

LCC 3710 Principles of Interaction Design

Week 11

Class agenda:

- Readings
- UbiComp, Wearables
- Group Activity

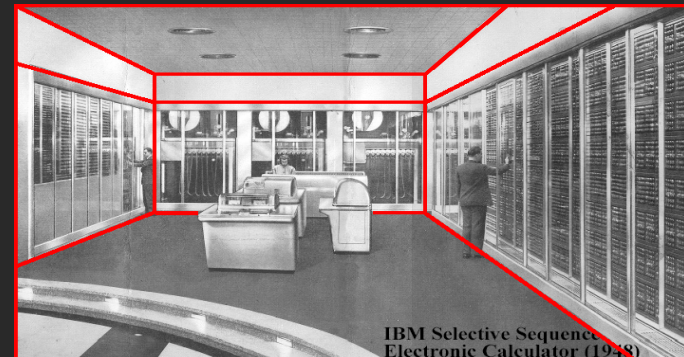
Readings

Weiser, Mark (1991). "The Computer for the 21st Century" in *Scientific American*.

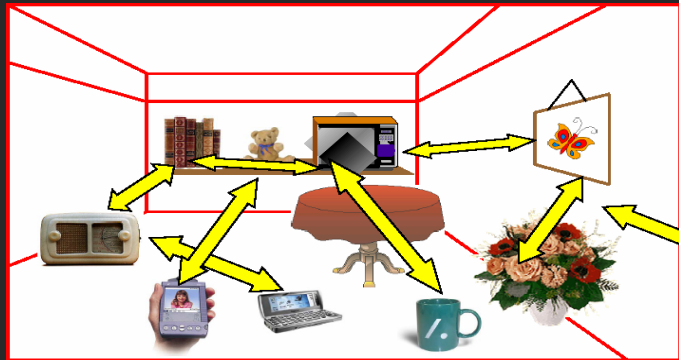
Starner, Thad (2001). "The Challenges of Wearable Computing: Part 1" in *IEEE Micro*, July-August 2001.

Ubiquitous Computing

Yesterday's computers filled rooms ...



... So will tomorrow's



Ubiquitous Computing

Definitions

Ubiquitous computing is the method of enhancing computer use by making many computers available throughout the physical environment, but making them effectively invisible to the user. (Mark Weiser)

Ubiquitous computing, or calm technology, is a paradigm shift where technology becomes virtually invisible in our lives. (Marcia Riley)

Some Principles

The purpose of a computer is to help you do something else, so the best computer is a quiet invisible servant

Technology should remain calm:

Can computing technology be as easy to use as literacy technology?

Difficulty does not stem from UI problems

The idea of the *personal* computer is the problem

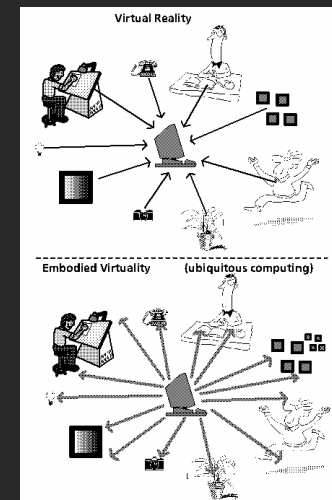
Virtual Reality & Embodied Reality

Virtual Reality

Immerses us in simulated world

Ubiquitous Computing

Invisibly enhances real world



UbiComp Technologies

Computational media everywhere — the environment becomes a computer

Technology

Wall-sized displays

Laptops, palmtops, PDAs

Active badges, smart watches, wearable computers

Computers in doors, walls, garages, cars, refrigerators, ...

Sensing context

Who? What? Where? When? Why?

UbiComp Applications

Applications

Intelligent and adaptive systems

Health care, e.g. for seniors

Telephone forwarding

Social and community awareness

Social issues

Privacy and monitoring, security

Impacts of recording

Some Research Themes

Transparent interfaces

Awareness of context

Capture experience

Transparent Interfaces

Hide their presence from user, provide interaction between user and application

Natural interactions... Gesture recognition, speech recognition, free form pen interaction, computational perception etc.

Yet currently... keyboard and mouse are still the most commonly used interfaces

UbiComp needs flexible interfaces, varied interfaces that can provide similar functionality

Context Awareness

Context is information about the environment with which the application is associated

E.g. location and time

A context aware application can capture the context, assign meaning to it, and change its behavior accordingly

UbiComp needs applications that are context aware and allow rapid personalization of their services

Automated Capture

To capture our day-to-day experience and make it available for future use.

Constraints:

- Multiple streams of information
- Their time synchronization
- Their correlation and integration

UbiComp needs automated tools that support capture, integration and future access of info.

Xerox PARC UbiComp

Computing by the inch, foot and yard

Tabs – size of a pack of cards

Personalized and carried with you

Pads – size of a piece of paper

Scrap computers, antidote to "windows"

Boards – yard size

Large displays for groups of people

Videos:

[Intro, pads, tabs, interaction, summary](http://nano.xerox.com/hypertext/weiser/UbiMovies.html)

(<http://nano.xerox.com/hypertext/weiser/UbiMovies.html>)



Today: PDA,
tablet PC,
smart board

Technology Research

Hardware technologies

- Processors, memories
- (Wireless) networking
- Sensors, actuators
- Power
- Packing and integration
- Potentially: entirely new technologies (optoelectronics, biomaterials)

Software technologies

- Operating environments
- Networking
- Middleware
- Platform technologies
- User interfaces

Example 1

VTT Soapbox

Developed at VTT Electronics, Finland

Basic board:

Bidirectional, single channel 868 MHz short range radio

Microcontroller

Real-time clock

Calendar circuit

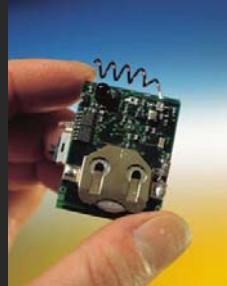
Sensor board:

3-axis acceleration sensors

Electronic compass

Light sensor

Optical IR-based proximity detector



Example 2

Smart Badge

Developed by HP Labs / Royal Institute of Technology (KTH)

Hardware

Intel SA1110 processor and SA1111 coprocessor

Audio CODEC

IR module

Accelerometer

Temperature

Humidity

Light

<http://www.it.kth.se/~maguire/badge4.html>



Example 3

Berkeley Smart Dust: COTS Dust

Designed for testing communication and sensing capabilities of large numbers of nodes

Devices that incorporate communications, processing, sensors, and batteries into a package about a cubic inch in size

Potential applications include fire detectors, espionage, earthquake monitoring, people tracking

http://www-bsac.eecs.berkeley.edu/archive/users/hollar-seth/macro_motes/macromotes.html

weC
RF 916.5 MHz OOK
10kbps 20 meter range
Sensors: light, temperature



Mini Mote
RF 916.5MHz OOK
10kbps 20 meter range
Sensors: temperature

Example 4

RFID Tags

A remotely readable tag that replies an incoming RF signal with some data

RFID has been around for some 10 years, but high tag prices have limited its use



Example 5

FOLED (Universal Display Corp)

Organic light emitting devices that are built on flexible substrates such as plastic or metallic foil (~ 1 mm thick)

Applications are emerging (e.g. curved or flexible displays)

[Video Clip](#)



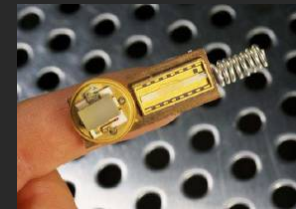
Example 6

Standalone Smart Sensors

No external power supply, energy from the actuation process

Piezoelectric and pyroelectric materials transform changes in pressure or temperature into energy

RF signal is transmitted via an antenna (20 m distance)



Wearable Computing

Portability and Mobility

Portability refers to how easy it is for you to carry around your technology

Mobility encompasses what you have the ability to do with your technology while carrying it around

Wearable Computers

Small portable computers designed to be worn on the body during use

Mediate non-computer activities without interfering with the user's everyday tasks

Generally integrated into the user's clothing or attached to the body, e.g. wristband

May be integrated into everyday objects worn on the body, e.g. wrist watch or hands-free cell phone

Differ from PDAs, which are designed for hand-held use



Portable while operational
Hands-free
Sensors
Attention-getting
Always-on

Input/Output

Input

"keyers" (e.g. Twiddler) and trackballs

Gesture, speech recognition, context awareness sensors

Output

Displays, lights, sound, haptic interfaces

Mediated reality (augmented, diminished, or otherwise modified reality) systems can also be considered wearable computers.



Applications & Uses

Personal/Recreational Use

Email/text/video messaging, note taking
Audio/video entertainment

Professional Use

Constant contact with advisors/secretaries
Commuting/working on the move
Desktop applications
Military applications

Disability aids

Navigation, obstacle recognition
Face recognition, vision enhancement



Research Questions

The image of humans interacting with a wearable computer has been found all over science fiction

Is it practical?

Many design constraints

E.g. Size, power consumption...

Expectations falling short currently

Current "works in progress" will surely develop into more usable devices in the future



Steve Mann circa 1981



Evolution of Wearables



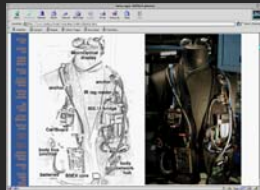
Academic Research

Thad Starner @ Georgia Tech

Steve Mann @ U of T ECE

Sandy Pentland @ MIT Media Lab

Wearable Research @ CMU HCI Institute



Wristwatch Computer Videophone

"Dick Tracy" style watch

Created by Steve Mann, University of Toronto, 2000

Combination wristwatch and imaging device

Send and receive video over short distances



Gait Shoe

Wearable device for gait tracking

Joe Paradiso, MIT Media Lab, 2002

On-shoe device used for continuous and real-time monitoring of gait

Provides information about the 3D motion, position, and pressure distribution of the foot

Medical applications, e.g. investigating the effects of physical therapy on subjects with Parkinson's disease at Massachusetts General Hospital (MGH) BioMotion Lab



[Video Clip](#)

Commercial Development

Continuous Body Monitoring

Products	Overview	Features	Specifications
<p>SenseWear™ Armband</p> <p>The SenseWear™ Armband is a sleek, wearable body monitor that enables accurate, wireless, free-living data collection. Worn on the back of the upper arm, it utilizes a unique combination of sensors that continuously gather the following data: movement, heat flow, skin temperature, ambient temperature, and galvanic skin response.</p> <p>For expanded functionality, the SenseWear Armband contains 2-way communication capabilities enabling it to:</p> <ul style="list-style-type: none"> • Receive customized sensor protocols and user configurations • Act as a platform to collect data from other third-party devices • Upload data without removing the SenseWear Armband from the body. 			
		<p>Package includes:</p> <ul style="list-style-type: none"> SenseWear™ Armband FREE Polar™ Heart Rate Monitor Cradle (with power supply and serial port connector) 	

Commercial Development

NEONLINE go to TOP

IBM Japan and Citizen Watch co-develop a wristwatch computer

Oct 13, 2001

IBM Japan and Citizen Watch announced that they have jointly developed a prototype of "WatchPad," a Linux wristwatch computer with the cooperation of IBM Research.

WatchPad is based on 32-bit MPU and incorporates 8-Mbyte DRAM and 16-Mbyte Flash EEPROM. It includes QVGA (320 by 240 dots) LCD device, a voice-compatible Bluetooth and infrared data communication as standard equipment. Touch panel and input device that were developed by applying the mechanisms of buttons and watch dials are equipped as devices for inputting basic data. In addition, WatchPad comes with fingerprint sensor for user identification and accelerated sensor for researching the various angles of the watches when used and monitoring the movement of arms.

Commercial Developments

Affordable Clip-On Display!

The new **Micro-Optical SV-3** clip-on display is the ultimate in wearable display technology, with full VGA resolution (640x480 pixels), 16 degree field of view, 6-bit color, small driver electronics, low power consumption (950 mW), and an unbelievably low price tag of \$995. This is the least obtrusive, most comfortable, and most usable mobile display we've ever tried, and we've tried them all. Decent head mounted displays are now affordable for anyone!



Charmed Technology

Your SmartBadge is the CharmBadge

The **CharmBadge** will provide information infrastructure for the "last meter" person-to-person communication. While the **CharmBadge** system generalizes to many different areas, the **CharmBadge** is designed for aiding the communication and networking that occurs at conferences. Using data recovered from an infrared electronic conference badge, the **CharmBadge** system automatically creates private, personalized web pages documenting an attendee's or exhibitor's experiences during the conference.



You've got Contacts screen shot
[Forbes.com: "Inventing the Future"](#)



Matias Corp.

Group Activity

Design for the Real World

In groups of three or four, think about how human interactions with the following real-world objects could be in some way enhanced by computation:

1. a refrigerator
2. a chair
3. a door

Develop and sketch out an idea for how to computationally enhance each of these objects.

Some particular questions to consider:

- What is the purpose of each object? What is its physical form?
- How do we interact with each object currently?
- What feedback do the objects provide when we interact with them?
- What would be the purpose of adding computation?
- What might be the sensing approach and feedback?
- How can consistency be maintained when computation is added?

Present your ideas to the class.