Human Computer Interaction  
– Lecture 04 [ Paradigms ]

Imran Ihsan  
Assistant Professor  
www.imranihsan.com

why study paradigms

• Concerns
  – how can an interactive system be developed to ensure its usability?
  – how can the usability of an interactive system be demonstrated or measured?

• History of interactive system design provides paradigms for usable designs
**What are Paradigms?**

- Predominant theoretical frameworks or scientific world views
  - e.g., Aristotelian, Newtonian, Einsteinian (relativistic) paradigms in physics

- Understanding HCI history is largely about understanding a series of paradigm shifts
  - Not all listed here are necessarily “paradigm” shifts, but are at least candidates
  - History will judge which are true shifts

**Paradigms of Interaction**

- New computing technologies arrive, creating a new perception of the human—computer relationship.

- We can trace some of these shifts in the history of interactive technologies.
Computing in 1945

- Ballistics calculations
- Physical switches (before microprocessor)
- Paper tape
- Simple arithmetic & fixed calculations (before programs)
- 3 seconds to multiply

Picture from http://www.gmcc.ab.ca/~supy/

The initial paradigm

- Batch Processing

Impersonal computing
Paradigm Shifts

- Batch processing
- Time-sharing

Interactive computing

Paradigm Shifts

- Batch processing
- Timesharing
- Networking

Community computing
Paradigm Shifts

- Batch processing
- Timesharing
- Networking
- Graphical displays

Direct manipulation

Paradigm Shifts

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

Personal computing
Paradigm Shifts

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

Global information

Paradigm Shifts

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

A symbiosis of physical and electronic worlds in service of everyday activities.
**Time-sharing**

- 1940s and 1950s – explosive technological growth
- 1960s – need to channel the power
- J.C.R. Licklider at ARPA
  - 1960 - Postulated “man-computer symbiosis”
  - Couple human brains and computing machines tightly to revolutionize information handling
- Single computer supporting multiple users

**Video Display Units**

- More suitable medium than paper
- 1962 – Sutherland’s Sketchpad
  - 1963 PhD thesis at MIT
  - Hierarchy - pictures & subpictures
  - Master picture with instances (ie, OOP)
  - Constraints
  - Icons
  - Copying
  - Light pen input device
  - Recursive operations
- Computers for visualizing and manipulating data
- One person’s contribution could drastically change the history of computing
**Programming Toolkits**

- Engelbart at Stanford Research Institute
- 1963 – augmenting man’s intellect
- 1968 NLS/Augment system demonstration

  - Landmark system/demo:
    - hierarchical hypertext, multimedia, mouse, high-res display, windows, shared files, electronic messaging, CSCW, teleconferencing, ...

- the right programming toolkit provides building blocks to producing complex interactive systems

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**Personal Computing**

- 1970s – 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 machines dedicated to the individual

- Alan Kay at Xerox PARC – the Dynabook as the ultimate personal computer
  - Notebook sized computer loaded with multimedia and can store everything
  - @PARC
  - Personal computing
  - Desktop interface
  - Overlapping windows
**Window systems & WIMP interface**

- humans can pursue more than one task at a time
- windows used for dialogue partitioning, to “change the topic”
- 1981 – Xerox Star first commercial windowing system
- windows, icons, menus and pointers now familiar interaction mechanisms

**Direct manipulation**

- 1982 – Shneiderman describes appeal of graphically-based interaction
  - visibility of objects
  - incremental action and rapid feedback
  - reversibility encourages exploration
  - syntactic correctness of all actions
  - replace language with action
- 1984 – Apple Macintosh
- the model-world metaphor
- What You See Is What You Get (WYSIWYG)
- Coins and explores notion of direct manipulation of interface
- Long-time Director of HCI Lab at Maryland
**Language versus Action**

- Actions do not always speak louder than words!
- DM – interface replaces underlying system
- Language paradigm
- Interface as mediator
- Interface acts as intelligent agent
- Programming by example is both action and language

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**Hypertext**

- 1945 – Vannevar Bush and the memex
- Key to success in managing explosion of information
- Mid 1960s – Ted Nelson describes hypertext as non-linear browsing structure
- Hypermedia and multimedia
- Nelson's Xanadu project still a dream today
  - http://xanadu.com/
- Coined term "hypertext"
Multimodality

- a mode is a human communication channel
- emphasis on simultaneous use of multiple channels for input and output

Computer Supported Cooperative Work (CSCW)

- CSCW removes bias of single user / single computer system
- Can no longer neglect the social aspects
- Electronic mail is most prominent success
### The World Wide Web

- Hypertext, as originally realized, was a closed system

- Simple, universal protocols (e.g. HTTP) and mark-up languages (e.g. HTML) made publishing and accessing easy

- Critical mass of users lead to a complete transformation of our information economy.

### Agent-based Interfaces

- Original interfaces
  - Commands given to computer
  - Language-based

- Direct Manipulation/WIMP
  - Commands performed on “world” representation
  - Action based

- Agents - return to language by instilling proactivity and “intelligence” in command processor
  - Avatars, natural language processing
**Innovator: Nicholas Negroponte**

- MIT Architecture Machine Group
  - ‘69-‘80s - prior to Media Lab
- Ideas
  - wall-sized displays, video disks, AI in interfaces (agents), speech recognition, multimedia with hypertext
  - Put That There (Video)

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**Ubiquitous Computing**

“The most profound technologies are those that disappear.”
Mark Weiser, 1991

- Late 1980’s: computer was very apparent
- How to make it disappear?
  - Shrink and embed/distribute it in the physical world
  - Design interactions that don’t demand our intention
**Innovator: Mark Weiser**

- Introduced notion of *Ubiquitous Computing* and *Calm Technology*
  - It’s everywhere, but recedes quietly into background

- CTO of Xerox PARC

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**Sensor-based and Context-aware Interaction**

- Humans are good at recognizing the “context” of a situation and reacting appropriately

- Automatically sensing physical phenomena (e.g., light, temp, location, identity) becoming easier

- How can we go from sensed physical measures to interactions that behave as if made “aware” of the surroundings?