



# Wearable Computing

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## Overview

### Introduction

A short historic overview

A first Definition

### Examples

Engineering: Symbol Wearable

Philosophy: Personal Imaging and Humanistic Intelligence

### Conclusion

# Wearable Computing - Overview

**Course:** Wearable Computing

**VAK:** 03-799.01

**Time:** Mo, 13-15

**Place:** 1.51 TAB

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# Overview of the course

- ▶ What is wearable computing?
- ▶ History of wearable computing
- ▶ Building blocks of wearable computing
  1. Hard- and Software
  2. Wearable Human Computer Interfaces
  3. Context-Aware Computing
- ▶ Wearable computing between engineering and philosophy

# The Rules

1. Good scientific practice:
  - 1.1 Be precise and clear in statements. This is no literature class!
  - 1.2 Use scientific sources. (Journalistic articles aren't. Wikipedia isn't.)
  - 1.3 Cite! Plagiarism of ANY source is forbidden!
  - 1.4 Cooperate within limits: Talking OK, Copying not!
  - 1.5 Always use your own words.
2. Homework
  - 2.1 in groups, group size  $\leq 3$ , no exceptions
  - 2.2 Fixed groups

# The Grading

## 1. Schein

- 1.1 At least 30% of the points of each problem sheet
- 1.2 Homework grades serve as initial group grade
- 1.3 Individual oral exam (Fachgespräch) to verify individual contribution.

## 2. Modulprüfung

- 2.1 Homework recommended but points have no influence
- 2.2 Longer oral exam (Modulprüfung)

# Wearable Computing?

- ▶ Evolution of computer hardware
  - 1950s Central computing facilities, Batch processing
  - 1960-1980 Timesharing, "mini"-computers
  - 1980s Personal Computers
  - 1989 Nintendo Gameboy
  - 1990 GSM Mobile Phones
  - 1992 Apple Newton PDA

# Wearable Computing?

► Evolution of computer hardware

- 1992 IBM Smartphone (sold by BellSouth in 1993)
- 1996 Digital Camcorder (Sony Digital8, MiniDV)
- 1998 MP3 Player (MPMan, Diamond Rio,...)
- 1999 Bluetooth SIG: Personal Area Network



# Wearable Computing?

► Evolution of computer users

1950s Experts build computers and use them

1960s Computer companies: Commercial use

1980s "Geek" user: Desktop, Home use  
(communication, games)

1990s "Everyone" user: Mass Medium (Internet,  
Games)

2000s "Everywhere" User (Notebook, PDA, Mobile  
Phone,...)

# Wearable Computing?

- ▶ Evolution of computer uses
  - 1950s Special tasks, special computers
  - 1960s Business Support (Accounting)
  - 1980s Business, Information (BTX), Entertainment (video games)
  - 1990s Information (internet), Communication (e-mail, chat)
  - 2000s Mobile information and communication, casual use (SMS, WAP)

# Is this wearable computing?!?



"Wearable" mobile phone?

# Is this wearable computing?!?

*Can you imagine hauling around a large, light-tight wooden trunk containing a co-worker or an assistant whom you take out only for occasional, brief interaction. For each session, you would have to open the box, wake up (boot) the assistant, and afterward seal him back in the box. Human dynamics aside, wouldn't that person seem like more of a burden than a help? In some ways, today's multimedia portables are just as burdensome.*

Steve Mann

# Is this wearable computing?!?



Cyborg?

# So what's Wearable Computing?

- ▶ Support the user (during a primary task)
  - ▶ Don't *disturb* the user
  - ▶ Provide useful functions *all the time*
- ▶ Seamless integration
  - ▶ Into existing processes and tasks
  - ▶ Into environment (avoid Cyborg look)

## An Example: Symbol Wearable

*In January of 1995, a major customer, the United Parcel Service (UPS), challenged Symbol Technologies to create a Wearable Data Collection device for their package loaders to use.*

(Stein et al: Development of a Commercially Successful Wearable Data Collection System, ISWC'98)

# Symbol Wearable: Requirements

- ▶ Package loaders scan barcodes on packages
- ▶ Existing solution: Symbol APS3395 (from 1992): Three components (Display/Keyboard, CPU, Scanner) interconnected by wires
- ▶ fatigue-free scanning, 5.5h operation time
- ▶ improve hygiene, operation, reliability



# Symbol Wearable: Challenges

- ▶ Ergonomics and Hygiene: safe, comfortable, unobtrusive
- ▶ Miniaturisation of computer and scanner
- ▶ Power management: 5.5h with single battery
- ▶ Ruggedization - Operation in hostile environment

# Symbol Ws 1000



Image from Symbol Technology Inc.

# Design Process

- ▶ "interactive design process": user testing, feedback
- ▶ Observation, Interviews, Scientific Literature
- ▶ concept sketches
- ▶ creating mockups
- ▶ user tests with mockups

## User testing and feedback

- ▶ Interviews with many users, male and female
- ▶ Main concerns: comfort for wide range of body sizes, ruggedness, user safety, hygiene/cleanliness
- ▶ Design challenge: One Device for different hand and arm sizes, connecting "soft goods" to hard plastic

## Scientific input

- ▶ Physiological studies: arm, hand, fingers in neutral position most of the time
- ▶ Study of potential disease transmission: synthetic cloth materials for soft goods
- ▶ Ergonomic Evaluation in Lab: six subjects, simulation of UPS tasks

# Steve Mann

Steve Mann's "wearable computer" and "reality mediator" inventions of the 1970s have evolved into what looks like ordinary eyeglasses.



Image from [eyetab.org](http://eyetab.org) website

# Humanistic Intelligence

*HI is a new information processing framework in which the processing apparatus is inextricably intertwined with the natural capabilities of our human body and intelligence. [ . . . ] Devices that embody HI are worn continuously during all facets of ordinary day-to-day living. Through long-term adaptation they begin to function as a true extension of the mind and body*

Steve Mann, Intelligent Image Processing

# Features of HI

- ▶ Relies on the existence of the human user
- ▶ operational constancy (always on)
- ▶ interactional constancy (inputs and outputs potentially always on)
- ▶ HI does not necessarily mean user-friendly, user learns from the device
- ▶ WearComp as means of realizing HI



# WearComp Constancy

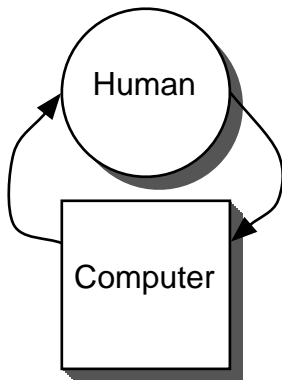


Image from Steve Mann: Intelligent Image Processing, Pg 5. Fig 1.1

# WearComp Augmented Intelligence and Augmented Reality

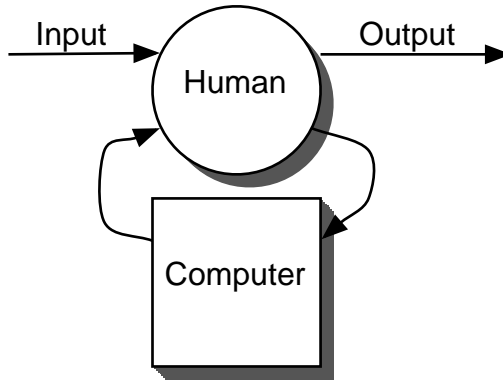


Image from Steve Mann: Intelligent Image Processing, Pg 5. Fig 1.1

# WearComp encapsulating the user

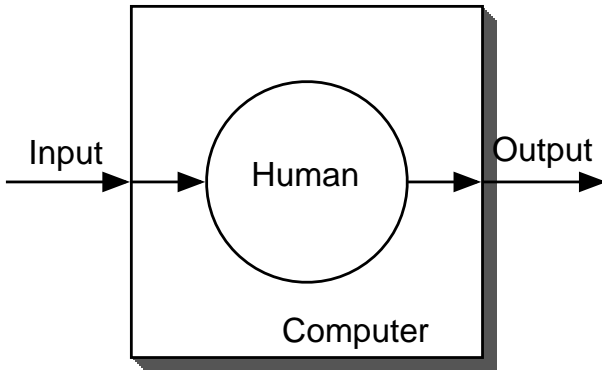


Image from Steve Mann: Intelligent Image Processing, Pg 5. Fig 1.1

# WearComp encapsulation with Constancy and AR

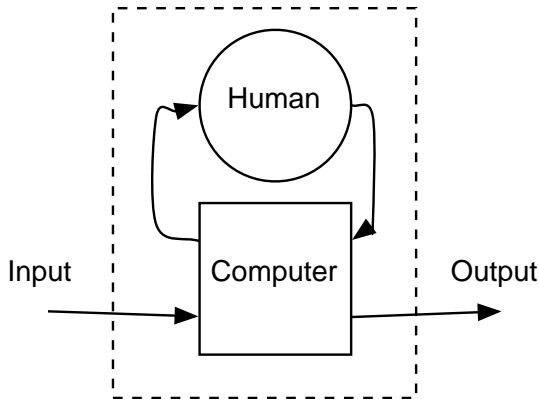


Image from Steve Mann: Intelligent Image Processing, Pg 5. Fig 1.1

# Personal Imaging



*Human beings obtain their main sensory information from their visual system. [...] A computationally mediated visual reality is a natural extension of the next-generation computing machines. [...] This will not be done by implanting devices into the brain [...], but rather by noninvasively “tapping” the highest bandwidth pipe into the brain, namely the eye.*

Steve Mann, Intelligent Image Processing Image from Steve Mann's [eyetap.org](http://eyetap.org)

# Research Problems

- ▶ System engineering: How to build it? (so that it's useful?)
- ▶ Human Machine Interaction: How can it be used?
- ▶ Context-awareness: How does it know what's going on?
- ▶ Augmenting human capacity: Building better cyborgs?
- ▶ ...

# Wearable Computing!

- ▶ Properties of wearable computing
  - ▶ Unobtrusive
    - ▶ mobile, small, lightweight, no wires
    - ▶ body-wearable (sometimes in clothing)
  - ▶ Supporting a primary (work) task
    - ▶ Don't disturb, be useful all the time
  - ▶ casual use, context-aware, "smart"
- ▶ Engineering discipline or cyborg philosophy?