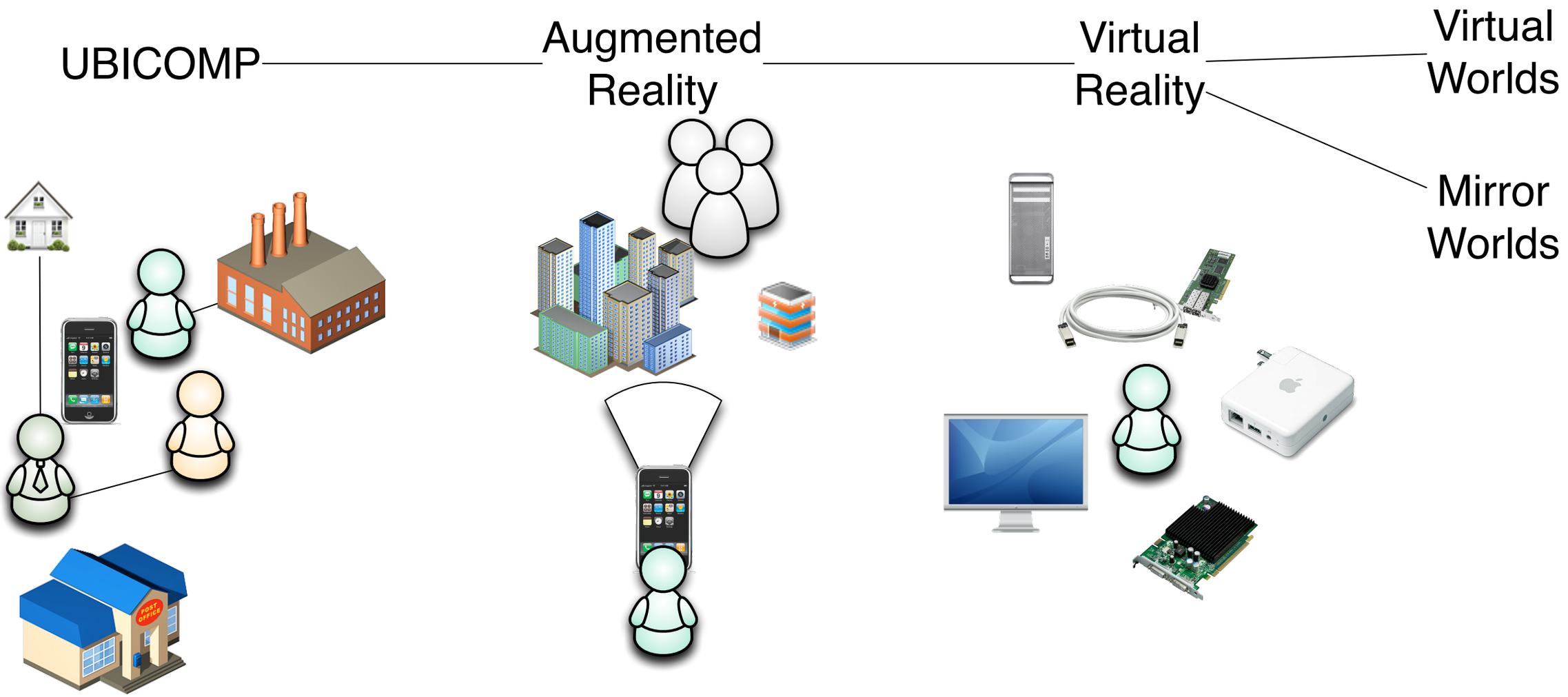
User Interaction: Ubiquitous Computing

Asst. Professor Donald J. Patterson
INF 133 Fall 2010

- From Webster:
  - Main Entry: ubiq·ui·tous
  - Pronunciation: yü-'bi-kw&-t&s
  - Function: adjective
  - Date: 1837
  - : existing or being everywhere at the same time : constantly encountered : WIDESPREAD

- ubiquitous computing
  - filling the real world with computation

- virtual and augmented reality
  - making the real world in a computer!


UBICOMP
Augmented Reality
Virtual Reality
Virtual Worlds
Mirror Worlds
POST OFFICE

UBICOMP

The Computer for the 21st Century

Specialized elements of hardware and software, connected by wires, radio waves and infrared, will be so ubiquitous that no one will notice their presence

by Mark Weiser

The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.

Consider writing, perhaps the first information technology. The ability to represent spoken language symbolically for long-term storage freed information from the limits of individual memory. Today this technology is ubiquitous in industrialized countries. Not only do books, magazines and newspapers convey written information, but so do street signs, billboards, shop signs and even graffiti. Candy wrappers are covered in writing. The constant background presence of these products of "literacy technology" does not require active attention, but the information to be transmitted is ready for use at a glance. It is difficult to imagine modern life otherwise.

Silicon-based information technology, in contrast, is far from having become part of the environment. More than 50 million personal computers have been sold, and the computer nonetheless remains largely in a world of its own. It is approachable only through complex jargon that has nothing to do with the tasks for which people use computers. The state of the art is perhaps analogous to the period when scribes had to know as much about making ink or baking clay as they did about writing.

The arcane aura that surrounds personal computers is not just a "user interface" problem. My colleagues and I at the Xerox Palo Alto Research Center think that the idea of a "personal" computer itself is misplaced and that the vision of laptop machines, dynabooks and "knowledge navigators" is only a transitional step toward achieving the real potential of information technology. Such machines cannot truly make computing an integral, invisible part of people's lives. We are therefore trying to conceive a new way of thinking about computers, one that takes into account the human world and allows the computers themselves to vanish into the background.

Such a disappearance is a fundamental consequence not of technology but of human psychology. Whenever people learn something sufficiently well, they cease to be aware of it. When you look at a street sign, for example, you absorb its information without consciously performing the act of reading. Computer scientist, economist and Nobelist Herbert A. Simon calls this phenomenon "compiling"; philosopher Michael Polanyi calls it the "tacit dimension"; psychologist J. J. Gibson calls it "visual invariants"; philosophers Hans Georg Gadamer and Martin Heidegger call it the "horizon" and the "ready-to-hand"; John Seely Brown of PARC calls it the "periphery." All say, in essence, that only when things disappear in this way are we freed to use them without thinking and so to focus beyond them on new goals.

The idea of integrating computers seamlessly into the world at large runs counter to a number of present-day trends. "Ubiquitous computing" in this context does not mean just computers that can be carried to the beach, jungle or airport. Even the most powerful notebook computer, with access to a worldwide information network, still focuses attention on a single box. By analogy with writing, carrying a superlaptop is like owning just one very important book. Customizing this book, even writing millions of other books, does not begin to capture the real power of literacy.

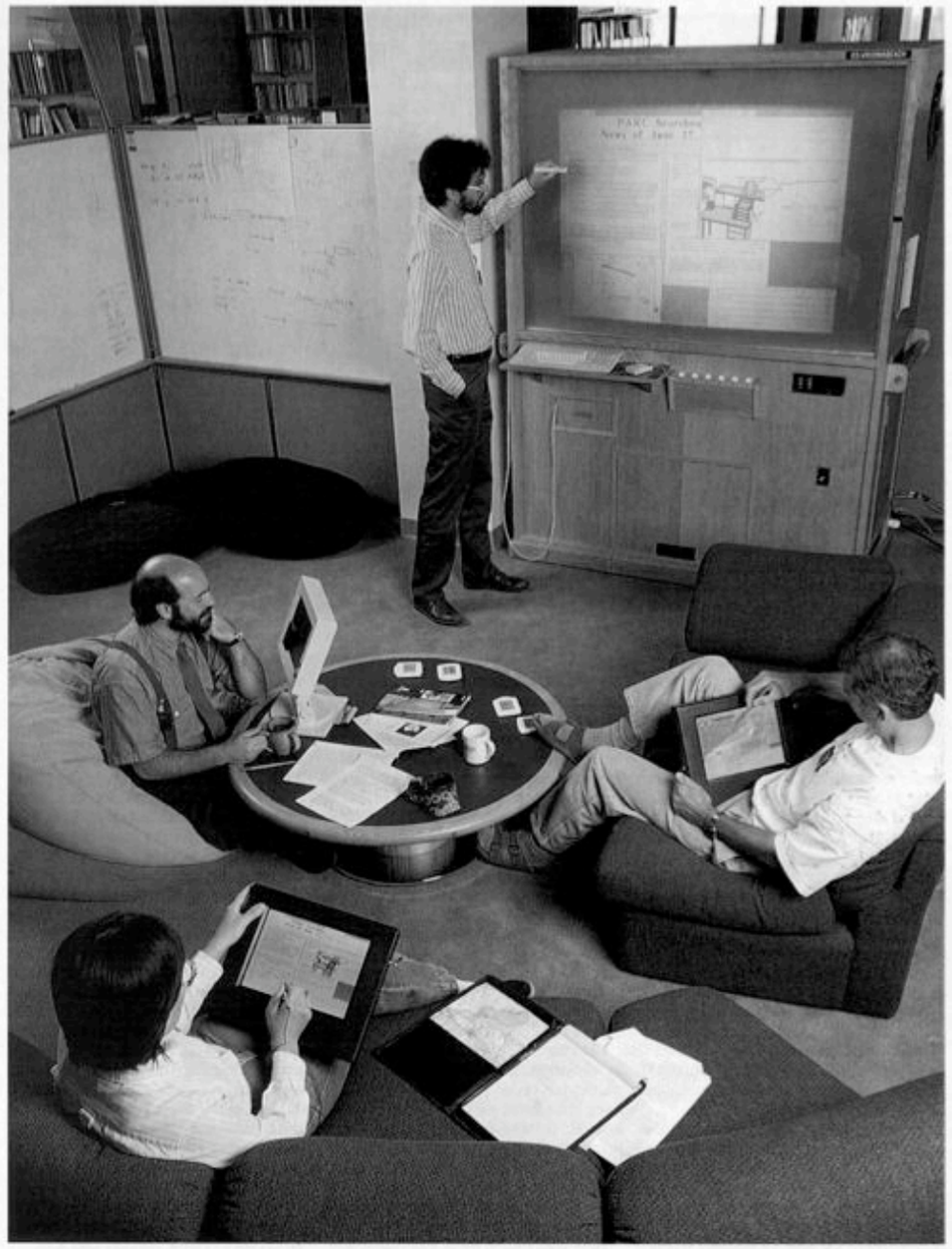
Furthermore, although ubiquitous computers may use sound and video in addition to text and graphics, that does not make them "multimedia computers." Today's multimedia machine makes the computer screen into a demanding focus of attention rather than allowing it to fade into the background.

Perhaps most diametrically opposed to our vision is the notion of virtual reality, which attempts to make a world inside the computer. Users don special goggles that project an artificial scene onto their eyes; they wear gloves or even bodysuits that sense their motions and gestures so that they can move about and manipulate virtual objects. Although it may have its purpose in allowing people to explore realms otherwise inaccessible—the insides of cells, the surfaces of distant planets, the information web of data bases—virtual reality is only a map, not a territory. It excludes desks, offices, other people not wearing goggles and bodysuits, weather, trees, walks, chance encounters and, in general, the infinite richness of the universe. Virtual reality focuses an enormous apparatus on simulating the world rather than on invisibly enhancing the world that already exists.

Indeed, the opposition between the

MARK WEISER is head of the Computer Science Laboratory at the Xerox Palo Alto Research Center. He is working on the next revolution of computing after workstations, variously known as ubiquitous computing or embodied virtuality. Before working at PARC, he was a professor of computer science at the University of Maryland; he received his Ph.D. from the University of Michigan in 1979. Weiser also helped found an electronic publishing company and a video arts company and claims to enjoy computer programming "for the fun of it." His most recent technical work involved the implementation of new theories of automatic computer memory reclamation, known in the field as garbage collection.

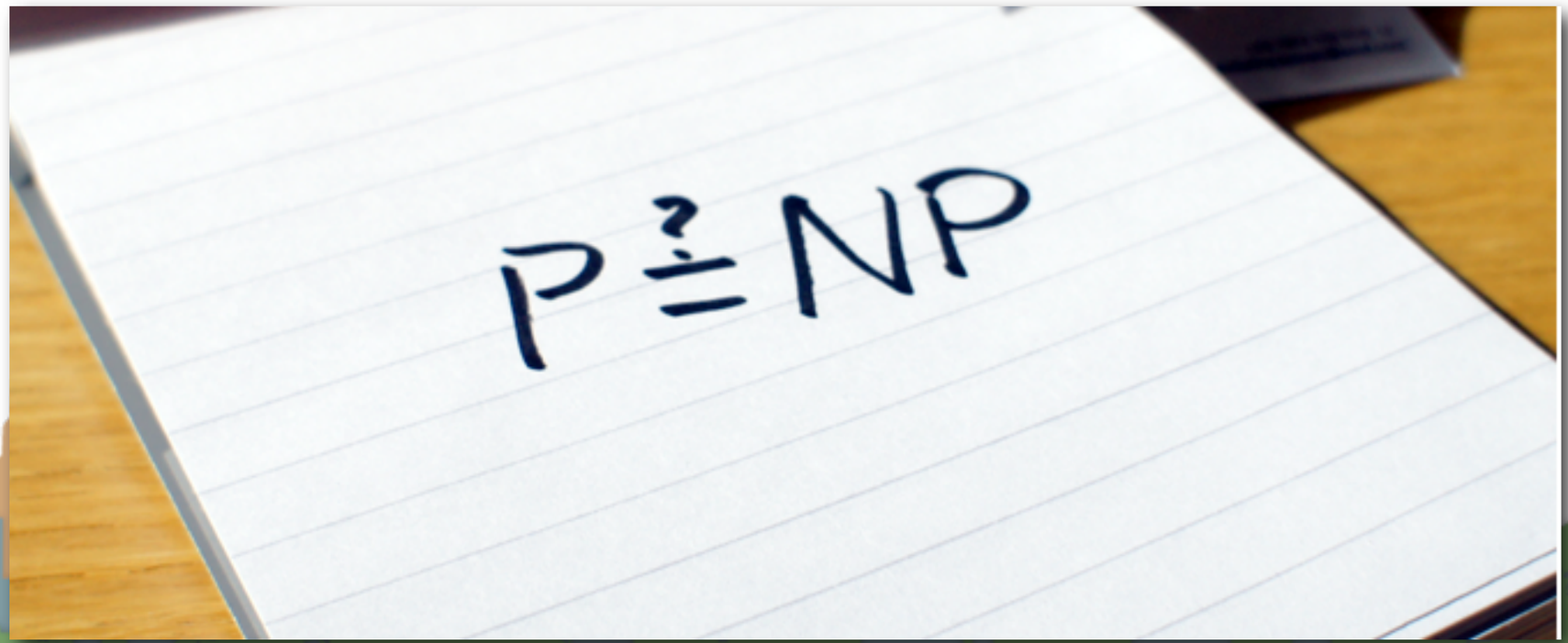
Reprinted from the September 1991 issue



UBIQUITOUS COMPUTING begins to emerge in the form of live boards that replace chalkboards as well as in other devices at the Xerox Palo Alto Research Center. Computer scientists gather around a live board for discussion. Building boards and integrating them with other tools has helped researchers understand better the eventual shape of ubiquitous computing. In conjunction with active badges, live boards can customize the information they display.

Zero Wave

- Computerless Computing
  - 1940-1950
  - Computers are theoretical technology
  - Church and Turing establish fundamental limits on computability



http://www.wired.co.uk/news/archive/2010-08/11/p-vs-np-solved

First Wave

- Main Frame Computing
  - 1960-1970
  - Massive Computers to do simple data processing
- Few computers in the world

Flickr: http://www.flickr.com/photos/carrick/61952845/in/photostream/

Second Wave

- Desktop Computing
  - 1980-1990
  - Business applications drive usage
  - One computer per desk
  - Computers connected in intranets to a massive global network
  - All wired

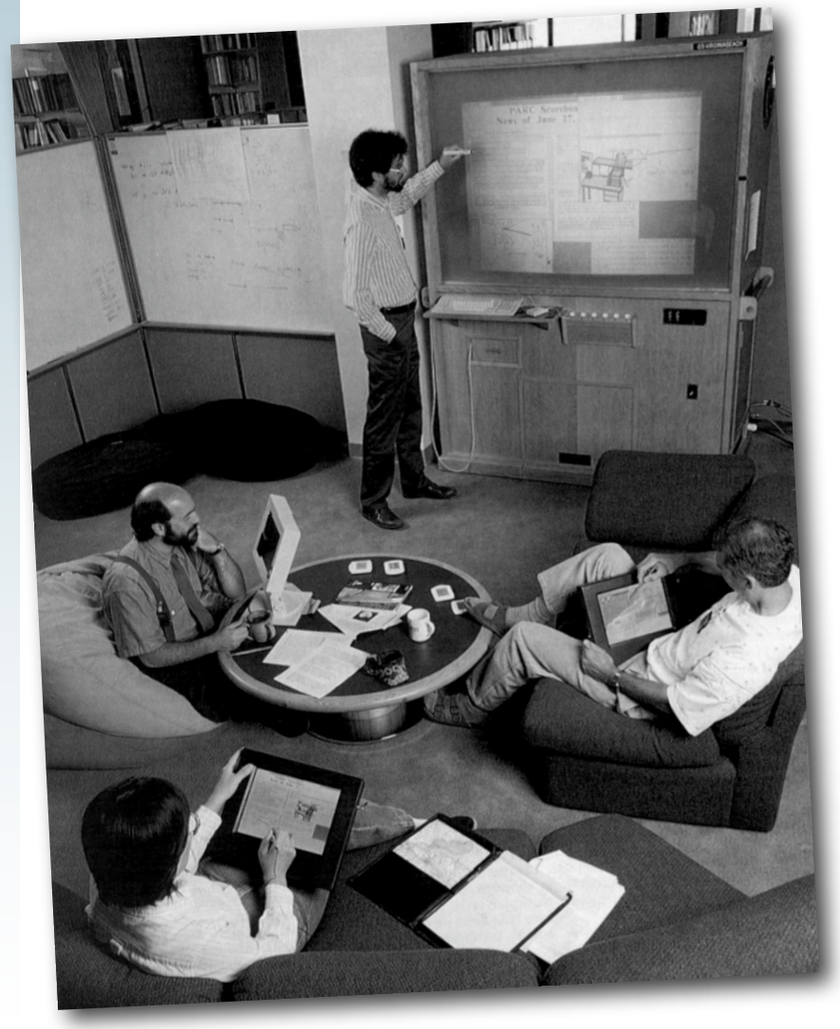
Flickr: http://www.flickr.com/photos/williamhook/486320803/in/photostream/

Third Wave

- Ubiquitous Computing
  - 2000 - present
  - Information creation and access drive usage
  - Multiple computers per environment/ person
  - Computers disappearing into the infrastructure
  - WANs, LANs, PANs, ad-hoc networking

Flickr: http://www.flickr.com/photos/mckln/3134985100/in/photostream/

Challenges to HCI Assumptions



- What do we imagine when we think of a computer?
  - "The most profound technologies are those that disappear." Weiser

- 1990's: this was not our imagined computer!
- Single User -> groups -> organizations
- Desktop -> mobile phone -> sensors
- Computing in place -> mobile computing
- Wired -> wireless

Synonyms

- Ubiquitous Computing
- Pervasive Computing
- Mobile Computing
- Sensor Networks
- (sort of) Human-Computer Interaction

Variations in Ubicomp

- Embedded Systems
  - Cars
  - Airplanes
  - Smart Control
  - Specialized
  - ASICs
  - Real-time
  - High reliability

Variations in Ubicomp

- New devices
  - Hi-tech
  - Silicone-based gadgets
    - PDAs
    - Cellphones (keitai)
    - mp3 players
    - active displays

Variations in Ubicomp

- New Infrastructure
  - Connecting the existing physical world to a computational scaffold
  - ordinary objects re-envisioned
  - add computation

Ubiquitous Computing

- Any computing technology that permits human interaction away from a single workstation
- Implications for
  - Technology defining the interactive experience
  - Applications or uses
  - Underlying theories of interaction

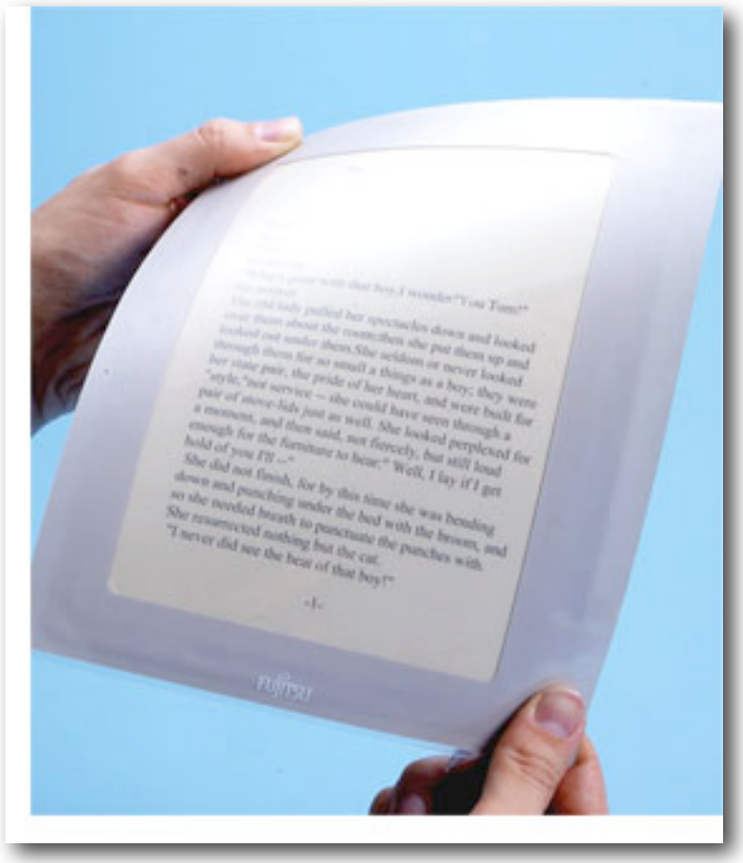
Technology: Scales of devices

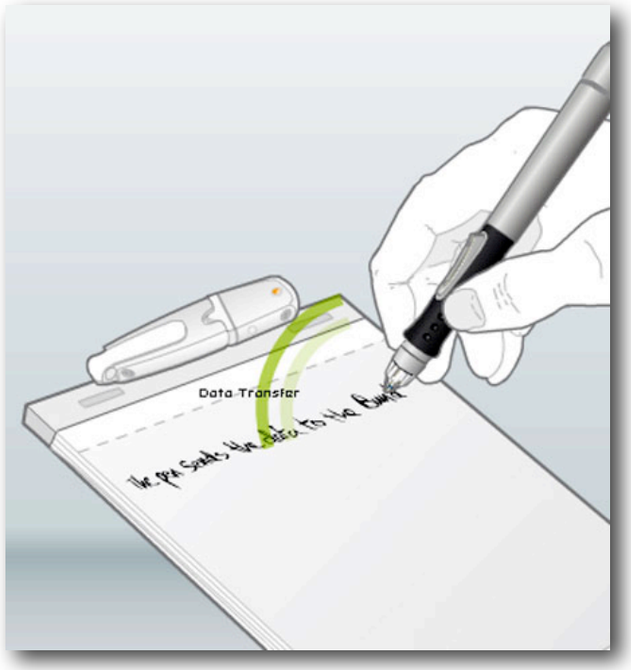
- Weiser proposed
  - Inch
  - Foot
  - Yard
- Implications for device size as well as relationship to people

Technology: Scales of devices

- Inch
  - smart phones
  - PARCTAB
  - Voice Recorders
- Individuals own many of them and they can all communicate with each other and environment.

Technology: Scales of devices





- Foot
  - notebooks
  - tablets
  - digital paper
- Individual owns several but not assumed to be always with them.

Scales of devices

- Yard
  - electronic whiteboards
  - plasma displays
  - smart bulletin boards
- Buildings or institutions own them and lots of people share them.

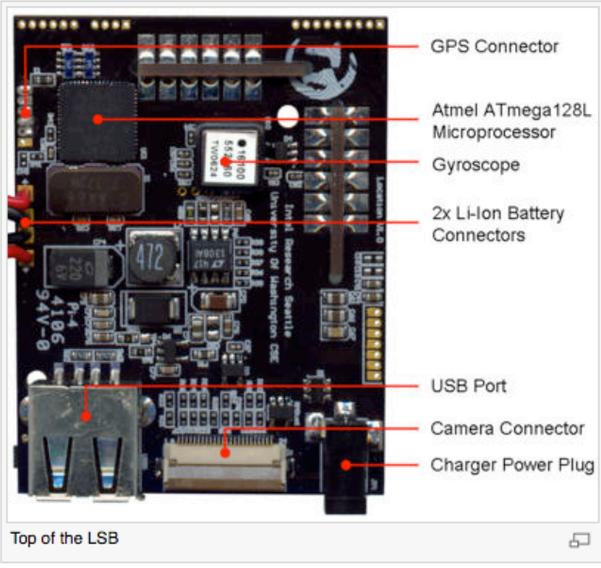
Technology: Redefining the Interaction Experience

- Implicit input
  - Sensor-based input
  - Extends traditional explicit input (e.g., keyboard and mouse)
  - Towards “awareness”
  - Use of recognition technologies
  - Introduces ambiguity because recognizers are not perfect
    - Probabilistic interaction is a new paradigm

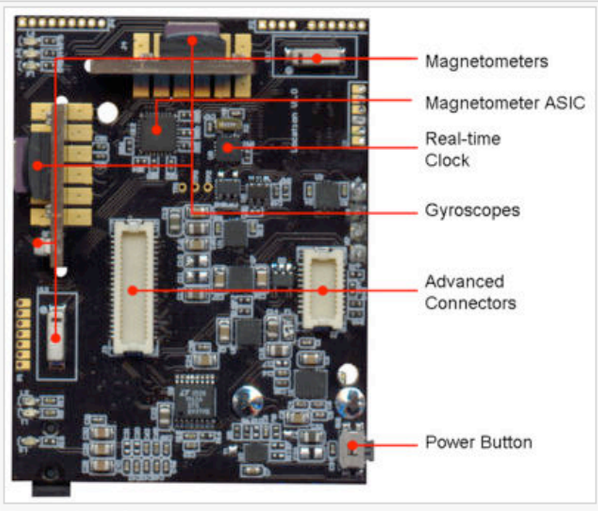
Technology: Different inputs

- Large-Screen Touch
  - MS Surface
    - http://www.metacafe.com/watch/618189/microsoft_surface_computing_the_power/
    - http://www.youtube.com/watch?v=CZrr7AZ9nCY

Overview Images



Top of the LSB



Bottom of the LSB

Proximity range sensor:

Infrared (IR) receiver

IR emitter (below receiver to right)

Touch sensitivity:

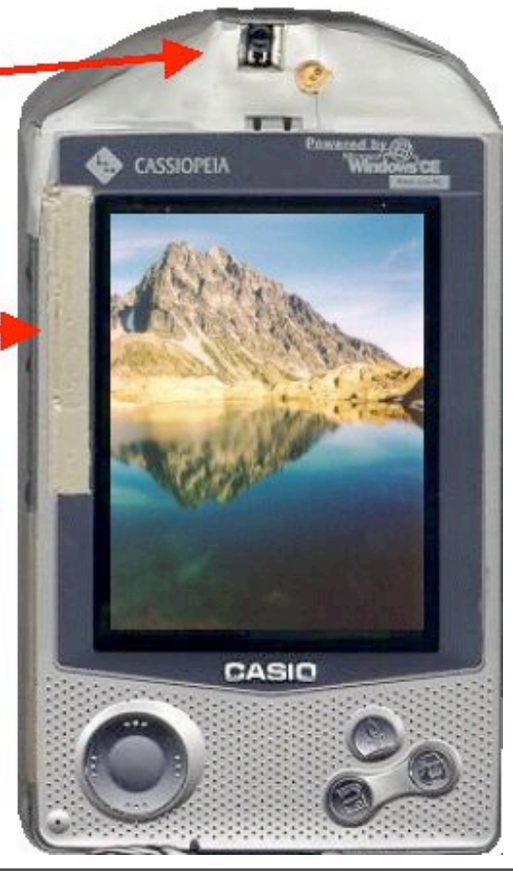
Screen bezel

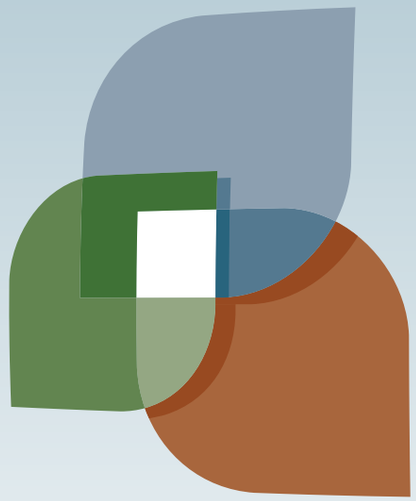
On sides & back of device

Tilt sensor:

Inside device, in plane of the display

2-axis linear accelerometer





LUCI

Wednesday, November 10, 2010