

Instrumented Environments

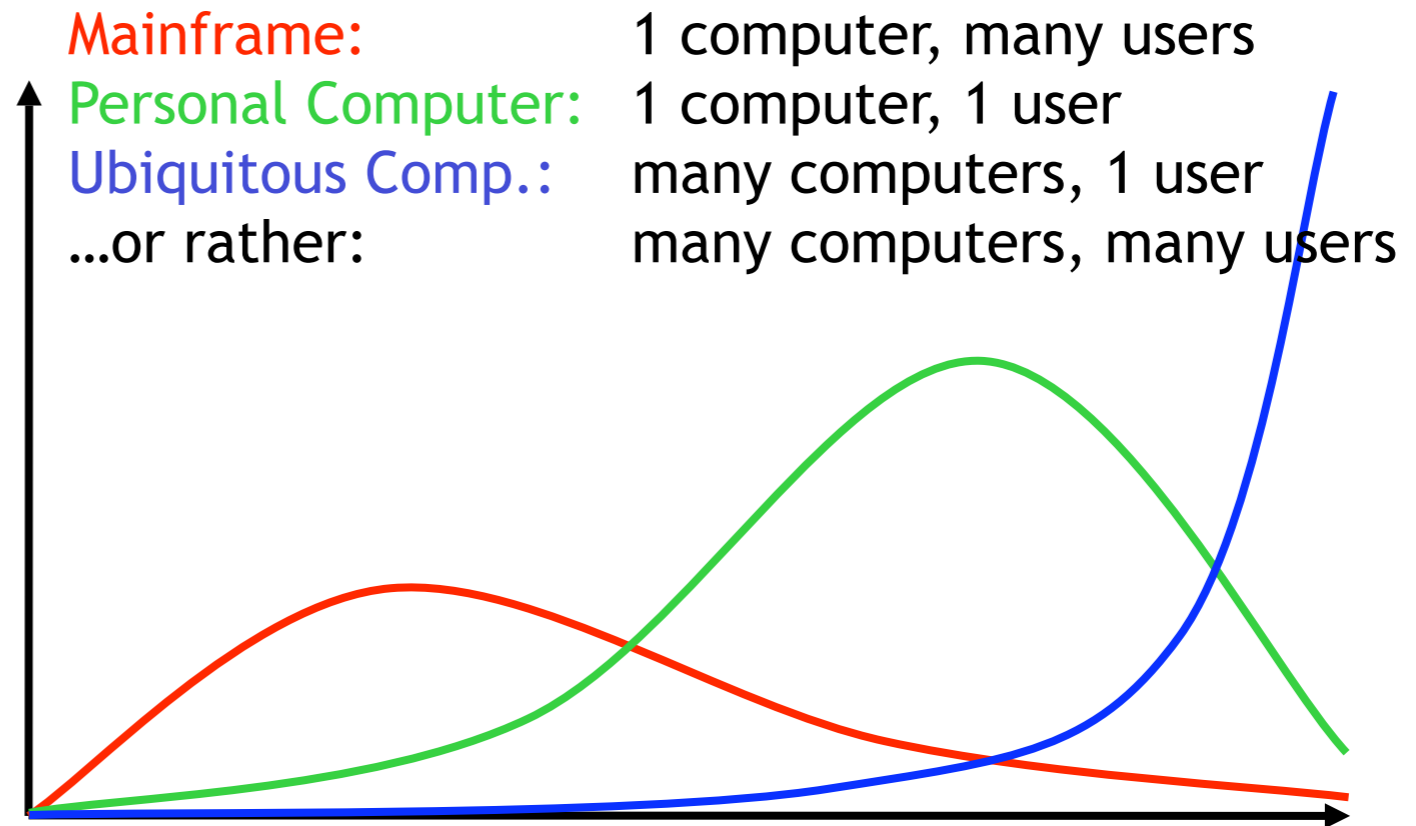
Andreas Butz, butz@ifi.lmu.de, www.mimuc.de



Topics today

- Introduction, Motivation
 - Ubiquitous Computing
 - Instrumented environments
- Overview of this class
 - Class topics
 - Appointments
 - Exercises, examples
 - Criteria for the certificate

Post-PC Era or Ubiquitous Computing



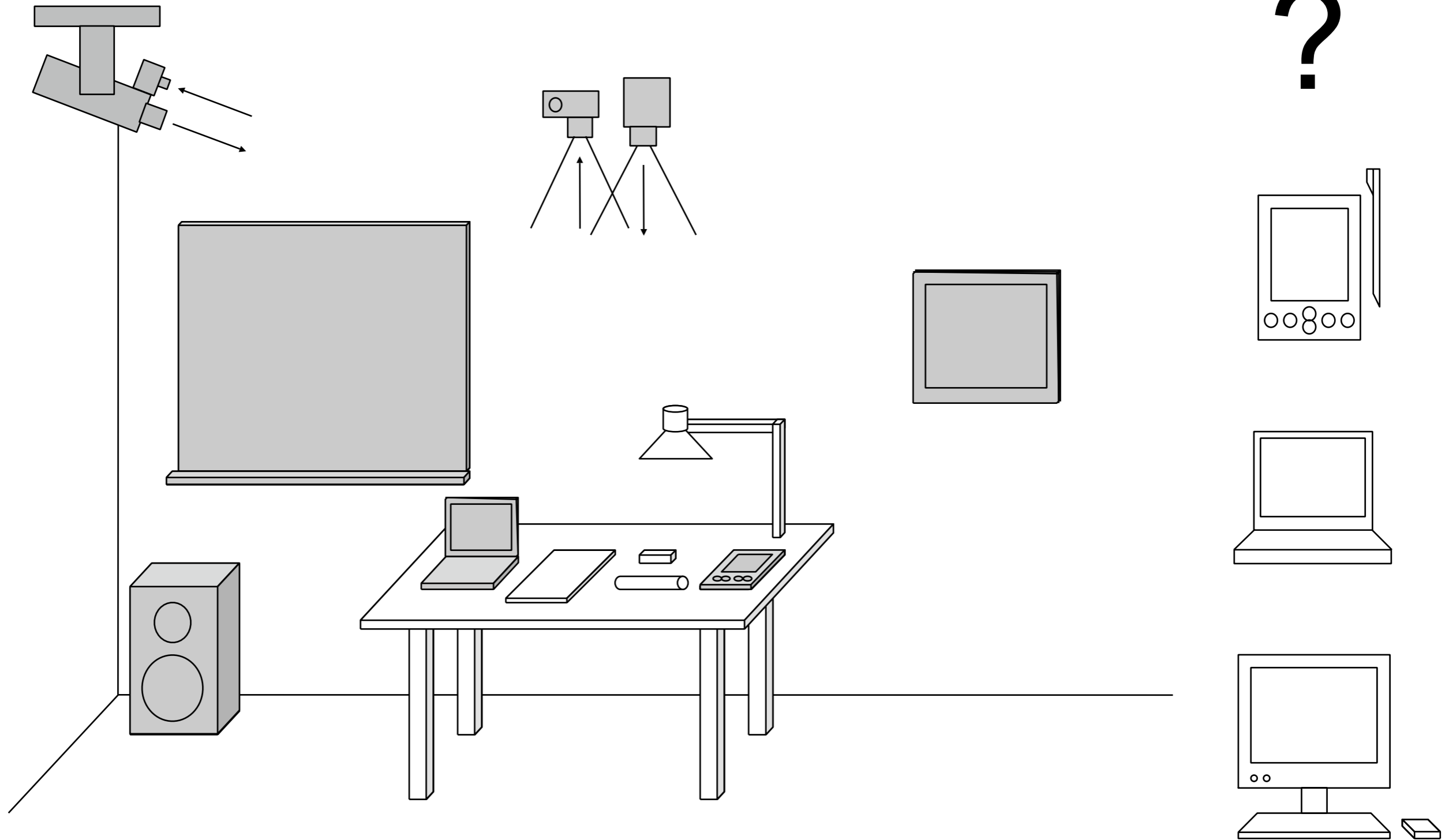
Mark Weiser: What Ubiquitous Computing Isn't

Ubiquitous computing is roughly the opposite of virtual reality. Where virtual reality puts people inside a computer-generated world, ubiquitous computing forces the computer to live out here in the world with people.

Computer out here in the world: Instrumented Environments



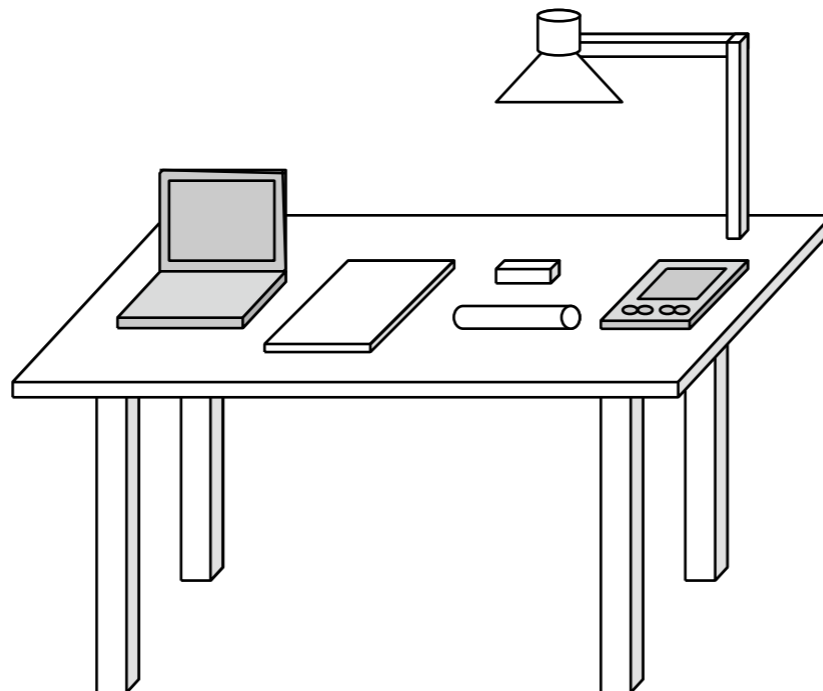
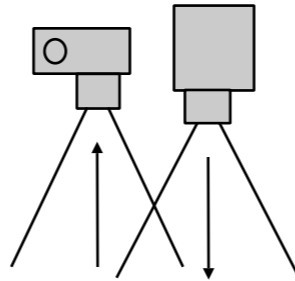
Instrumented Environments



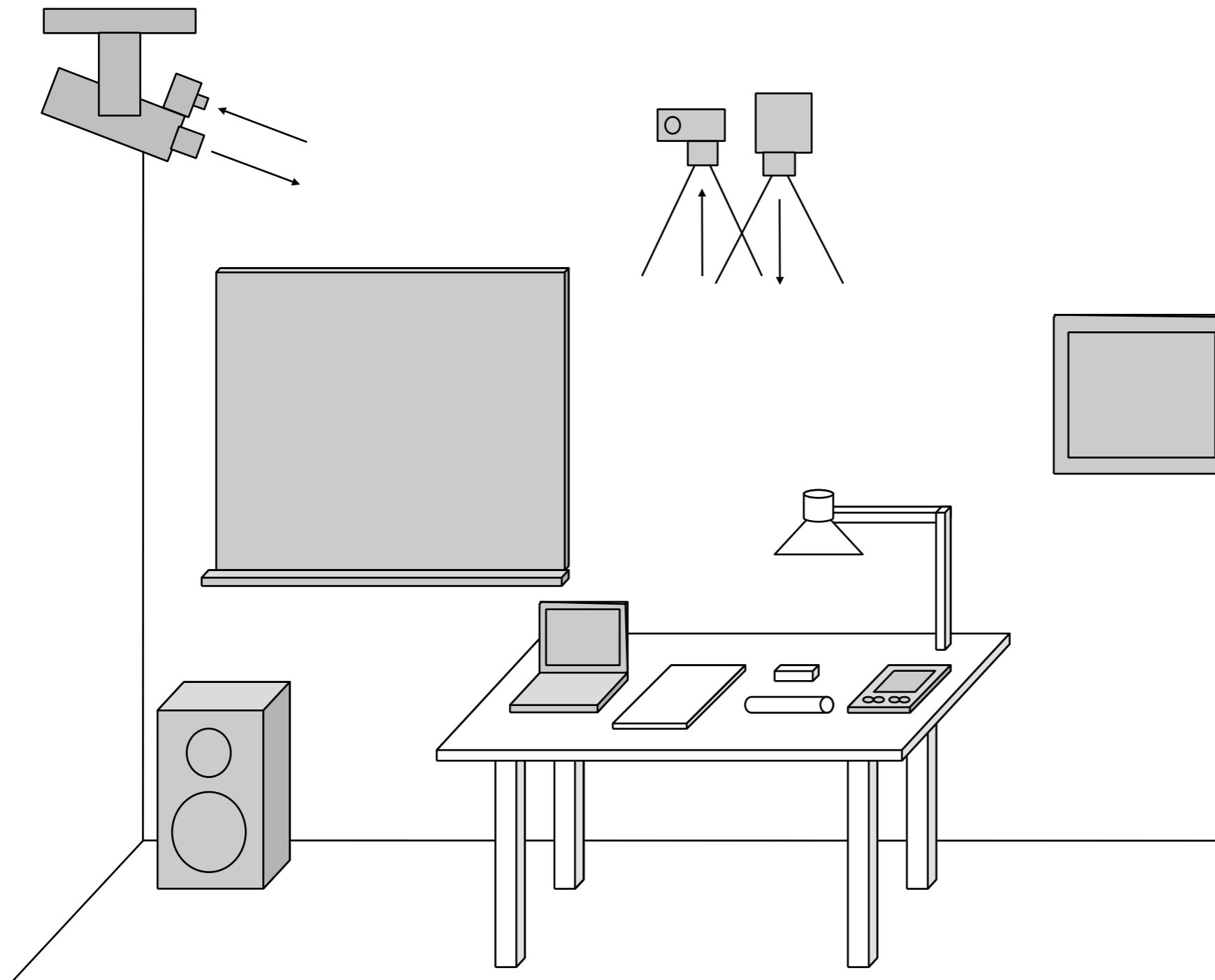
Instrumented desk

Research Topics:

- Borders between phys. and virtual world
- Interaction objects
- Physical tools for virtual media



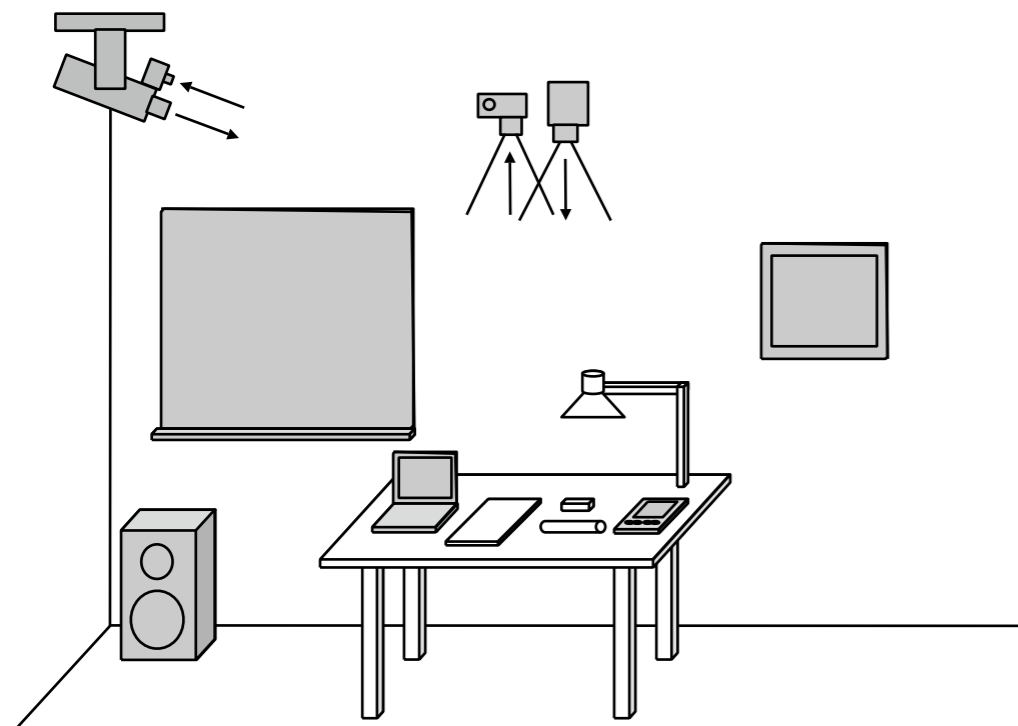
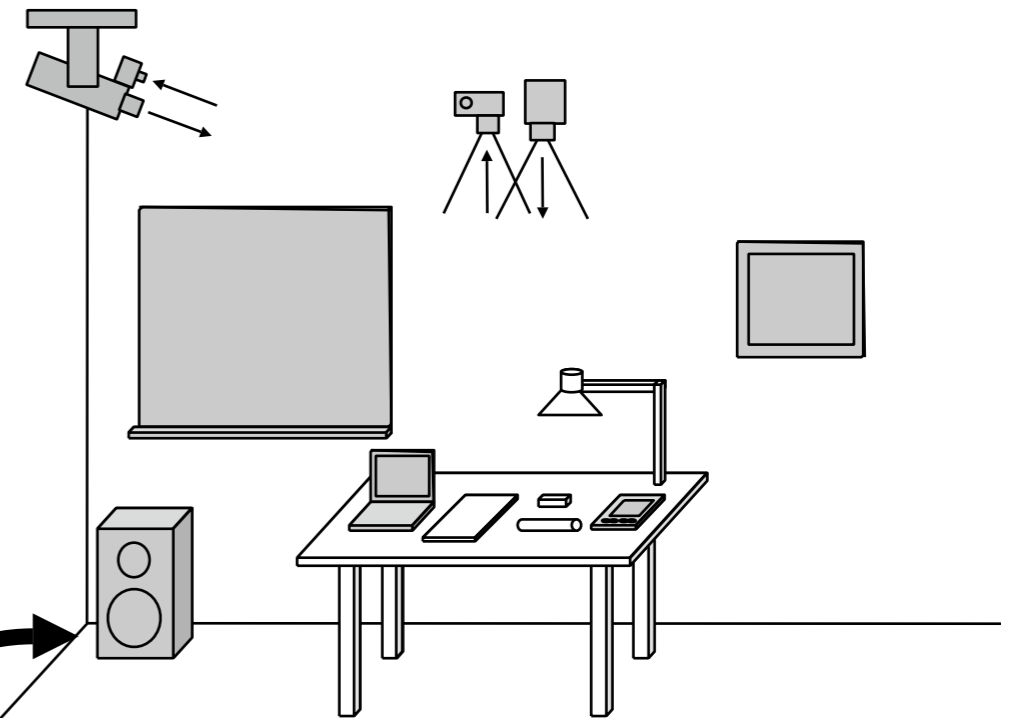
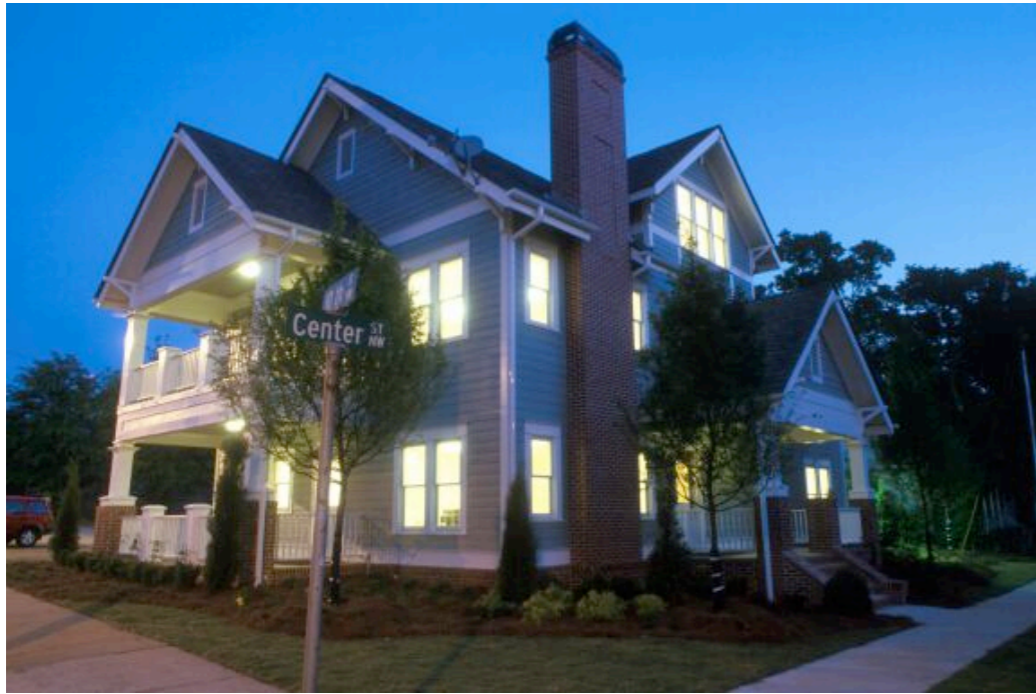
Instrumented room



Research Topics:

- Borders between phys. and virtual world
- Interaction objects
- Physical tools for virtual media
- Environment as display continuum (+ audio)
- Interaction with large displays
- Interaction with many different displays
- Ambient displays

Instrumented building



- Interaction between different displays without line of sight
- place holder objects, transport metaphors
- interaction over distance

Instrumented city



Sci-Fi version of Instr. Env.



Interaction with IE, some visions



Electronic Ink, Ubiquitous displays



Interaction, multiple heterogeneous displays

Source: "Minority Report"
(Steven Spielberg, USA 2002)
Consulting by
John Underkoffler (gestures),
Jaron Lanier (VR)



Some related conferences and workshops

- International Conference on Ubiquitous Computing (Ubicomp, Springer)
- International Conference on Pervasive Computing (Pervasive, Springer)
- IEEE International Conference on Pervasive Computing and Communications (PerCom, IEEE)
- IEE Symposium on Intelligent Environments
- Mobile Human-Computer-Interaction (mobileHCI, Springer)
- Computer-Human-Interaction (CHI, ACM)
- Intelligent User Interfaces (IUI, ACM)

- AI in mobile Systems (AIMS, ECAI/IJCAI-Workshop notes)
- AITAmI workshop
- Multi-User Ubiquitous User Interfaces (MU3I, IUI workshop notes)
- Smart Graphics Symposium (SG, Springer)
- User Modeling (UM, Springer)

Some Journals and Digital Libraries

- IEEE Pervasive Computing
- Personal and Ubiquitous Computing, Springer
- ACM Transactions on Computer-Human Interaction

- ACM Digital Library <http://portal.acm.org>
- Springer Online <http://link.springer.de/ol/csol/>
 - Lecture Notes in Computer Sciences Series

Class top level structure

- Intro & Motivation
- Base technologies
 - Displays
 - Sensing & Tracking
 - networking
 - HW & SW toolkits
- Interaction in IE
 - context
 - interaction styles
 - Tangible & Ambient UI
- Related fields
 - wearable computing
 - augmented reality
- Summary

Base technologies: hardware

- Displays
 - small, med, large
 - projection, steerable
 - touch screens/input
 - digital ink, e-paper
- Sensing
 - Cameras, microphones
 - RFID, NFC
 - IR, BT
- Tracking
 - Optical: markers & markerless
 - Acoustic: active & passive
 - Radio: GPS, WLAN
 - hybrid: Cricket
- Networking
 - Magnetic
 - Load sensing, Floor tiles
 - Tracking Meta-techniques
 - sensor fusion
 - temporal filtering
 - Dead reckoning
- hardware toolkits
 - IR
 - WLAN/BT/custom RF
 - 1-wire bus, Pin&Play
- hardware toolkits
 - SmartIts
 - Motes
 - [...]
 - Phidgets

Base technologies: SW & modeling

- Device descriptions
 - JINI, UPNP, [...]
- Architectures
 - tuple spaces/event heap
 - (multi-) blackboards
 - pipe-and-filter
- SW architectures in research systems
 - BEACH,
 - Stanford irOS
- Context modeling
 - context toolkit
 - genius loci & numen
 - [...]

Interaction in instrum. environments

- direct physical interaction
- tangible interaction
- implicit interaction
- ambient UIs
- interface agents
- interaction models
 - strictly tool-based
 - automation, assisted living
 - proactivity, intelligent agents

Example Systems

- Xerox ParcTab
- Active Badges
- OXYGEN, i-room
- FhG Roomware
- Rekimoto Continuous work spaces
- Microsoft Research projects
- [...]

Related fields, Summary

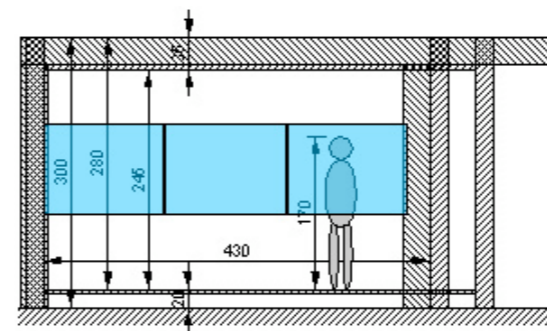
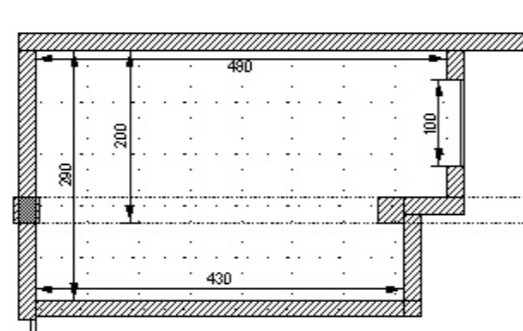
- IE vs. wearable computing
- IE vs. AR

- Summary, hints for exam questions
- Demos of exercise projects

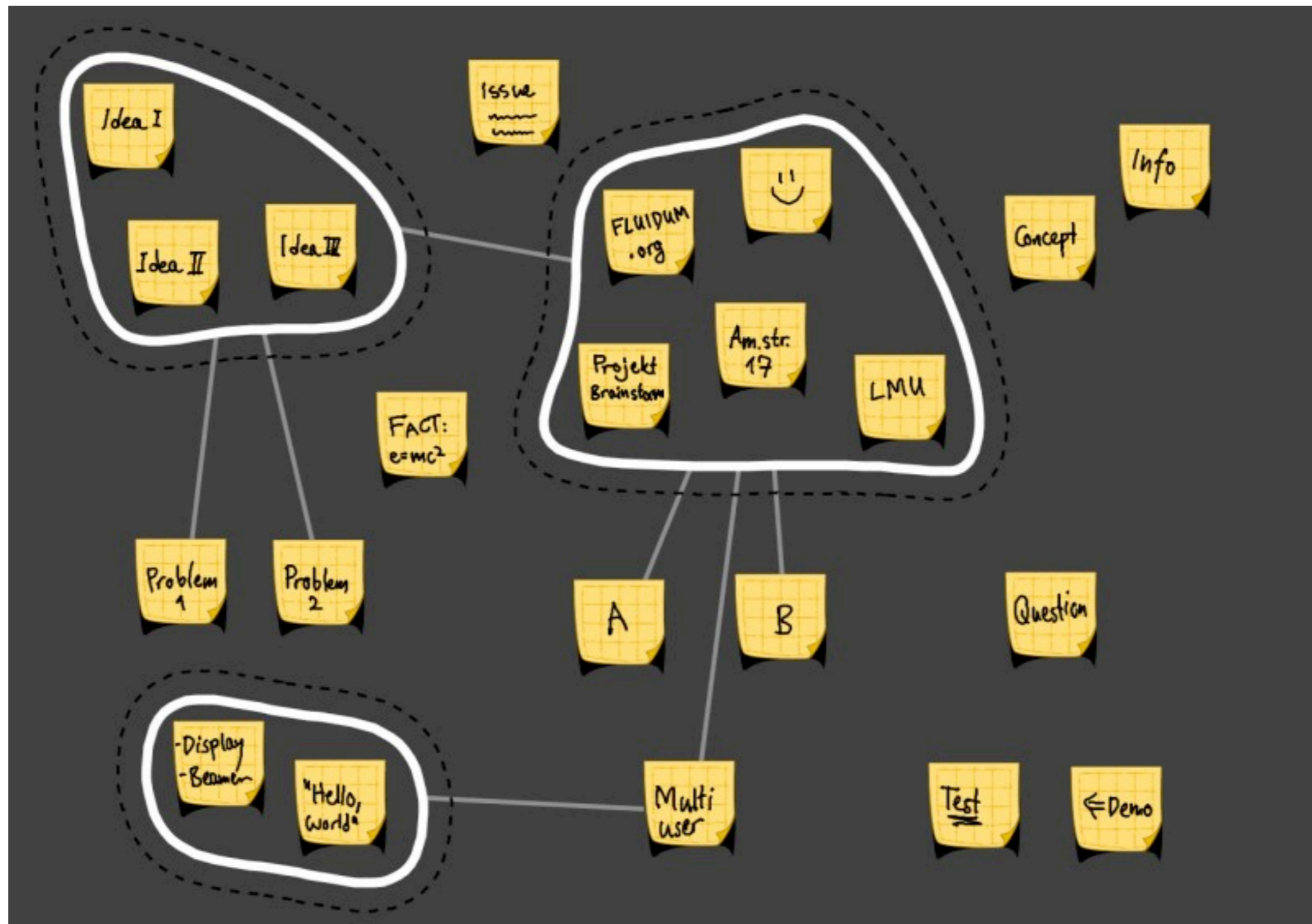
Appointments

14.10.	1 - Intro, overview
21.10.	Visit in the Fluidum IE, exercise groups
28.10.	2 - displays
4.11.	3 - sensing, tracking
11.11.	4 - networking
18.11.	-> Otmar Hilliges: multi touch sensing
25.11.	5 - HW toolkits
2.12.	6 - SW toolkits
9.12.	7 - interaction, context
16.12.	8 - TUI, ambient UI
23.12.	-> ??? ;-)
13.1.	9 - wearable computing, summary
20.1.	-> Presentations of exercise results
27.01.	AB traveling

The FLUIDUM Instrumented Environment

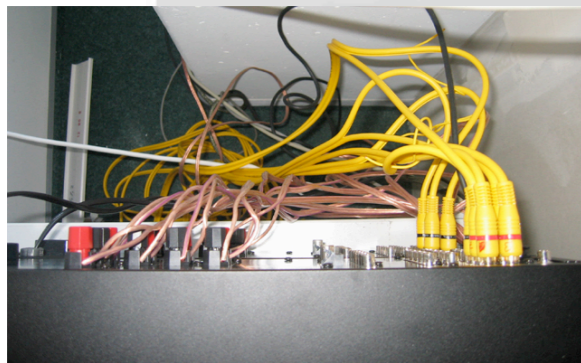


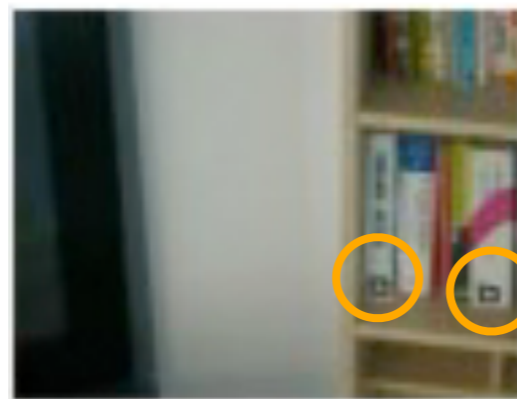
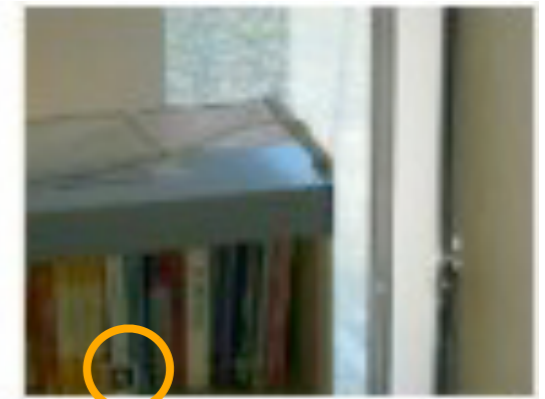
Brainstorming Demo



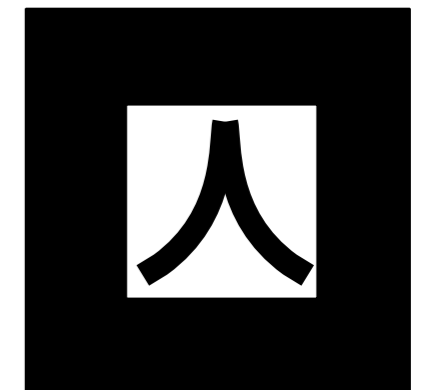
Instrumented Environment SUPIE

Saarland University Pervasive Instrumented Environment



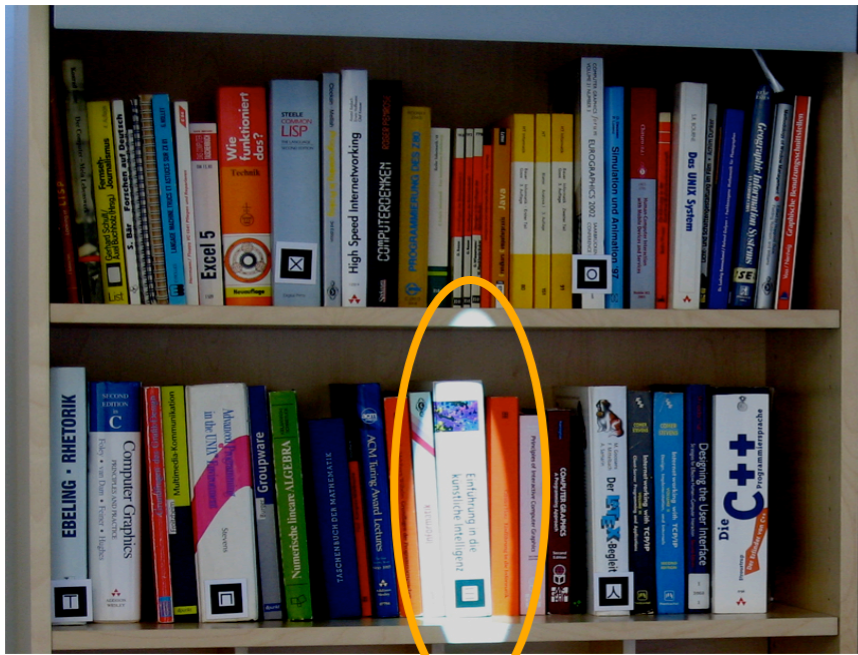


- Search for optical markers
 - AR-Toolkit library
 - Marker size 3cm
- Store all marker positions
 - Position in the image, Pan/Tilt angles



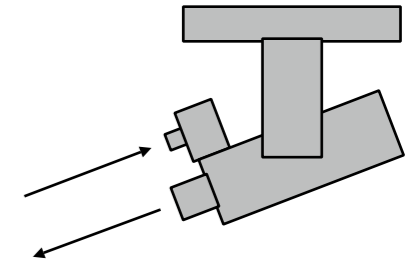
Searchlight

[Butz, Spassova, Pervasive 2004]



- Goal: Search function for physical objects
- 2nd step: highlight search results with a pin spot
- When highlighting a marker ID,
 - Set steerable projector to the stored Pan/Tilt angles
 - Project a circular spot around the stored position

Annotating physical objects



■ Idea:

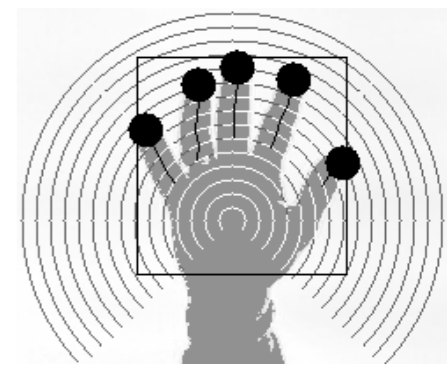
- Environment should be able to „label“ objects

■ Approach:

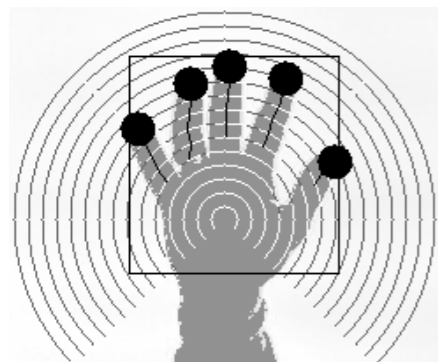
- Describe possible display the 3D model
- Position annotations acc. to:
 - Proximity to objects
 - Uniqueness of position
 - Grouping of annotations
 - Main axes of objects



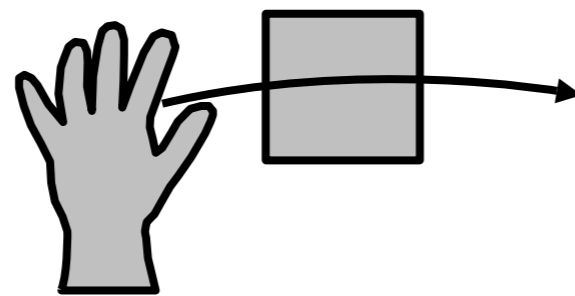
camera-based interaction



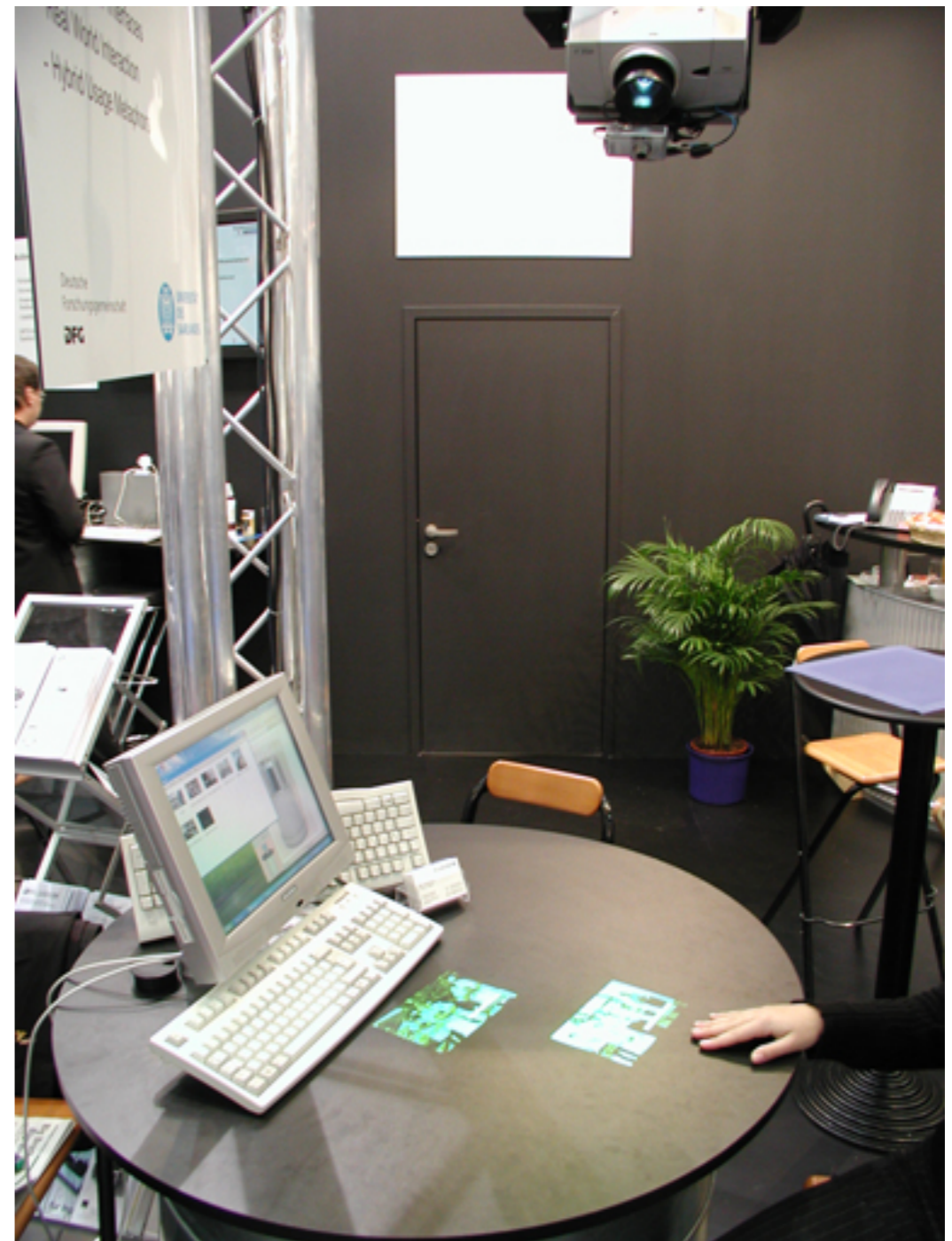
projection widgets



finger
gestures



hand
gestures



Course Material

- Web site: mimuc.de/ie
- Literature
 - Relevant scientific articles will be given as necessary
- Presentation slides
 - will be available before each appointment (pdf)
- Relevant material for exams:
 - Lecture slides
 - Understanding from the articles given

Exercises

- Tutor: Sebastian Boring (+ Marko Jurmu)
- Task: develop a component for the Fluidum IE (Amalienstrasse 17, basement)
- Meet weekly to discuss progress, exchange and demo intermediate states
- End of semester: final presentation (slides and demo)

Lecture certificate

- Based on
 - Successful demo of the exercise project
 - Final presentation of the project
- Graded (!)
 - Irrelevant for Diploma students (just ignore)
 - Relevant if you switch to Bachelor/Master later