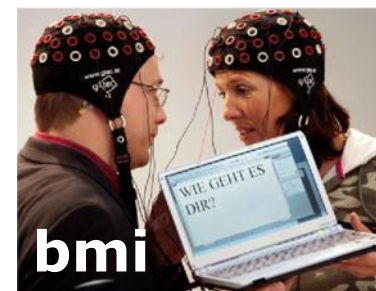


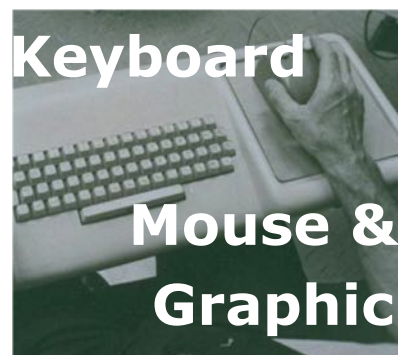


# What was this course about?

1960



2010

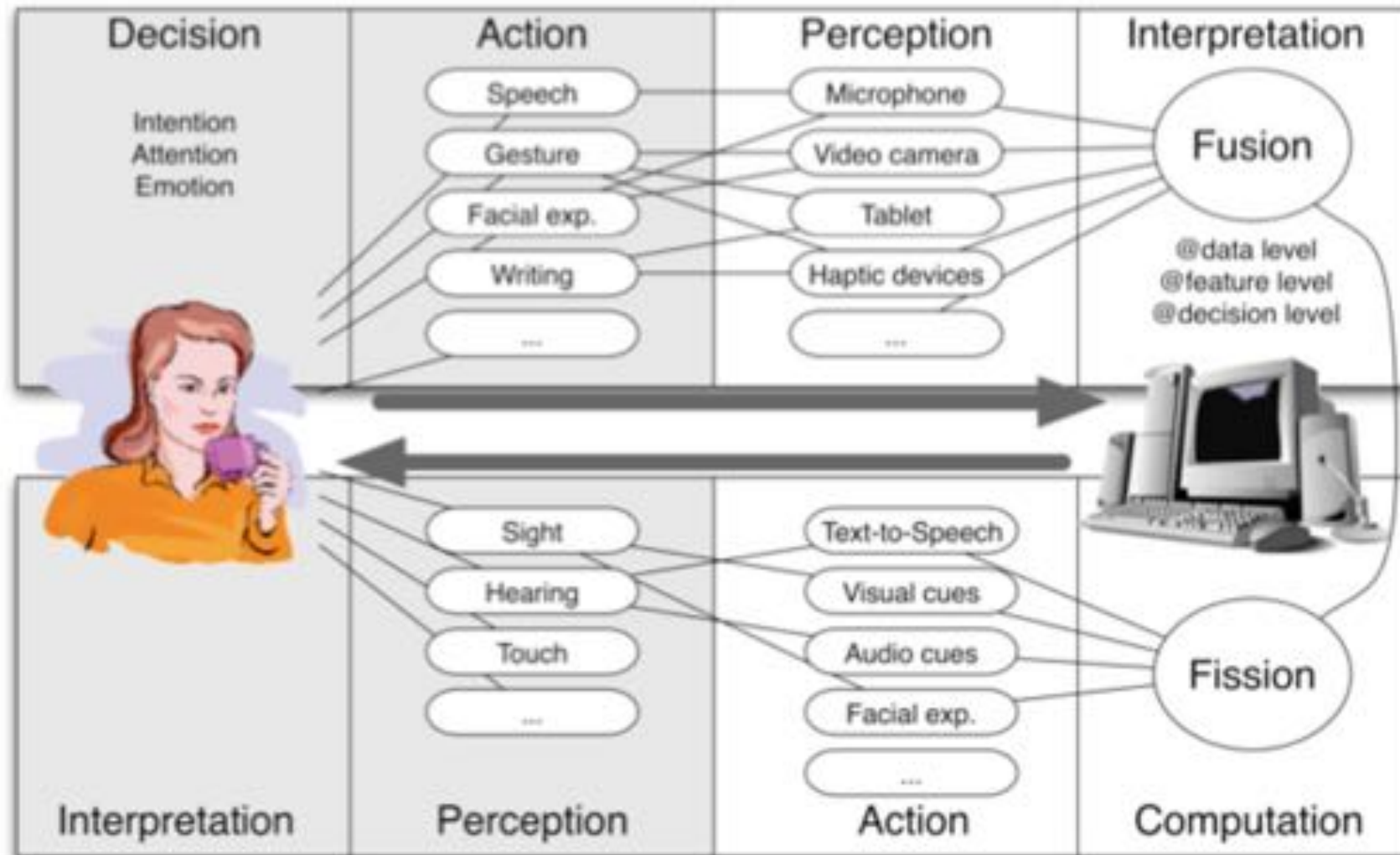


Week	Course	Date	What
1	MMI_01	19.02	Introduction (DL)
2	MMI_02	26.02	Multimodal Interaction (DL)
3	MMI_03	05.03	Multimodal Fusion (DL)
4	MMI_04	12.03	Tangibles + Gestures + Voice (DL)
5	MMI_05	19.03	Wearable & ubiquitous Computing (AL)
6	MMI_06	26.03	Virtual Reality + Augmented Reality (AL)
7	MMI_07	02.04	Ambient computing (HA)
8	MMI_08	09.04	User Evaluations of MMI (DL)
9		16.04	Intermediary presentations (ALL)
10		24.04	Easter
11	MMI_09	30.04	Affective & Brain interfaces (DL)
12	MMI_10	07.05	Information Visualization (FE)
13	MMI_11	14.05	CSCW (HA)
14	MMI_12	21.05	Wrap Up (DL)
15		28.05	Final presentations (ALL)

## [2] Multimodal interfaces: intro



# Multimodal Interaction



Dumas, B., Lalanne, D., Oviatt, S. Multimodal Interfaces: A Survey of Principles, Models and Frameworks. In Denis Lalanne, Jürg Kohlas eds. (2009). Human Machine Interaction, LNCS 5440, Springer-Verlag, Berlin/Heidelberg, pp. 3-27.

# Complementarity of modalities

- Speech- the “Portable Power Tool”



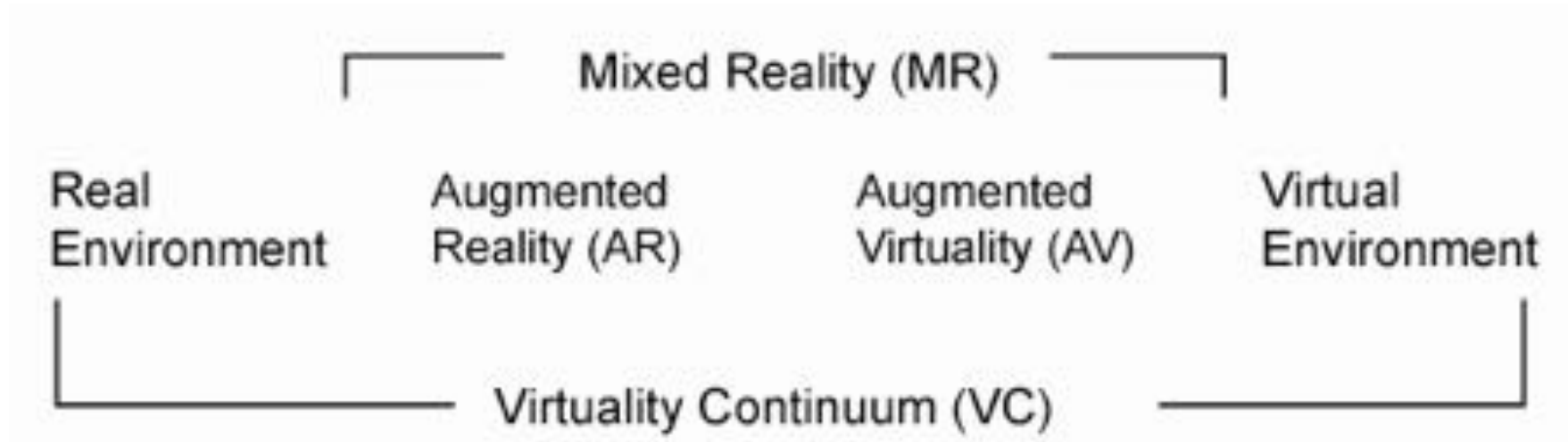
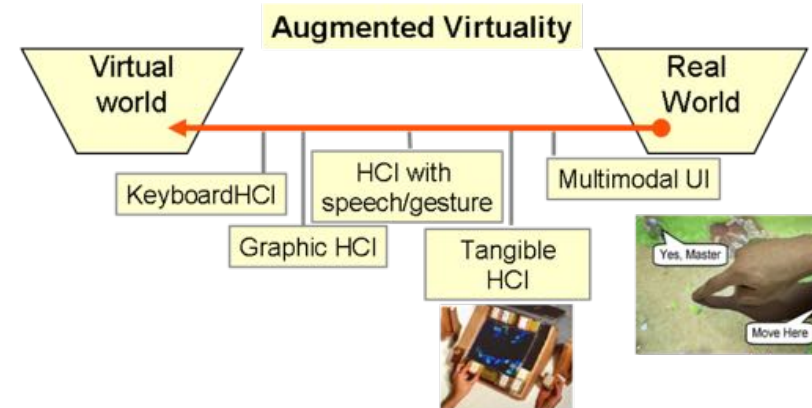
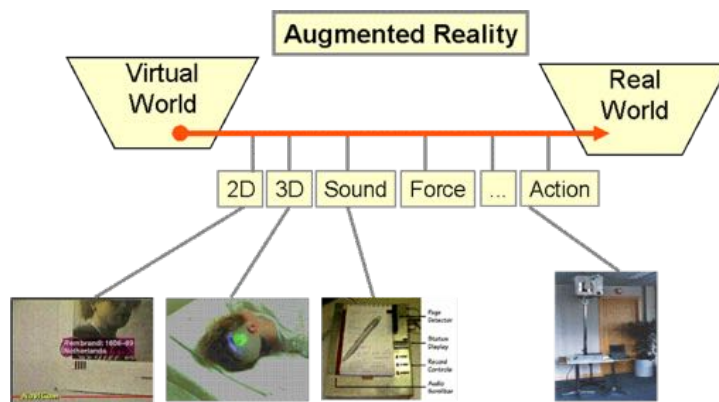
- Pen- the “Compact Multifunctional Chameleon”



- Human Gaze- the “Active Index of Interest”



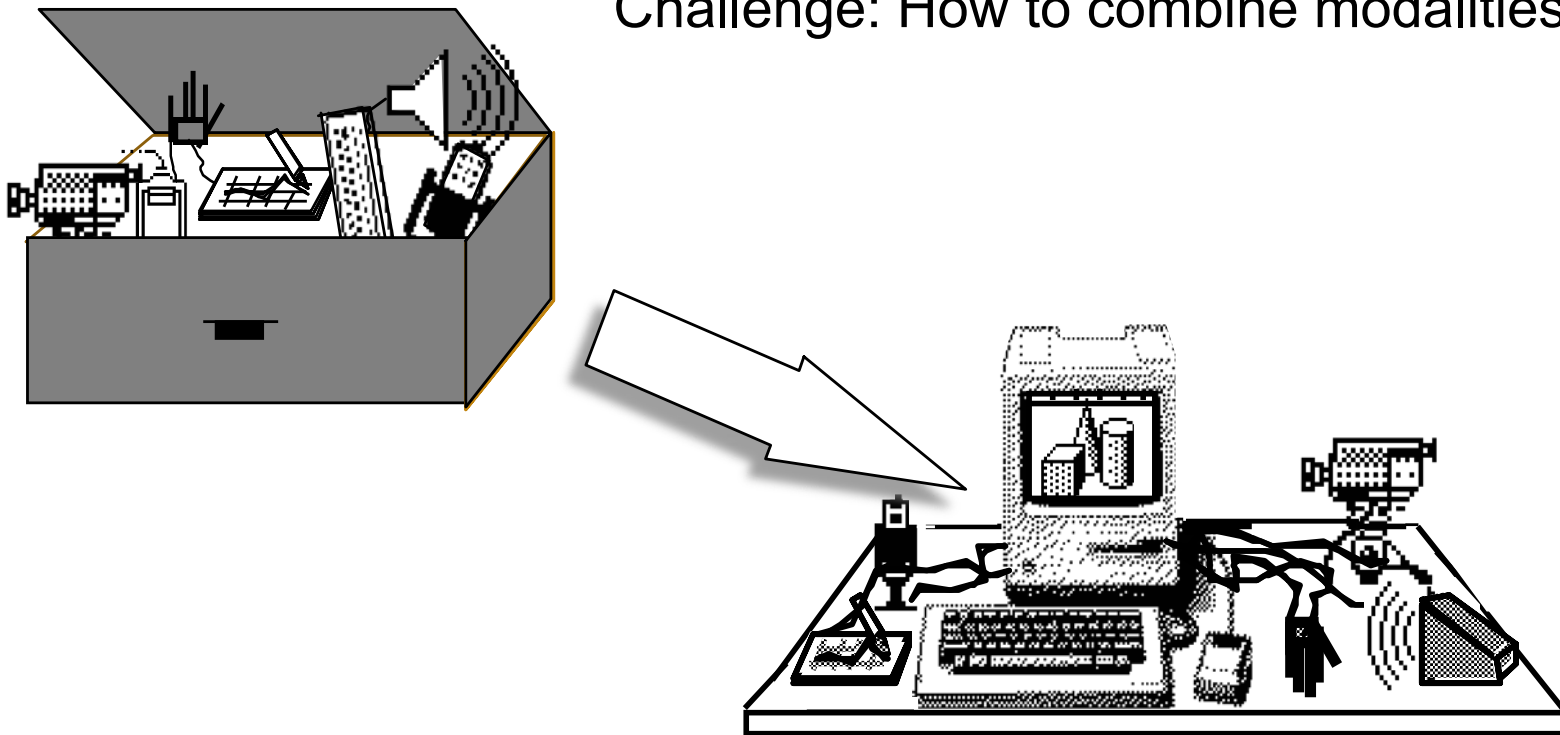
# Virtuality Continuum





# [3] Multimodal Interaction: Fusion, fission and systems architecture

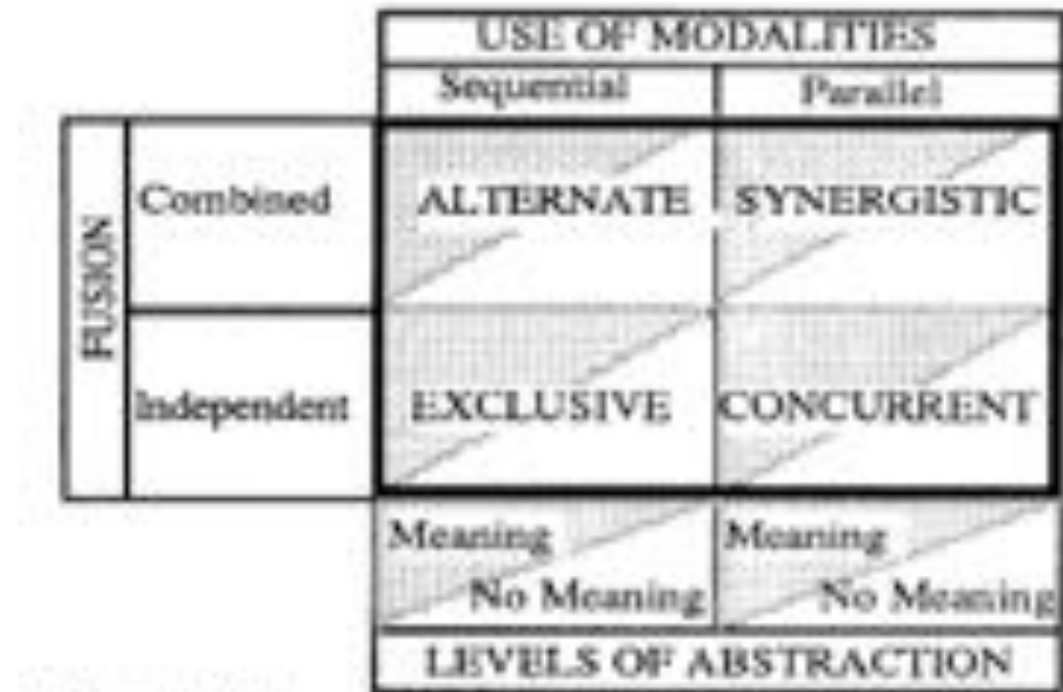
Challenge: How to combine modalities ??





# The CASE model: Multimodal systems Communication types

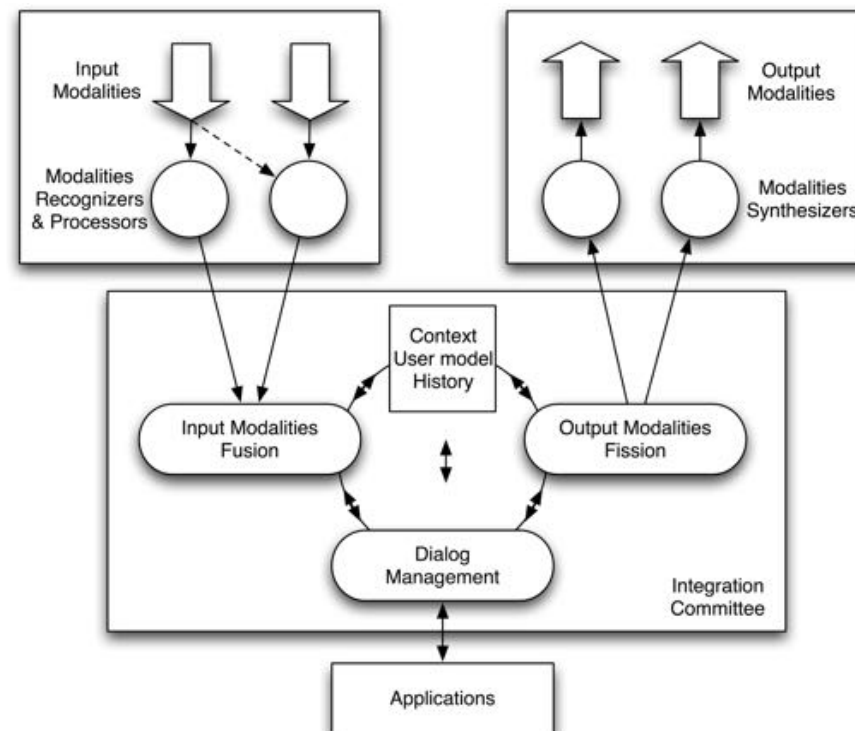
- 3 dimensions in the design space :
  - Levels of abstraction
  - Use of modalities
  - Fusion



## And also...

- The CARE model (**C**omplementarity, **A**ssignment, **R**edundancy, **E**quivalence)
  - Human side of fusion
- Error-handling and feedback
  - Mechanisms to correct or manage recognition errors
  - Visual or sound feedback (so that user can understand the machine interpretation)

### ■ Architecture



# [4] Voice & Gesture Interaction

- Natural means for interacting...



# Voice-Based Interaction

- Why speech?
  - Natural way to interact with people
  - Fast
  - Free-hand interaction
- What is voice-based interaction?
- How works voice recognition and voice synthesis?
- Explain challenges of voice-based interaction system

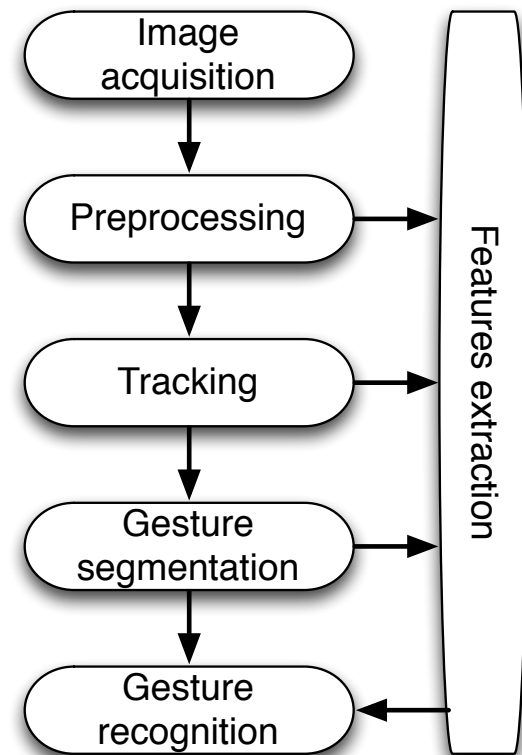


# Gesture Recognition and HCI

- Challenge: capture with a webcam...

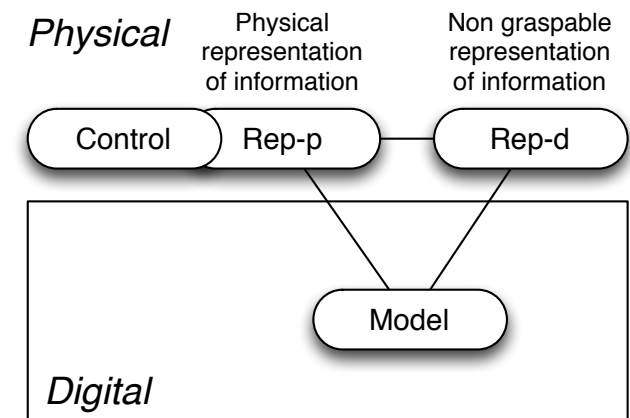
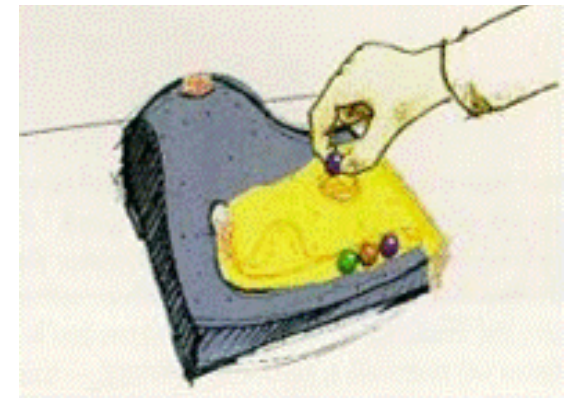
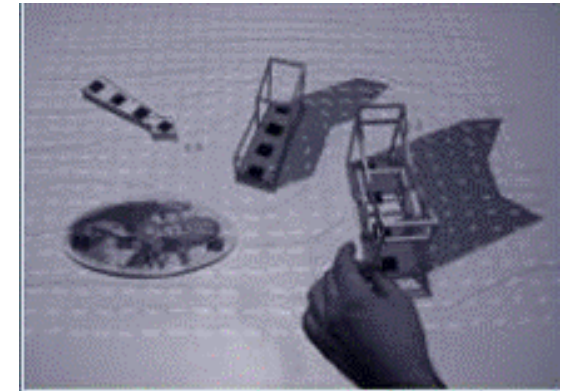


- ... and track the hand, to recognise a gesture (dynamic)
- Give a definition of a gesture
- Describe a pipeline for gesture recognition
- Describe how to define a good gesture vocabulary



# [4] Tangible Interaction

- Giving physical form to digital information
  - + interaction capabilities
- At the border between the physical and the digital
  - *“Direct link between the digital bit and the physical atom”*
- Give a definition of tangible interaction
- What are the goals of tangible interaction?
- Describe some models
  - the MCRpd interaction model
  - tokens, containers and tools are
  - Describe the taxonomy of Fishkin (axes)
- Compare GUIs and TUIs



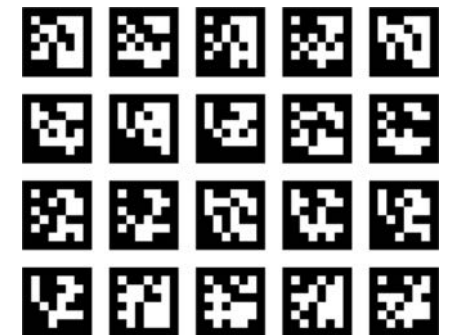
# [5] Wearable and Ubiquitous Computing

- Vision of Computing for the Computing of 21<sup>st</sup> Century
- The descendants of Ubicomp: Mobile Computing and Distributed Systems
- Current Technical Challenges
- Application Areas
- Interaction Paradigms
- Re-thinking Ubicomp (or has Ubicomp achieved its objectives)
  
- Example Question1: Describe the vision of Ubicomp, and exemplify it with pioneering projects in academia and the well-adopted ones in industry
- Example Question2: Describe the parameters of the context and how to recognize them (with available technologies), given a certain situation (for example autonomous thermostat)



# [6] Virtual and Augmented Reality

- Explain the differences between virtual reality, augmented reality, augmented virtuality and mixed reality
- Give a definition of virtual reality
- Describe technologies for virtual reality
- Describe interaction techniques for virtual reality
- Describe techniques for augmented reality
- Explain the problem of tracking, and ways to solve it
- Describe the reality-virtuality continuum taxonomy



# [7] Ambient computing

- Human's background processing
- Part of Ubicomp vision: computing in the background of attention
- The use of metaphors
- Spatial configuration of information and its impact on users' perception
- Ambient interfaces to change individual and social behaviour
  
- Example Question1: Describe with example project the coupling of physical space and digital information, and discuss its impact on the users.
- Example Question2: We give you a problem and ask to you to propose an ambient solution which details (1) what type(s) of information, (2) in what form of physical manifestation, and (3) through what metaphors are provided.

# [8] Evaluating with users

- Goals
  - Gather valuable requirements / insights
  - Decide between competing solutions
  - Test theoretical questions
- Methods
  - Observation/Testing
  - Questionnaires/Interviews
  - Controlled experiments
- What are qualitative vs quantitative user evaluations?
- How to setup a controlled experiment? Hypothesis? IV, DV?
- Two main aspects:
  - Effectiveness
    - ✓ Does the user find the system usable, is s/he effective with it
    - ✓ You can apply most of the qualitative methods
  - Efficiency
    - ✓ How efficient users are with the system



- Goal of brain-computer interface (BCI)
- Explain challenges, advantages, and drawbacks of BCI
- Describe the different types of mental tasks (Endogenous, Exogenous, ...)
- Explain the physiological problems & proposed solutions
  - Limited vocabulary
  - Limited recognition accuracy
  - Limited activation/usage periods

## [9.2] Affective computing

- Describe what is considered an emotion;
- Give a definition.
- Explain different models of emotions (discrete and dimensional).
- Which channels can be used to recognise emotions?



# **[10] Information visualization (infovis)**

- What is infovis? Give a definition
- What is the role of infovis?
- What are the major techniques
- What are the major issues related to infovis

# [11] CSCW Overview

- Understanding Communication - Grounding Process
  - Awareness and Coordination
  - Groupware and Roomware
  - Multi-Modal Collaborative Interfaces
- 
- Example Question: If you have to design a group chat tool. How will you make it better than the existing apps such as Messenger or WhatsApp Group Chat? What awareness features will you incorporate so as to minimize the repair operations?
  - Example Question: How can you design video-conferencing systems (eg. Skype) in a way that they provide a rich experience. This implies that you have to identify the faults with the off-the-shelf systems, and ways of improving it.



# Mini-project: Evaluation criteria

1. Idea / design
2. Quality of work
3. Multimodality
  - In respect to CASE/CARE models
  - Both inputs (fusion) and outputs (fission)
4. Interaction quality
  - Usability
  - Error handling / feedback
5. Report → the day of the presentation (2 printed copies)
6. Presentation (oral presentation, demo, video)
7. User evaluation

# Written exam

- 2 hours
- No document
- 1 A4 page
  - One side
  - Hand-written (no xerox copy)
  - Put your name on it



# Exam, typical questions (1)

- What are the important features of multimodal interfaces (MMI) compared to standard graphical user interfaces (GUI)?
- Please indicate the strengths, weaknesses, typical applications and users for the following modalities: voice, gesture, eye gaze.
- Please explain the two following properties of the **CASE** using speech and eye gaze as examples (combining them or not)
- Give an example of tangible user interface and discuss its quality features compared to another type of HCI
- What the difference between AR and AV? And VR? Please give examples to illustrate your points.

# Exam, typical questions (2)

- In a project in which we combine gesture and speech recognition, we wanted to compare ....
  - What is a valid hypothesis for this experiment?
  - What are the IV and the DV?
- What are the typical questions you want to address with user evaluations when testing a multimodal interactive system?
- Describe the main concept of "Wearable computing" and highlight the related challenges.
- Concerning BCI, describe the different types of mental tasks (endogenous, exogenous, modulated response). For each type, give some examples and explain advantages and drawbacks.
- How is it possible to automatically recognize emotion?