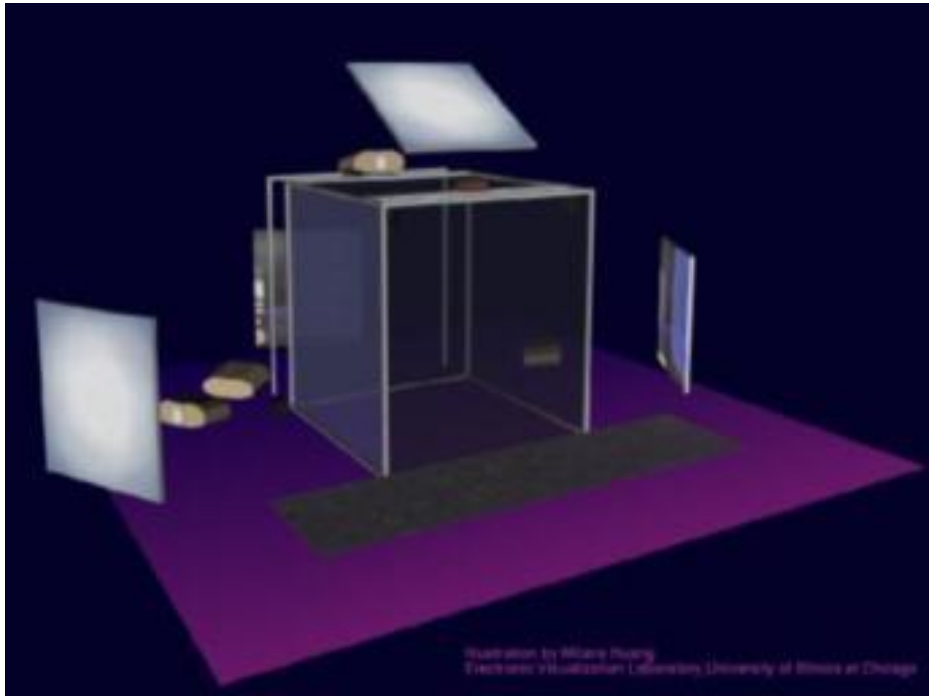


History (contd.)

- 1992: CAVE: Cave Automated Virtual Environment
  (Carolina Cruz Neira, University of Chicago)

Cruz-Neira, C., Sandin, D.J., DeFanti, T.A., Kenyon, R., and Hart, J.C. The CAVE, Audio Visual Experience Automatic Virtual Environment. Communications of the ACM, June 1992. pp. 64-72





Picture: Electronic Visualization Lab, Univ. of Chicago

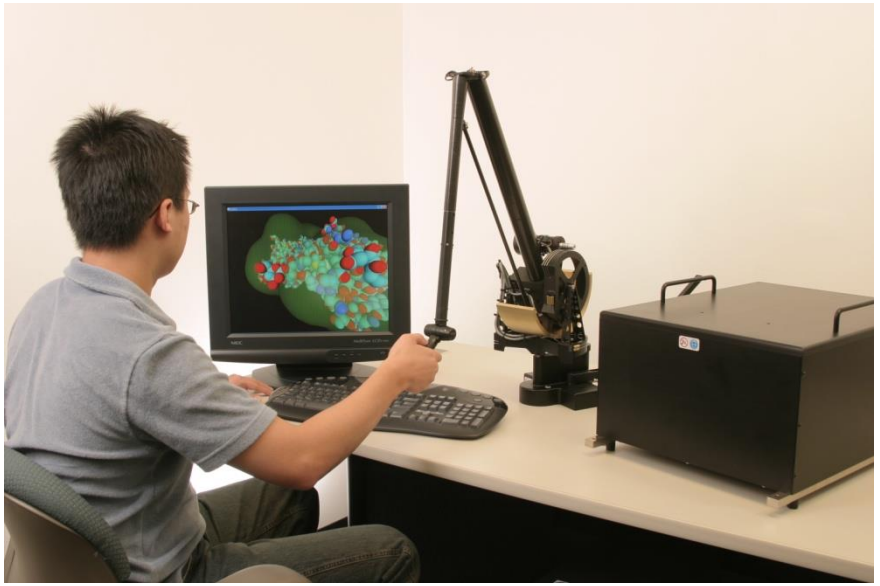
History (contd.)

- 1993: Silicon Graphics Reality Engine:

  Hardware-supported Gouraud Shading, Texture Mapping, Z-Buffering, Anti-Aliasing (ca. 200 000 Polygons/sec)

- 1993: OpenGL Standard (graphics library)
- 1993: PHANToM Haptic Device (T. Massie, K. Salisbury)

Pictures: Sensable Technologies



History (contd.)

- The early 90's: VR programming environments
  - RB2 – Reality Built for two (VPL Research)
  - WorldToolKit (Sense8 Corporation)

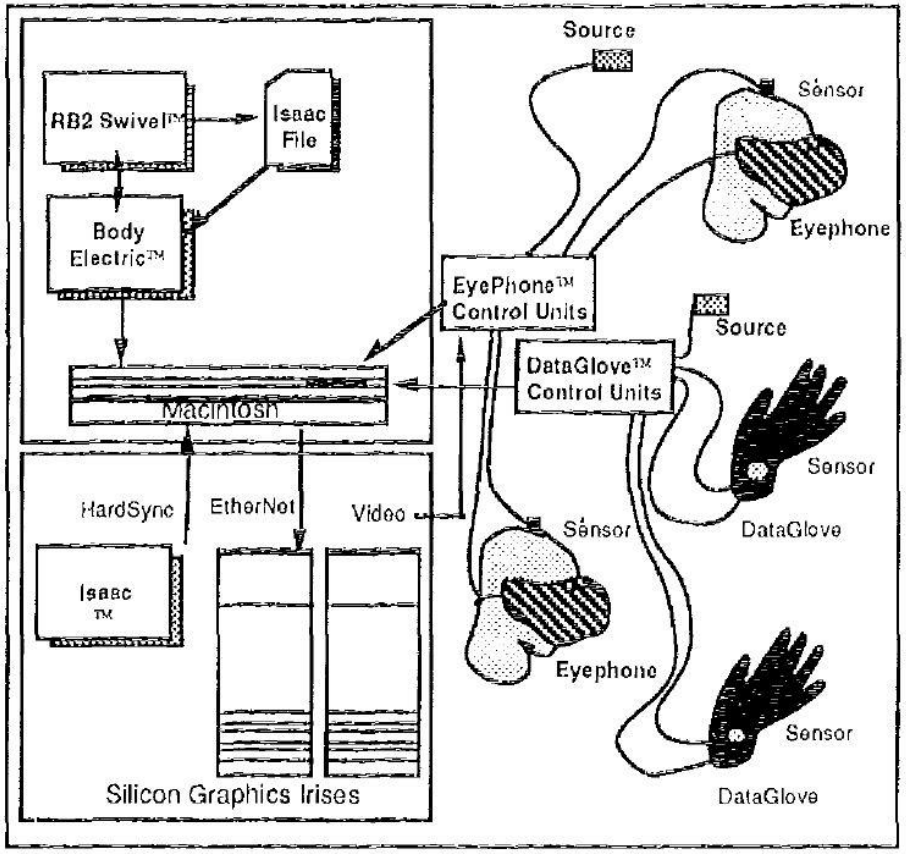


figure 1: RB2 Functional Diagram

History (contd.)

- 1995: Augmented Reality shows up
- 1996: Silicon Graphics Infinite Reality
- 1998: Silicon Graphics Infinite Reality2 (13 Mio Polygons/sec)
- 1998: Installation of an SGI Infinite Reality2 @ RWTH Computing Center

Picture: Silicon Graphics Inc.

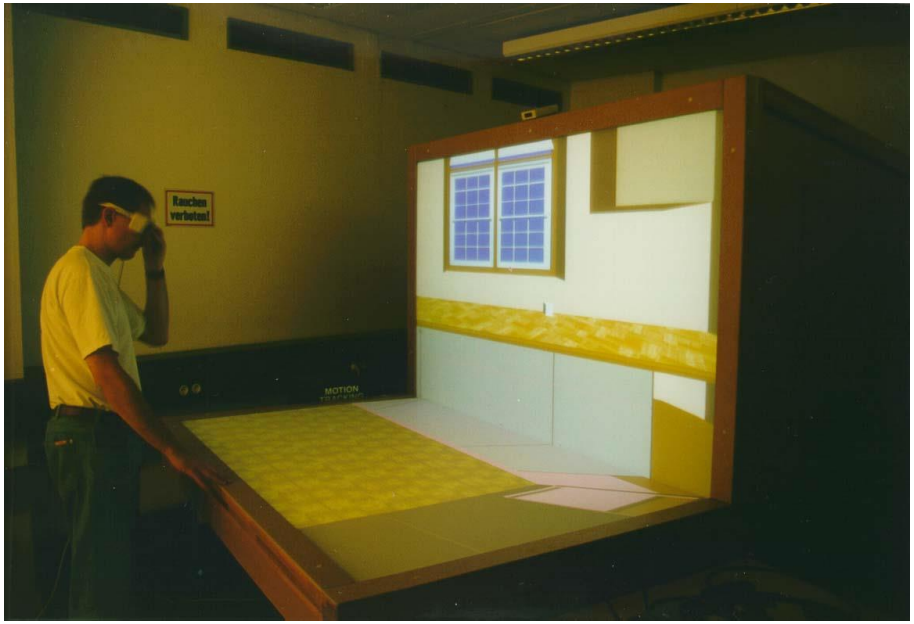
History (contd.)

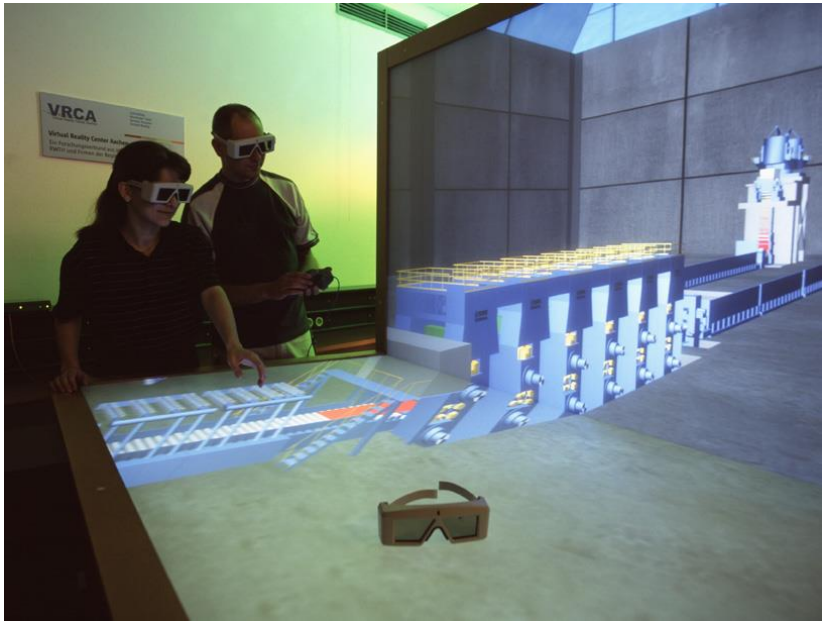
- German VR software companies get founded
  - 1998: VRCOM, Darmstadt
  - 1999: RTT, Munich
  - 2001: IC:IDO, Stuttgart (now member of the ESI Group)

- Virtual Reality Conferences and Associations
  - 1991: VRAIS Symposium
  - Since 1991: International Confernce on Artificial Reality and Tele-Existence in Japan (ICAT)
  - Since 1993: Eurographics Workshops on Virtual Environments in Europe (EGVE)
  - **Since 1999: IEEE International Virtual Reality Conference**
  - **Since 2003: Fachgruppe VR/AR der Gesellschaft für Informatik (GI)**

History (contd.)

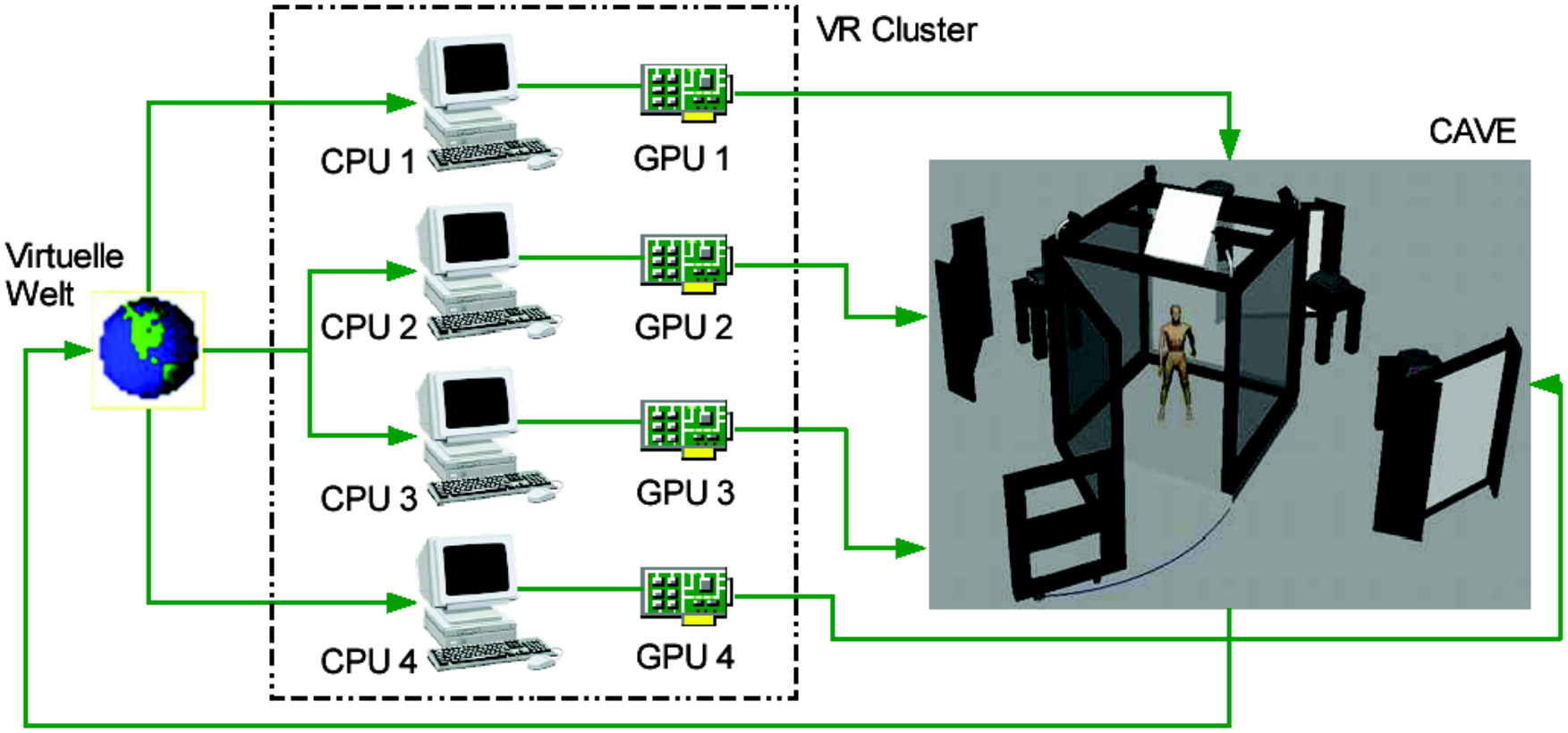
- 1998: Installation of an L-Bench @ RWTH Computing Center





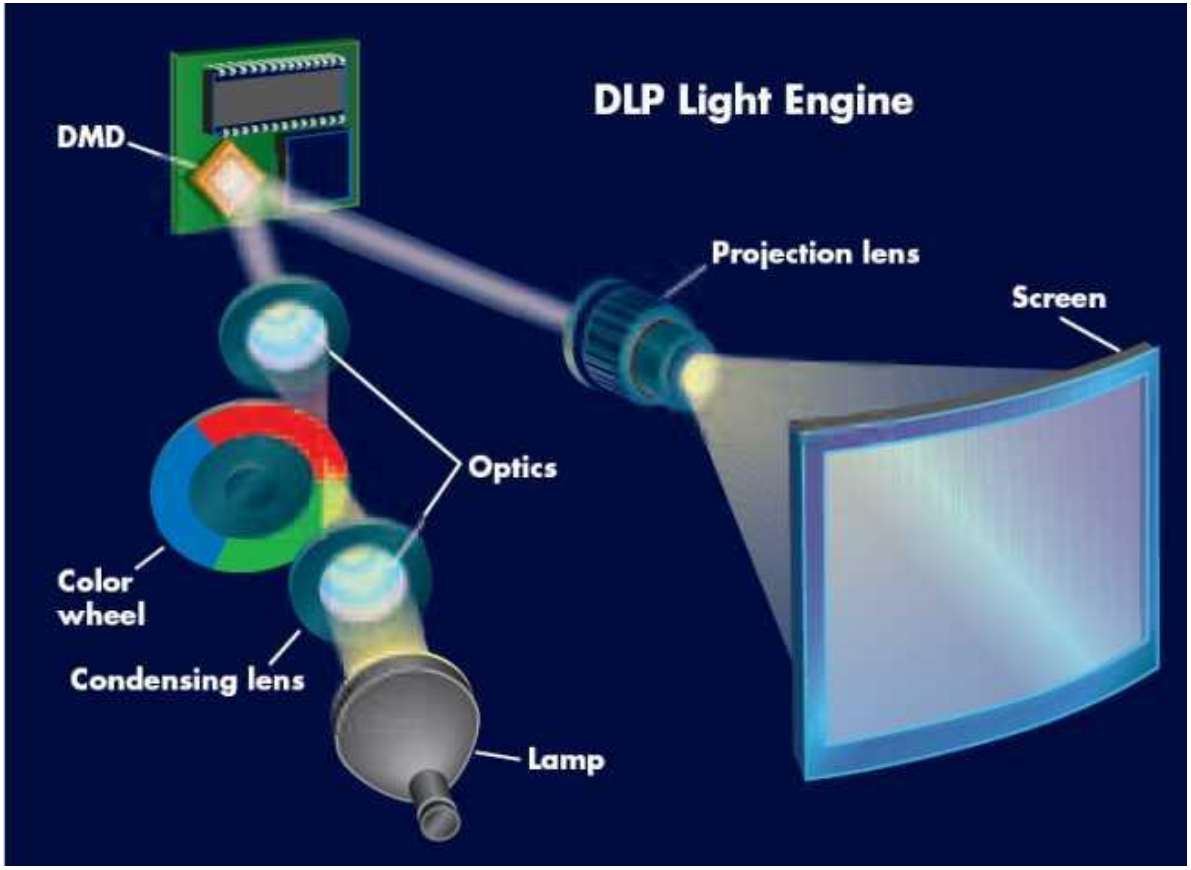
History (contd.)

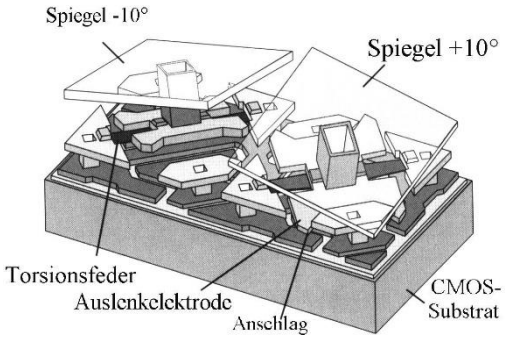
- 2002: PC graphics & PC Clusters (NVIDIA FX4000: 130 Mio. polygons/sec)

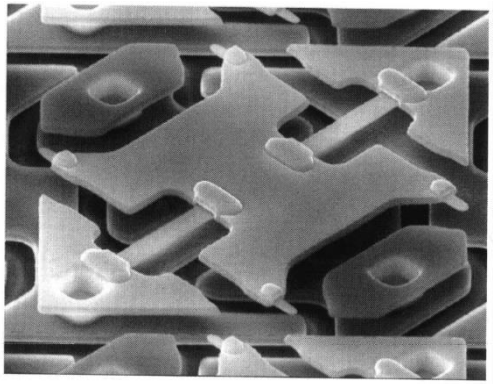


History (contd.)

- 2002: DLP/LCD Beamers & Optical Tracking in VR Systems

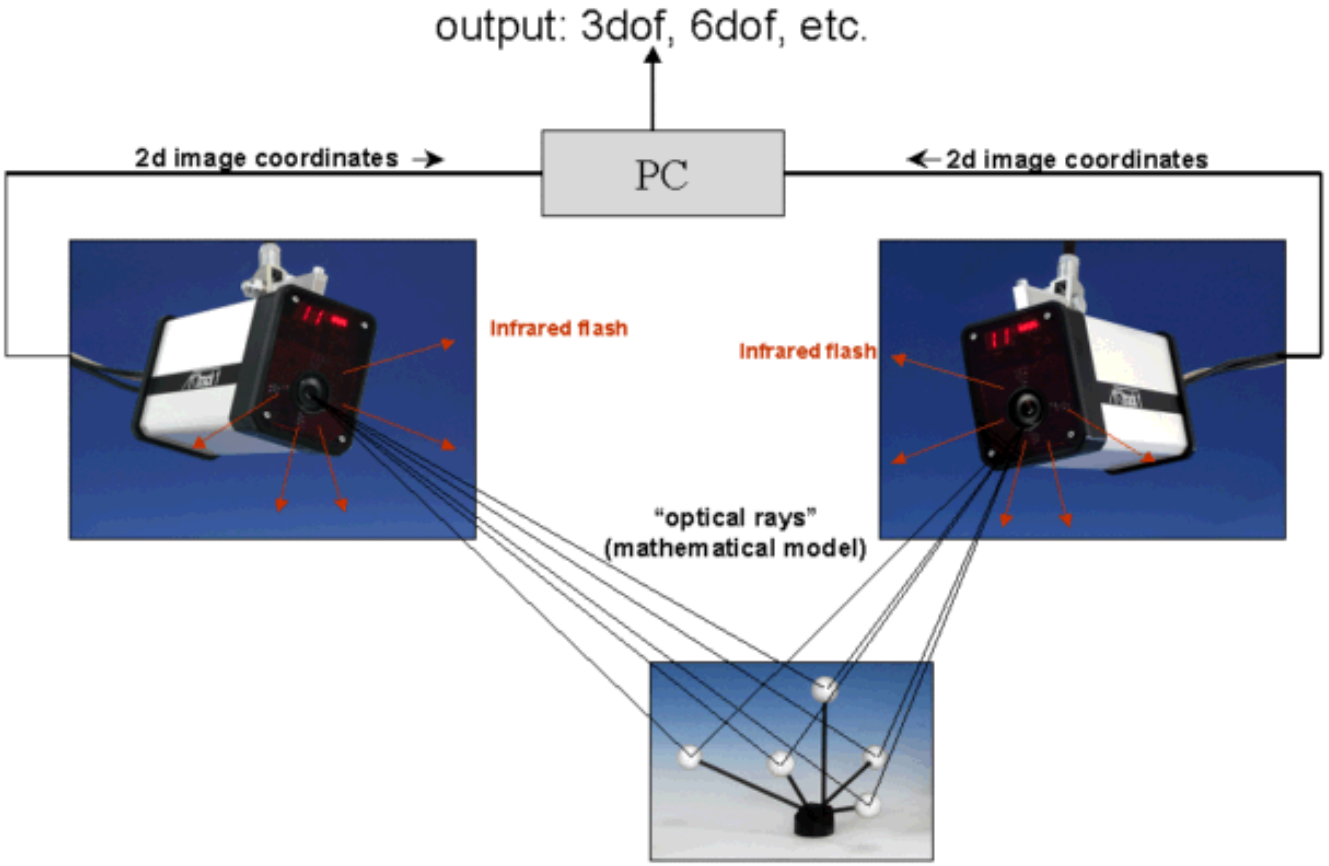






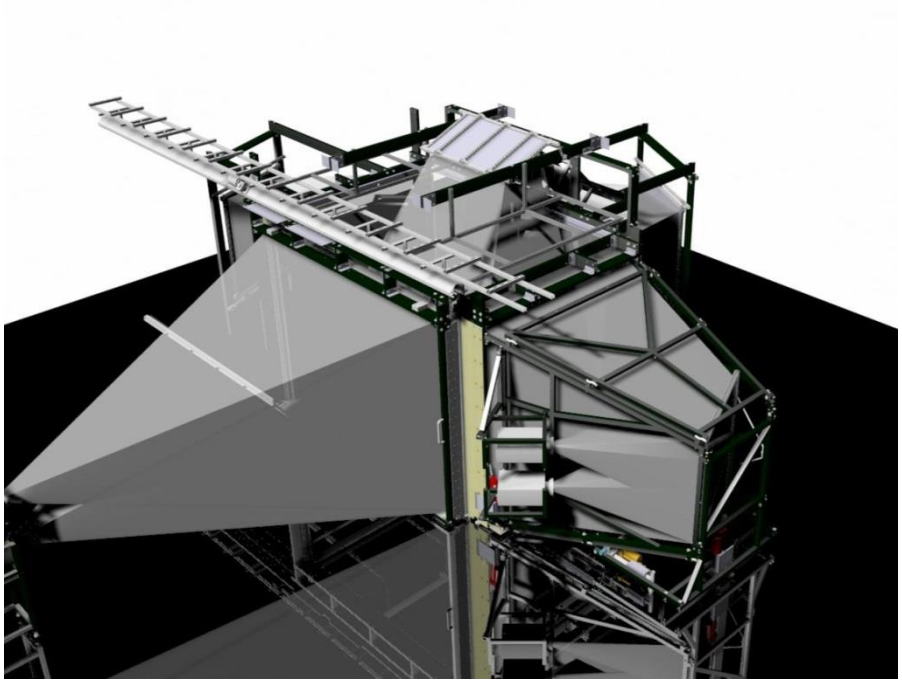
History (contd.)

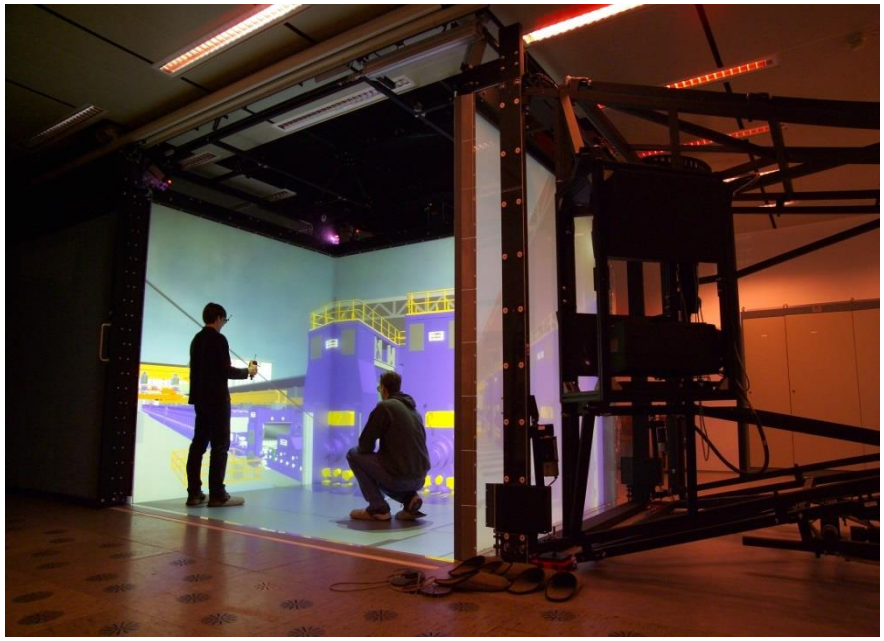
- 2002: DLP/LCD Beamers & Optical Tracking in VR Systems



History (contd.)

- 2004: First CAVE @ RWTH Computing Center





History (contd.)

- > 2010:
  - Development of VR applications in military, automotive industry, medicine, …
- 2012: First Cave-like displays based on LCD panels

- > 2013:
  - Consumer products for 3D interaction and immersion
  - Game engines become “VR-aware” (Unity, Blender, Unreal, Crytek …)

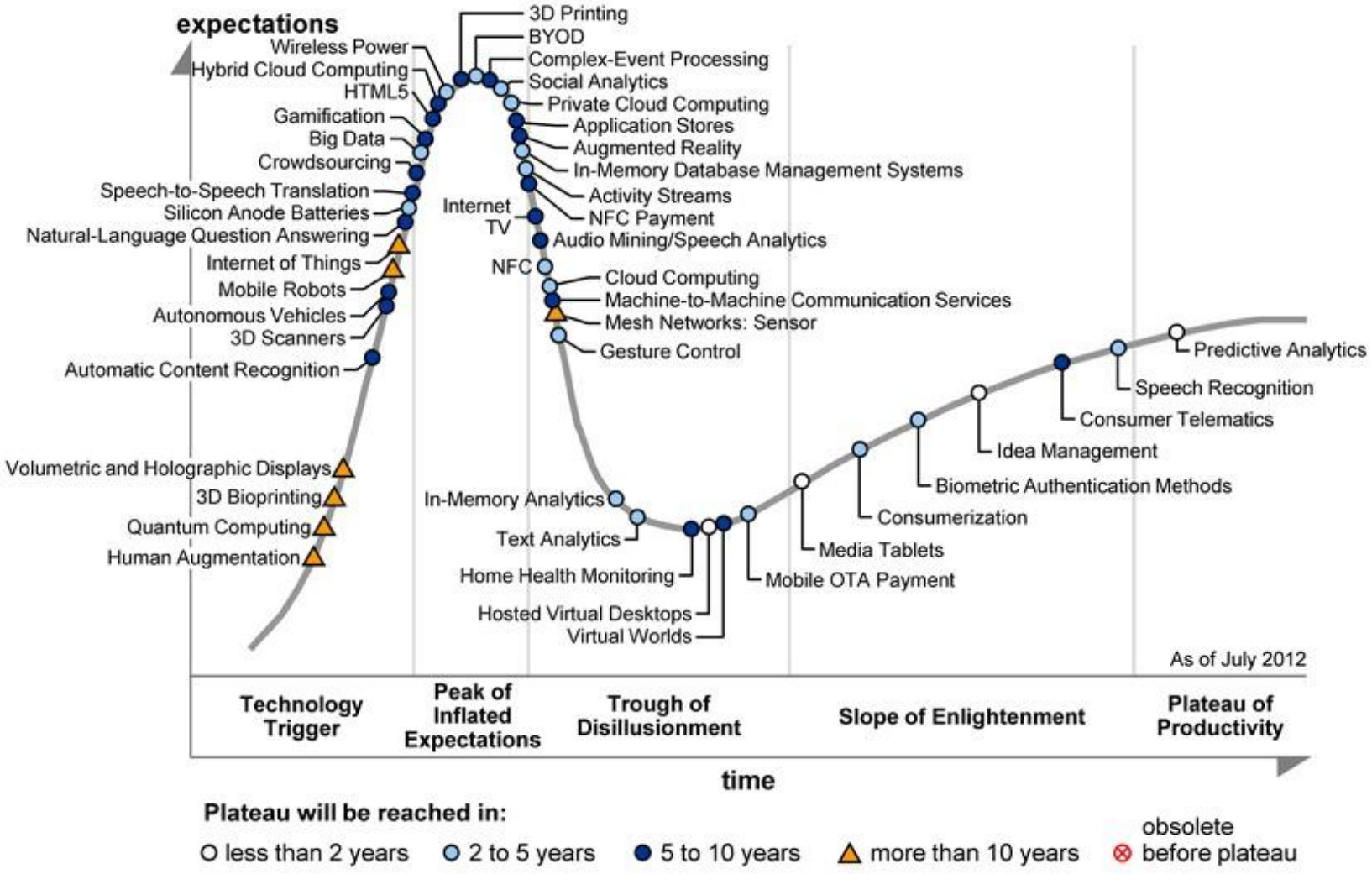
History (contd.)

- 2015: BMW simulator as example for a serious application in product development making use of
  - Unreal 4 game engine
  - HTC vive HMD

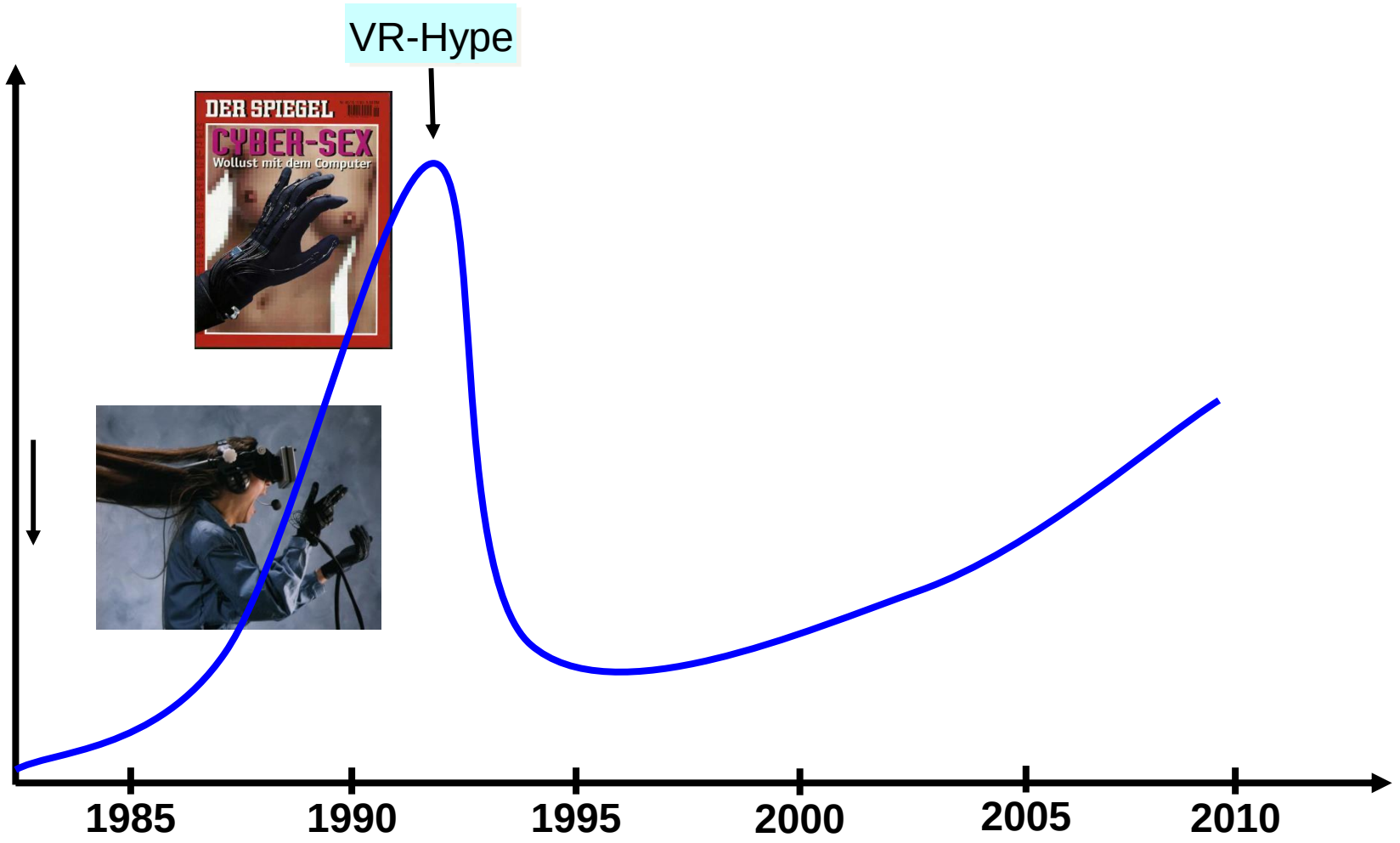
History (contd.)

- 2016 IEEE VR Technical Achievement Award for Oculus Rift developers

Gartner's 2012 Hype Cycle for Emerging Technologies



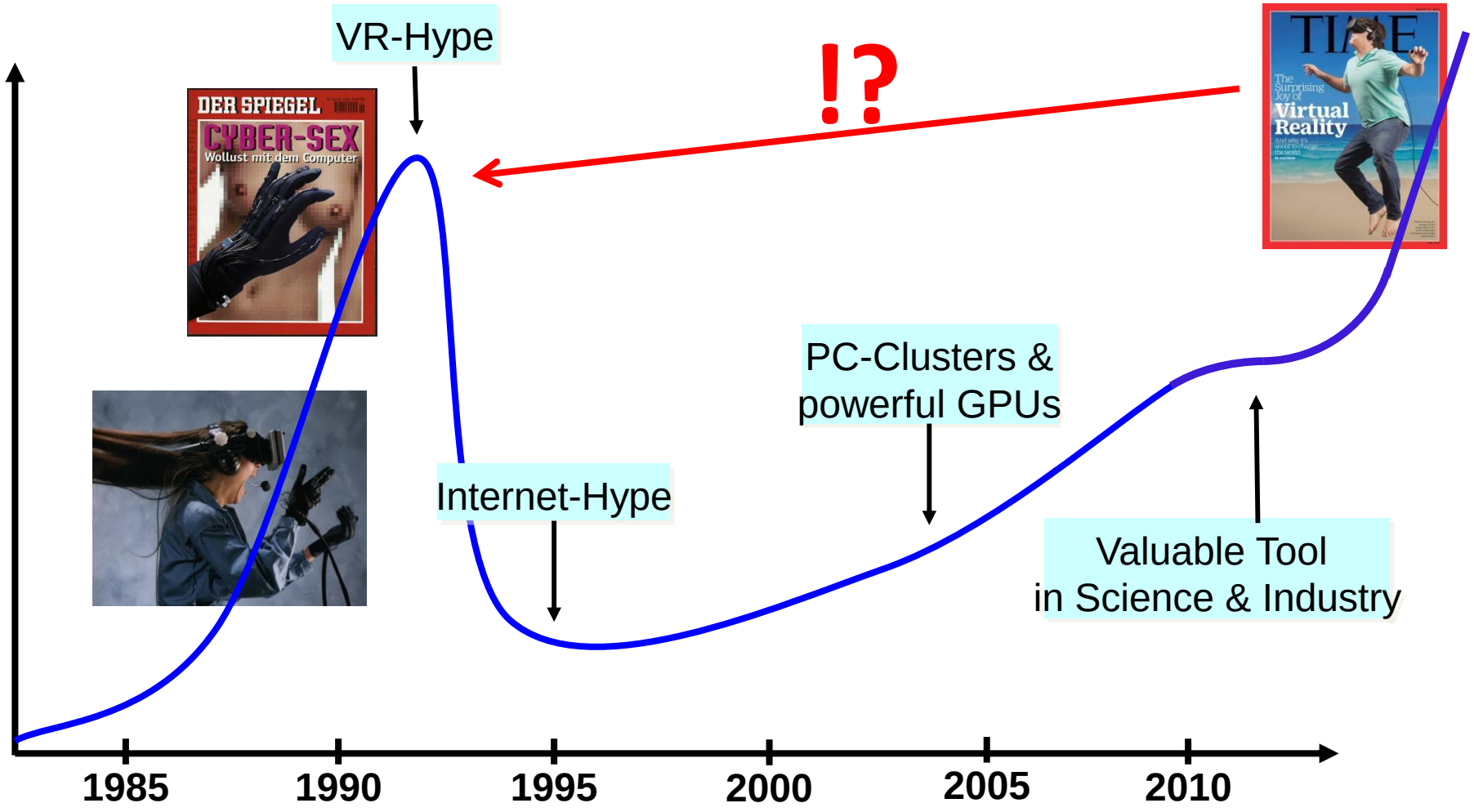
VR “Success Rate” over the Years



A Typical Attitude in the Early 90's Hype

"Cyberspace lasse die Grenzen zwischen Wirklichkeit und Illusion verschwimmen, fürchtet hingegen der Berliner Datenschutzbeauftragte Hansjürgen Garstka: Er ahnt suchtbildendes Potenzial, sieht 'die Möglichkeit, eine heile Welt zu erschaffen, in der man alle Probleme lösen kann, immer als Sieger hervorgeht' - ein Fluchtversuch, der nur scheitern könne und Menschen lebensuntüchtig mache."

VR “Success Rate” over the Years



A Typical Attitude in the New Hype

“I have little doubt that fifty years from now, parents will be raising a howl over Virtual Reality shooter games be Virtual Reality shooter games that allow their kids to actually feel the splatting blood from the blown-off head of a holographic zombie, and that they will pine for the idyllic days of 2004, when children enjoyed such harmlessly cartoonish pastimes as ‘Resident Evil’ and ‘Grand Theft Auto’.”

"*Ich habe kaum Zweifel, dass sich Eltern in fünfzig Jahren über Virtual-Reality-Ballerspiele aufregen werden, die es ihren Kindern ermöglichen, das Blut tatsächlich zu fühlen, dass aus dem holografischen Zombie kommt, dem der Kopf weggeballert wurde. Sie werden sich nach den idyllischen Tagen von 2004 sehnen, als Kinder so harmlose, Cartoon-artige Freizeitbeschäftigungen wie 'Resident Evil' und 'Grand Theft Auto' hatten*.“

(Harold Schechter, Professor at Queen College New York City and prominent book author)