Lecture 2
Interaction Paradigms

Historical innovations
Computing environments
Analysing interaction paradigms
Interaction paradigms

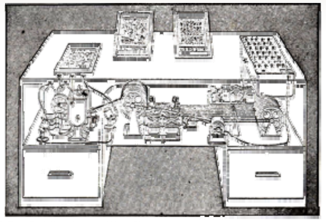
Heim, Chapter 1

Innovation - Vannevar Bush

- “As We May Think.” (1945) in the July issue of the *Atlantic Monthly*
- Bush envisioned a device that would help people organize information in a meaningful way.
- He called this device the “Memex”:

Innovation - Vannevar Bush

- Memex



A Memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory. (*Bush, 1945, 12*)

Innovation - Douglas Engelbart
Turing Award 1997

- Human Augmentation System
  - Augmentation Research Center (ARC) of the Stanford Research Institute (SRI) in Menlo Park, CA.
- oNLine System (NLS), presented at the Fall Joint Computer Conference in San Francisco in 1968

Innovation - Douglas Engelbart

- Human Augmentation System

It seemed clear to everyone else at the time that nobody would ever take seriously the idea of using computers in direct, immediate interaction with people. The idea of interactive computing—well, it seemed simply ludicrous to most sensible people. (*Engelbart,1968*)

Engelbart conducting a workshop - *Circa* 1967-68.
Courtesy Douglas Engelbart and Bootstrap Institute

http://sloan.stanford.edu/MouseSite/1968Demo.html
The Demo (Clip 3+8)

Innovation - Douglas Engelbart

- Human Augmentation System

NLS Mouse and workstation

First Mouse

Ergonomic Keyboard Console

 Courtesy Douglas Engelbart and Bootstrap Alliance.

Innovation - Ivan Sutherland

Turing Award 1988

- The Ultimate Display (1965)
- He proposed novel ways of interacting with computers, including the concept of a kinesthetic display

Innovation - Ivan Sutherland

- The Ultimate Display – Ivan Sutherland

The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal. With appropriate programming such a display could literally be the Wonderland into which Alice walked. (*Sutherland, 1965, 508*)

The Ultimate Display

Computing Environments

- Physical Computing Environment
- Social Computing Environment
- Cognitive Computing Environment

Computing Environments

- Physical Computing Environment
  - Safety
  - Efficiency
  - User Space
  - Work Space
  - Lighting
  - Noise
  - Pollution

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Default settings must be carefully thought out

Computing Environments

- Social Computing Environment
  - The social environment affects the way people use computers.
  - Computer use has also been shown to affect human social interaction.
  - Different computing paradigms imply different social environments.
    - For instance, personal computing is usually a solitary activity done in an office or an isolated corner of the house. Mobile computing is often done outside and in public places

Computing Environments

- Cognitive Computing Environment
  - Age
  - Disabilities
  - Degree of technical knowledge
  - Degree of focus
  - Cognitive Stress

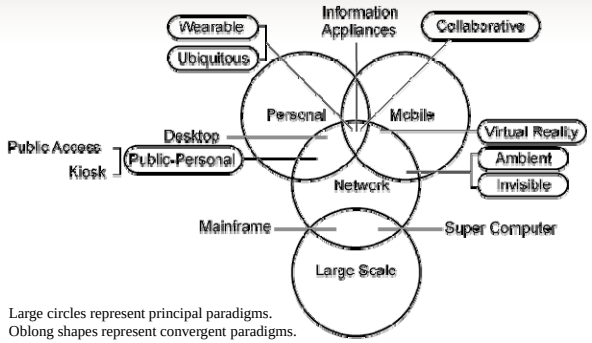
Analyzing Interaction Paradigms

- 5W + H
  - What/How
  - Where/When
  - Who/Why
- Who? Person, actor, group
- What? Fact, act
- When? Time, (opportunity)
- Where? Location, physical environment
- Why? Cause, reason, motive
- How? With what, tools, auxiliary means

Interaction Paradigms

- Large Scale Computing
- Personal Computing
- Networked Computing
- Mobile Computing
- Collaborative Environments
- Virtual Reality
- Augmented Reality

Interaction Paradigms



Large circles represent principal paradigms.
Oblong shapes represent convergent paradigms.
Words without surrounding shapes represent specific system architectures
(sometimes used for a paradigm reference, as in desktop computing for personal computing).

Large Scale Computing

- The original mainframe computers were large-scale computing machines, referred to as hosts
- They resided in a central location
- They were accessed by remote alphanumeric terminals equipped with keyboards
  - The terminals were referred to as “dumb terminals”
  - These systems are also referred to as host/terminal systems

Large Scale Computing

- They were programmed using punch cards

IBM card punch machines.
Courtesy IBM Corporate Archives.

- Time-sharing services (TSSs) were schemes that used the downtime of one user for another user who was currently active.

Large Scale Computing

- Mainframe computers are currently used in enterprise computing environments like Wall Street
- Super Computers
  - These highly specialized machines crunch large amounts of data at high speed, as in computing fluid dynamics, weather patterns, seismic activity predictions, and nuclear explosion dynamics.
  - Supercomputers are used for the very high speed backbone (vBNS) connections that constitute the core of the Internet.

National Center for Super Computing Applications (NCSA)

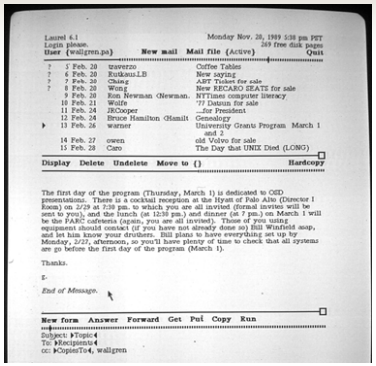
Personal Computing

- Desktop Computing

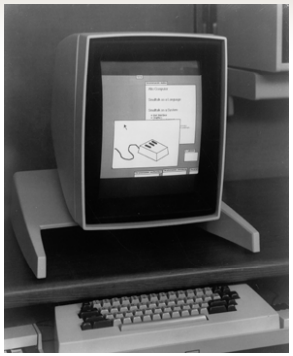
The Xerox Alto computer (1973)
Courtesy Palo Alto Research Center.

The Alto, developed at the Xerox Palo Alto Research Center in 1973, was the first computer to use a GUI that involved the desktop metaphor: pop-up menus, windows, and icons

Personal Computing



The Xerox Alto mail program (1973)



The Xerox Alto computer (1973)

Courtesy Palo Alto Research Center.

Personal Computing

- Personal-Public Computing
  - Public Access Computing – The information divide
  - Public Information Appliances

Automated teller machine with touchscreen.
Courtesy BigStockPhoto.com

Networked Computing

- Licklider – The Galactic Network
- ARPAnet - 10:30 pm on October 29, 1969
- Scope
  - WAN – Wide Area Network
  - MAN – Metropolitan Area Network
  - LAN – Local Area Network
  - PAN – Personal Area Network
- Wired - Wireless
  - Wi-Fi (IEEE 802.11*x*)
  - Bluetooth
  - 3G

Mobile Computing

- Mobile computing technologies comprise a very diverse family of devices:
  - Laptop computers
  - Tablet computers
  - Game players
  - MP3 players
  - PDAs
  - Cell phones

Mobile Computing

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Desktop metaphors do not translate well to mobile devices.

Tablet computer

Cell phone

MP3 player

Laptop computer

Courtesy BigStockPhoto.com

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Hybrid desktop/mobile environments can afford optimal interaction efficiency.

Applicable Metaphors?

My Blackberry is not working

Mobile Computing

- Mobile devices can be connected to global positioning systems (GPS)
  - These have touchscreens and voice interaction to alleviate potential visual attention problems during driving

On-board navigation system.
Courtesy BigStockPhoto.com

Mobile Computing

- Mobile devices can offer situational computing that can take advantage of location-specific information through location-based mobile services (LMS).
  - LMS can be beneficial for location-sensitive advertisements, public service announcements, social interactions, and location-specific educational information.

500,000 Internet newbies every day
In 2007 just over 10% of Mobiles on Internet, now up to 80%

Collaborative Environments

- Networks allow members of a group to interact with other members on shared files and documents.
  - This creates a virtual space where people can collaborate and work collectively.
  - Groupware

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Networks facilitate collaborative activities.

Collaborative Environments

- Collaborative work
  - Communication
  - Coordination
  - Organization
  - Presentation
- Computer-mediated communication (CMC)
- Computer-supported cooperative work (CSCW)

- What are some of the different types of groupware?

Collaborative Environments

- Remote interaction
  - Synchronous
    - Video conferencing
    - Instant messaging
    - Chat rooms
    - Remote access white boards
  - Asynchronous
    - Recommender systems
    - Bulletin boards
    - Email

Collaborative Environments

- Face-to-face
  - Smart rooms
    - Projectors
    - Smart Boards

Actalyst™ interactive digital signage

SMART Board™ Interactive Whiteboard

Collaborative Environments

- Collaboratory (Laboratories without walls)
  - Developed to allow the scientific community to perform and share research projects and results regardless of physical location.
    - The Research Collaboratory for Structural Bioinformatics (RCSB)
    - The Chimpanzee Collaboratory
    - The National Fusion Grid
    - Space Physics and Aeronomy Research Collaboratory (SPARC)
  - eResearch at University of Auckland

Embodied Virtuality

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—all the different ways in which it can be altered, processed and analyzed—is brought into the physical world.
(*Weiser, 1991, 95*)

Embodied Virtuality

- How do we disperse computing functionality throughout the environment?
- What form should EV computing take?
- What kind of interface does it require?
- How much control should we retain, and how much should be automated?

Embodied Virtuality

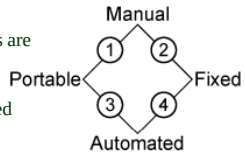
- Four discernable currents in EV (location/operation)

Side 1—Portable/manual (sometimes wearable) devices such as cell phones, MP3 players, digital cameras, and PDAs offer portable functionality the user can manipulate.

Side 2—Manual/fixed devices such as ATMs and kiosks are manipulated by the user but are fixed in place.

Side 3—Portable/automated devices are read by situated sensors, such as the car transceivers used for toll both payments. There are no possible manual operations.

Side 4—Automated/fixed devices such as alarm sensors can be used to detect the presence of intruders or industrial hazards.



Embodied virtuality environments location/operation.

Embodied Virtuality - *Ubiquitous/pervasive*

- Third Paradigm (Alan Key)
- Devices like cameras, video recorders, musical instruments, and picture frames are becoming "smart" through the introduction of embedded chips.
- The essence of UbiComp is that, to fulfill their potential, computing technologies must be considered a part of the fabric of our lives and not something that resides in a gray box.

Embodied Virtuality - *Ubiquitous/pervasive*

- Ambient computing
  - The concept of a computational grid that is seamlessly integrated into our physical environment
    - Lighting systems
    - Heating systems
    - Electrical systems
  - Smart environments that sense and recognize people
    - Face recognition
    - ID tags

E.g., video/picture recognition

Picasa 2010 Zhu and Brilakis 2008

Embodied Virtuality - *Invisible/transparent*

- The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.
  (*Weiser, 1991, 94*)
  - Two approaches
    - Make the interface simple and intuitive
      - Driving a car
    - Remove the interface entirely
      - Automotive breaking systems

Google's driverless car project

Embodied Virtuality - *Invisible/transparent*

- Information Appliances

An appliance specializing in information: knowledge, facts, graphics, images, video, or sound. An information appliance is designed to perform a specific activity, such as music, photography, or writing. A distinguishing feature of information appliances is the ability to share information among themselves. (*Norman, 1998, 53*)

A BlackBerry type of device.

  - PDAs, BlackBerry® devices, digital cameras, MP3 players, and portable game players.

 Courtesy of BigStockPhoto.com.

Embodied Virtuality - *Wearable*

- The underlying principle of wearable computing is the merging of information space with work space - humionics.
- The goal of humionics is to create an interface that is unobtrusive and easily operated under work-related conditions.
- Traditional I/O technologies are generally inadequate
- Wearable systems must take advantage of auditory and haptic as well as visual interaction.

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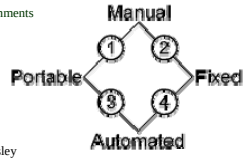
Wearable computing systems require multimodal interfaces.

Embodied Virtuality

- Embodied Virtuality Environments and Their Characteristics

	Manual	Automated	Fixed	Portable
UbiComp	Some systems are manual	Some systems are automated	Some components are embedded	Some devices are portable
Invisible	User does not interact with computer	System takes care of all computer functionality	Some system components are embedded	Some devices are portable
Wearable	Many of the wearable components allow manual control	Some of the wearable components interact automatically with embedded sensors	Some systems use situated sensors that interact with wearable components	Most system components are portable (wearable)

Embodied virtuality environments location/operation.



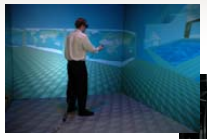
Virtual Reality

- The goals of the virtual reality (VR) community are the direct opposite of the goals of the 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:
  - Nonimmersive environments
  - Immersive environments

Virtual Reality

- Nonimmersive - screen-based, pointer-driven, three-dimensional (3D) graphical presentations that may involve haptic feedback
  - VRML
  - QuickTime VR
- Immersive VR environments are designed to create a sense of “being” in a world populated by virtual objects.
  - To create a convincing illusion, they must use as many human perceptual channels as possible.

Virtual Reality - *Immersive*



Sketching a virtual world in the VR design tool ShadowLight.

CAVE automated virtual environment at the National Center for Supercomputing Applications (NCSA).
http://brighton.ncsa.uiuc.edu/~prajlich/cave.html

Photographs and ShadowLight application courtesy of Kalev Leetaru.

Sensics piSight
Virtual Reality (VR) system.
http://www.sensics.com/

Virtual Reality - *Immersive*

- VR I/O devices
  - Head-movement-tracking systems
  - Passive systems
    - Platform device
      - Flight simulation
  - Active locomotion systems
    - Treadmill
      - Military training

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.
- Criteria for AR environments
  - The virtual information must be:
    - Relevant to and
    - in sync with the real-world environment.

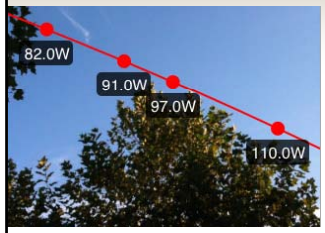
Augmented Reality

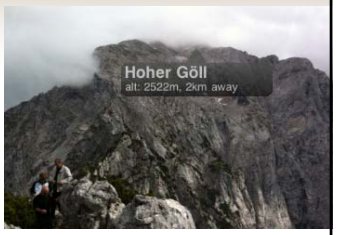
- AR I/O devices
  - Heads Up Displays (HUD)
    - Optical see through
    - Video see through

MicroOptical MD-6 Critical Data Viewer.
http://microoptical.net/

Sportvue MC1 motorcycle helmet heads-up display.
http://www.sportvue.com/

37 best AR iPhone apps (www.iphoneness.com)

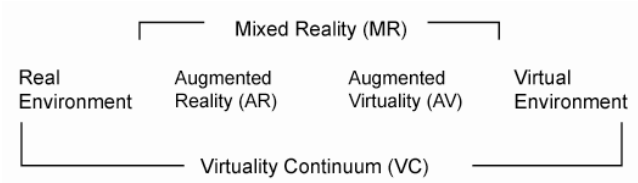




AR on construction site?

CICC 1998

Virtuality Continuum



Summary

- You determine the interaction paradigm best suited for a software system
- Through understanding different paradigms you can develop systems which suit a user's abilities, limitations and tasks