

User Centered Design

[3] Interaction paradigms

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October 2nd, 2018

Goal

- Look back to HCI history in relation with paradigm shifts
- Provide an overview of existing human computer interaction techniques and paradigms
- Know better which interface technique is best for which activity?

Paradigm shifts in computer science

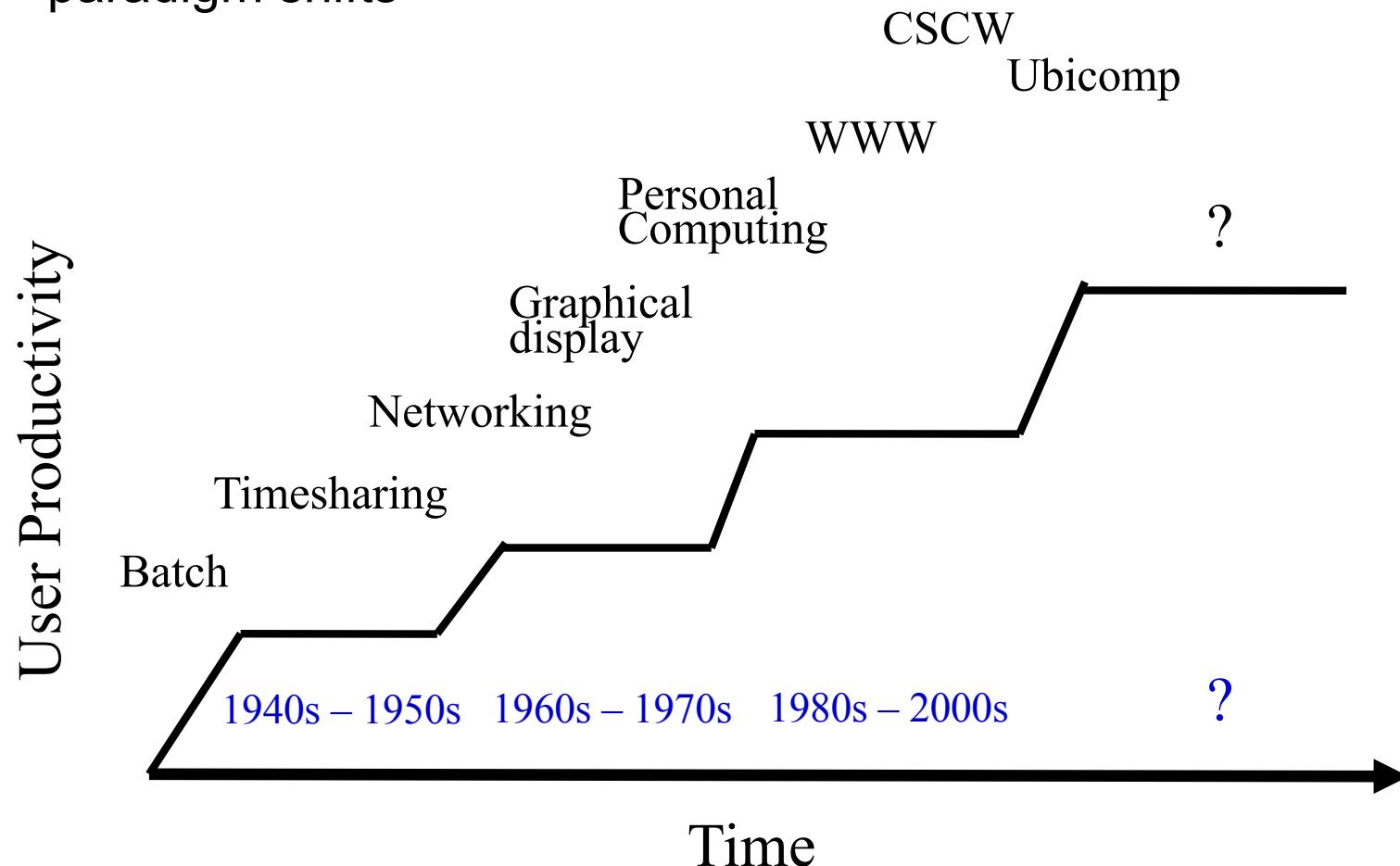
... and how it affected the evolution of HCI

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Paradigm Shifts

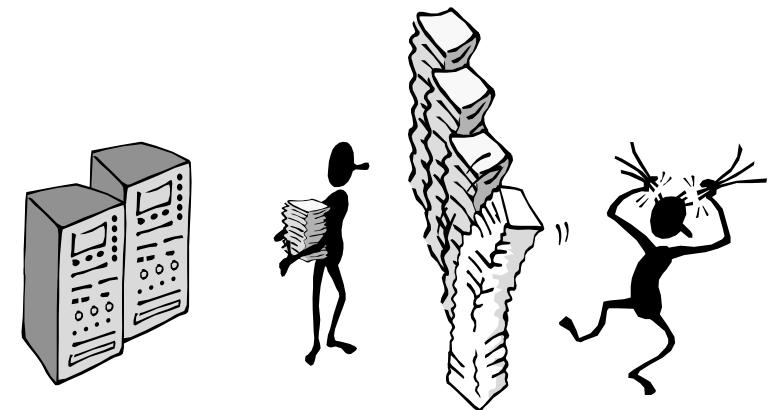
- Understanding HCI history is largely about understanding a series of paradigm shifts



Adapted from : <http://www.hcibook.com/e3/resources/>

The Initial Paradigm: Batch processing & Large scale computing

- The original mainframe computers were large-scale computing machines, referred to as hosts
- They resided in a central location



Impersonal computing



Archives IBM – IBM SSEC 1948



From IBM Archives (ENIAC 1943)



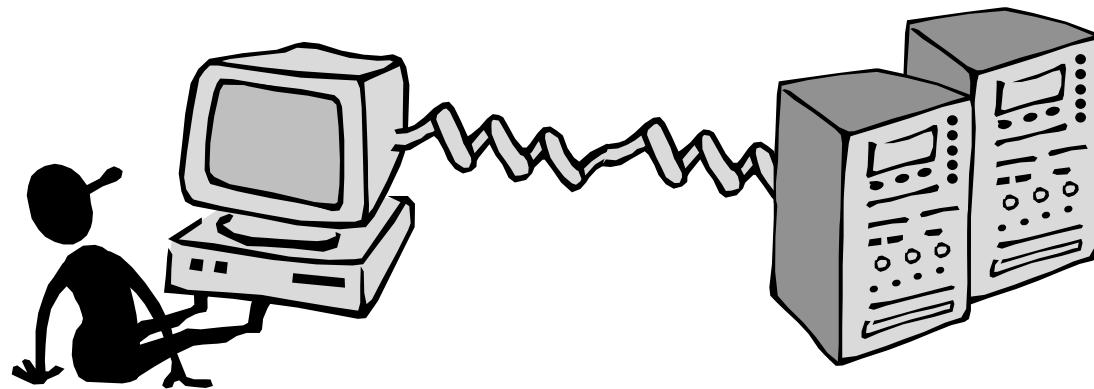
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Paradigm Shifts

- Batch processing
- Time-sharing



Interactive computing

Adapted from : <http://www.hcibook.com/e3/resources/>

Significant Advances 1960 - 1980

- Mid '60s
 - computers too expensive for a single person
 - single computer supporting multiple users
 - programmed using punch cards
- J.C.R. Licklider roadmap (1960)
 - Outlined “man-computer symbiosis”
“The hope is that, in not too many years, human brains and computing machines will be coupled together very tightly and that the resulting partnership will think as no human brain has ever thought and process data (...).”
- Time-sharing
 - the illusion that each user has a personal machine
 - led to need to support human-computer interaction
 - ✓ Community through computers (and eventually through networks) via email, shared files, etc.



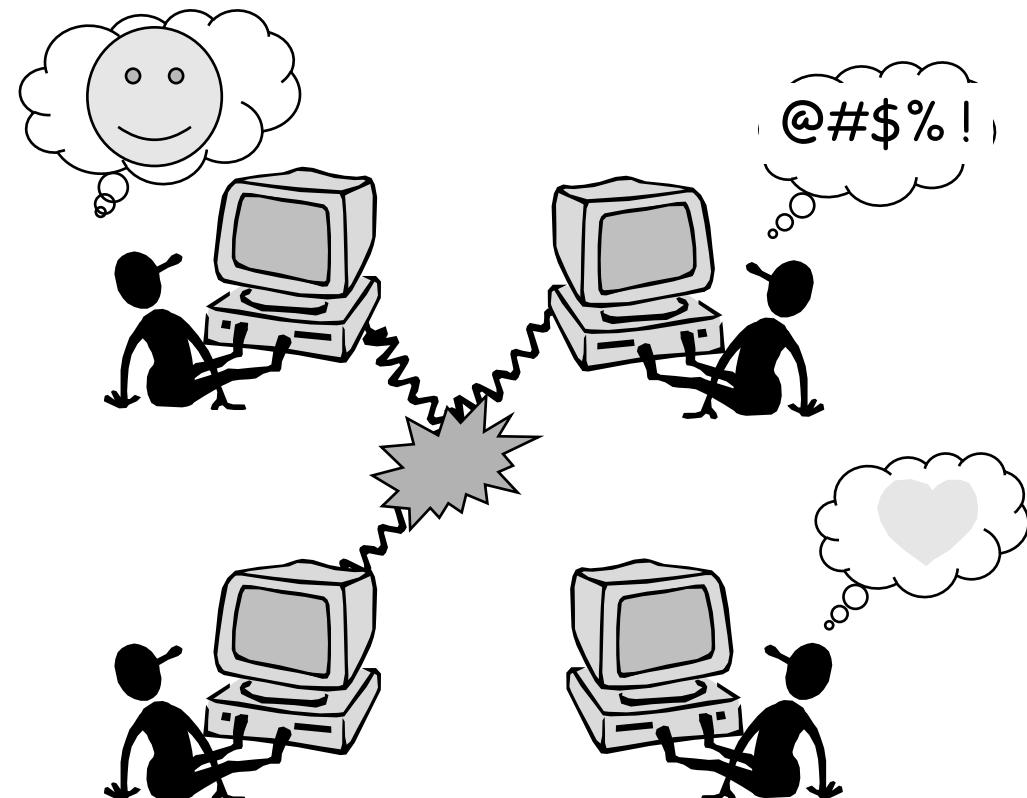
IBM card punch machines



J.C.R. Licklider

Paradigm Shifts

- Batch processing
- Timesharing
- Networking

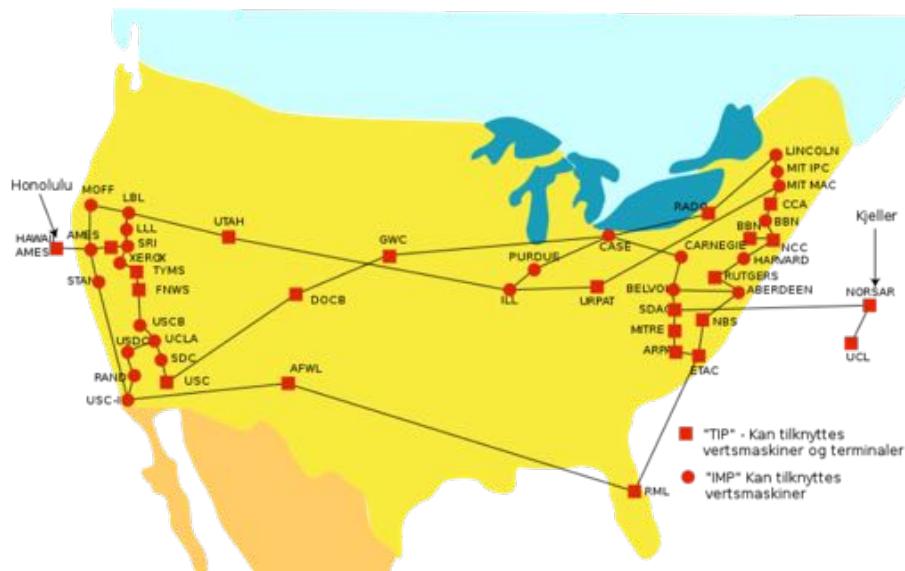


Community computing

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Internet history

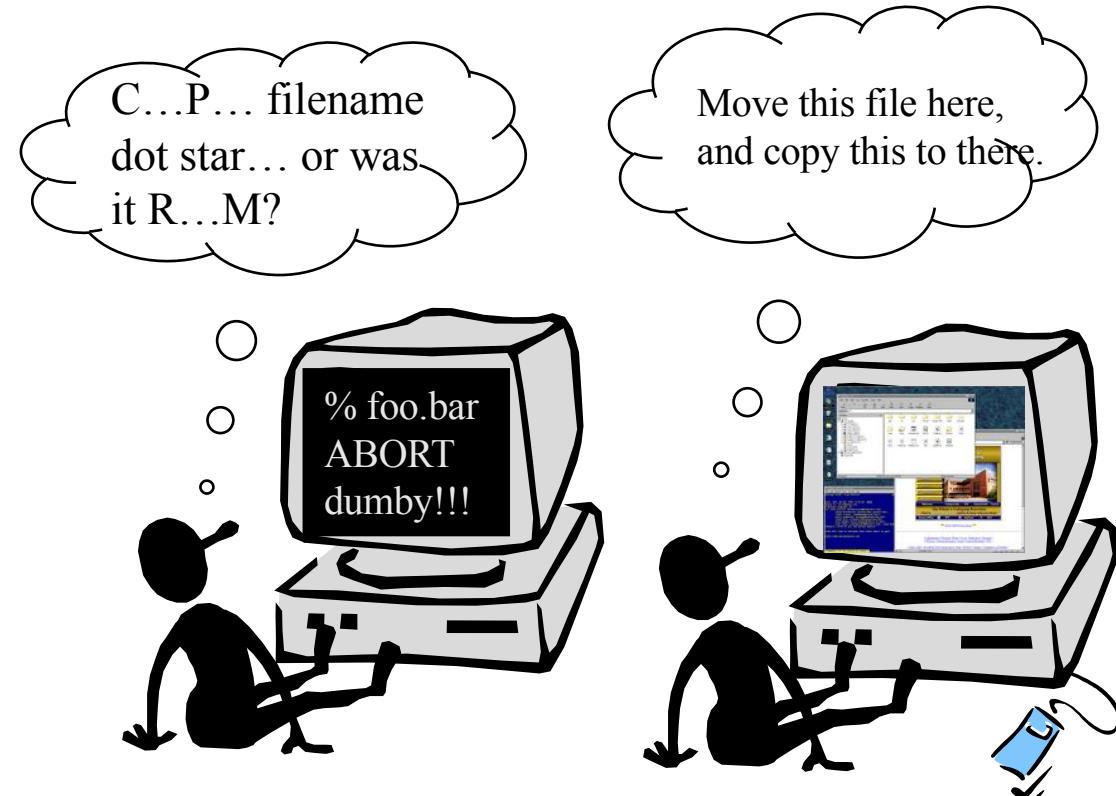
- To prevent an attack (during cold war)
- Early 1960 - DARPA (Defense Advanced Research Projects Agency) directed by **Licklider**
- End 1960 - ARPANET (« Advanced Research Projects Agency Network ») & research on packet switching by Roberts
 - 1969 - 4 host computers (UCLA, SRI, UCSB, University of Utah)
 - 1971 - 23 host computers
- 1982 – TCP-IP and “internet”
- 1983 – First DNS



ARPANET in 1974.

Paradigm Shifts

- Batch processing
- Timesharing
- Networking
- Graphical displays



Direct manipulation

Adapted from : <http://www.hcibook.com/e3/resources/>

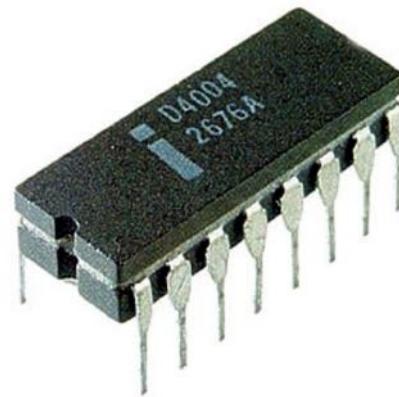
First graphical interface...

- Ivan Sutherland 1963 (PhD thesis MIT)
- Computers for visualizing and manipulating data
 - more suitable medium than paper
- Sketchpad
 - Drawing tool
 - Optical pen and buttons
 - Direct manipulation
 - Icons
 - Zoom
 - Copy/Paste
 - Master picture with instances (i.e., OOP)



Paradigm Shifts

- Batch processing
- Timesharing
- Networking
- Graphical display
- Microprocessor



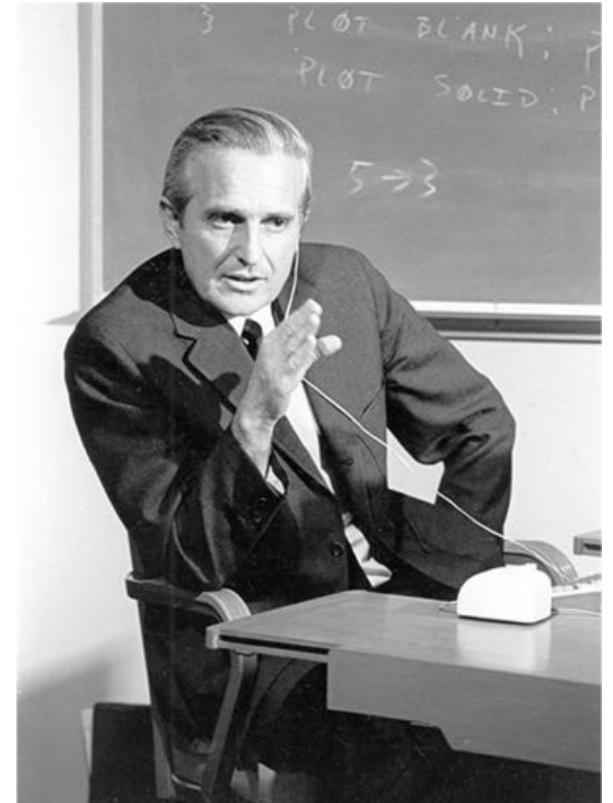
Personal computing

Adapted from : <http://www.hcibook.com/e3/resources/>

Douglas Engelbart

■ The Problem (early '50s)

- "...The world is getting more complex, and problems (...). These must be dealt with collectively.
- If you could do something to improve human capability to deal with these problems, then you'd really contribute something basic."



■ The Vision (Early 50's)

- ...I had the image of sitting at a big CRT screen with all kinds of symbols, new and different symbols, not restricted to our old ones. The computer could be manipulated, and you could be operating all kinds of things to drive the computer
- ... I also had a clear picture that one's colleagues could be sitting in other rooms with similar work stations, tied to the same computer complex, and could be sharing and working and collaborating very closely. (...)"

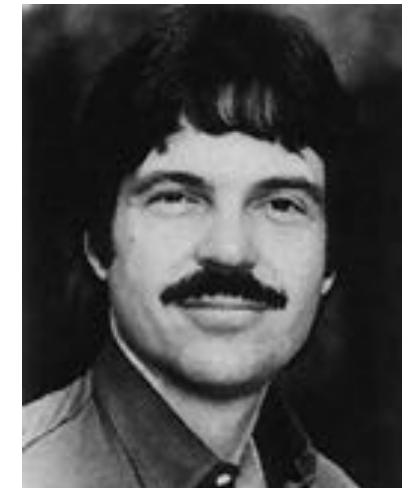
Douglas Engelbart

- Engelbart at Stanford Research Institute
- A Conceptual Framework for Augmenting Human Intellect (SRI Report, 1962)
- 1968 NLS/Augment system demonstration
 - Text edition
 - Video conference
 - Two dimensional screen
 - Device on knee
 - Mouse
 - hypertext
- The right programming toolkit provides building blocks to producing complex interactive systems



The Personal Computer

Alan Kay

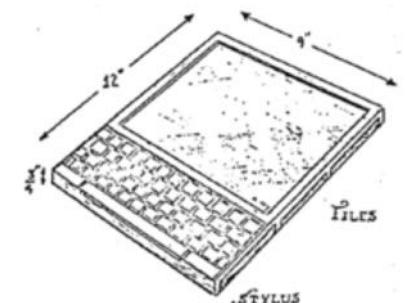


- 1967 – Papert's LOGO language for simple graphics programming by children
 - A system is more powerful as it becomes easier to user
 - Future of computing in small, powerful personal machines



- Alan Kay (Xerox PARC - 1969)
 - 1972- Dynabook vision (and cardboard prototype) of a notebook computer:
 - ✓ “A Personal Computer For Children Of All Ages.”
 - ✓ “Imagine having your own self-contained knowledge manipulator in a portable package the size and shape of an ordinary notebook. Suppose it had enough power to out-race your senses of sight and hearing, enough capacity to store for later retrieval thousands of ... documents, records, drawings, animations, musical scores...”

Dynabook -
Notebook sized
computer loaded
with multimedia
and can store
everything



The WIMP interface

- 1973 - Xerox Parc Alto
 - “the interim Dynabook”
 - Local processor, bitmap display, mouse
 - Precursor to modern GUI, windows, menus, scrollbars
 - LAN – Ethernet
- 1981 – Xerox Star first commercial windowing system
 - Digital screen, mouse
 - Windows, icons, menus and pointers, etc.
 - What you see is what you get (WYSIWYG)
 - Interaction without modes
 - First system based on usability tests
 - Commercial failure (cost \$15,000)



The Xerox Alto (1973)



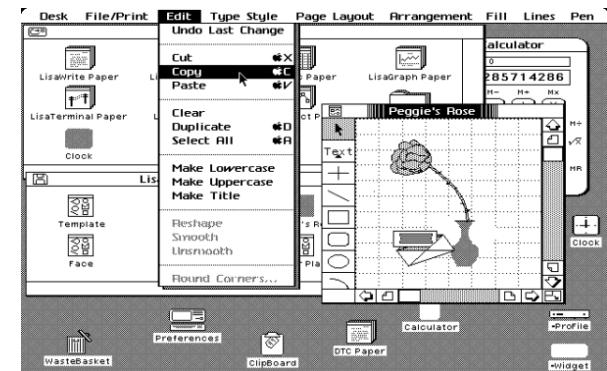
Apple Lisa (1983)

- Based on ideas of Star (Xerox)
- Commercial failure (price ≈ \$10'000)



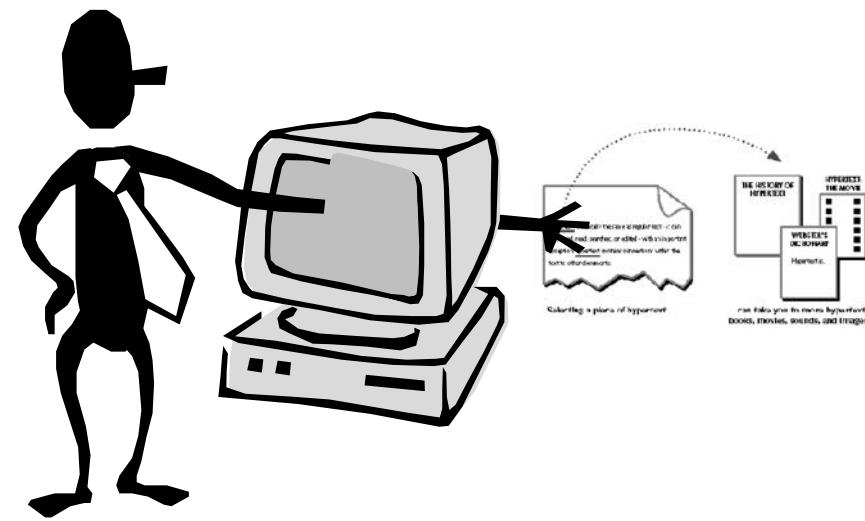
Apple Macintosh (1984)

- « old ideas » but well done
- Attractive price
- Interface guidelines => consistency between applications
- Developer's toolkit => more software developed by 3rd parties
- Success in edition because printer prices reasonable + excellent graphism



Example Paradigm Shifts

- Batch processing
- Timesharing
- Networking
- Graphical display
- Microprocessor
- WWW

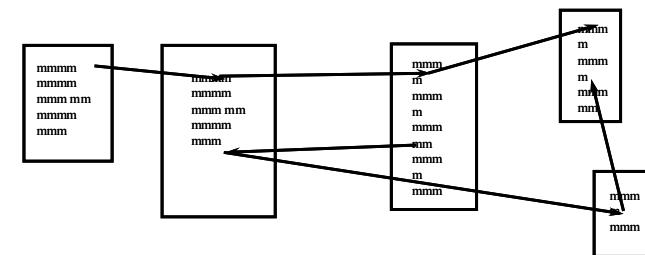
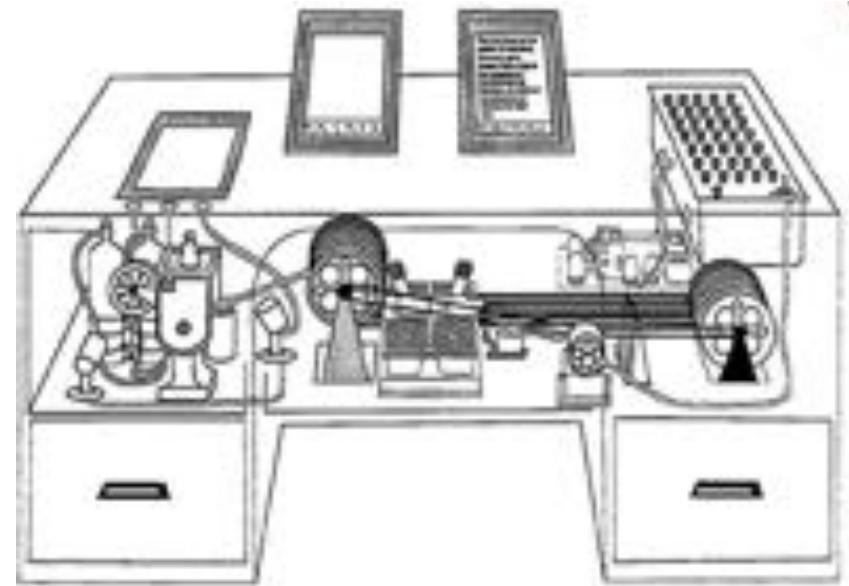


Global information

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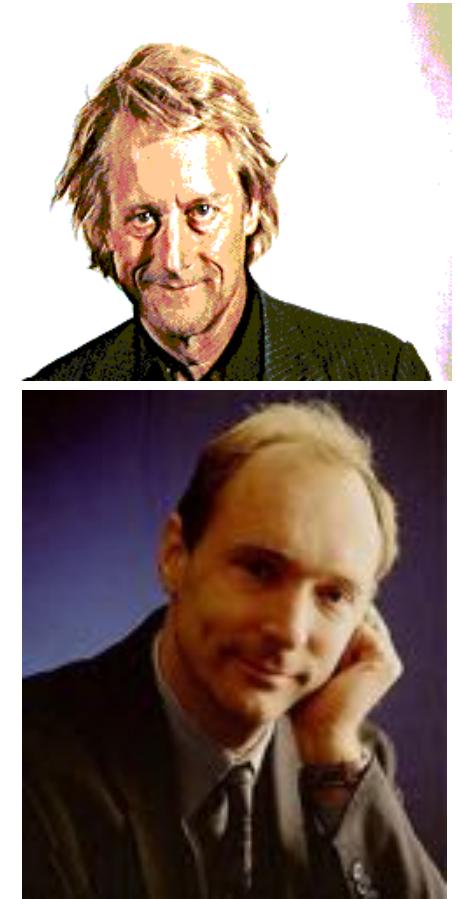
Conceptual foundations

- Vannevar Bush (1945)
- “As We May Think” - 1945 Atlantic Monthly
 - Conceiving Hypertext and the World Wide Web
 - a device where individuals stores all personal books, records, communications etc.
 - items retrieved rapidly through indexing, keywords, cross references,...
 - can annotate text with margin notes, comments.
 - can construct and save a trail (chain of links) through the material
- Bush’s Memex based on microfilm records! (not implemented)



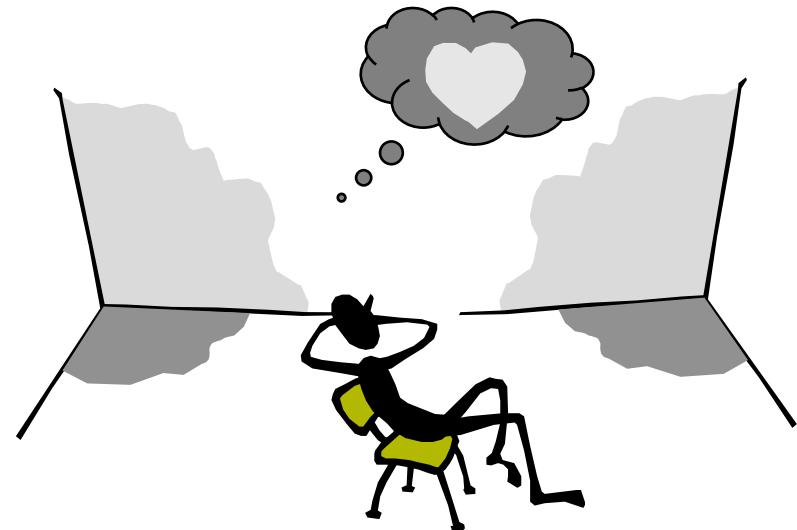
Hypertext

- Mid 1960s – Nelson describes hypertext as non-linear browsing structure
 - Nelson's Xanadu project: <http://xanadu.com/>
 - HTTP & HTML Created by Tim Berners-Lee at CERN in 1989
 - The idea was that anybody who used the web would have a space where they could write and so the first browser was an editor, it was a writer as well as a reader. Every person who used the web had the ability to write something (Tim Berners-Lee)
- => 1999 ... : Web 2.0 and Rich Internet Application
(the interactive web)



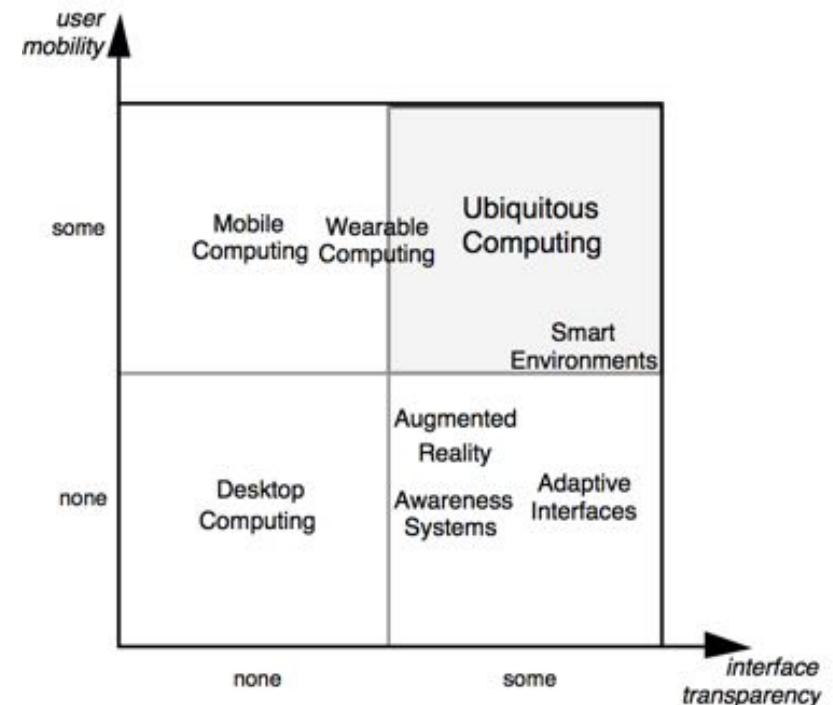
Example Paradigm Shifts

- Batch processing
 - Timesharing
 - Networking
 - Graphical display
 - Microprocessor
 - WWW
 - **Ubiquitous Computing**
- A symbiosis of physical and electronic worlds in service of everyday activities.



Ubiquitous computing (Embodied virtuality)

- New interaction paradigms
 - Technology embedded in the environment
 - Pervasive computing or transparent computing:
 - ✓ seamless integration of technology), e.g., smart phones, PDAs, fridges
 - ✓ Mobile computing
 - Wearable computing (or wearables)



Some of us use the term “embodied virtuality” to refer to the process of drawing computers out of their electronic shells. The “virtuality” of computer-readable data (...) is brought into the physical world. (Weiser, 1991, 95)

Next Paradigm and technology ?



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Evolution of Interaction techniques

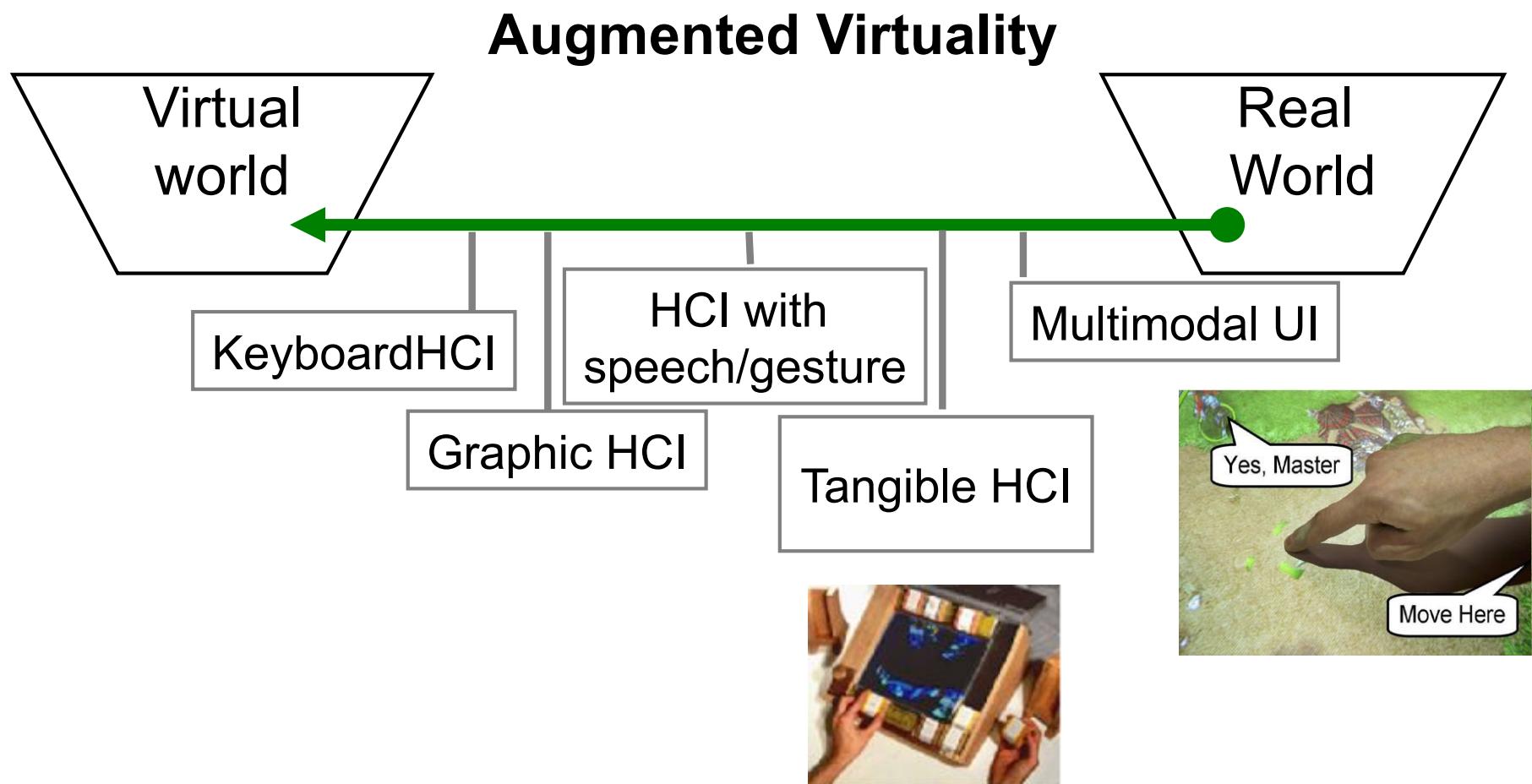
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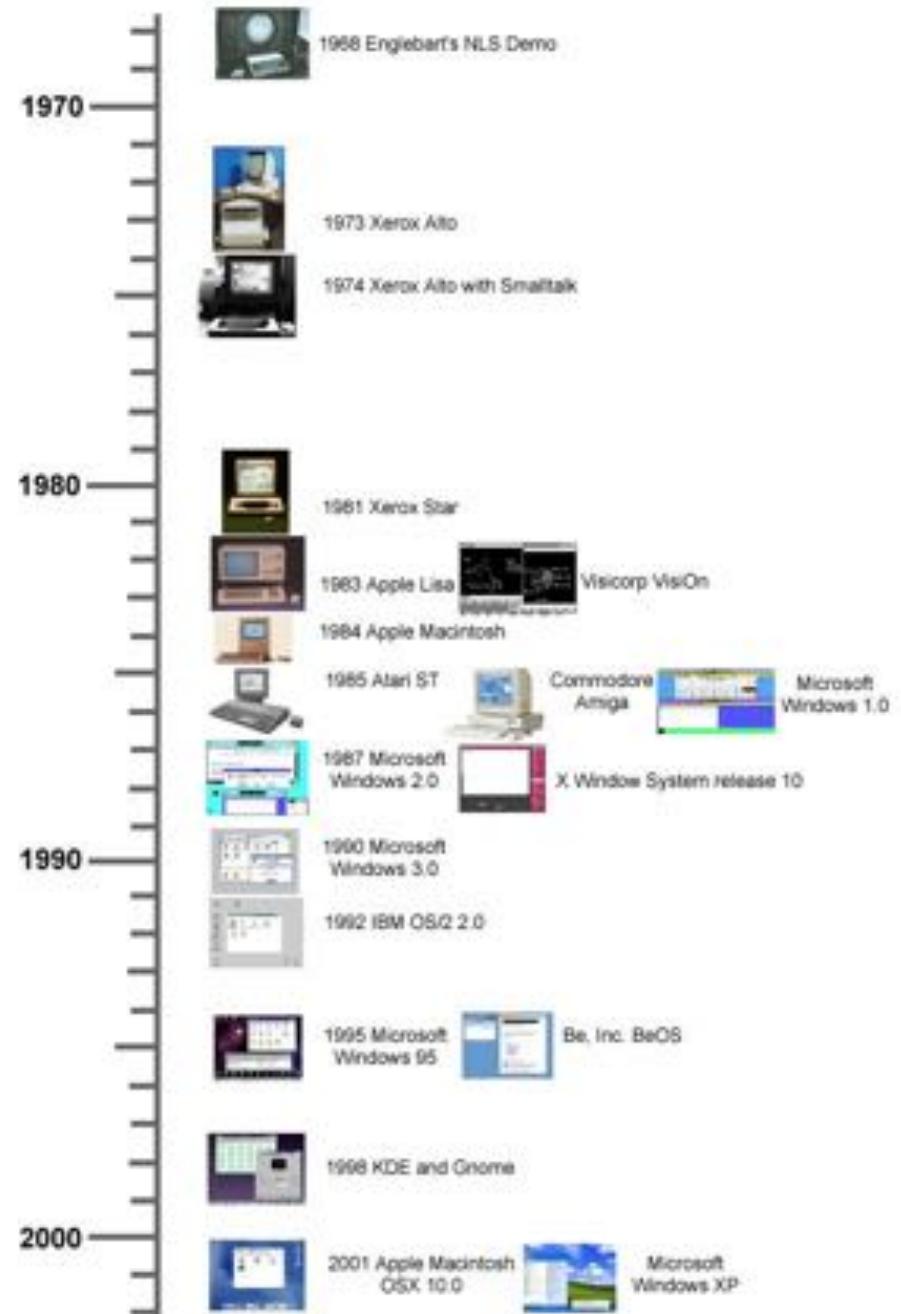
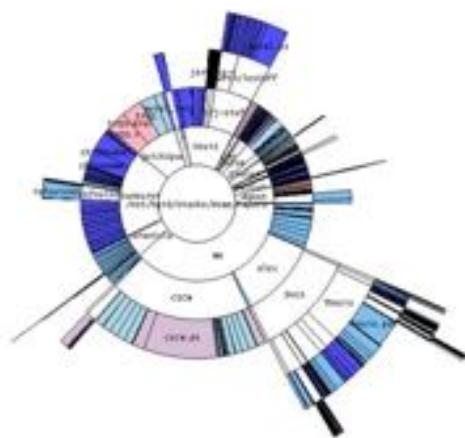
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Evolution of Interactions (1)

Improvement of the integration in the real world:



Graphic HCI



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HCI using voice / speech



- Direction Assistance [1988]



- Hyperspeech [1991]



- Talkback [2002]



- Conversation Finder [2003]



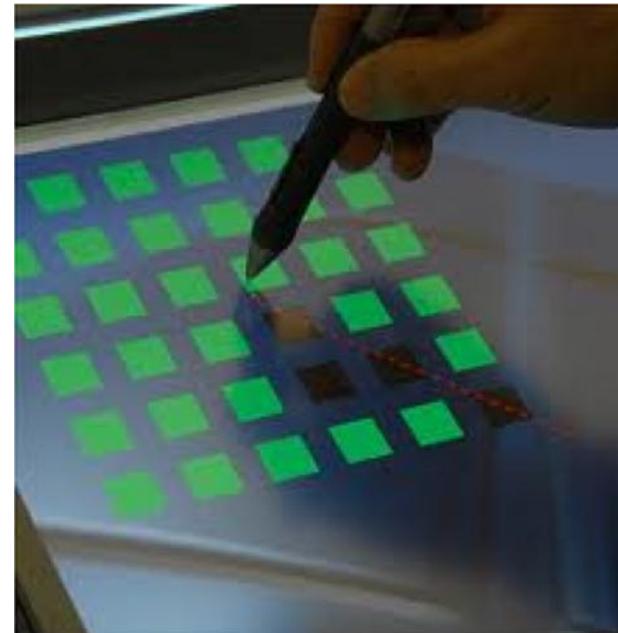
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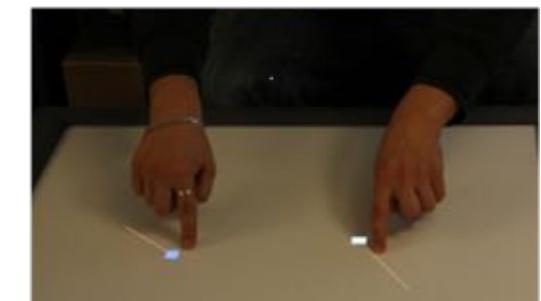
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Pen-based interaction

- Accurate and good for spatial tasks
- Good for sketching, Signing, annotating



2D gestures



Mid-air gestures



The importance of observing current practices



Virtual Reality

- The goals of the virtual reality (VR) community are the direct opposite of the goals of the Embodied Virtuality (EV) community.
 - EV strives to integrate computer functionality with the real world
 - VR strives to immerse humans in a virtual world
- Virtual reality technologies can be divided into two distinct groups.

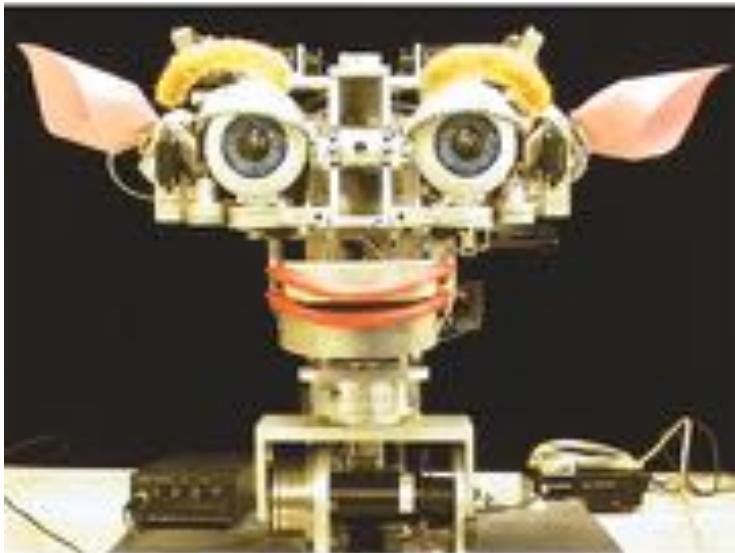


CAVE automated virtual environment at the National Center for Supercomputing Applications (NCSA).

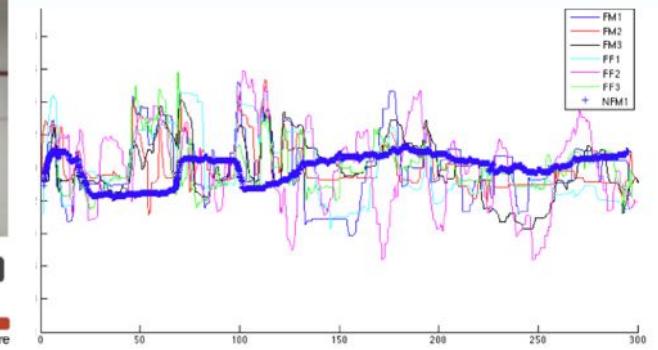
Brain machine interfaces



Emotional interfaces - synthesis & recognition

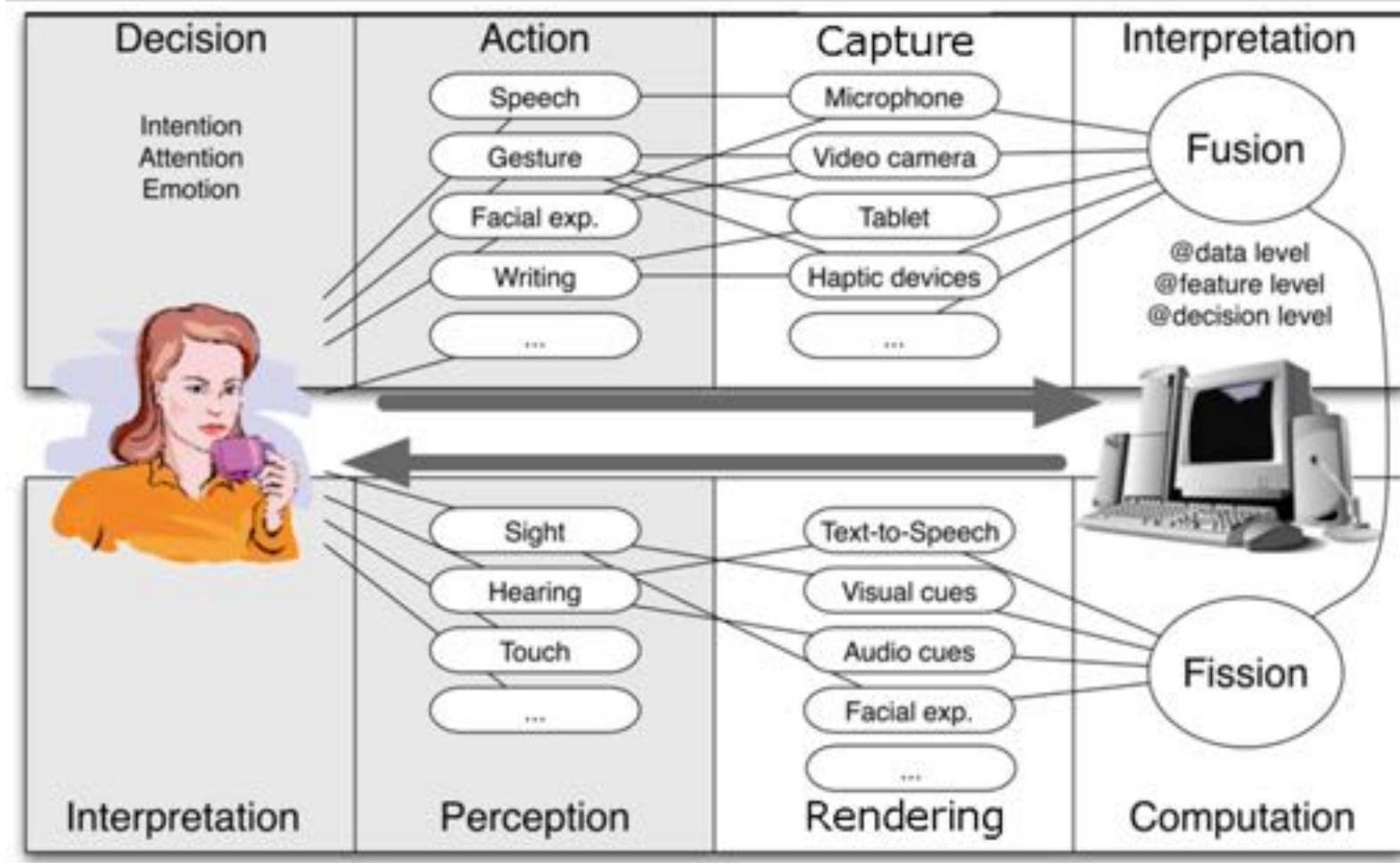


RECOLA Database
Remote Collaborative and Affective Interactions



Multimodal Interaction

- Combine in a natural manner complementary modalities



Dumas & Lalanne, 2008

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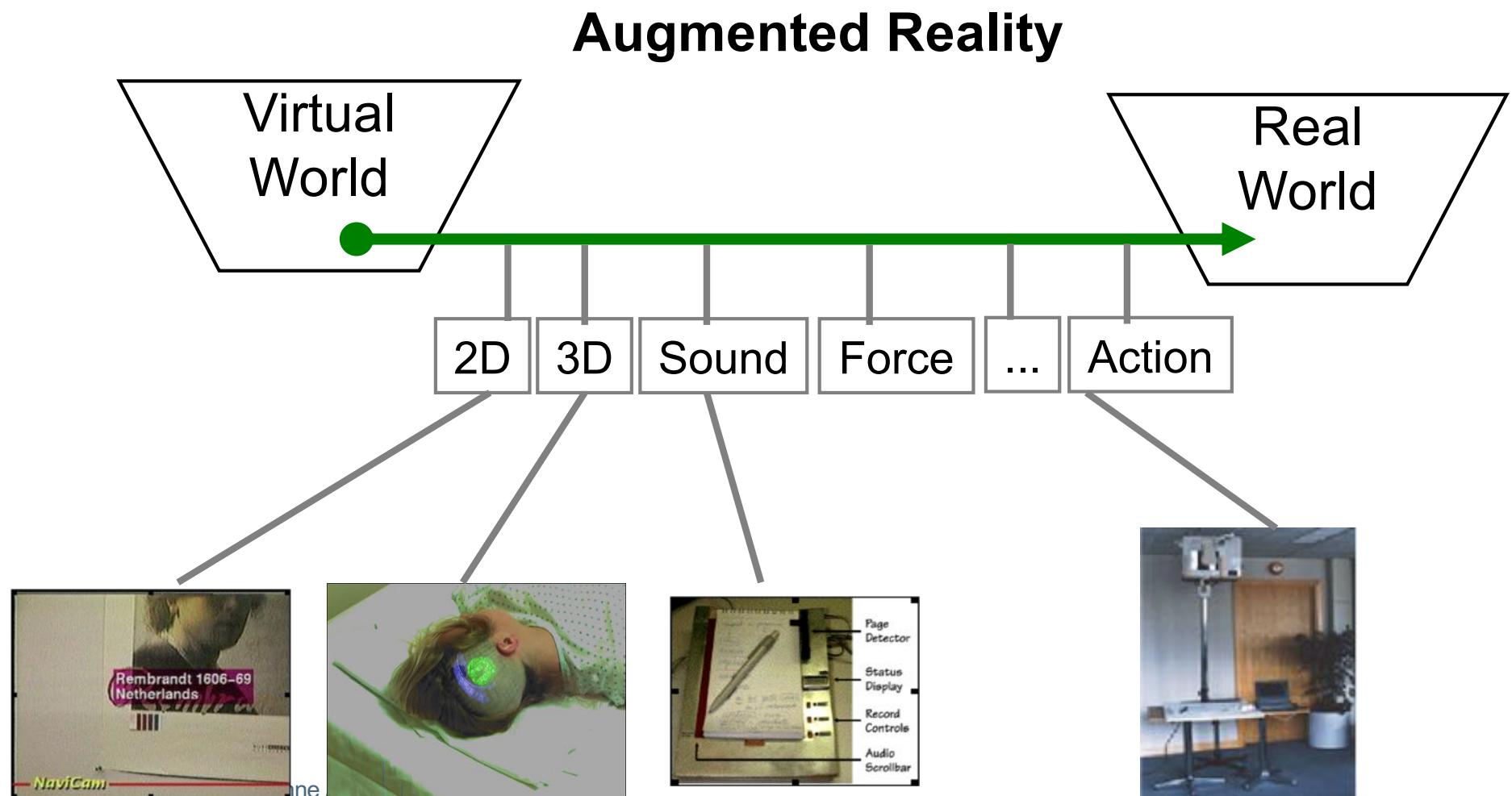


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Evolution of Interactions (2)

Change of target for the interaction:

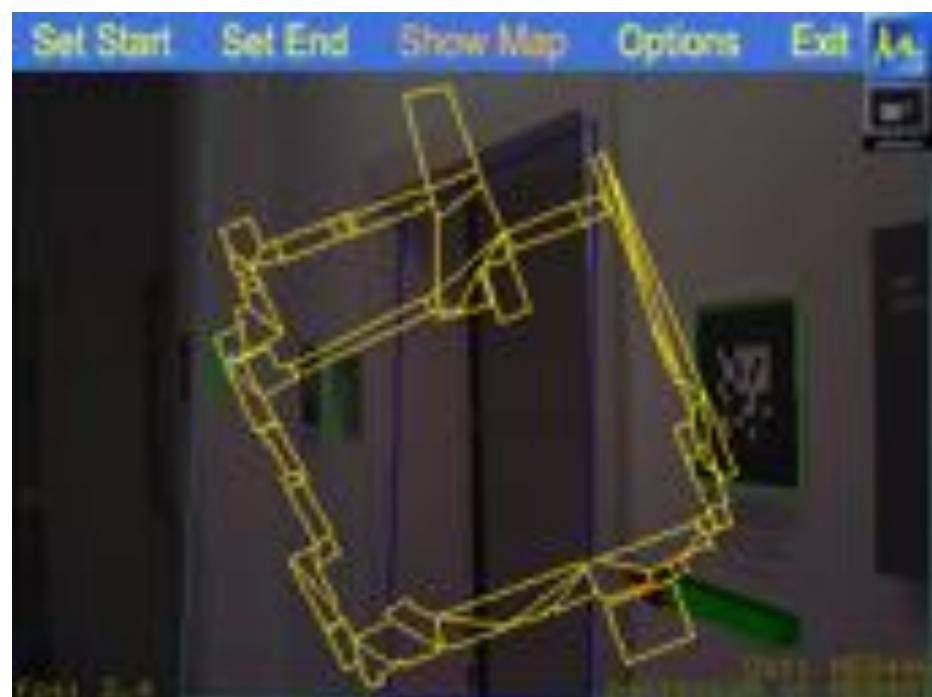
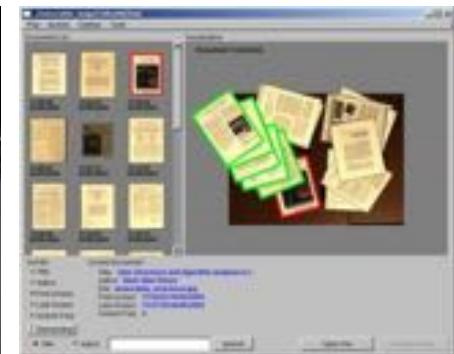


Augmented Reality

- The goal of AR is to create a seamless integration between real and virtual objects in a way that augments the user's perception and experience.
- New interaction paradigms
 - Tangible bits, augmented reality, and physical/virtual integration
 - Attentive environments and transparent computing
 - ✓ Anticipate what users want to do, e.g., detect where people are looking and decide what to display (GAP store in Minority Report – Tom Cruise)

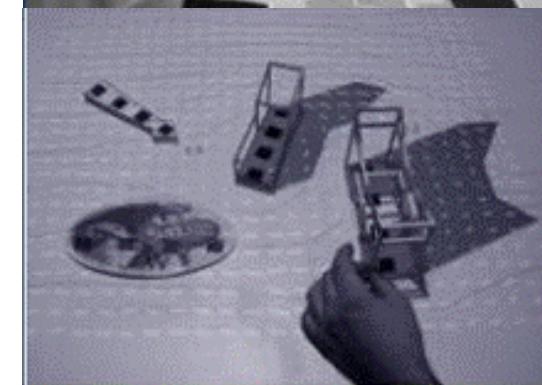
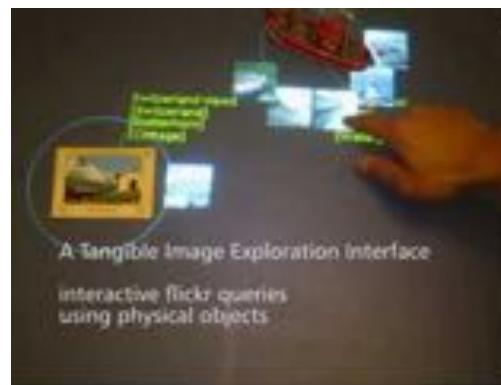
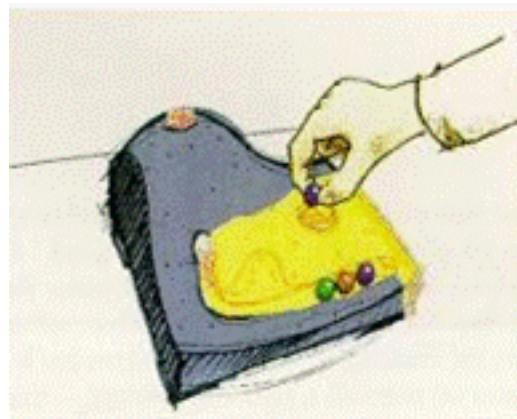


Augmented Reality

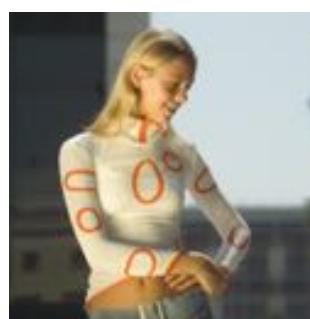


Tangible Interfaces – AR or AV?

« giving physical form to digital information » + interaction capabilities

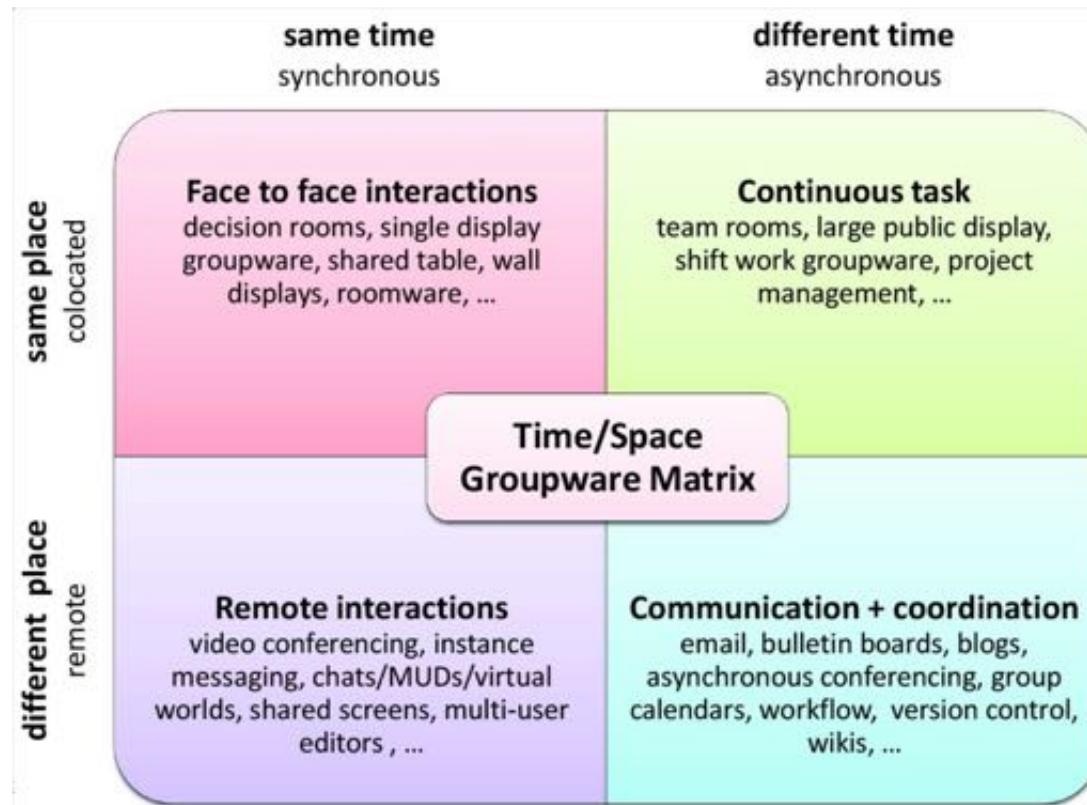


Wearable computing – AR or AV?

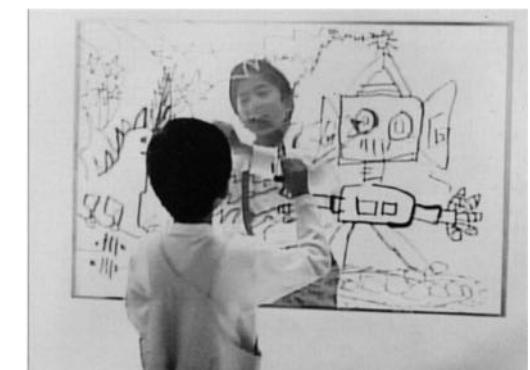
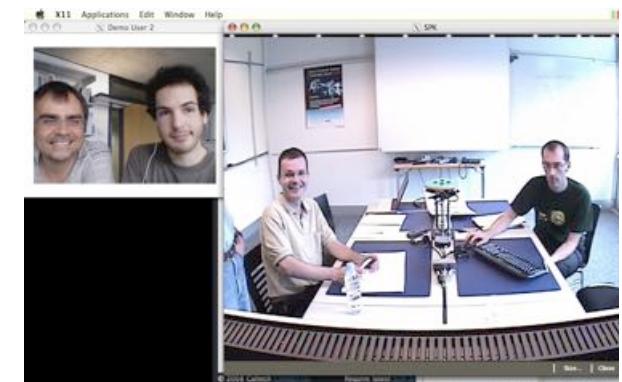


Computer Supported Collaborative Work - CSCW

- Focus on human-human interaction mediated by machines rather than “direct” human-computer interaction



Inspired by Robert Johansen (1988): *Groupware. Computer Support for Business Teams, The Free Press, New York and London, 1988.*



Interaction paradigms

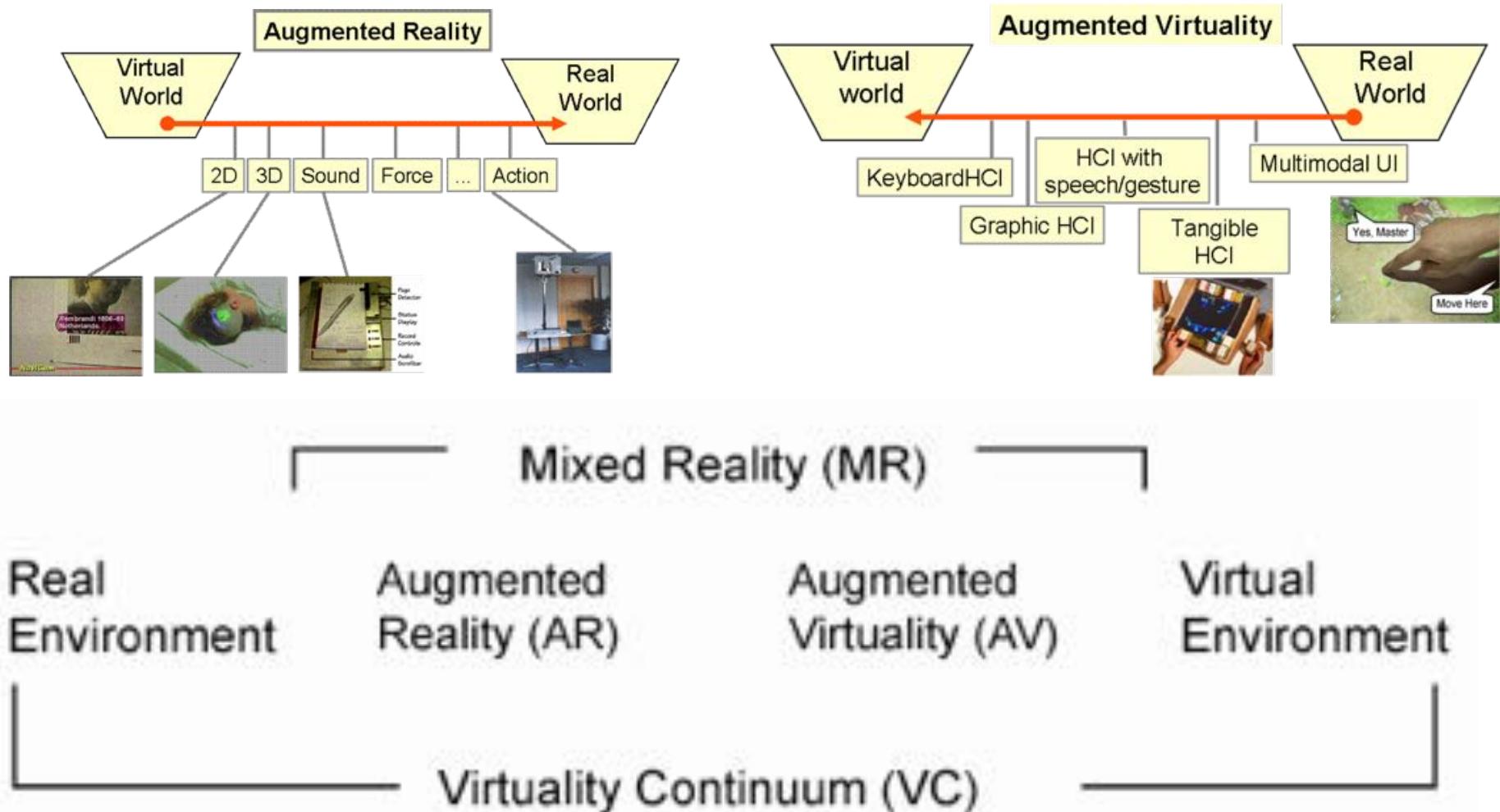
Wrap up

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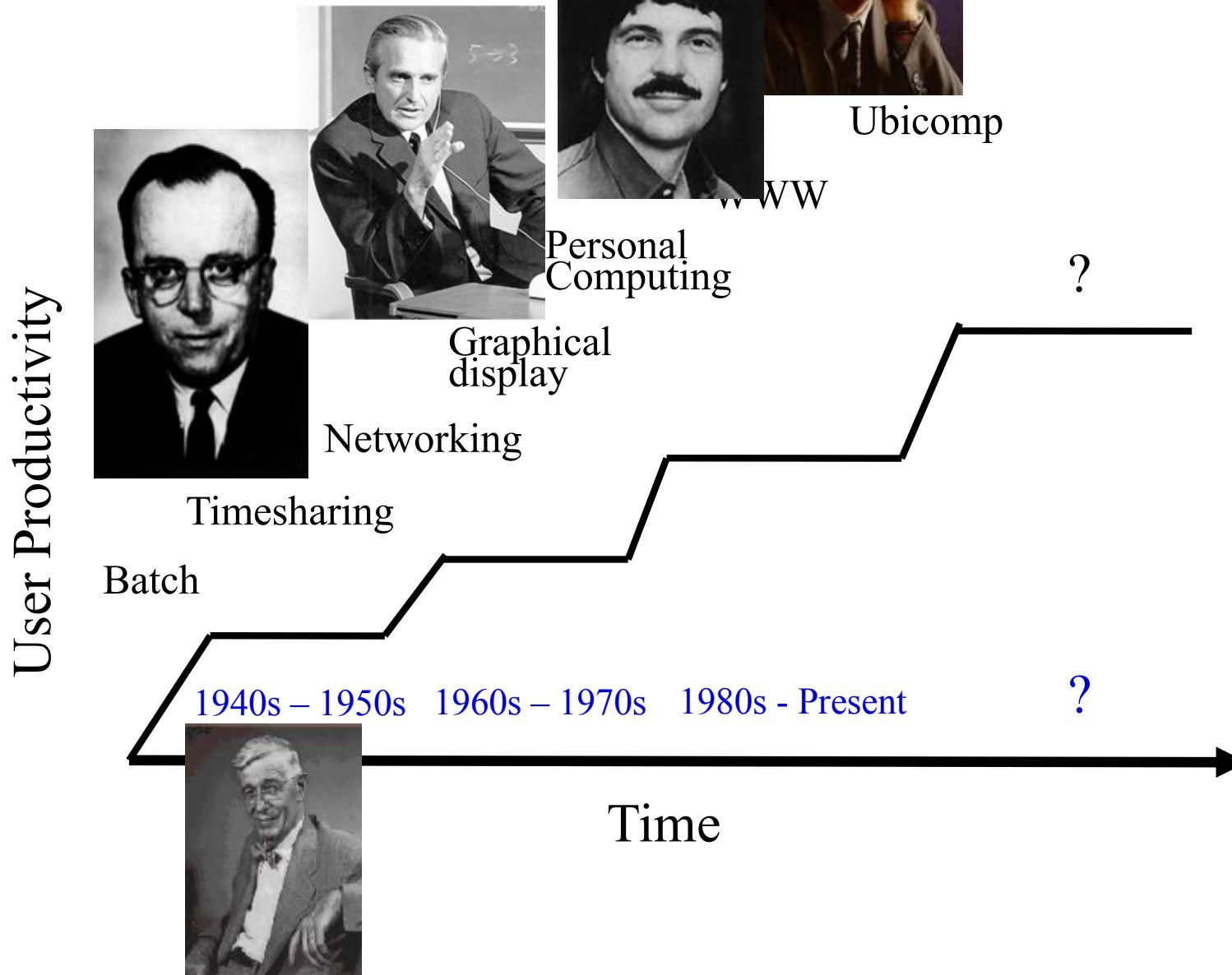
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Virtuality Continuum



Paradigm Shifts



Major interaction techniques

- Graphical interfaces
- Ubiquitous computing
- Virtual reality
- Augmented reality
- Tangible User interfaces
- Multimodal Interfaces

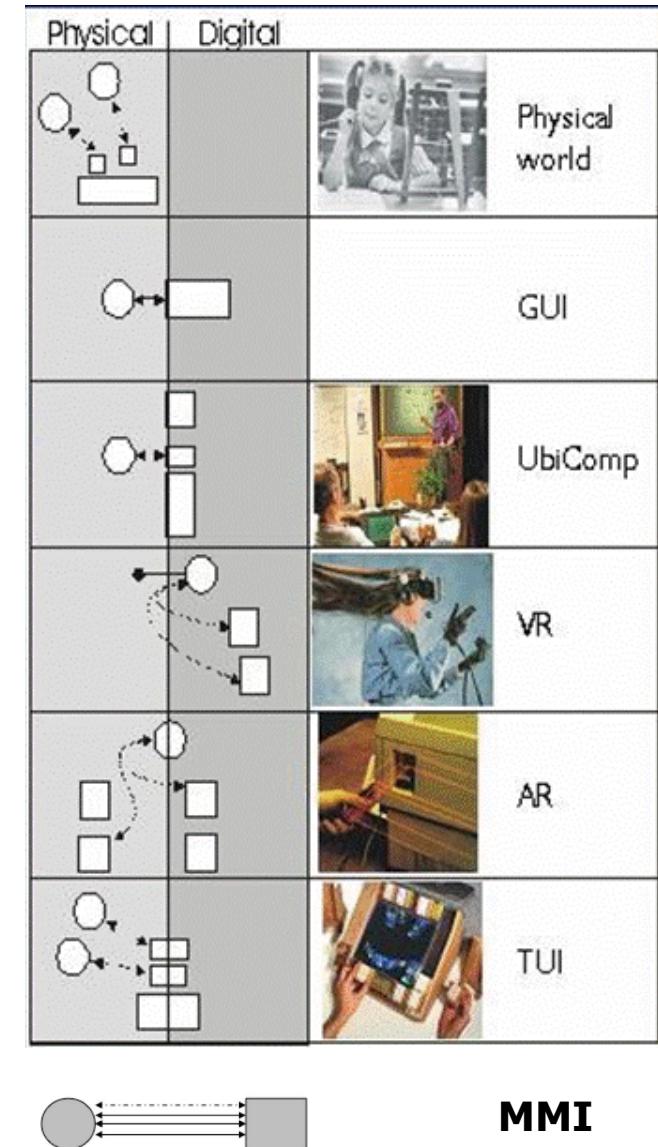


Table taken and slightly adapted from Brygg Ullmer

New paradigms and challenges

- Physicality - Embodiment
 - Augmented reality
 - The disappearing and ubiquitous computer
 - Migration from electronic to the physical world
 - Tangible interaction
- Mobility
 - User mobile but the interactive device is fixed (Personal data everywhere)
 - Mobility of user and of interaction device (interface context dependent)
- Plasticity and adaptation
 - Adaptation of interactivity to surface size
 - Plasticity of interfaces, adaptation to
 - ✓ context of interaction,
 - ✓ the user!
 - Multimodality is a key element to achieve the plasticity of a system
- Natural User Interfaces?

Which Interface?

- Best match between
 - Requirements
 - Available technologies
 - Task, Context
 - Users
- Some technologies are better
 - for collaborative work in co-presence (e.g. tangibles),
 - for precise selection individual tasks (e.g. mouse),
 - for entertainment (e.g. gestures)...
- It is all about choosing the best technology for its purpose
- There is no classification or rules to chose the best technology according to the type of tasks available at the moment: “common sense”

What you should know by now

- Where did HCI innovations and philosophy come from?
- Who were the major personalities?
- What were the important systems?
- What are the major HCI techniques?
- What are the main interaction paradigms?

Further readings

- Ben Shneiderman, Catherine Plaisant: "Designing the User Interface: Strategies for Effective Human-Computer Interaction" (5th edition)
 - Chapter 9
- Yvonne Rogers, Helen Sharp, Jennifer Preece: "Interaction Design: Beyond Human-Computer Interaction" (3rd edition)
 - Chapter 6

