From Webster:
- Main Entry: ubiq·ui·tous
- Pronunciation: yū-'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!
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 we do street signs, billboards, stop 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 can be transmitted in ready for use at a glance. It is difficult to imagine modern life otherwise.

Silicon-based information technology, in contrast, far from having become part of the environment. More than 50 million personal computers have been sold, and the computer has become into a central part of the environment. The idea of integrating computers seamlessly into the world at large is not currently a reality. Even the most powerful individual computer with access to a worldwide information network will focus attention on a single box, by analogy with writing, carrying a supergraph is like owning just one very important book. Customizing this book, even writing callouts 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 dramatically opposed to our vision in 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 body suits 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 real objects otherwise inaccessible—the inside of cells, the surfaces of distant planets, the information web of data bases—virtual reality is only a map, not a territory. It conveys desks, offices, other people, not wearing goggles and body suits, weather, trees, walls, chance encounters and, in general, the infinite richness of the universe. Virtual reality focuses on continuous appearance in simulating the world rather than on surprisingly enhancing the world that already exists.

Indeed, the opposition between the

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UBICOMP COMPUTING begins to emerge in the form of live boards that replace bulletins as well as to 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
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