Instrumented Environments

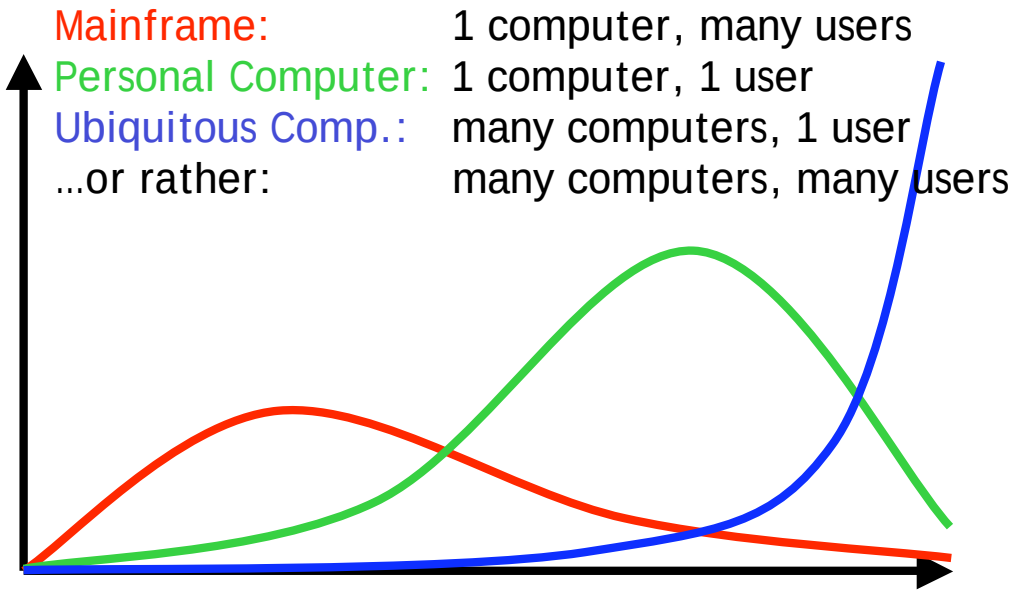
Andreas Butz, butz@ifi.lmu.de, www.mimuc.de

Fri, 12:15-13:45, Theresienstr. 39, Room E 045

Topics today

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

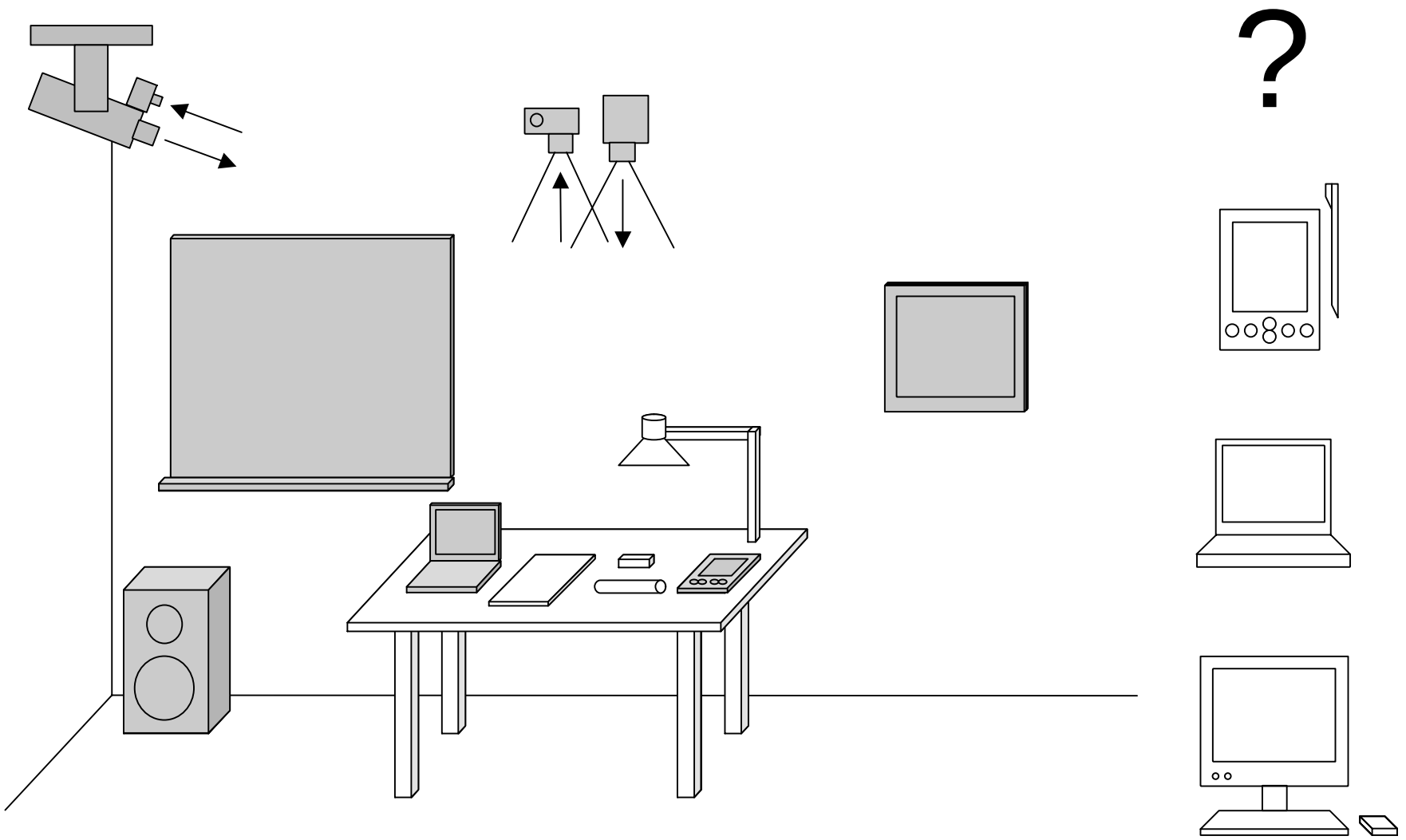
Post-PC Era or Ubiquitous Computing



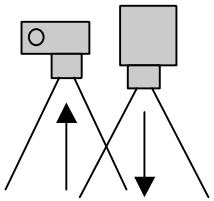
Mark Weiser: What Ubiquitous Computing Isn't
Ubiquitous computing is roughly the opposite of virtual reality. Where virtual reality puts people inside a computer-generated world, ubiquitous computing forces the computer to live out here in the world with people.

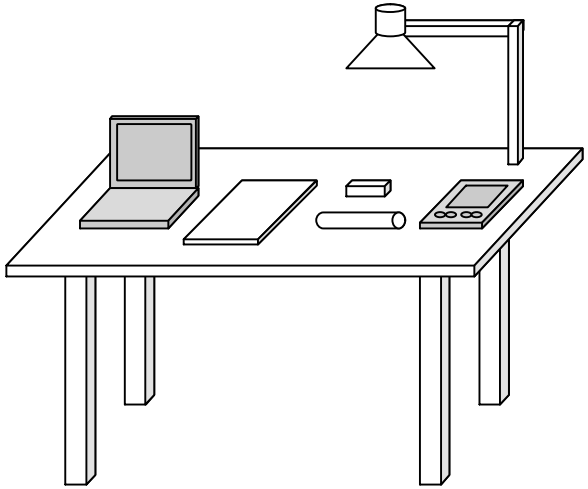
Computer out here in the world: Instrumented Environments

Instrumented Environments



Instrumented desk

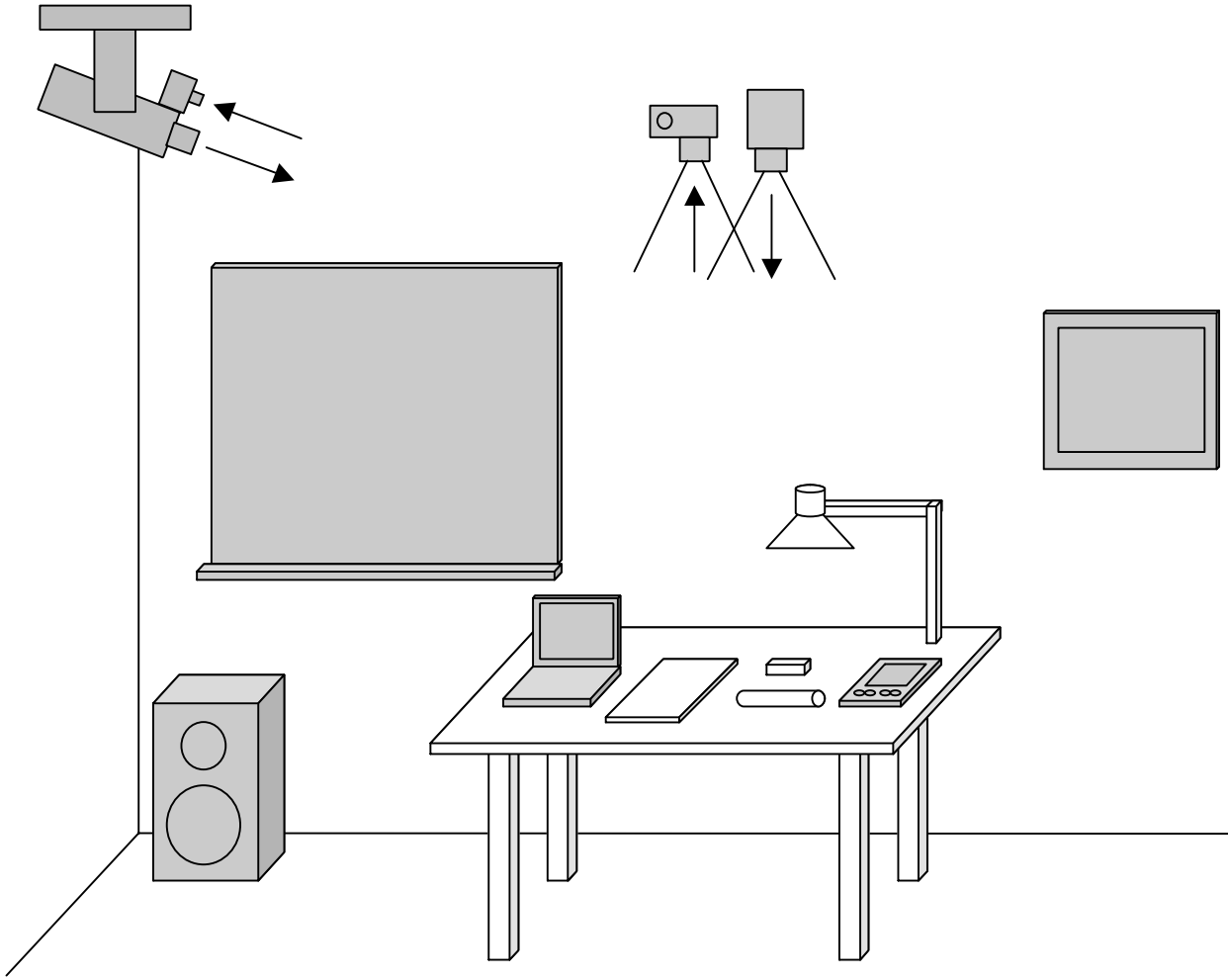




Research Topics:

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

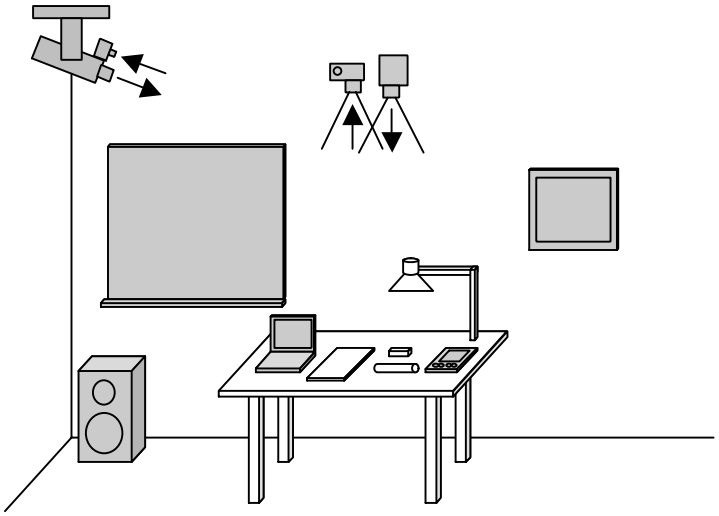
Instrumented room

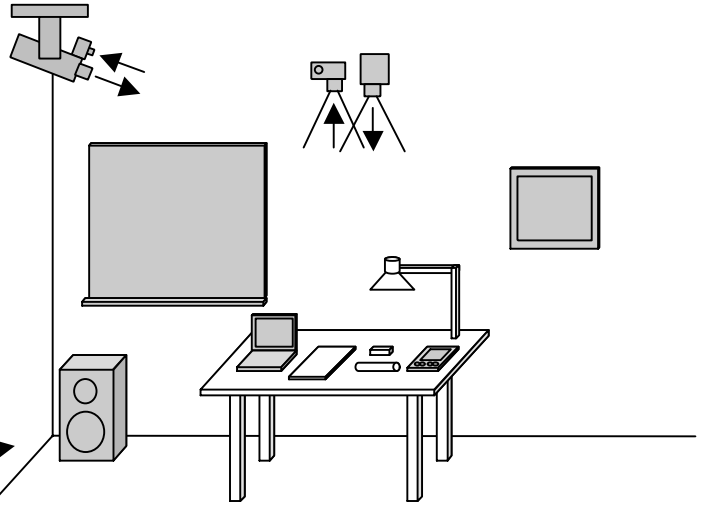


Research Topics:

- 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

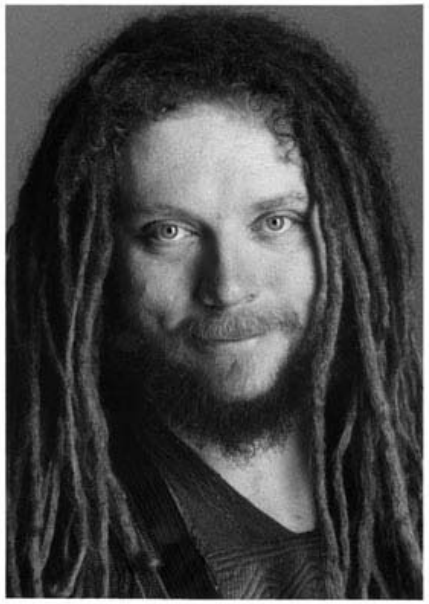
Sci-Fi version of Instr. Env.

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 (1)
- Base technologies
  - Hardware (2-3)
  - Software & modeling (2-3)
- Interaction in IE (2-3)
  - Different styles
- Intelligent IEs (1)
- Example systems (1)
- Related fields, Summary (1)
- Demos (1)

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
  - Magnetic
  - Load sensing, Floor tiles
  - Tracking Meta-techniques
    - sensor fusion
    - temporal filtering
    - Dead reckoning
- Networking
  - 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,
  - [...]
- User modeling
  - Individual Ums
  - Stereotypes
  - explicit vs. implicit UM acquisition
  - ubis world
- Context modeling
  - context toolkit
  - genius loci & numen
  - [...]

Interaction in instrum. environments

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

Intelligent instrum. environments

- representations of actions & time
- action & plan recognition
- dialog planning

Example Systems

- Xerox ParcTab
- Active Badges
- OXYGEN, i-room
- FhG Roomware
- Rekimoto Continuous work spaces
- Linz, Essex, SB projects
- [...]

Related fields, Summary

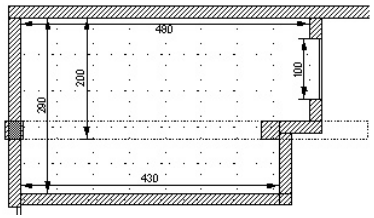
- IE vs. wearable computing
- IE vs. AR

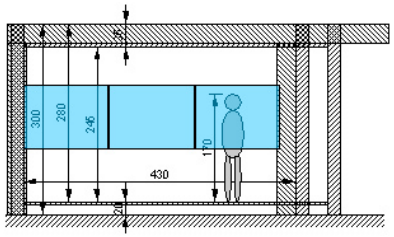
- Summary, hints for exam questions
- Demos of exercise projects

Appointments

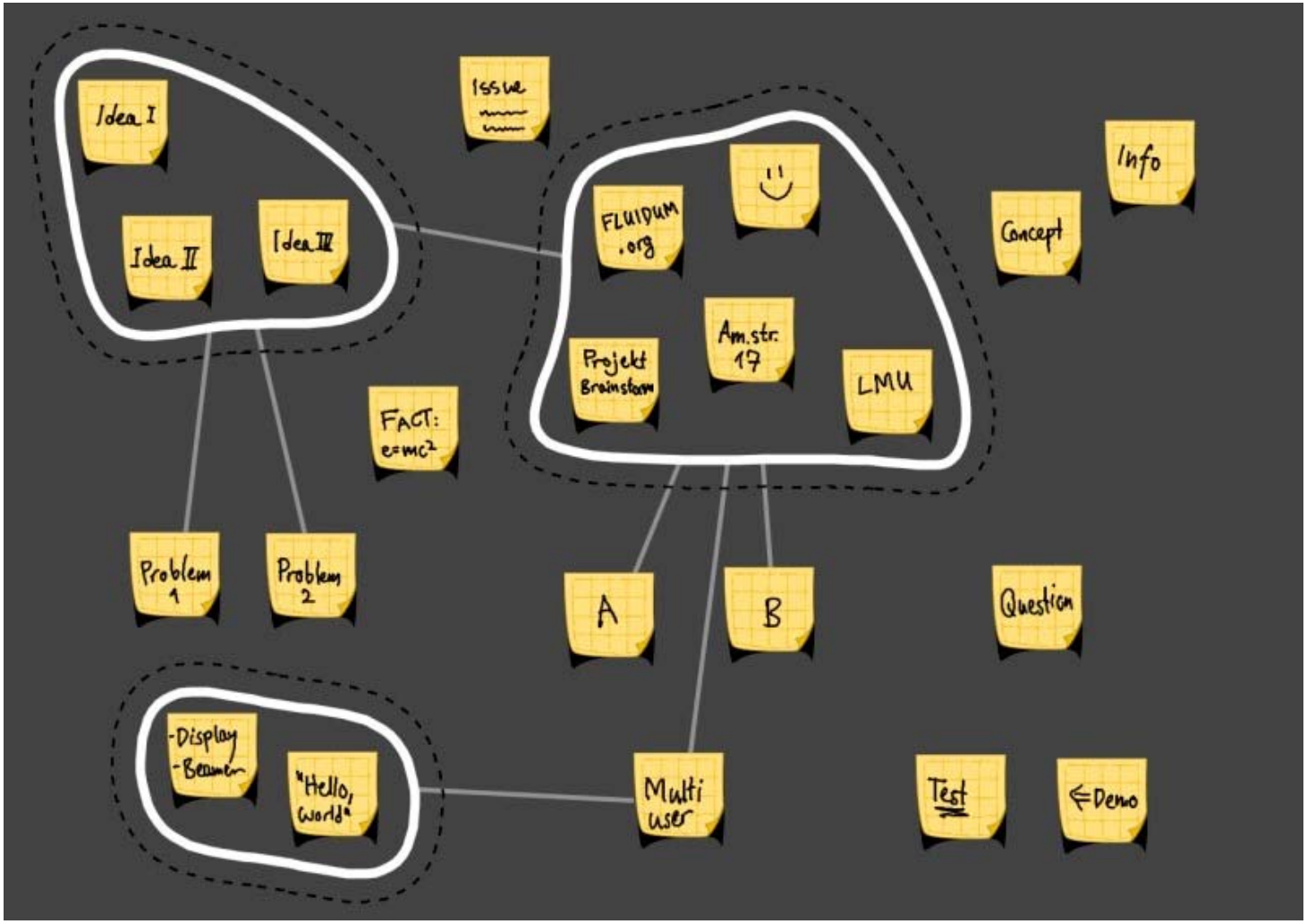
- 28.04. Intro, overview
- 05.05. Visit in the Fluidum IE, exercise groups
- 12.05.
- 19.05.
- 26.05. -> 24.05. (Christi Himmelfahrt)
- 02.06.
- 09.06.
- 16.06. -> 14.06. (Fronleichnam)
- 23.06.
- 30.06.
- 07.07.
- 14.07.
- 21.07. -> 19.07. Presentations of exercise results
- 28.07. AB & OH @SG symposium

The FLUIDUM Instrumented Environment





Brainstorming Demo



Instrumented Environment SUPIE

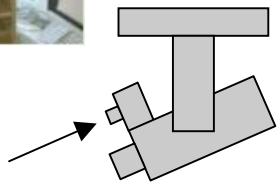
Saarland University Pervasive Instrumented Environment

REAL

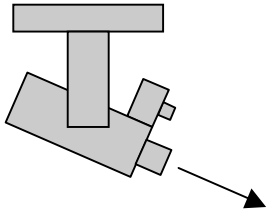
FLUIDUM

Physikalische Suchfunktion

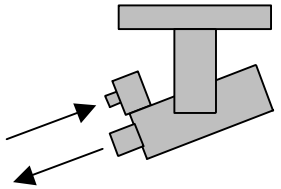
Indexerstellung: Abscannen des Raums mit Kamera
Marker-Erkennung (>= 1cm) mit AR-Toolkit
Abspeichern der Pan/Tilt Werte zu jeder Marker ID
Dauer: ca. 1h für gesamten Raum



Suchanfrage: Marker ID
Ansteuern der gespeicherten Pan/Tilt Werte
Anleuchten des Objektes
Bei ungenauer Position: Bereich ausleuchten



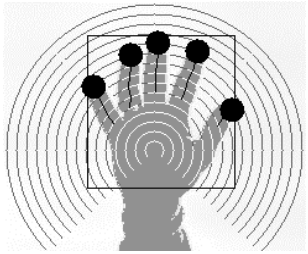
Annotating physical objects



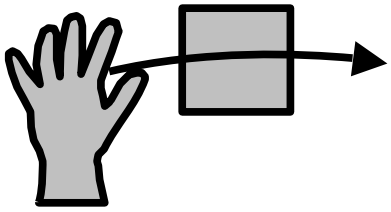
- Idea:
  - Environment should be able to „label“ objects
- Approach:
  - Describe possible display surfaces in the 3D model
  - Position annotations acc. to:
    - Proximity to objects
    - Uniqueness of position
    - Grouping of annotations
    - Main axes of objects

camera-based interaction

projection widgets



finger gestures



hand gestures

Course Material

- Web site: www.mimuc.de → Lehre
- Literature
  - Relevant scientific articles will be given as necessary
- Presentation slides
  - will be available shortly after each appointment (in pdf format)
  - All-in-one PDF file for exam preparation at the end of the semester
- Relevant material for exams:
  - Lecture slides
  - Understanding from the articles given

Exercises

- Tutor: Otmar Hilliges (+ Sebastian Boring)
- Task: develop a component for the Fluidum IE (Amalienstrasse 17, basement)
- Meet next week (Fri 5.5. 12:15) there to see room demo and define projects
- Meet weekly to discuss progress, exchange and demo intermediate states
- On 19.07. Final presentation (slides and demo)

Lecture certificate

- Based on
  - Succesful 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