

Chapter 1: Introduction

Augmented Reality – Principles and Practice

<http://www.augmentedrealitybook.org>

PRINCIPLES AND PRACTICE



Augmented
REALITY

Dieter **SCHMALSTIEG**
Tobias **HÖLLERER**

What is AR?

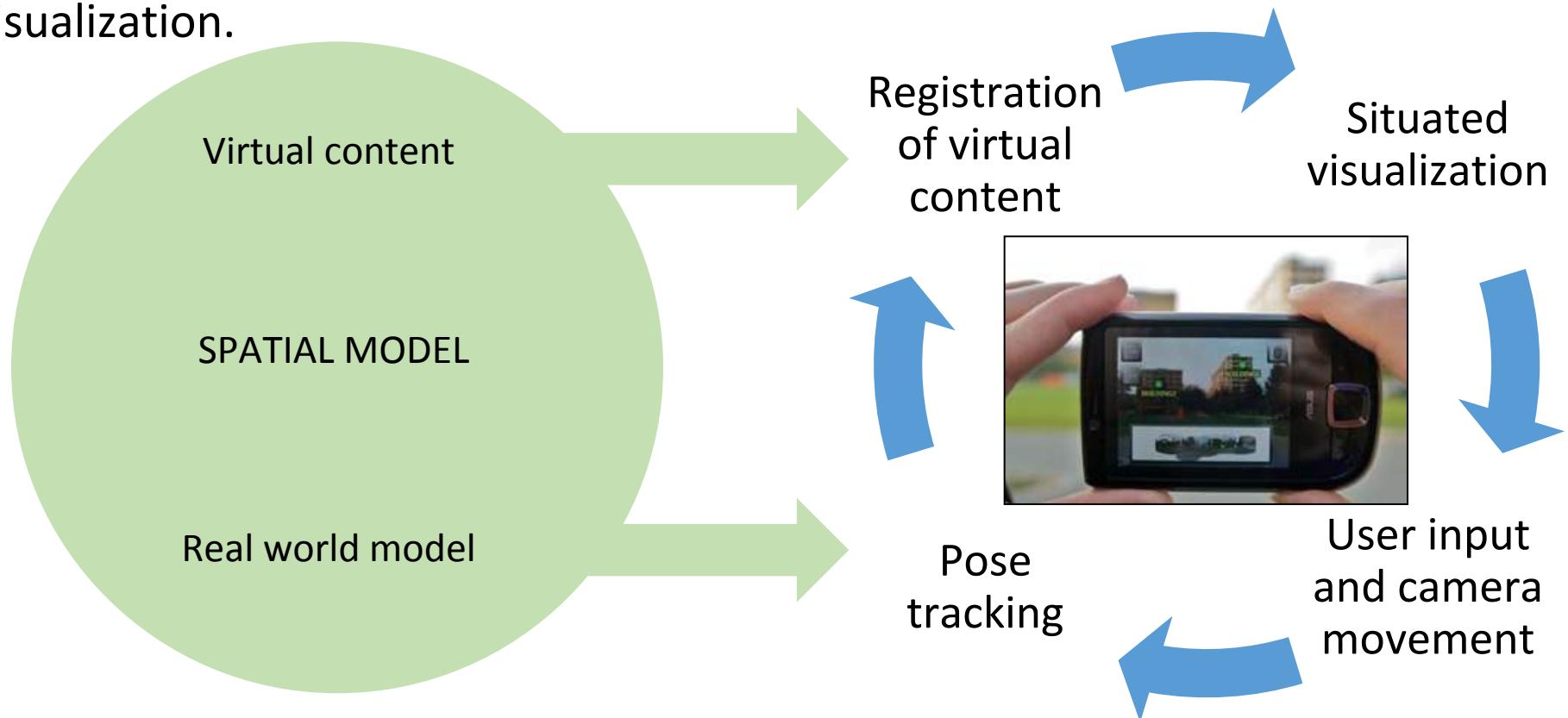
Azuma's definition:

- Combines real and virtual
- Interactive in real time
- Registered in 3D



AR Feedback Loop

AR uses a feedback loop between human user and computer system. The user observes the AR display and controls the viewpoint. The system tracks the user's viewpoint, registers the pose in the real world with the virtual content, and presents situated visualization.



Sword of Damocles

The Sword of Damocles was the nickname of the world's first head-mounted display, built in 1968.

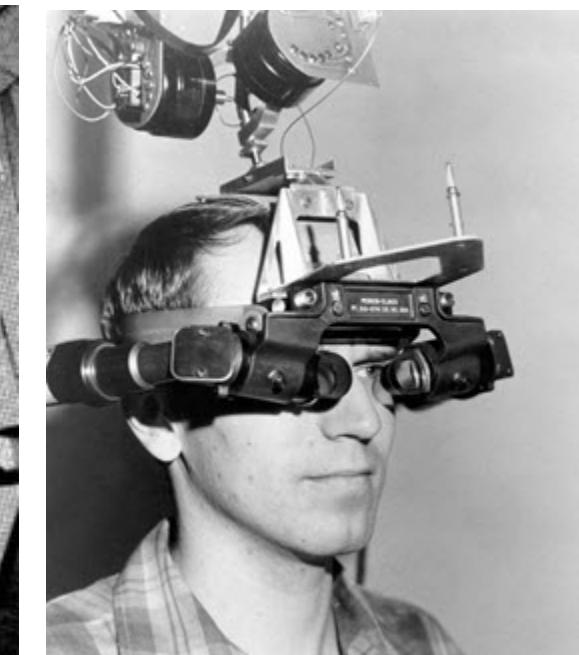
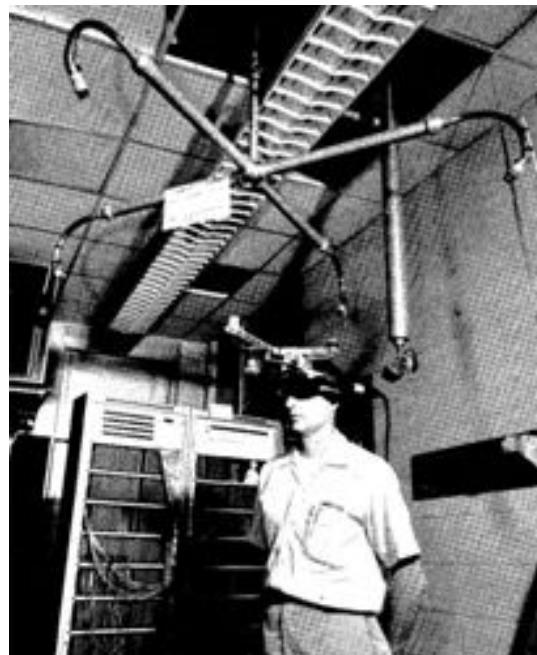


Image: Ivan Sutherland

Wire Harness Assembly

Researchers at Boing used a see-through HMD to guide the assembly of wire bundles for aircraft.



Image: David Mizell

KARMA

KARMA was the first knowledge-driven AR application.
A user with an HMD could see instructions on printer maintenance

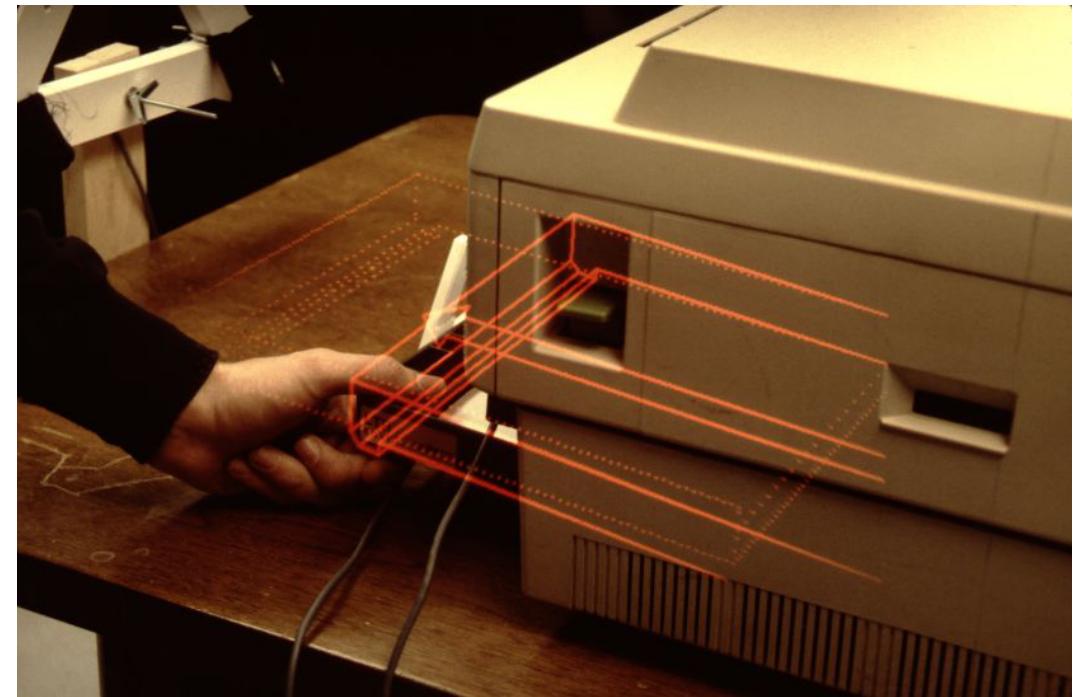


Image: Steve Feiner, Blair MacIntyre and Doreé Seligmann, Columbia University

Ultrasound Pregnancy Visualization

View inside the womb of an expecting mother



Image: Andrei State, UNC Chapel Hill

Handheld Augmented Reality

The NaviCam, a forerunner of today's AR browsers on smartphones



Image: Jun Rekimoto

Construct3D

Teaching geometry in AR to high school students

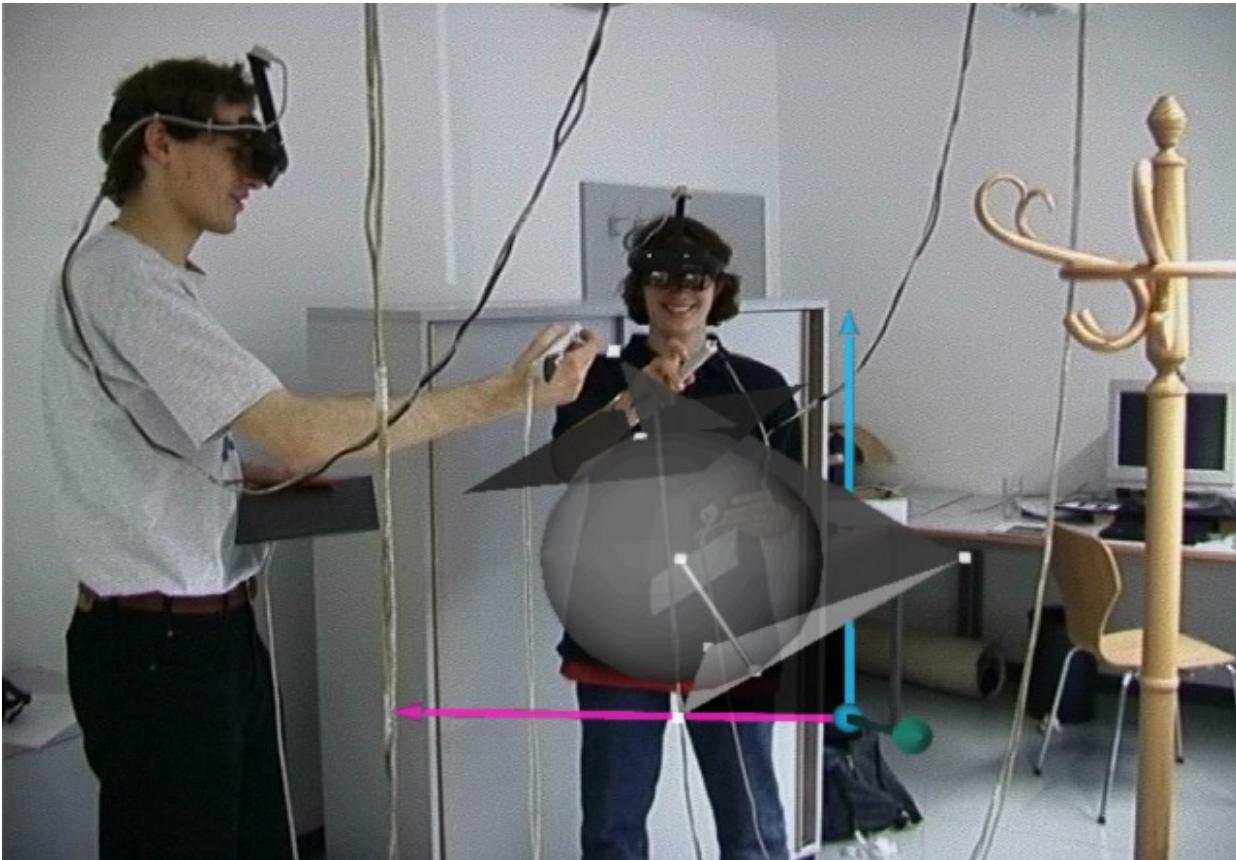


Image: Hannes Kaufmann

RV Boarder Guards

A multiuser shooting game developed in Canon's Mixed Reality Systems Laboratory

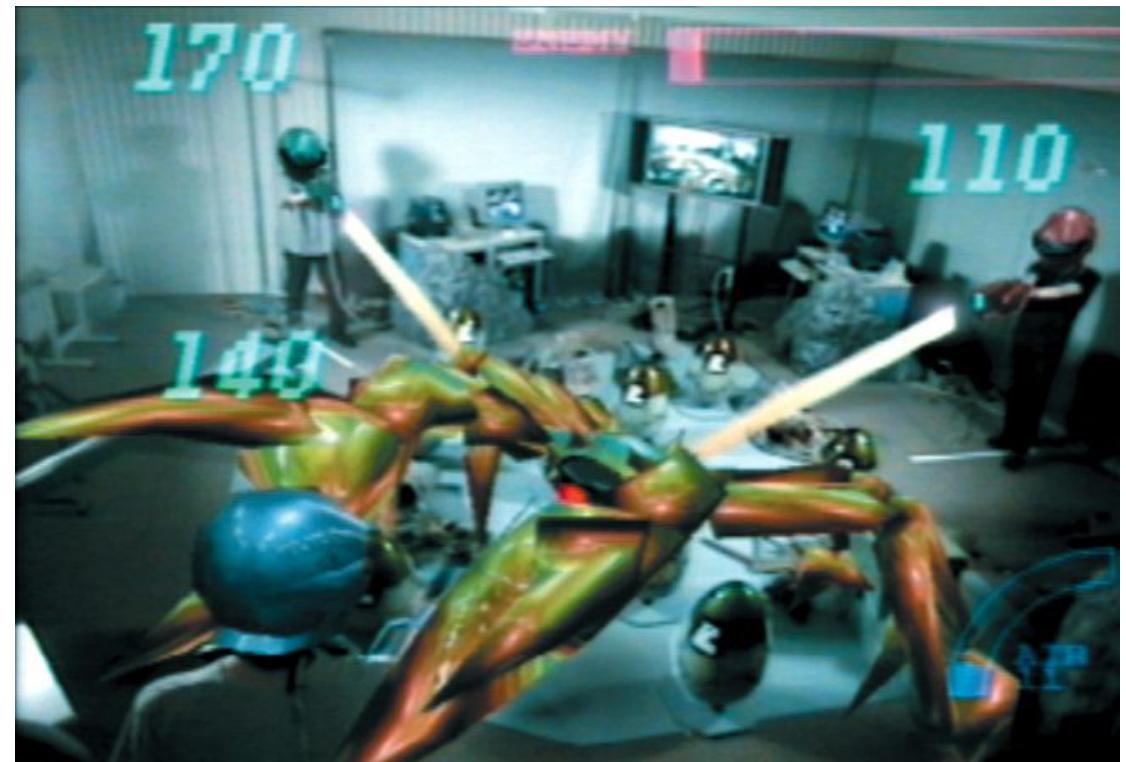
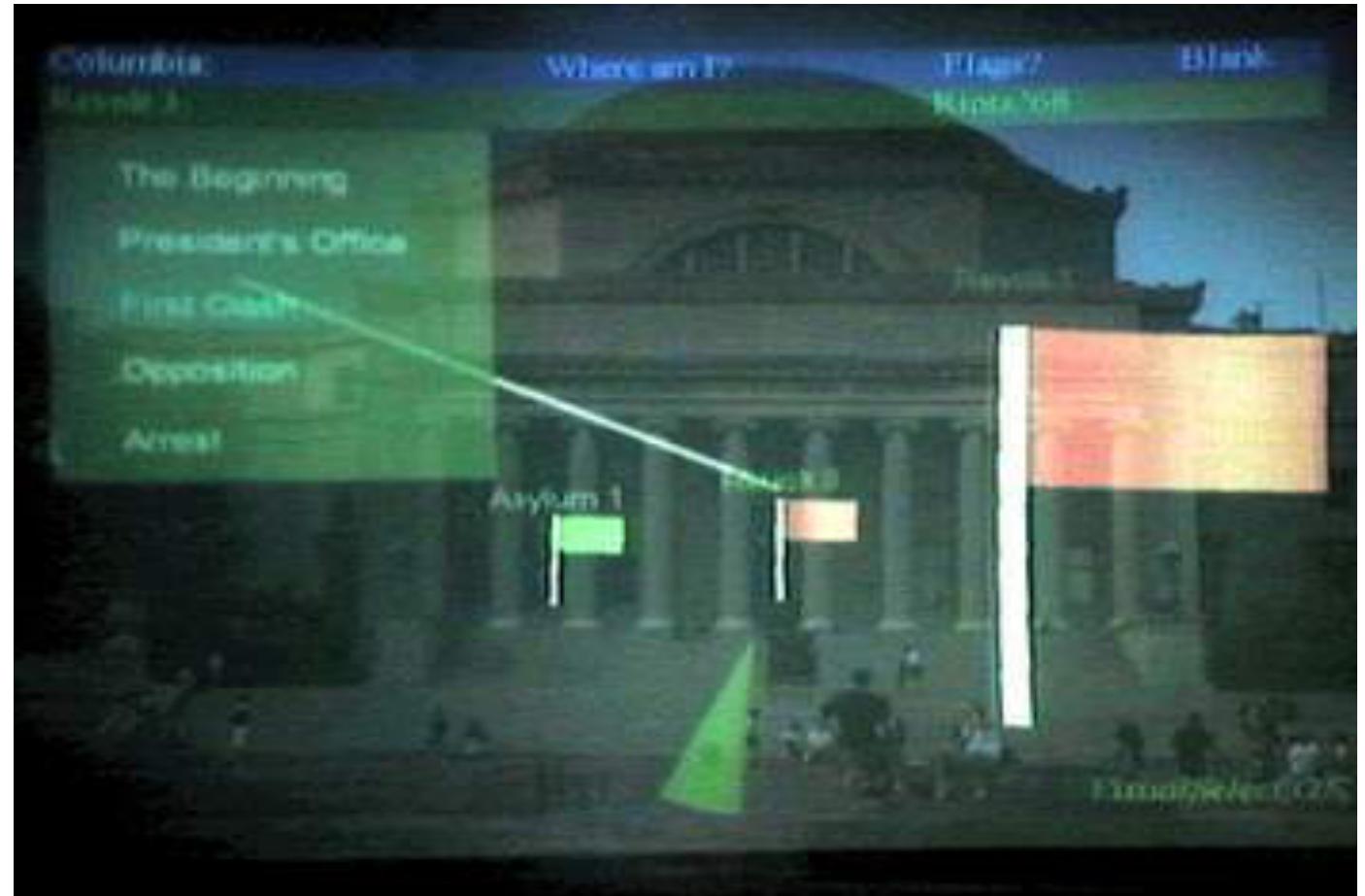


Image: Hiroyuki Yamamoto

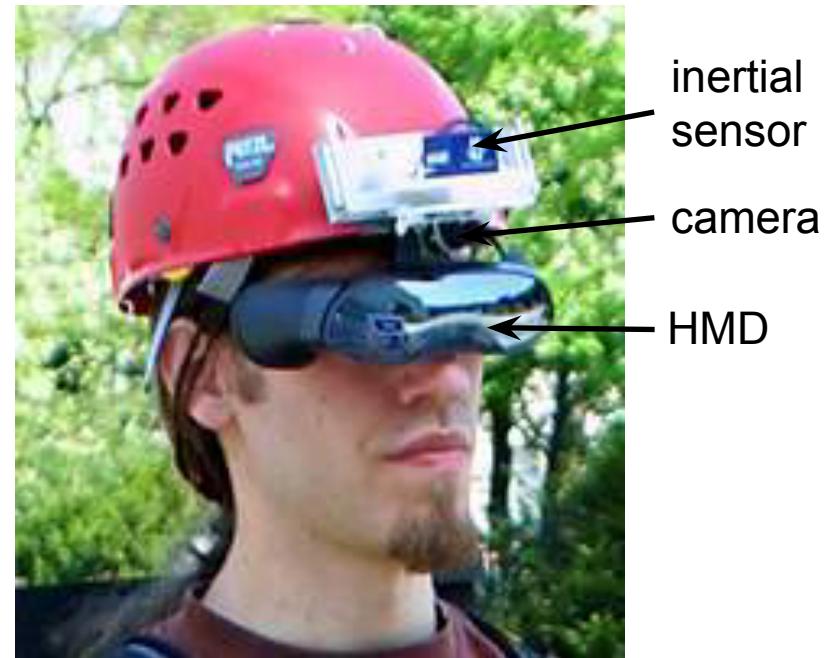
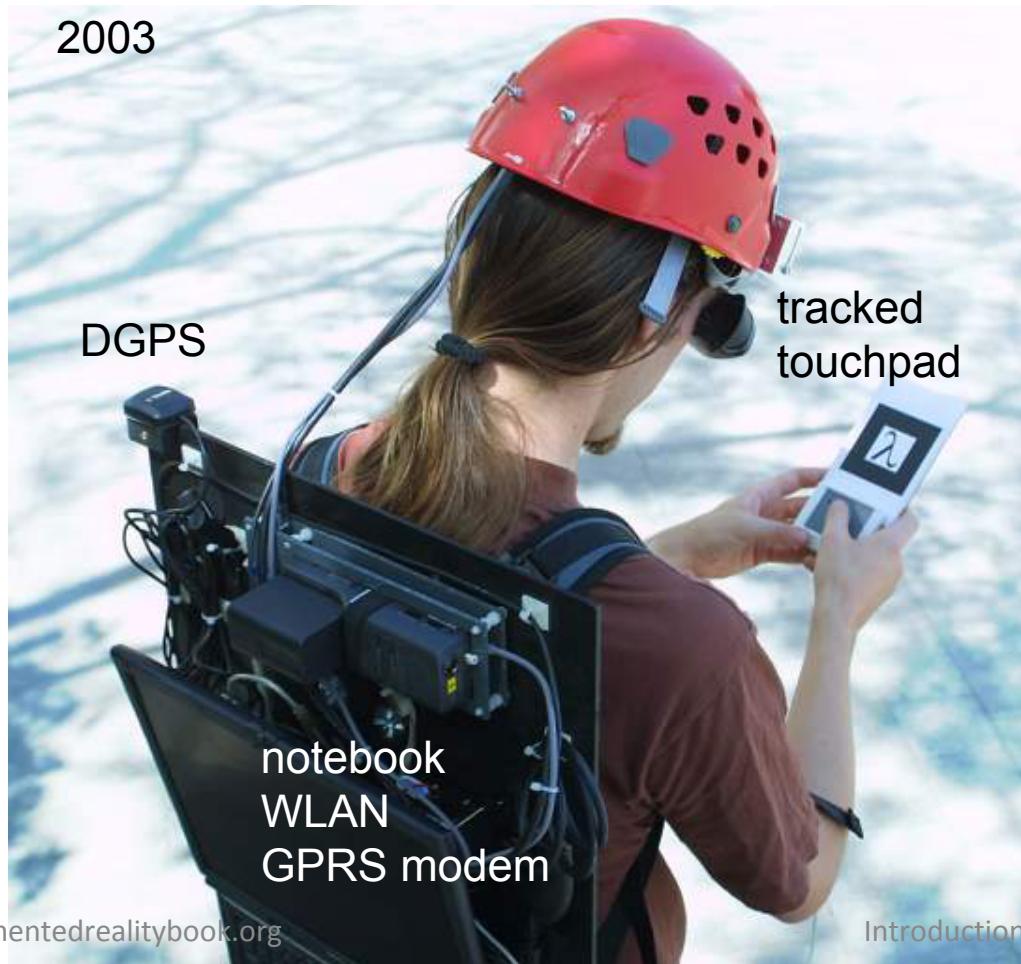
Touring Machine

Touring Machine, the
1st outdoor AR system

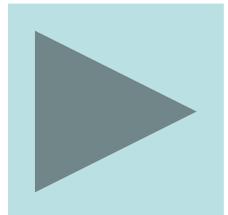


Situated Documentaries , a campus tour guide running on the Touring Machine

Studierstube Mobile AR System



Wide Area Tracking
DGPS (outdoors)
ARToolKit (indoors)



Application: Signpost Outdoors

- Wayfinding in open spaces



ARQuake

the first outdoor AR game



Image: Bruce Thomas and Wayne Piekarski

Location-based Computing

- WorldBoard [Spohrer '99]
 - The world as a repository of information
 - Place as index to information

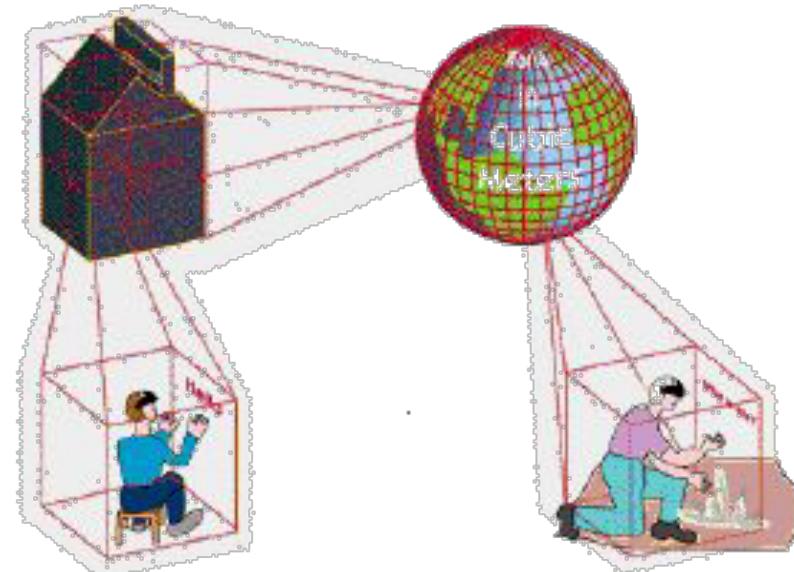


Image: J. Spohrer

- Mobile Augmented Reality as user interface for location-based information

ARToolKit

A person holding a square marker of ARToolKit, the popular open-source software framework for AR



Image: Mark Billinghurst

Invisible Train

The Invisible Train was a handheld AR game featuring virtual trains on real wooden tracks

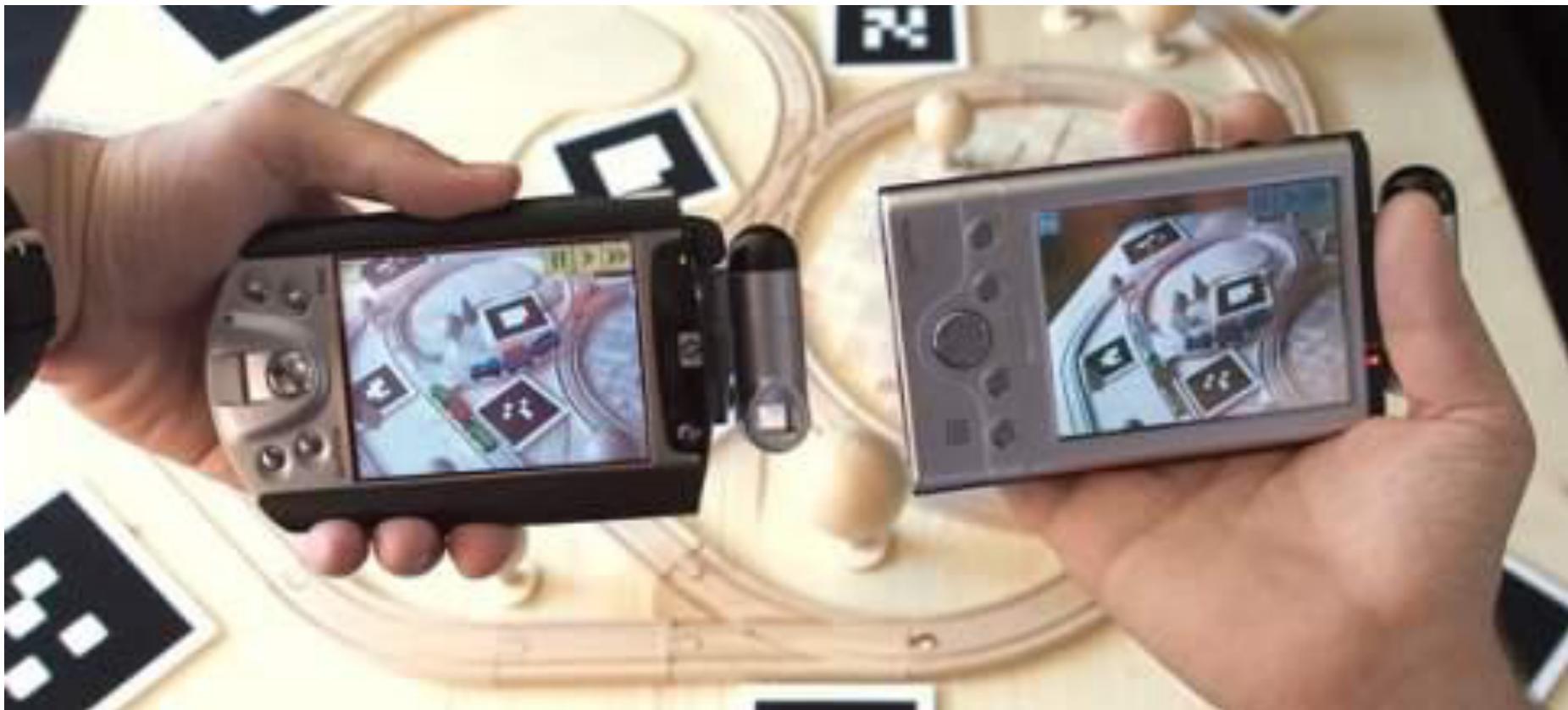


Image: Daniel Wagner

Application Examples

- Industry and construction
- Maintenance and training
- Medical diagnosis and interventions
- Personal information display
- Navigation
- Television
- Advertising and commerce
- Games

Discrepancy Analysis

Discrepancy analysis in industrial facilities using still frames overlaid with CAD information



Image: Nassir Navab

The valve on the right-hand side was mounted on the wrong side



Augmented Reality Building Acceptance

The Planar is a touchscreen display on wheels



discrepancy analysis directly on the factory floor

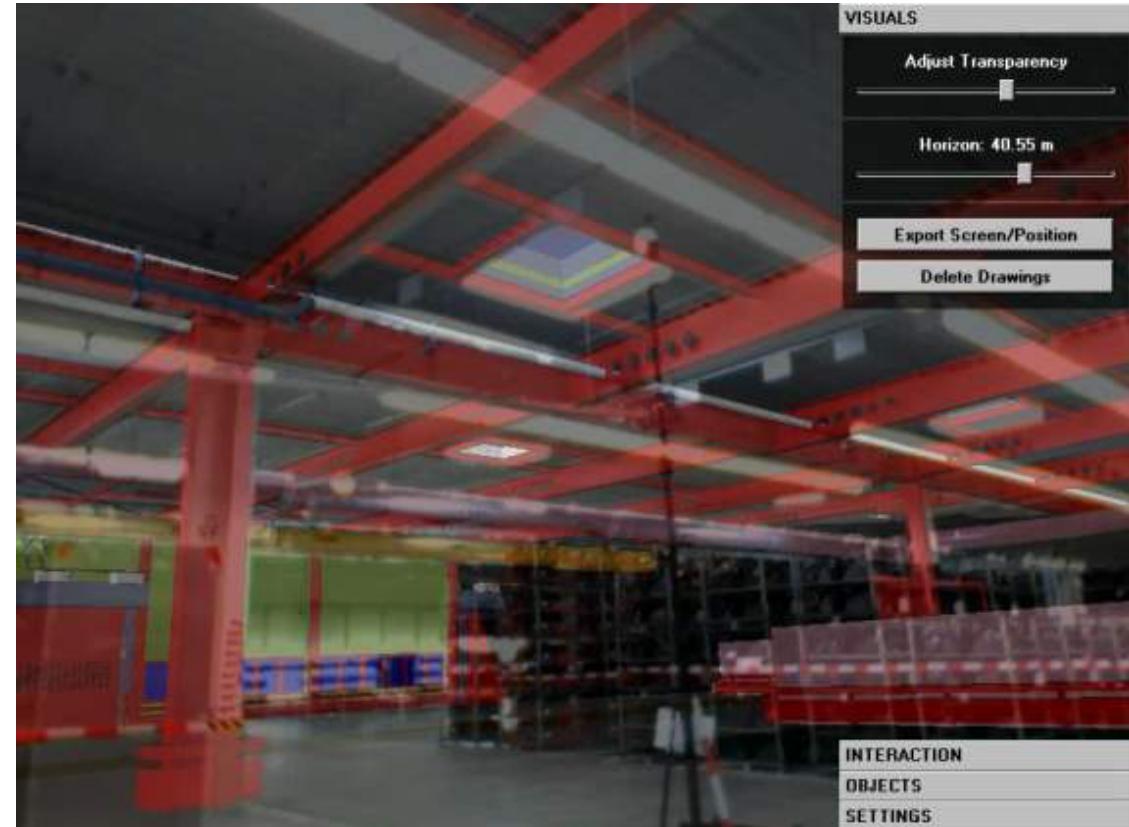


Image: Ralph Schönfelder

Underground Infrastructure Inspection

Tablet computer with differential GPS Geo-registered view of a virtual excavation revealing a gas pipe



Image: Gerhard Schall

Introduction

Flight Control for Aerial Reconstruction



While the drone has flown far away and is barely visible, its position can be visualized using a spherical AR overlay

Image: Stefanie Zollmann

Explaining How Things Work

Ghost visualization revealing the interior of a coffee machine to guide end-user maintenance

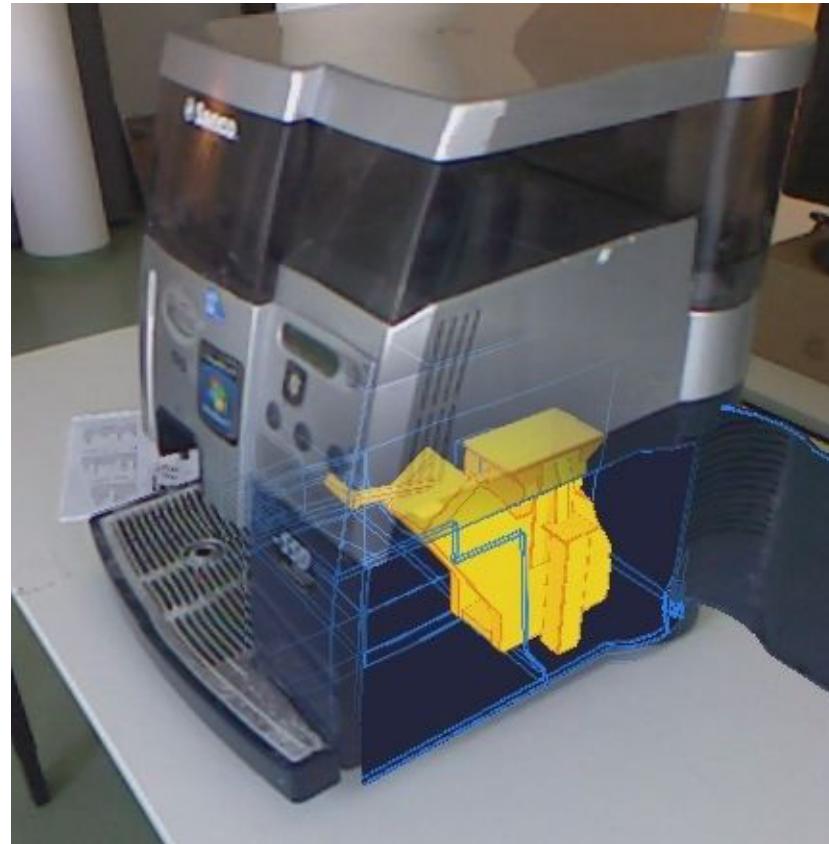


Image: Peter Mohr

Maintainence Instructions

Automatically generated disassembly sequence of a valve

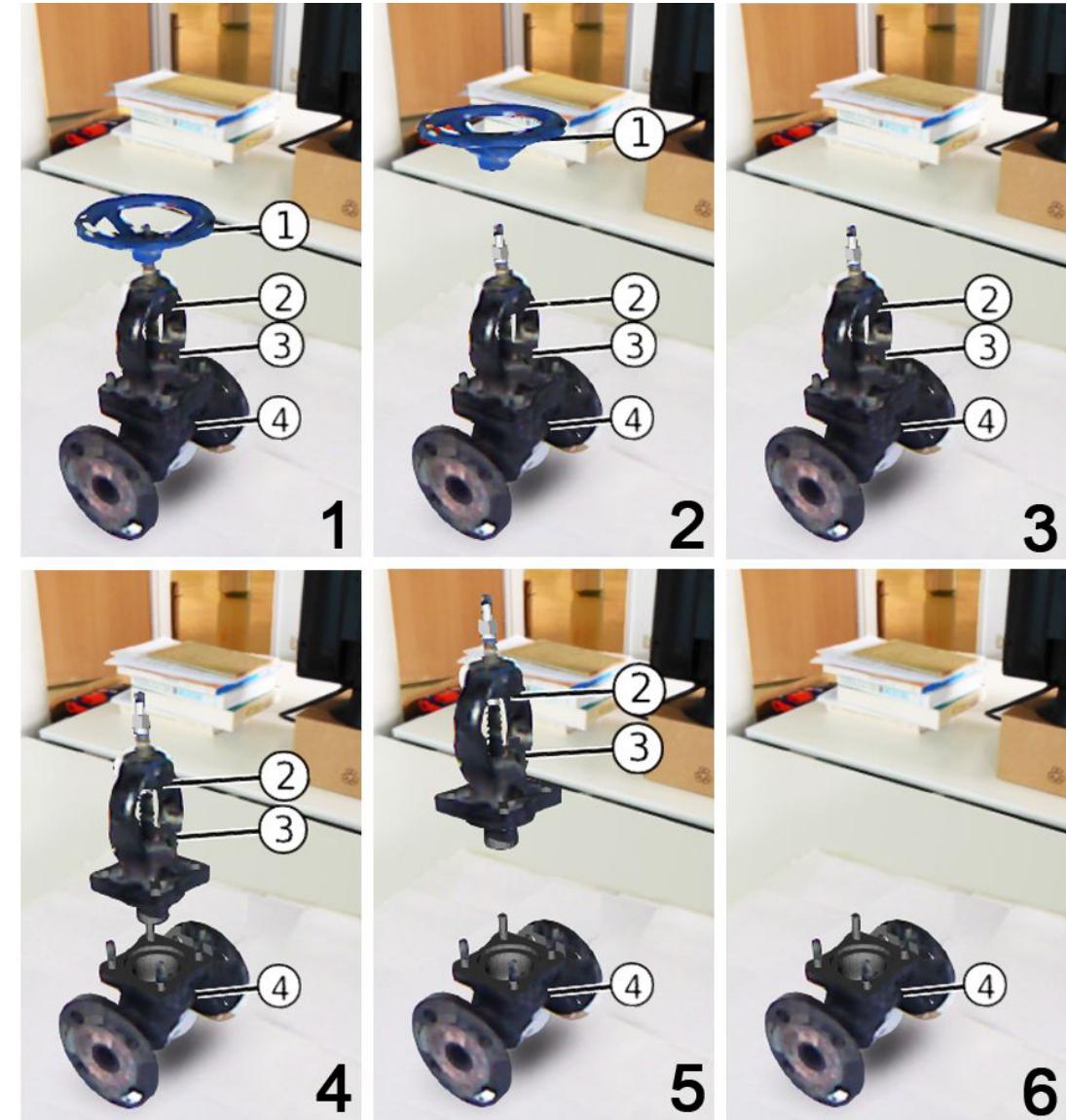


Image: Peter Mohr

Office of the Future

The Office of the Future project at UNC used projector-camera systems for immersive telepresence



Image: Henry Fuchs, UNC Chapel Hill

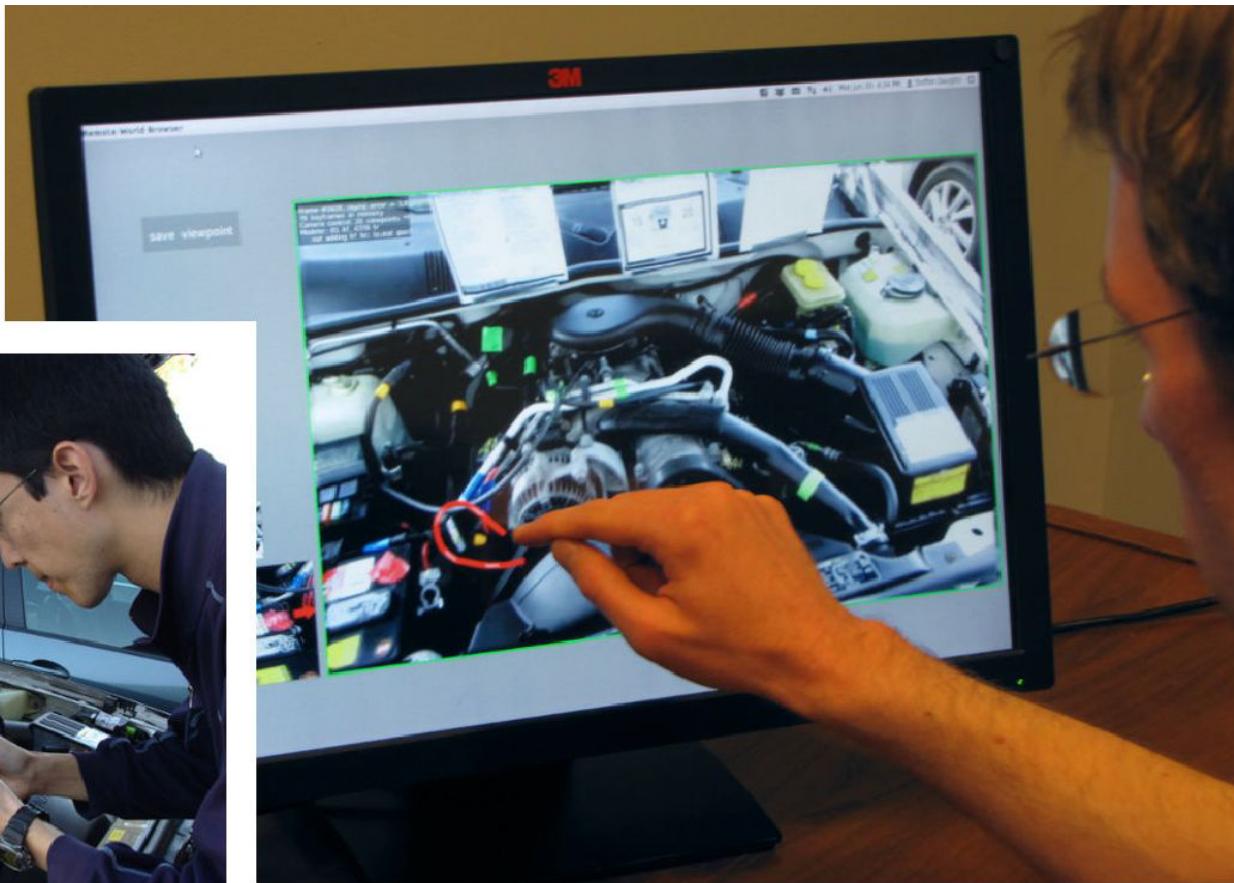
Image Based Telepresence



A car repair scenario assisted by a remote expert via AR tele-presence on a tablet computer



Image: Steffen Gauglitz



Remote expert draws hints directly on 3D model of car incrementally transmitted from the repair site

Medical Diagnosis

The CamC is a mobile C-arm, which allows a physician to seamlessly blend between a conventional camera view and X-ray images

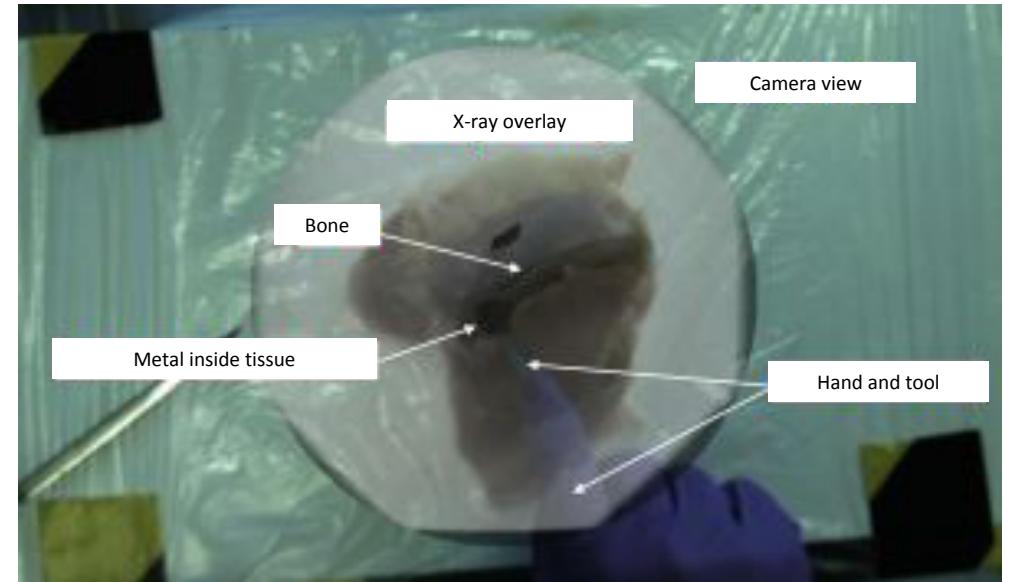
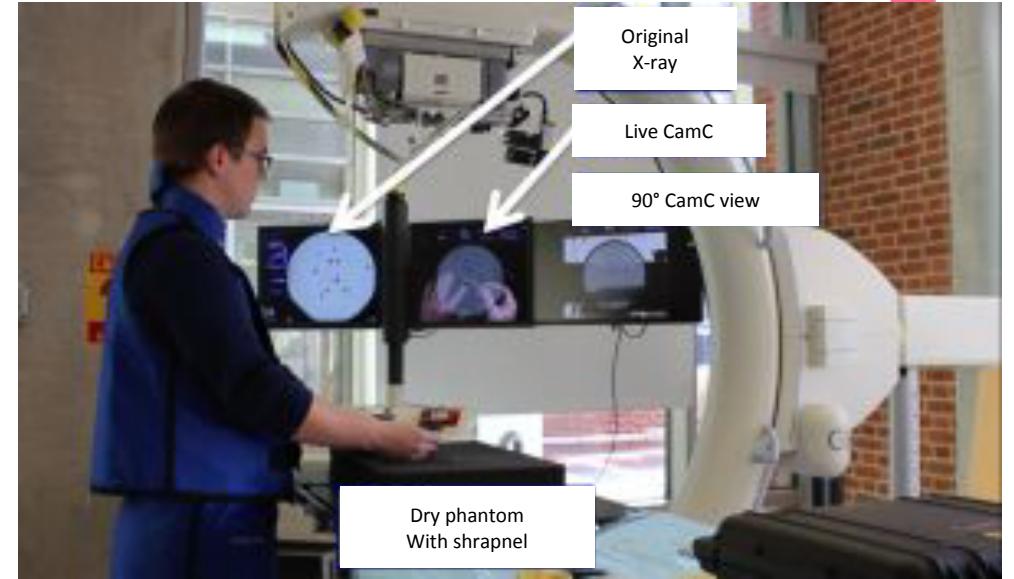
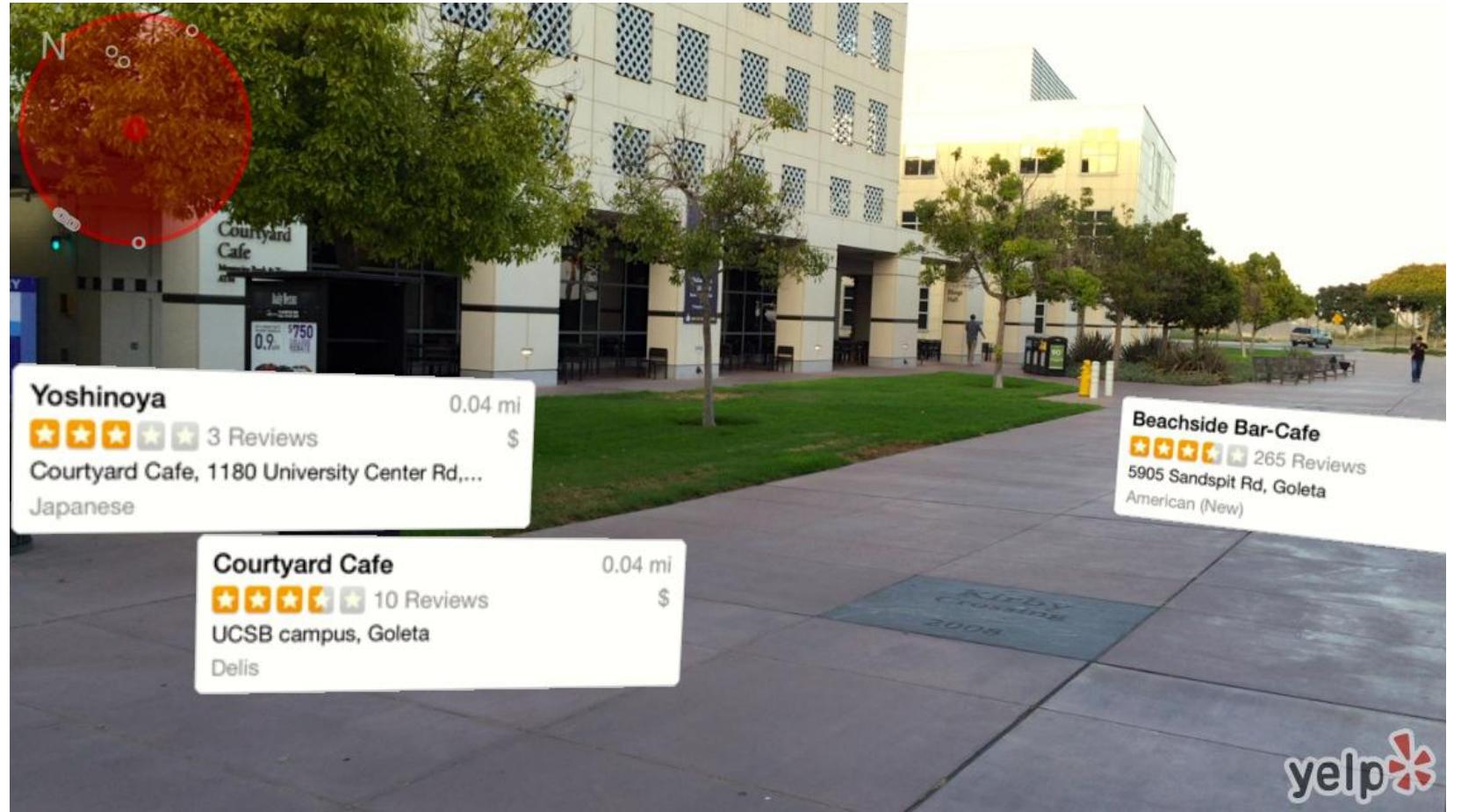


Image: Nassir Navab

AR Browser

AR browsers such as Yelp Monocle superimpose points of interest on a live video feed



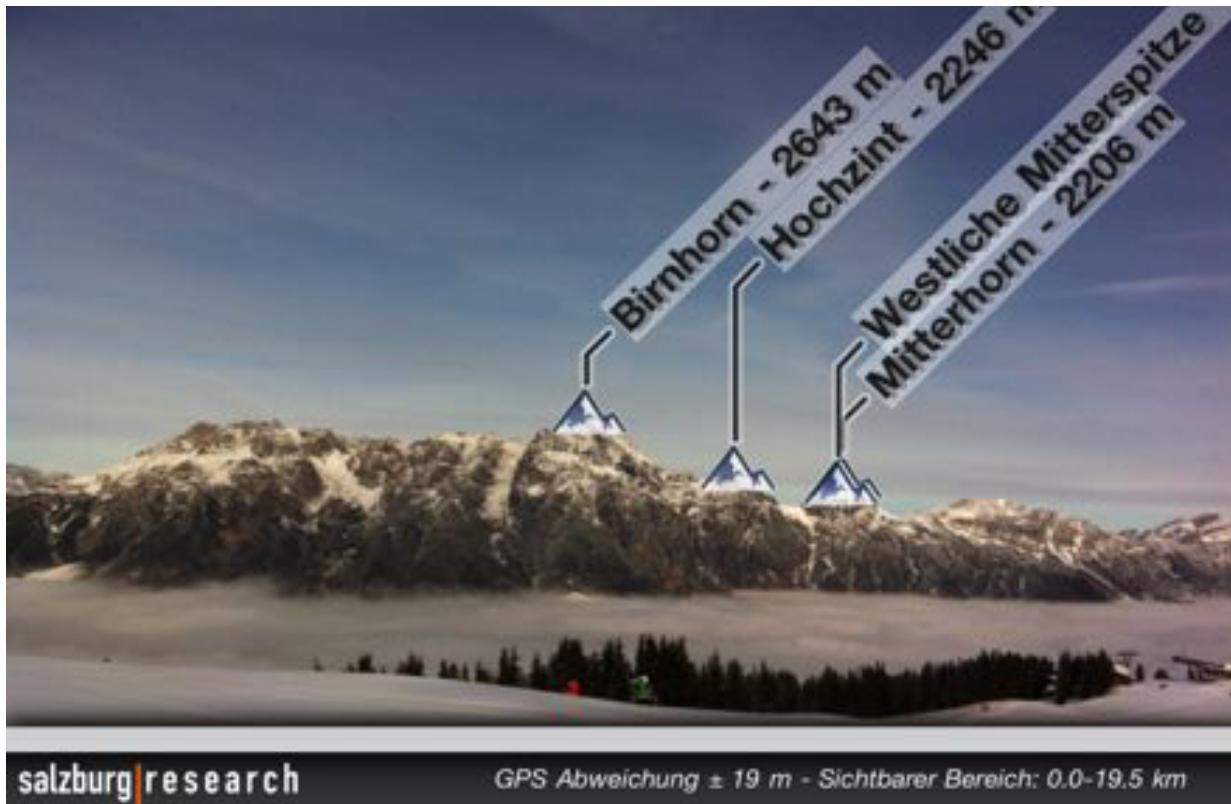
Translation

Google Translate superimposes spontaneous translations of text, recognized in real time, over the camera image



Navigation

Peak.AR showing mountain tops



Wikitude Drive superimposes a perspective view of the road ahead



Image: Wikitude GmbH

Parking Assistant

The parking assistant is a commercially available AR feature in many contemporary cars



Image: Brigitte Ludwig

Sport Broadcast Visualization

Augmented TV broadcast of a soccer game

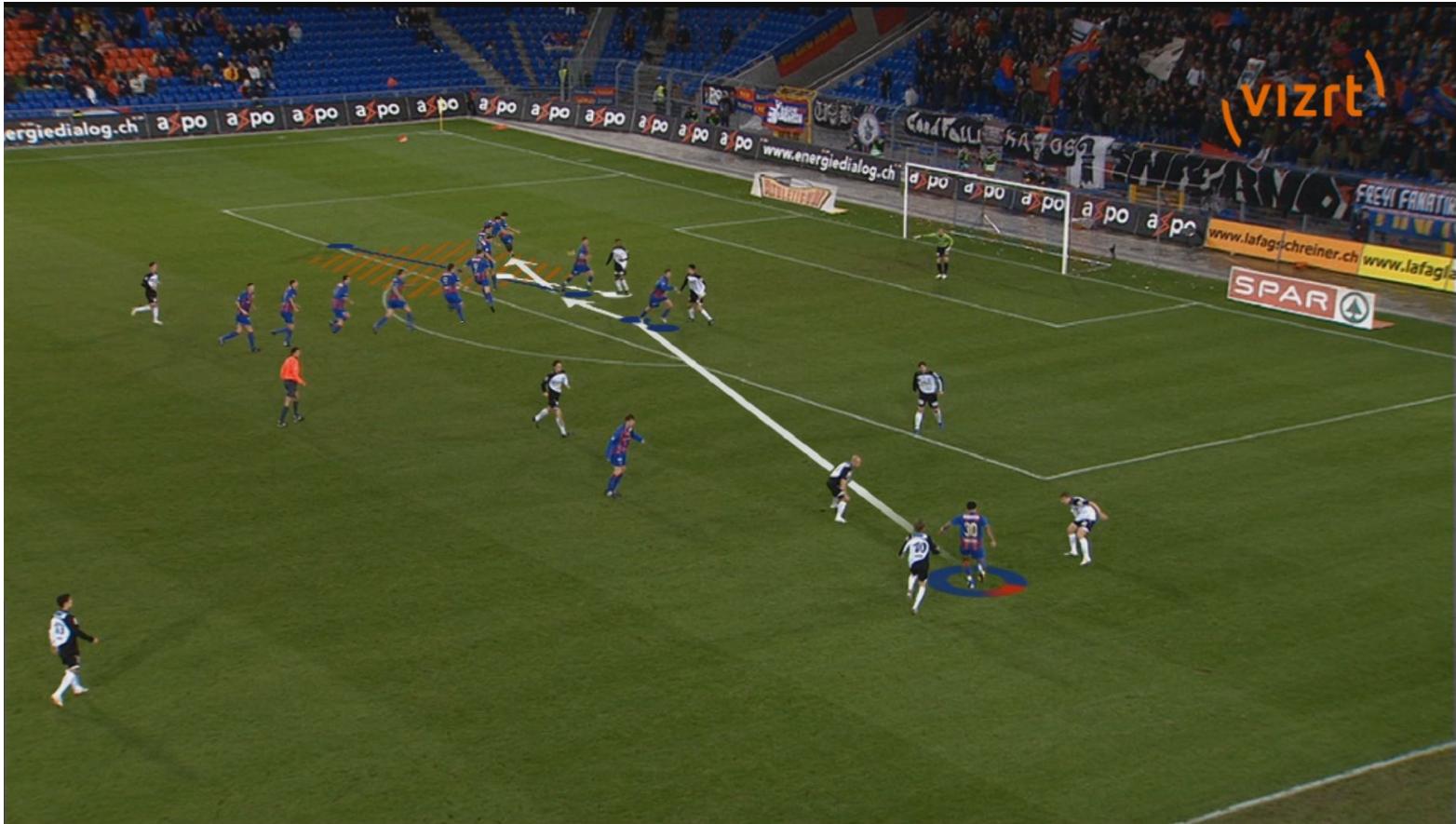


Image: Teleclub and Vizrt, Switzerland (LiberoVision AG)

Augmented Magazines

The lifestyle magazine *Red Bulletin* was the first print publication to feature dynamic content using AR



Image: Daniel Wagner

Marketing

Marketing presentation of a Waeco air-conditioning service unit

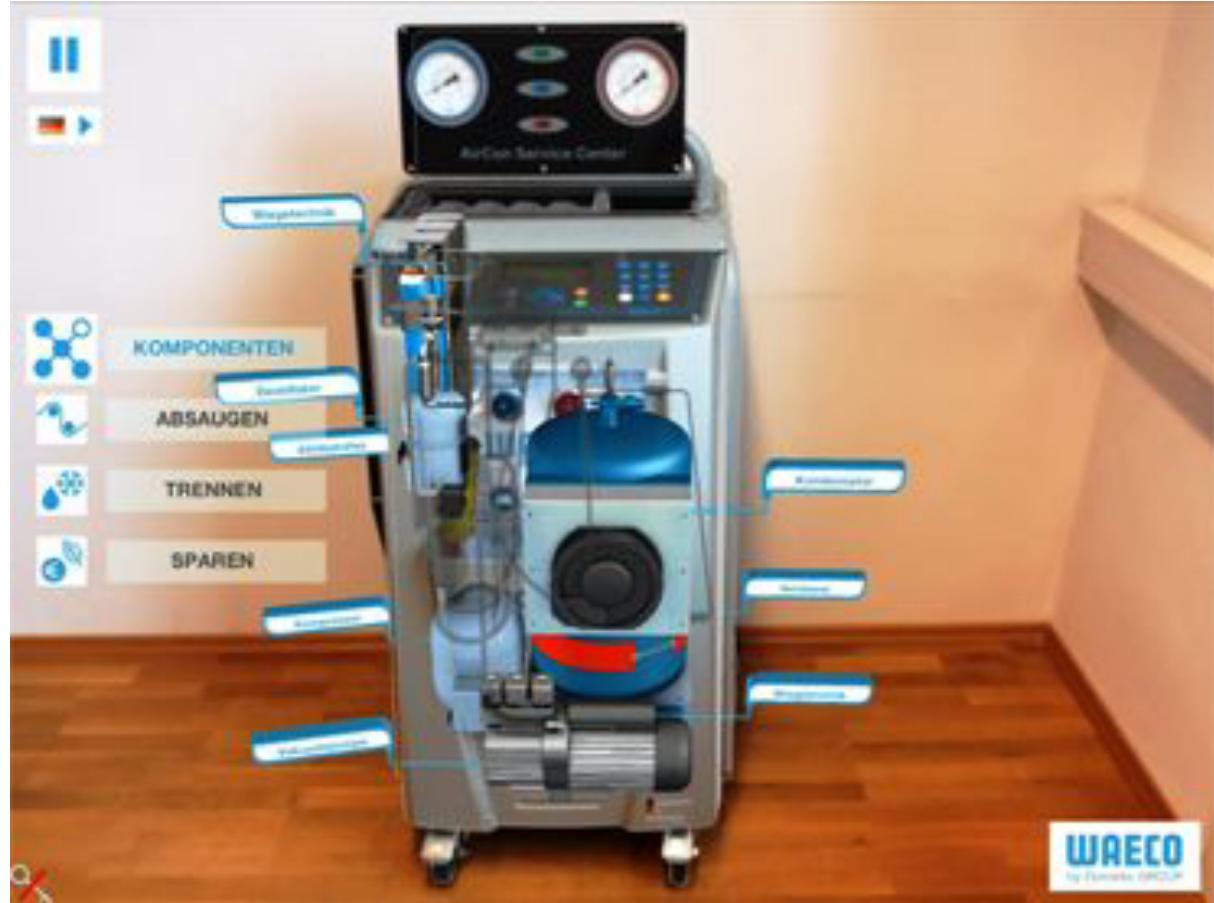


Image: magclensapp.com

Virtual Try-On

Pictofit extracts garment images from shopping sites and renders them to match customer image



Image: Stefan Hauswiesner, ReactiveReality

Eye of Judgement

Sony's Eye of Judgement was a Mixed Reality tabletop game for the PlayStation 3



Vuforia SmartTerrain

Vuforia SmartTerrain scans the environment and turns it into a game landscape



Images: © 2013 Qualcomm Connected Experiences, Inc. Used with permission

Immersive Games

Using a TV-plus-projector setup, the IllumiRoom extends the game world beyond the screen boundaries

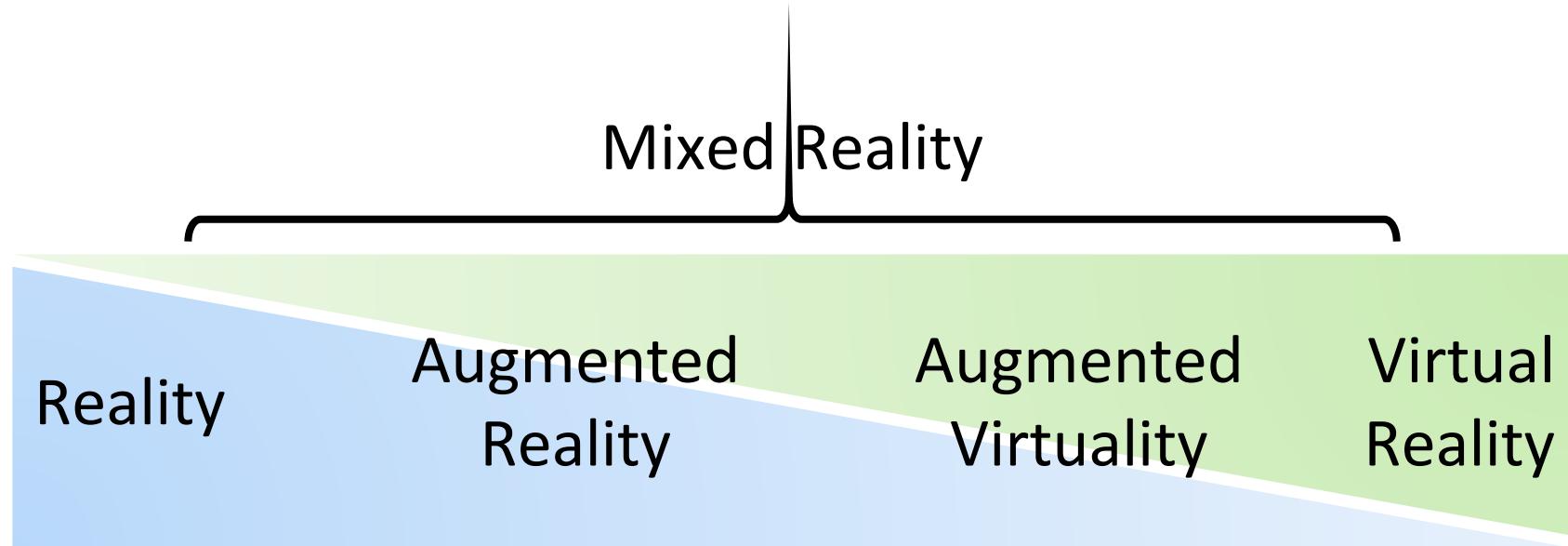


Image: Microsoft Research

Related Fields

- Virtual Reality
- Ubiquitous Computing

Mixed Reality Continuum



The mixed reality continuum captures all possible combinations of the real and virtual worlds

Milgram-Weiser Continuum

