Smart glasses: technology and applications

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Ubiquitous Computing Seminar FS2014

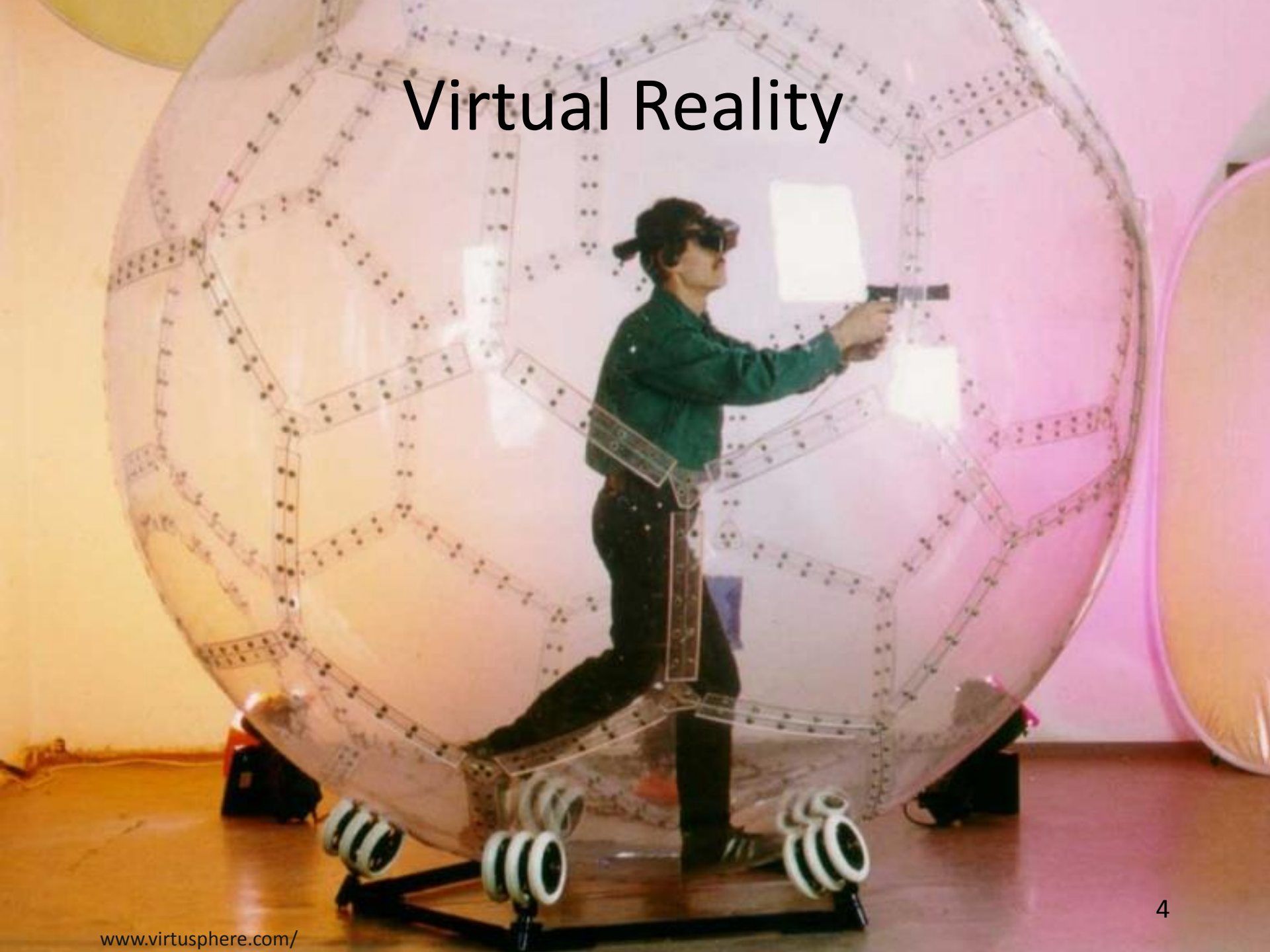
http://thenextweb.com/gadgets/2013/09/30/dont-fancy-a-smartwatch-ions-sub-100-smartglasses-might-be-for-you/#!AnvlE

How can we alter or improve what we see with digital content?

Augmented Reality

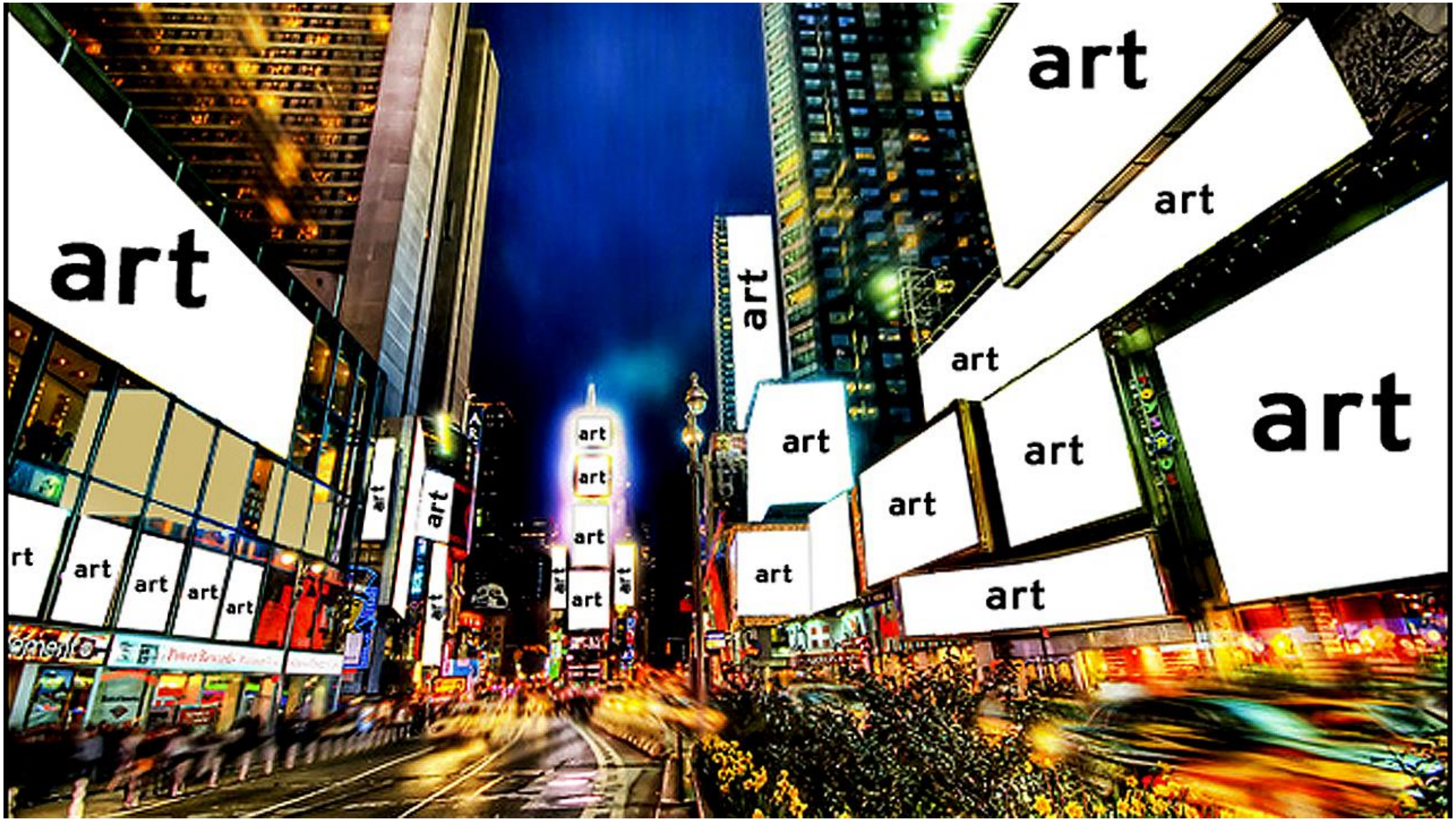
http://media.smashingmagazine.com/wp-content/uploads/2012/11/MIS_Ch05-028.jpg

Virtual Reality



www.virtusphere.com/

Diminished Reality



http://www.animalnewyork.com/2012/what-if-all-ads-in-times-square-were-replaced-with-art/

Challenges

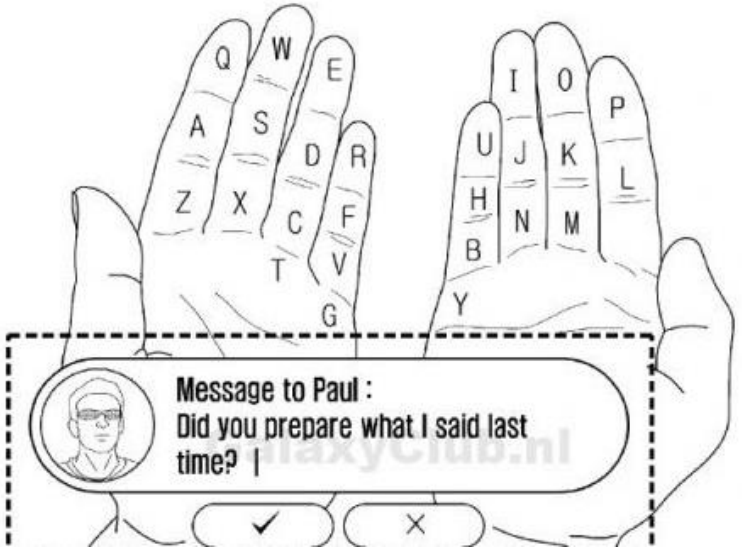
- Create high quality virtual content
- Aligning the virtual with the real
- Tracking position and orientation of head
- Size, weight and power consumption
- Display technology
- Latency
- Motion sickness
- Interaction

[Zhou 2008]
[Azuma 1999]

Interaction

- Speech
- Touch
- Eye Tracking
- Gestures
- Typing?

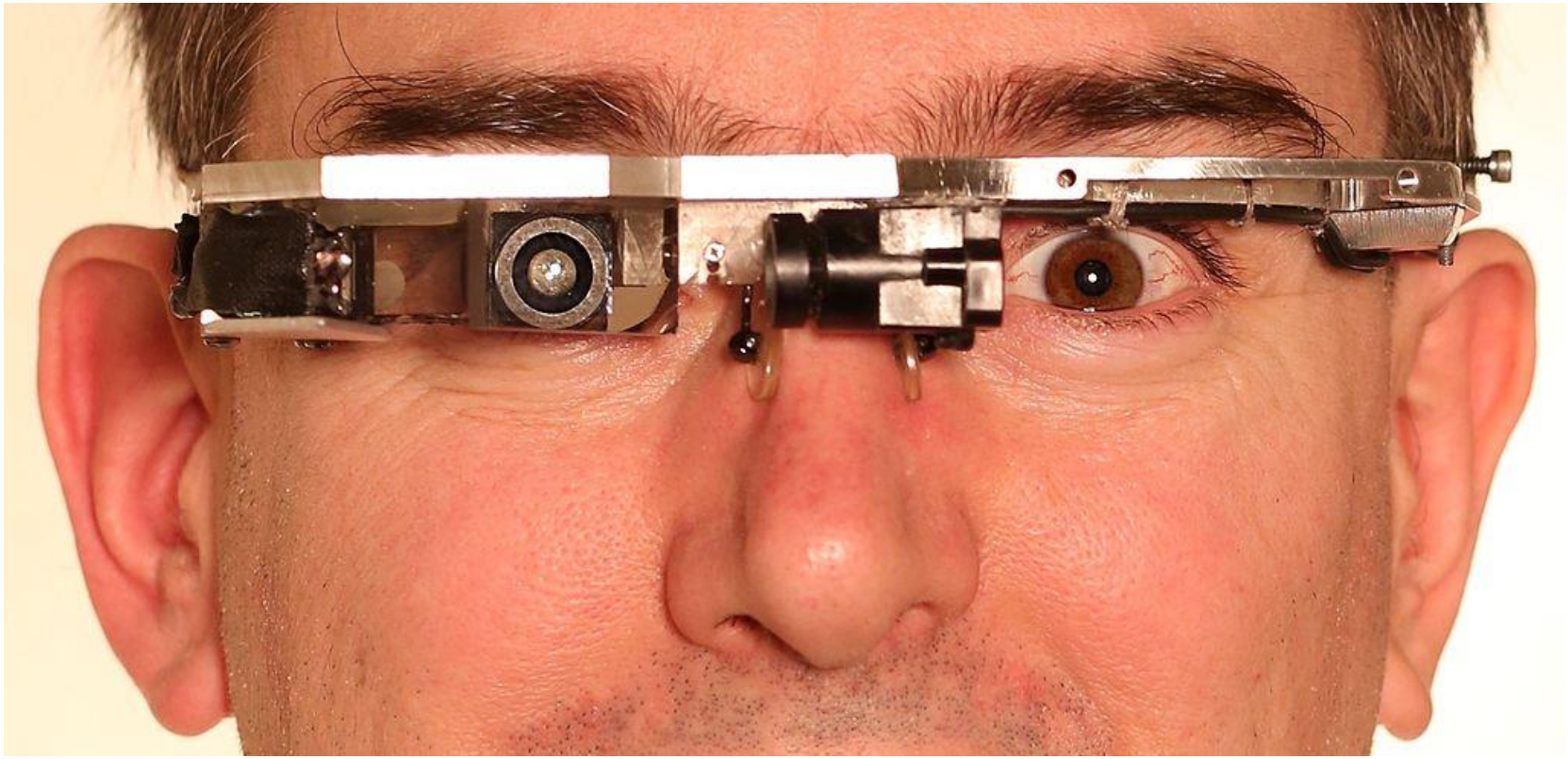
More next week



http://www.handykey.com/
http://www.intomobile.com/2014/03/07/samsung-glass-rock-augmented-reality-keyboard/

Different Smart glasses

History: Steve Mann



[Mann 2004]

Evolution

Glasses with one display in peripheral vision

Can:

- Display information
- Be “smart” (sensing, processing, actuation)

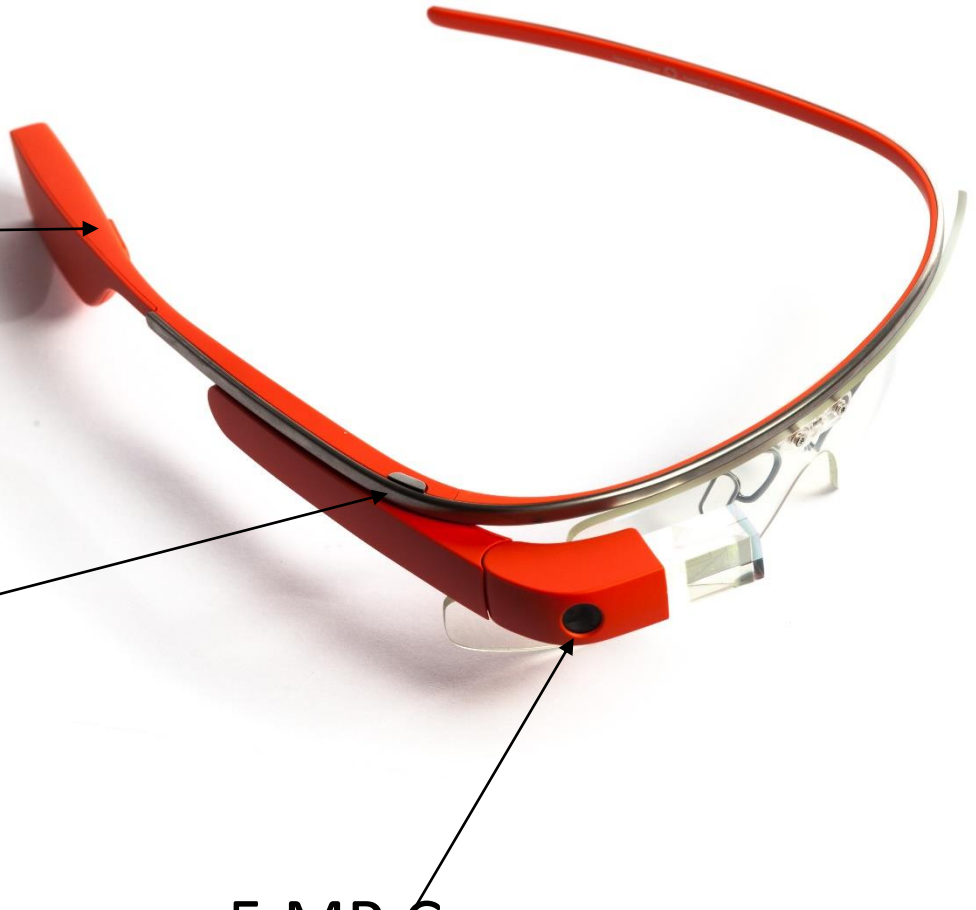
Can not:

- Produce 3D content
- Create a virtual or diminished reality
- Fully exhaust the possibilities of augmented reality

Google Glass

50g weight

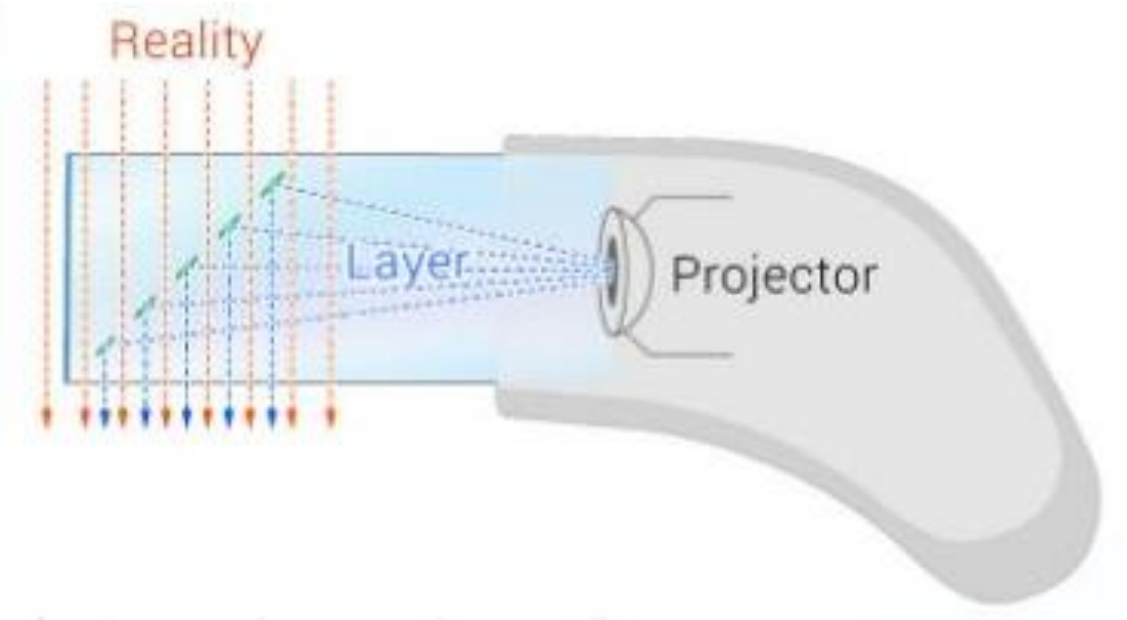
- Battery (~one day)
- Bone Conduction Transducer for audio



- Logic Board (no cellular connectivity) comparable to IPhone 4
- Camera/Video Button
- Touch Pad
- 5 MP Camera
- 720p Video

[Pedersen 2013]
http://www.catwig.com/google-glass-teardown/teardown/glass-clearshade-isometric.jpg

Google Glass: The display



http://www.dailymail.co.uk/sciencetech/article-2306382/How-Glass-works-New-infographic-reveals-secrets-Googles-interactive-eyewear.html

"Our goal is to reduce the time between intention and action"

Larry Page, Google CEO

Vuzix M100

- Hardware very similar to Glass
- Available now (in USA) $1000
- Cellular connectivity
- 428 x 240 color-LCD

http://www.vuzix.com/consumer/products_m100/

Sturdy industrial smart glasses

Brückner TRAVIS

- Embedded PC worn in a vest
- Six hardware buttons

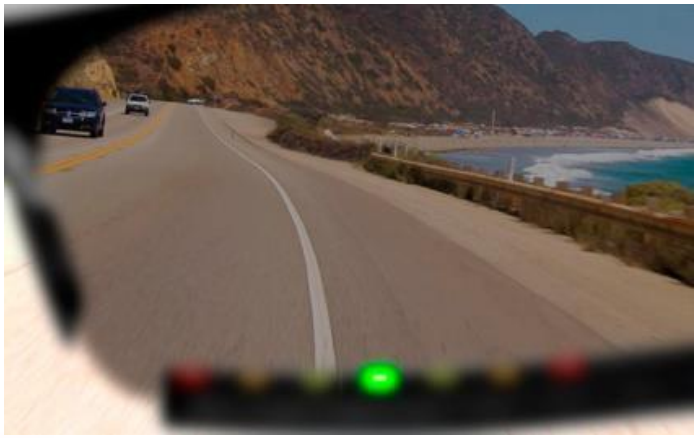
httpwww.brueckner.com/en/brueckner-servtec/services/remote-services/remote-service-tools

XOEye XOne

- No display
- two 5-megapixel cameras
- 128GB memory

http://www.xoeye.com/XOEye%20Press%20Kit%20%28January%29.pdf

Sport glasses: 4iiii Sportiiiis



Sport glasses: Reckon MOD

- -20°C to 30°C operating temperature
- Water resistant
- Wrist remote

http://www.techradar.com/reviews/gadgets/recon-instruments-mod-live-hud-1141185/review

Smart glasses with two displays

- Can be used to create:

  virtual reality

  augmented reality

  diminished reality

Augmented Reality with Cast AR

http://technabob.com/blog/2013/10/15/castar-augmented-reality-glasses/

Cast AR in action

http://www.youtube.com/watch?v=H3HGrclGkIE

How Cast AR works

- Projectors project video onto surface
  alternating time windows
  (50% of a small time interval for each projector)

- Retro-reflective sheet reflects rays back with almost the same angle.
  Enables multiple users with different perspective

- Active shutter glasses black out pictures destined for the other eye

Addition of RFID board for new way of interaction

- RFID board below surface
- Place RFID tags in miniature chess figures
- Board recognizes figures and communicates location to PC
- 3D Visualization will be added
  no need for controller or keyboard

Virtual reality with Oculus Rift

Tracks head movement in 3D space using:

- Gyroscope
- Accelerometer
- LED lights and camera
- Magnetometer

Relies on PC for calculations and rendering

http://www.pcworld.com/article/2096386/eyes-on-with-oculus-rifts-crystal-cove-vr-prototype-and-first-launch-game.html

Oculus Rift in action

http://www.pcgames.de/Oculus-Rift-Hardware-256208/News/Oculus-Rift-Crystals-Cove-Erster-Blick-auf-neuen-Prototypen-im-Video-1104328/

Latest Development

- Sony announced Project Morpheus

http://www.extremetech.com/gaming/178867-sonys-project-morpheus-prototype-is-a-hit-bodes-well-for-the-future-of-virtual-reality

Applications

Camera

- Video
- Pictures

- Hands-free
- Personal
- Point of view
- No obscured sight
- Hidden?

Convenience

- Navigation
- Time
- Notifications
- Memory aid

http://www.bmwblog.com/2011/10/07/head-up-display-2-0-augmented-reality/

Universal remote control

- Remote control television, speakers, heating… with virtual remote control

- Control PC with virtual display and virtual/physical remote control

[Heun 2013] [Colaco 2013]

Medical

- Track medicine consumption
- Subtitles for hearing impaired (future)
- VR to distract from pain in physical therapy
- Software adjustable seeing aid
- Lenses that measure blood sugar
- “Sighted companion” for the visually impaired

[Manduchi 2012]

http://www.mirror.co.uk/lifestyle/health/are-the-elderly-taking-too-much-medication-1190816

Safety

- Warn when in danger
- Accident detection and reaction
- Video & Audio stream to police
- Possibility for surveillance by government

http://webpages.scu.edu/ftp/j1simmons/surveillance_home.html

Education

- Living history
- Augmented professor
- Sophisticated simulations for training
- Virtual objects to experience physics
- Virtual classroom?

http://www.geekexchange.com/digging-digital-history-34949.html

Military - AR binoculars

Creates Augmented objects for military training

Visual odometry with two cameras :

- wide FOV always used
- Low FOV when slow movement and enough content

[Oskiper 2013]

Entertainment

- 3D Virtual Reality Cinema
- Individual subtitles
- Virtual reality games
- Augmented reality games (i.e. augmented chess)
- Gamification

- The entertainment industry (and military) play an important role in funding research

http://smarterplanet.tumblr.com/post/85006075/this-kind-of-augmented-reality-tech-has-been-seen

Commerce

- Enhance billboards with Video
- Navigate users through stores while tracking eyes for customer understanding
- Help employees recognize customers

- Diminish commerce?

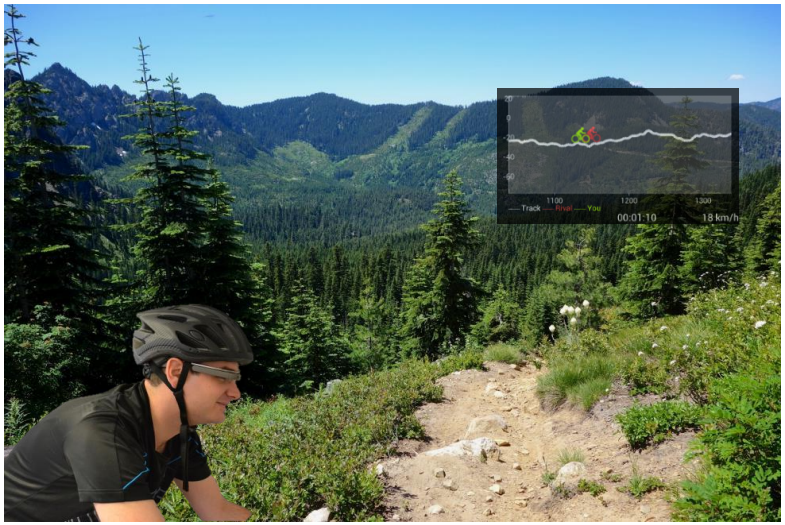
http://thenextweb.com/google/2014/02/10/google-glass-worn-virgin-atlantic-staff-help-passengers-check-londons-heathrow-airport/#!A6zsp

Productivity

- Stream Video to coworker, instructor, expert or trainee
- Watch instructions during work
- Real time translation
- Guide warehouse employees
- Augment construction sites with model
- Monitor employees eye movement?

Sports

- Performance measurement
- Performance comparison
- Communication
- In combination with other hands free features



[Sörös 2013]

Conclusion

- Promising hardware
  Will probably need a few iterations to get it right

- Many unique and useful applications possible
  Often easy to implement

- Interesting for business and entertainment industry
  → funding for research and development

Thank you for listening

References

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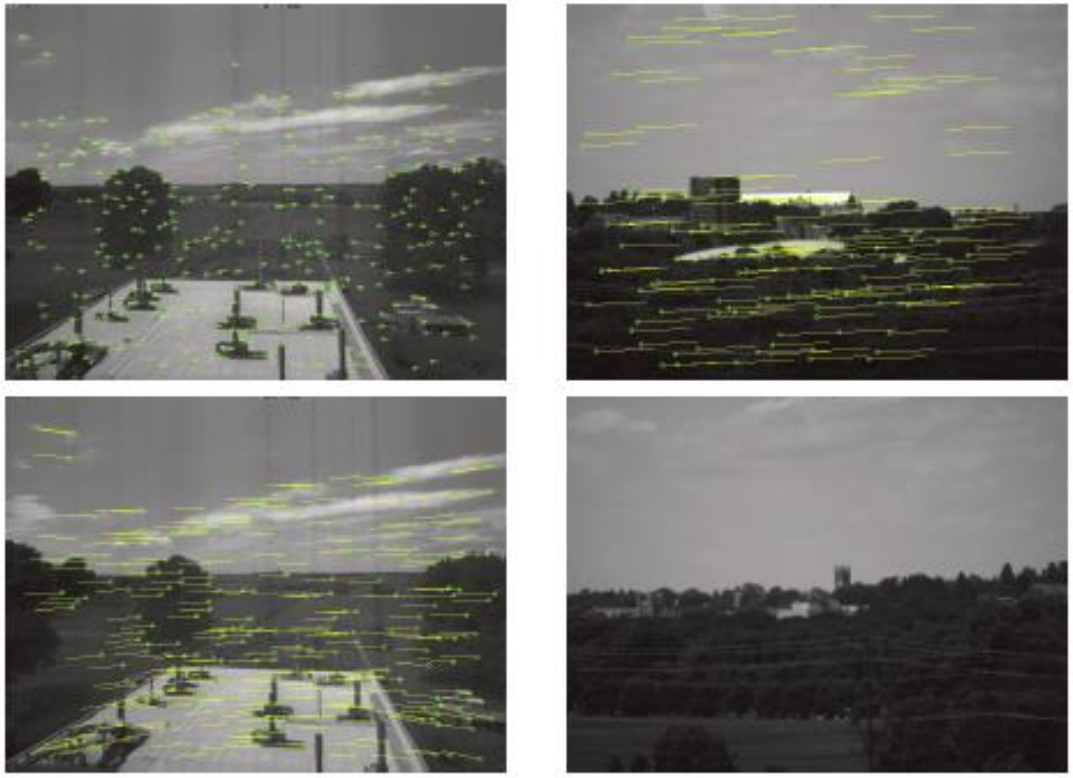
- **[Pedersen 2013]:** I. Pedersen et al - "Sergey Brin is Batman": Google's Project Glass & the Instigation of Computer Adoption in Popular Culture – CHI
- **[Oskiper 2013]:** T. Oskiper et al - Augmented Reality Binoculars - *ISMAR 2013*
- **[Zhou 2008]:** F. Zhou et al - Trends in Augmented Reality Tracking, Interaction and Display: A Review of Ten Years of ISMAR
- **[Heun 2013]:** V. Heun et al - Smarter Objects: Using AR technology to Program Physical Objects and their Interactions – *CHI*
- **[Colaco 2013]:** A. Colaco et al - Mime: Compact, Low-Power 3D Gesture Sensing for Interaction with Head-Mounted Displays - *UIST'13*
- **[Manduchi 2012]:** R. Manduchi and J. Coughlan - (Computer) Vision Without Sight
- **[Azuma 1999]:** R. Azuma - The Challenge of Making Augmented Reality Work Outdoors
- **[Sörös 2013]:** G. Sörös et al - Cyclo – A Personal Bike Coach Through the Glass

Backup Slides

Two cameras for Visual odometry

- Wide field of view camera always used
- Low FOV camera when movement slow (precise)



Glass Hardware

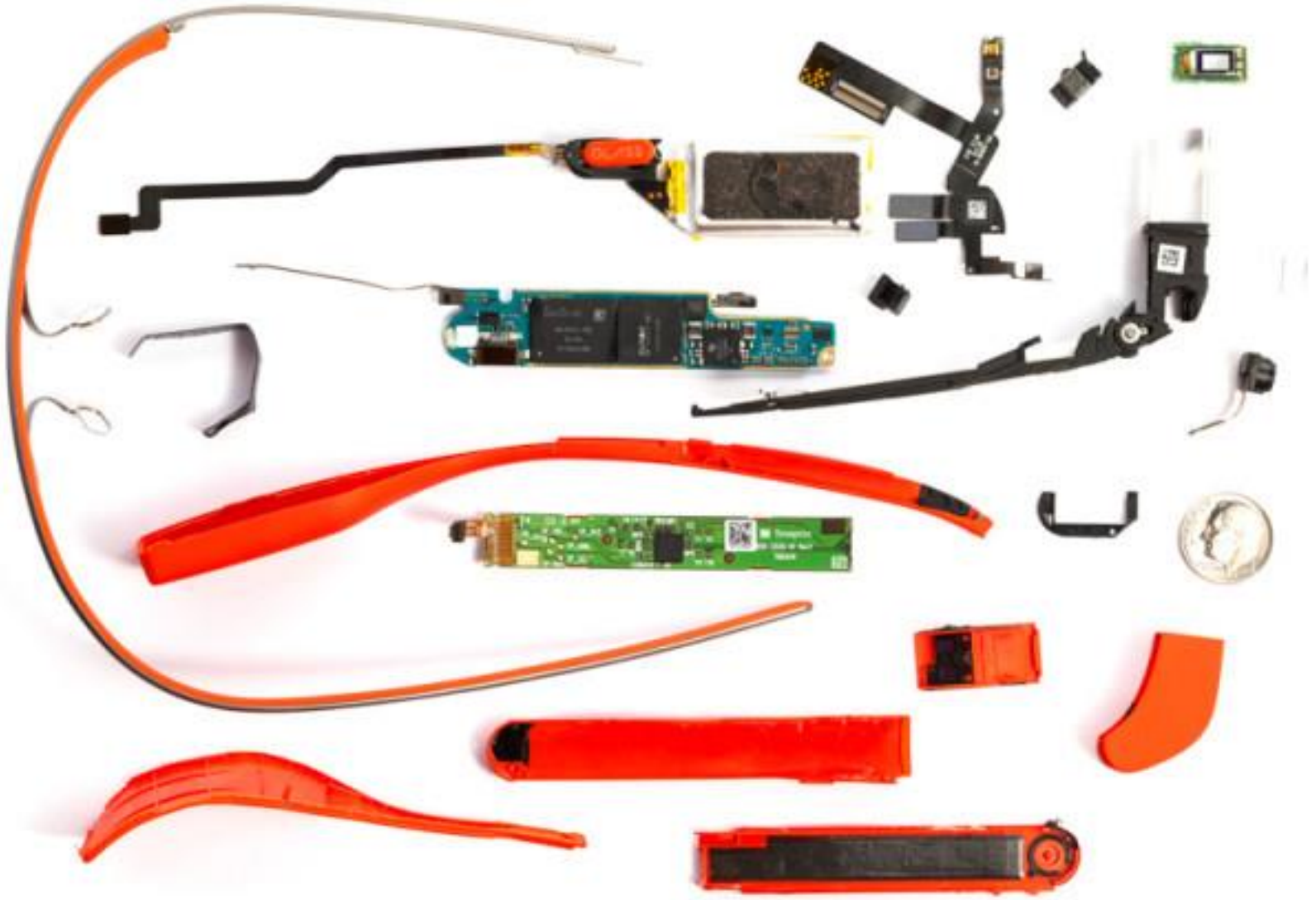


Image from http://andrewhy.de/what-is-inside-google-glass/

Glass Hardware

- **Processing**

  roughly equivalent to *iPhone 4* or *Samsung Galaxy Nexus*

  Texas Instruments OMAP 4430 SoC: 1.2 GHz Dual-core ARM Cortex-A9 CPU, PowerVR SGX540 GPU, 16GB storage, 682MB RAM, Android 4.0.4 OS (API 15)

- **Camera**

  cell-phone equivalent, 5MP still (2528x1856 pixels) or 720p video, no flash

- **Display**

  upright, color, prisma projector, 640×360 pixels, focused at a distance

- **Sensors**

  touchpad (long and narrow, 1366x187pixels), microphone, accelerometer, gyroscope, compass, GPS via phone

- **Communication**

  Bluetooth tethering through mobile phone, direct WLAN 802.11b/g,

  no cellular modem