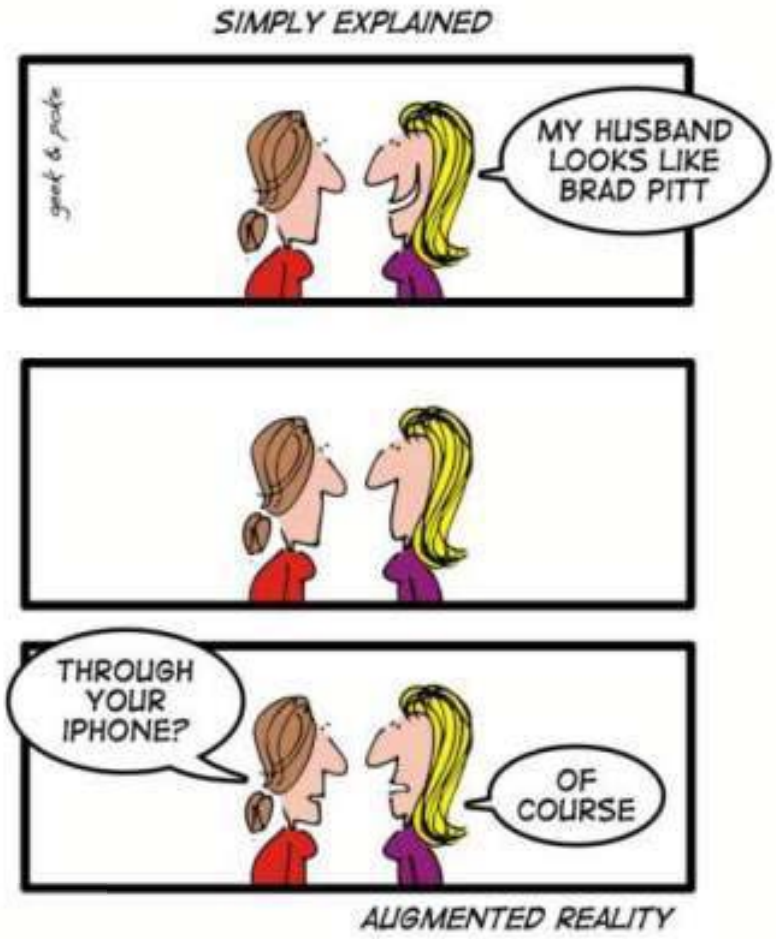
Recent Trends in Mixed Reality



Dieter Schmalstieg

What is Augmented Reality?

- **Virtual Reality**
- Completely replace real world

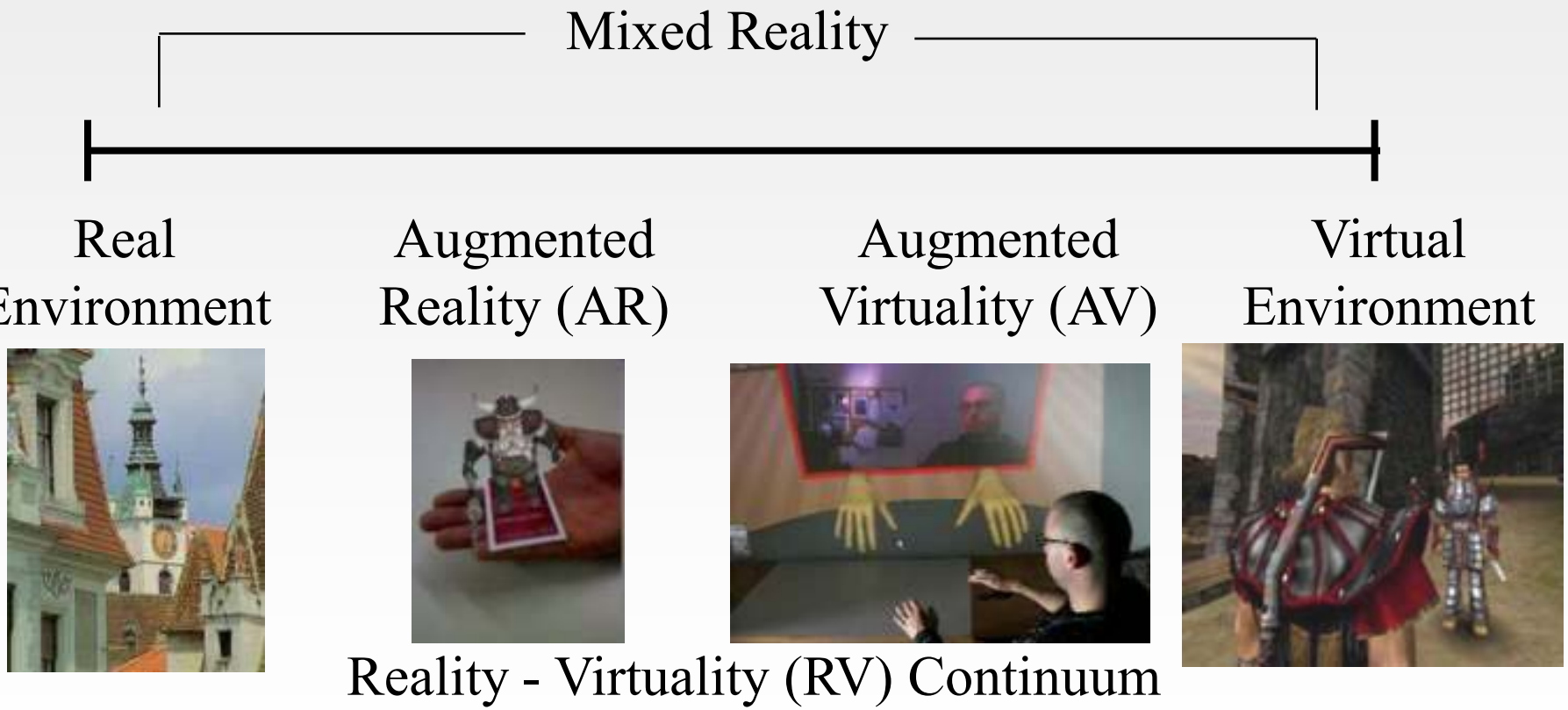
- **Augmented Reality**
- combine virtual + real
- Supplement reality
- Photorealism not a goal

Definition of Augmented Reality

1. Blends real and virtual, in real environment
2. Real-time interactive
3. Registered in 3-D

- Applies to all senses (auditory, haptic?)
- Not an HMD-specific definition
- Includes idea of removing part of real environment (a.k.a. mediated or diminished reality)

Milgram's Continuum



Adapted from Milgram, Takemura, Utsumi, Kishino.
Augmented Reality: A class of displays on the reality-virtuality continuum

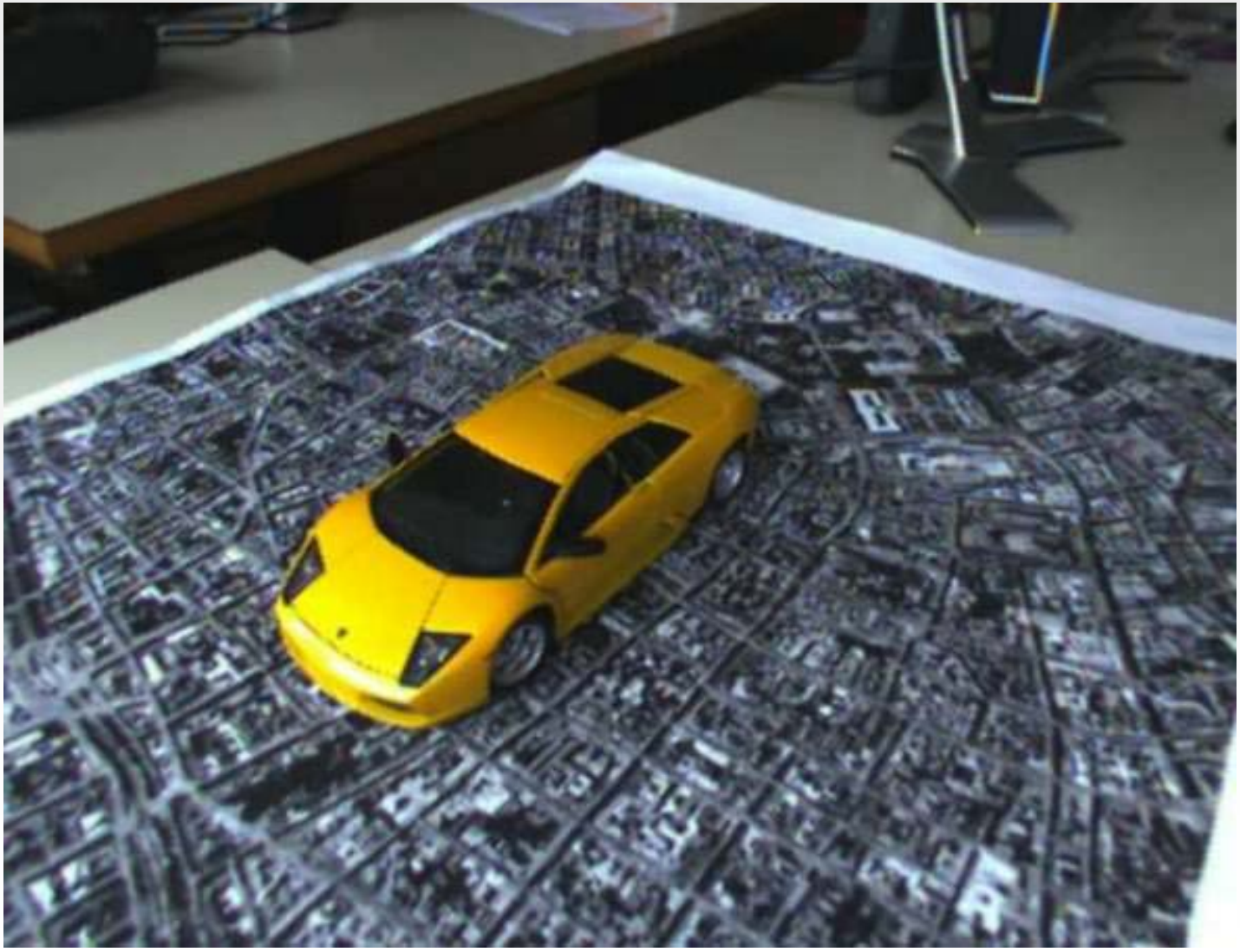
Why are we interested?

- Enhance perception of and interaction with the real world
- Potential for productivity improvements in real-world tasks

Origins of AR

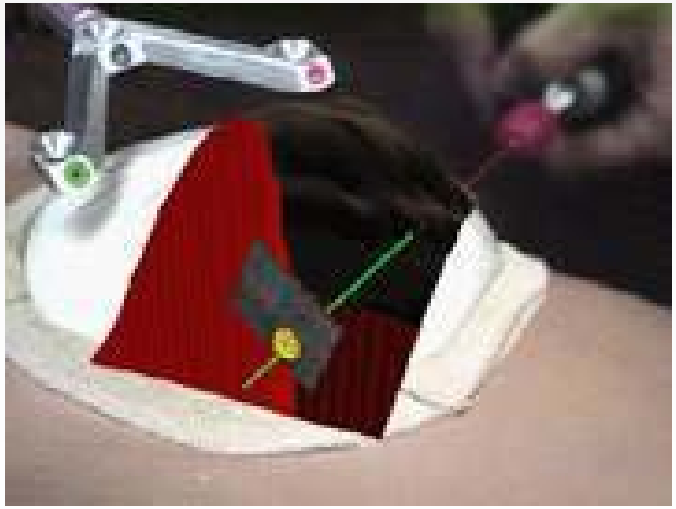
- 1960's: Sutherland / Sproull's first HMD system was see-through

X-Ray Vision



Applications in Surgery

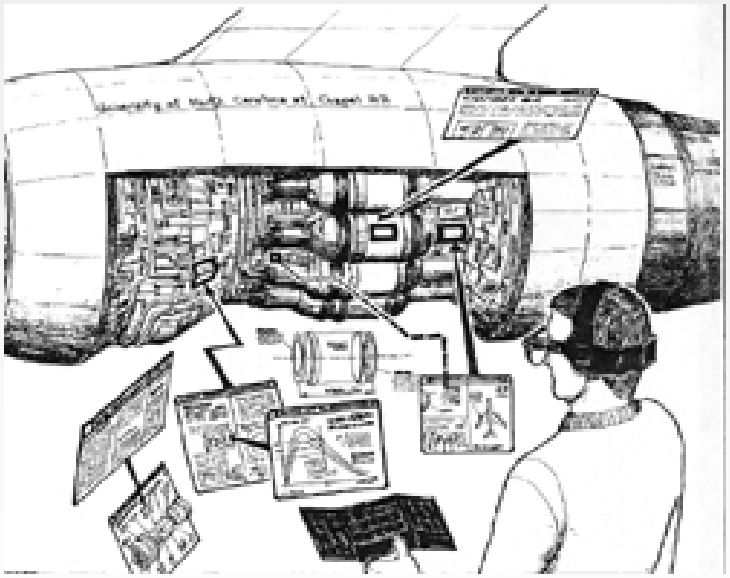
- "X-ray vision" for surgeons
- Aid visualization, minimally-invasive operations. Training. MRI, CT data.
  - Ultrasound project, UNC Chapel Hill.
  - ARAS, VRVis



Courtesy UNC Chapel Hill

Assembly and maintenance

**Boeing wire harness assembly.
Adam Janin wearing HMD.
Courtesy David Mizell, Boeing**



Courtesy Andrei State, UNC Chapel Hill

Application: broadcast augmentation

- Adding virtual content to live sports broadcasts
  - "First down" line in American football
  - Hockey puck trails, virtual advertisements
  - National flags in swimming lanes in 2000 Olympics
  - Advertisings at stadium boards

Applications: annotating environment

- Public and private annotations
- Aid recognition, “extended memory”
  - Libraries, maps [Fitzmaurice93]
  - Windows [Columbia]
  - Mechanical parts [many places]
  - Reminder notes [Sony, MIT Media Lab]
  - Navigation and spatial information access

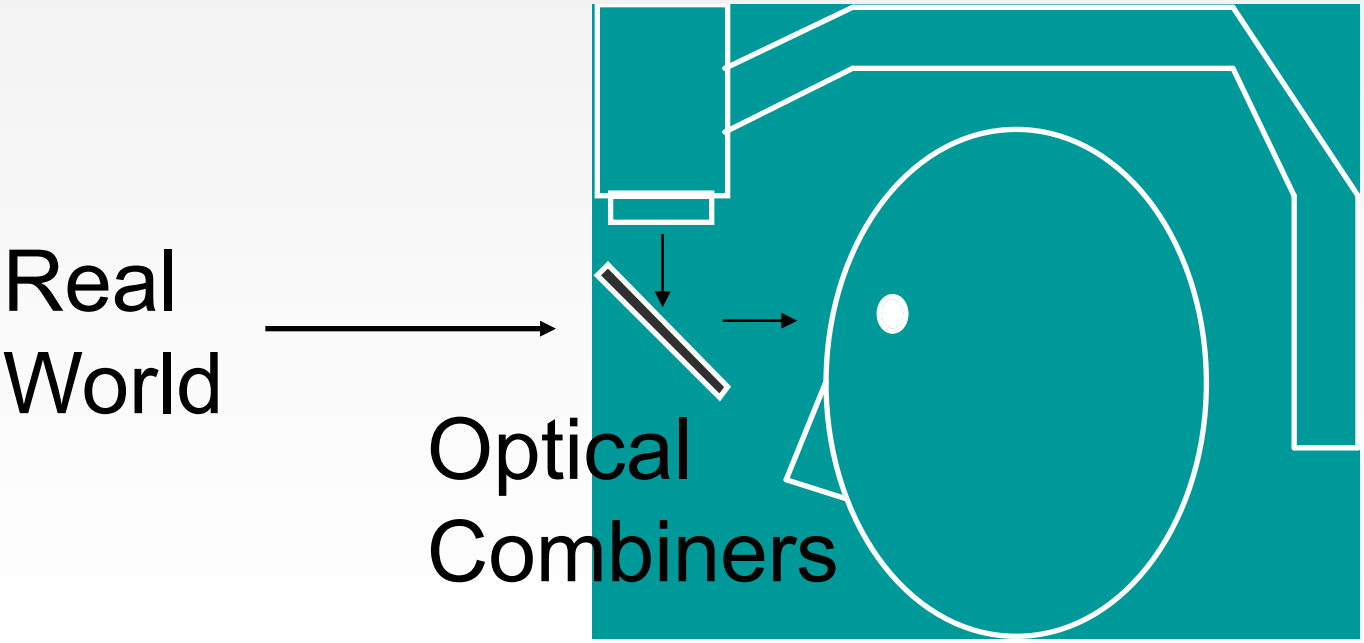
AR Panorama Interface

Displays for Augmented Reality

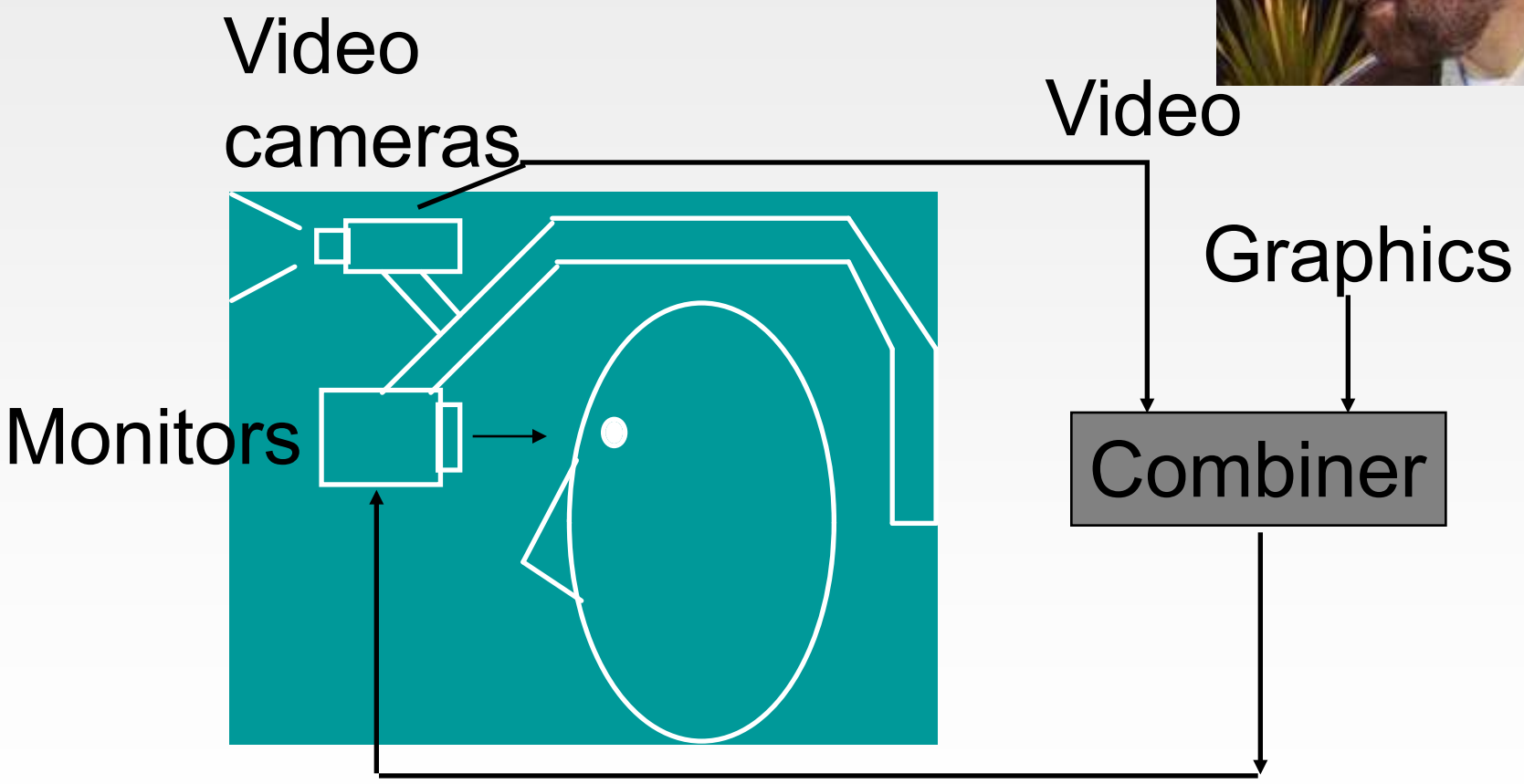
- Optical and Video see-through HMDs
- Video monitor Augmented Reality
- Projector based Augmented Reality

Optical see-through head-mounted display

Virtual images from monitors



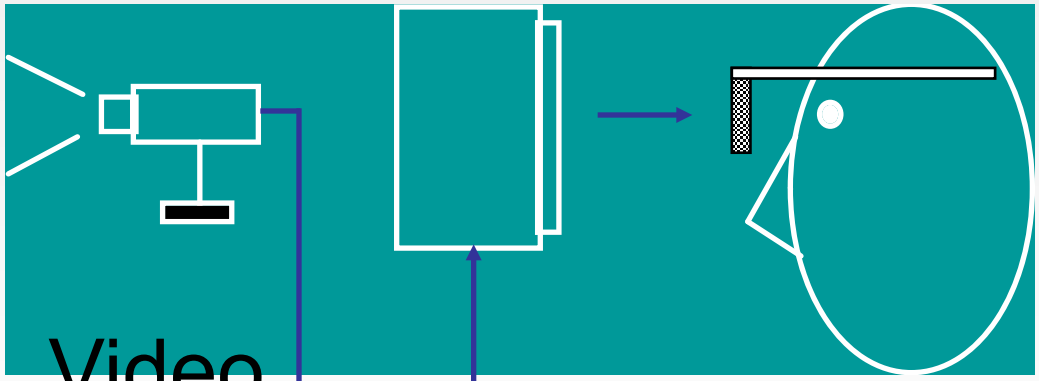
Video see-through head-mounted display



Video monitor Augmented Reality

Monitor
(or phone)

Video
cameras



Video

Graphics → Combiner

AR Backpack Examples

Columbia Touring Machine (2002)

Rockwell vest (1999)

AT&T Sentient AR (2001)

Handheld Augmented Reality

- Low Cost
- Robust and fool-proof
- Billions of devices
- Intuitive user
- Networking support
- Tracking support
- Rapid prototyping
- Content creation pipeline

Underground Visualization

Zooming Interface

MapLens

MR Experiences in *IPCity*

- *MapLens*: action in real environment, participants orient task to remote locations+people

- *TimeWarp*: action in augmented environment in Cologne - connect virtual and real gaming elements

- *MR Tent*: action takes place in real environment and participants make use of the resources of this environment to construct MR scenes

Web 2.0

- Flickr, Wikipedia, Youtub
- Social Networking
- End users provide content
- End users collaboratively rate/tag content
- Classification by statistics rather than semantics
- Phenomenon of critical mass
  - Universal broadband
  - Commodity PCs

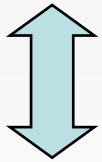
Geo-Databases

- Google Earth / MS Virtual Earth
- Massive amounts of data
- Added value through Mashups
- Free / paid by advertising

Enter Augmented Reality 2.0

AR for everybody:

- Smartphone
  = Inexpensive mass-marketed client



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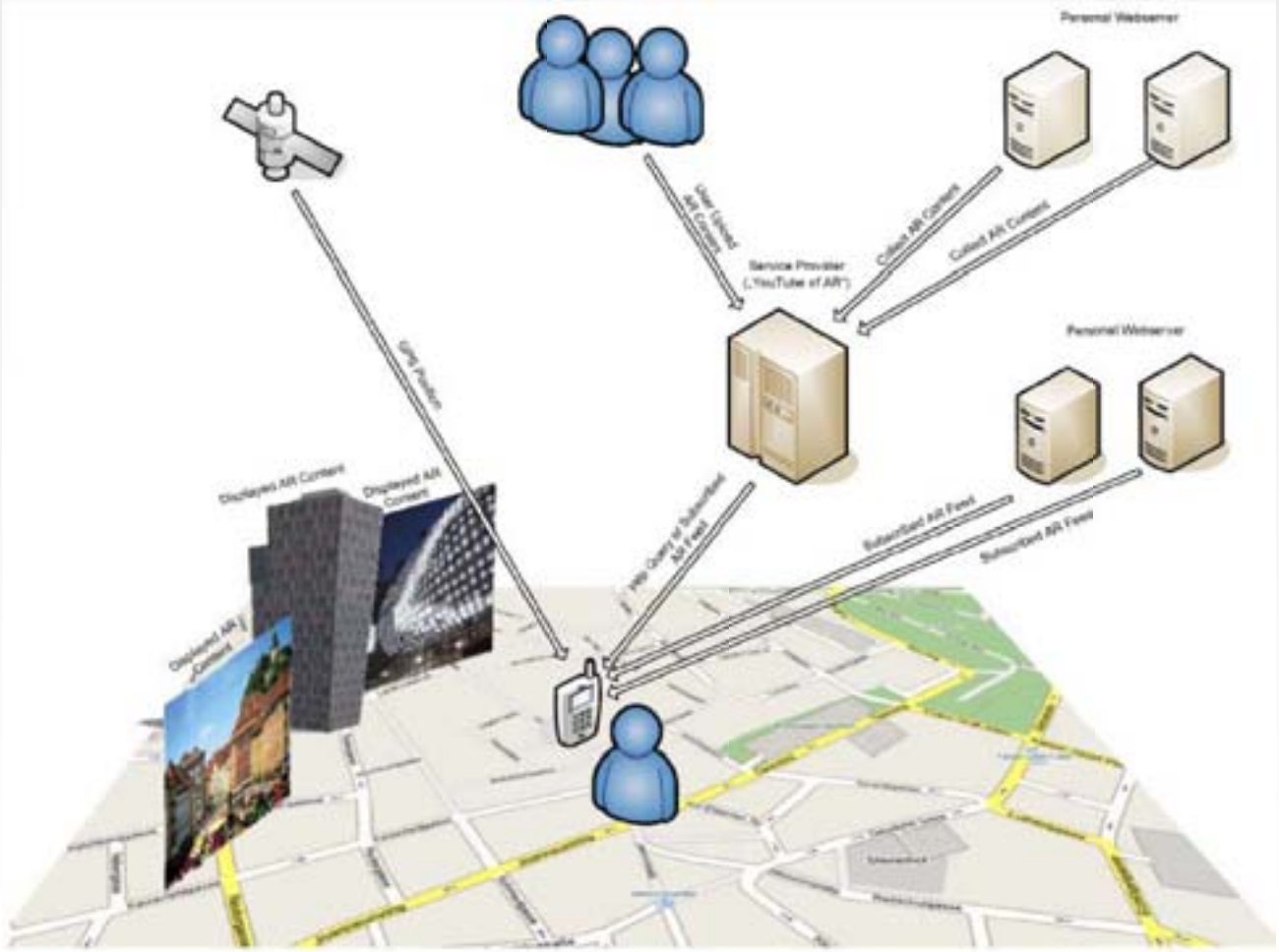
- Web 2.0
  = Deployment infrastructure

Leveraging Web 2.0

- Content retrieval using HTTP
- XML encoded meta information
  - KML placemarks + extensions
- Queries
  - Based on location (from GPS, image recognition)
  - Based on situation (barcode markers)
- Queries also deliver tracking feature databases
- Everybody can set up an AR 2.0 server
- Syndication:
  - Community servers for end-user content
  - Tagging
- AR client subscribes to arbitrary # of feeds

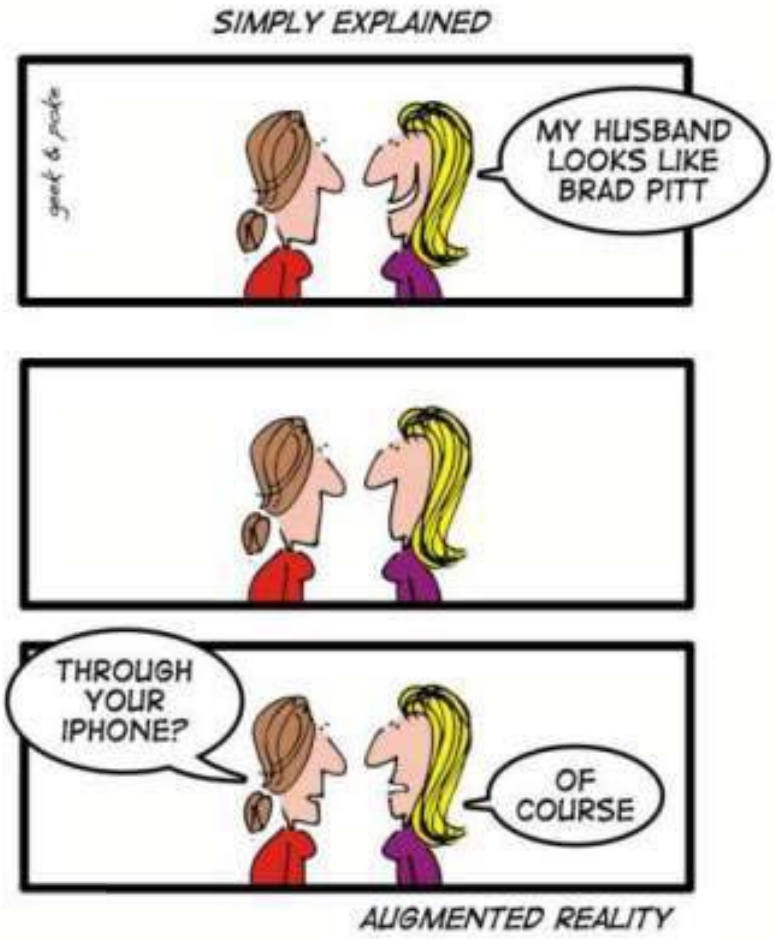
Augmented Reality 2.0 Infrastructure



Authoring – City Tales Scenario

- Most AR authoring to date on desktop
- Efficient for complex content preparation
- Efficient for large-scale overview
- Not efficient for detailed layout
- Not efficient for spontaneous authoring
- Web 2.0 syndicates based on XML formats
- Many authoring tools possible
- In-situ authoring: reconstruction+annotation [video]

Thanks!



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