

Ubiquitous, Tangible, and Wearable Computing

Course summary

CSEP 510
Lecture 10, March 11, 2004
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Homework

- How much time is needed to outline a lecture?
- Were you able to determine how long your partner spent on each outline?

Outline

- Beyond the desktop
 - Ubiquitous computing
 - Tangible computing
 - Wearable computing
- Course summary
 - What I want you to remember from this course

Widening the discourse to the physical world

- Computer centric paradigm



Ubiquitous computing

- "The most profound technologies are those that disappear."*
- New Paradigm



Mark Weiser

Classroom exercise

- How many motors are in your car?

Ubiquitous Computing Vision

- Computers everywhere
 - But we don't think about them!
- Information capture
- Location aware computing
- Activity inference
- Support for everyday activity



Critical Technical Issues

- Location
 - knowledge of "where" substitutes for intelligence
- Scale
 - one size does not fit all needs
- Networking
 - constant connectivity, wired and wireless
- Power

Location services

- Outdoor
 - Global Positioning Satellites (GPS)
 - wireless/cellular networks
- Indoor
 - active badges, electronic tags
 - vision
 - motion detectors, keyboard activity

Ethical and privacy issues

- Technology enables very powerful monitoring, data collection, and linkage
- Technological bias against privacy
- Technology does address real security concerns
- Conflicting goals
 - Ability to purchase anonymously
 - Security of credit card

Tangible computing

- "Rephysicalize"
 - Move tasks back to the physical world

Case study: Palette

- Palette: A paper interface for giving presentations, CHI '99
- Navigation of electronic slides by using index cards with barcodes
- Domain
 - Business meetings



Figure 1. Palette cards are encoded with slide information permitting presentation by simply sliding a card under the Palette code reader. A presenter may compose a talk by selecting cards from one or more sets of previous talks.

Direct manipulations of slides

- Slides as physical artifacts
 - Speaker mobility
 - Speaker use of hands
 - Talk initialization
 - Slide manipulation
 - Preview
 - Navigation
 - Talk construction
 - Reordering
 - Sharing

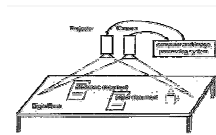
MIT Media Lab Tangible Bits

- Lens
 - Window
- Phicons
 - Icon
- Tray
 - Menu
- PHandle
 - Handle (e.g., for resizing window)
- Instrument
 - Widget

Other projects

Digital Desk

- Weisner, P., Mackay, W., and Gold, R. "Computer Augmented Environments: Back to the Real World". CACM 36(7), July 1993.
- "Magic Desk". Use cameras to see where hands are, what documents are on top, etc.
- Give feedback by projection system
- Integrate with hands
 - E.g. "where'd I put document X?"
 - E.g. "print this"



Hinckley Doll's Head

- Hinckley, K., Pausch, R., Gobbie, J., Kassell, N., Passive real-world interface traps for neurological visualization. Proceedings of CHI94. 1994. ACM, pp. 452-458
- Early and great example of power of metaphor.
- "So advanced, it's simple"
- Had actual users!
- Tangible but not Ubicomp – system totally "tethered" to PC.



Marble Machine

- Bishop, 1995. In Crampton Smith, G. "The Hand That Rocks the Cradle", I.D., May/June 1995.
- Reifies messages into marbles
- Any relation to "Minority Report" purely intentional
- Why is this cool? What have you gained?



Wearable computing

- n Integration of computing into daily life
- n "We will be assimilated"



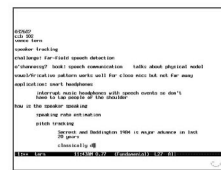
Wearable computers

- n Direct display to eye
 - n Eye glass mounted display
- n Input device
- n Portable computer
- n Always interacting with display

Thad Starner



Life inside an emacs buffer



Steve Mann



The descent of Mann



1980 1990 2000

Airport security

At Airport Gate, a Cyborg Unplugged

By LISA GURNEY

STEVE MANN, an engineering professor at the University of Toronto, has lived as a cyborg for more than 20 years, wearing a web of wires, computers and electronic sensors that are designed to augment his memory, enhance his vision and keep tabs on his vital signs. Although his wearable computer system sometimes elicited stares, he never encountered any problems going through the security gates at airports.



Steve Mann
SEEKING COMPENSATION - Prof. Steve Mann, a walking experiment in wearable computers, went through a three-day ordeal trying to board an Air Canada plane bound for Toronto.

Airport Security

Without a fully functional system, he said, he found it difficult to navigate normally. He said he fell at least twice in the airport, once passing out after hitting his head on what he described as a pile of fire extinguishers in his way. He boarded the plane in a wheelchair.

"I felt dizzy and disoriented and went downhill from there," he said.

Since losing the use of his vision system and computer memory several weeks ago, he said, he cannot concentrate and is behaving differently. He is now undergoing tests to determine whether his brain has been affected by the sudden detachment from the technology.

Lecture summary

- n What you should remember from this class

1. History

- n Visionary work in the 1940's
 - n Vannevar Bush
- n Implementation work in the 1960's
 - n Doug Englebart
- n Xerox Parc
- n What are the innovations since 1975?

1. History

- n The history of the field goes back a long time
- n Many HCI issues are similar, in spite of dramatic changes in cost / speed of computers



2. Design

- n General principles of design apply to computers and software as well
 - n How does form indicate use?
 - n Conceptual models
 - n Principle of mapping
 - n Cognitive load
 - n Modes



3. Modeling human behavior

- How the computer views the user
- Simplification of processes that are explanatory and predictive
- Human information processor
- Fitts' Law
 - Exponential targeting

4. Studying users performing tasks

- Modeling user actions
 - Example – mail handling as moving information to folders
 - Understand functionality of applications
 - Example – text entry on mobile
 - Predict performance of different schemes

4. Human subjects review

- Important ethical concerns on involving people in experiments
- Key issues
 - Protect subjects from harm
 - Privacy
 - Physical and mental distress
 - Informed consent

5. People and computing

- Viewing computing in context of getting a broader task accomplished
- Studying how people get work done
- Example application – electronic voting
 - Broad range of issues
 - Even when only focusing on human interaction with the device

Domain studies

- Latter lectures - looked at particular domains
 - Domain specific results
 - Patterns of study

6. Pen Computing

- Device level interaction
- Stylus input problem
- Tablet PC
 - Importance of the details

7. Document applications

- Ink based applications
 - Dependence on technology and scale
 - Difference between PDA and wall sized display
- Importance of domain / use case
 - Persistence of white board
 - Distributed note taking
 - Collaborative note taking

8. Educational Technology

- Support of classroom education
 - Classroom 2000
 - Capture of class for archival access
 - Ubiquitous computing – technology disappears
 - Tutored Video Instruction
 - Collaboration around technology
 - Social and technological factors

9. Video

- Capture without access is meaningless
- Information extraction from video
 - Reduction of time to process
 - Task dependent

Unifying theme

- How do you study people and technology?
- Questions and evidence
- Study methodology

Thanks!