

CG 121

Wearable Computing



Lecture Two

Hardware & Software

The University of Dodoma

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Wearable vs. Ubiquitous

- *Wearable computing:*
 - *Computers/sensors on **people***
- *Ubiquitous computing*
 - *Computer/sensors embedded in the **environment***
- *Complimentary*

Complimentary Duality

- *Wearable: Know more about **persons***
 - *privacy, authentication, and security*
 - *personalized information*
- *Ubiquitous: Know more about **environment***
 - *local environment information*
 - *local environment control*
 - *resource management*

Motivation

- *Why do we want/need wearable computers?*
 - *To communicate*
 - *to know **things you CARE about** whenever you can*
 - *To organize/remember*
 - *to get a hold of the **reality for the BUSY** people*
 - *To get information that we don't know here now*
 - *I don't know it but I can get it **right NOW right HERE***
 - *As a life style or fashion statement*
 - *I'm **cool** because I'm technologically up-to-date*

Motivation

- *What do we want from a wearable computer?*
 - *Physical/Hardware Features*
 - *Application/Software Features*

Hardware Features

- *light-weight (small)*
- *durable*
- *comfortable*
- *long battery lifetime*
- *easy to use*
- *affordable*
- *cool (invisible, hidden, disappearing)*

Application Features

- *person-to-person communication*
- *personal organization/remembrance aid*
- *context awareness*
- *effortless usage*
 - *natural, intuitive*

Big Picture

Application	
I/O	
Communication	
Heat	Power

I/O Interface

- *Visual*
- *Audio*

Visual

- *Input*
 - *computer vision*
- *Output*
 - *overlaying things*

Example: Eyeglass Display



- *Human factors studies*
 - *health and safety*
 - *social acceptance*



- *Concentrating on bi-ocular displays*
 - *for viewing 2D text and images*



Audio

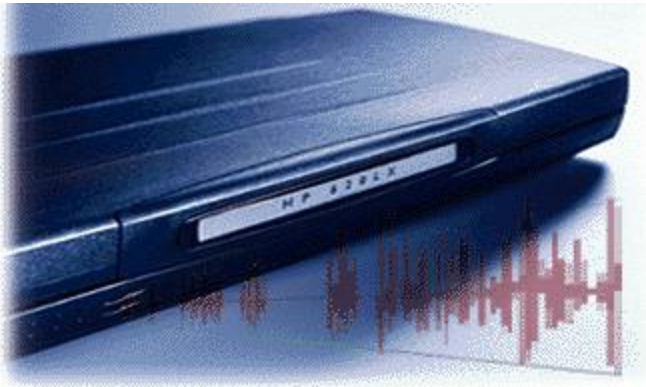
- ***Input***

- *speech recognition*
- *background noise separation*
- *speaker identity (voice fingerprint)*

- ***Output***

- *speech synthesis*

Speech Interaction

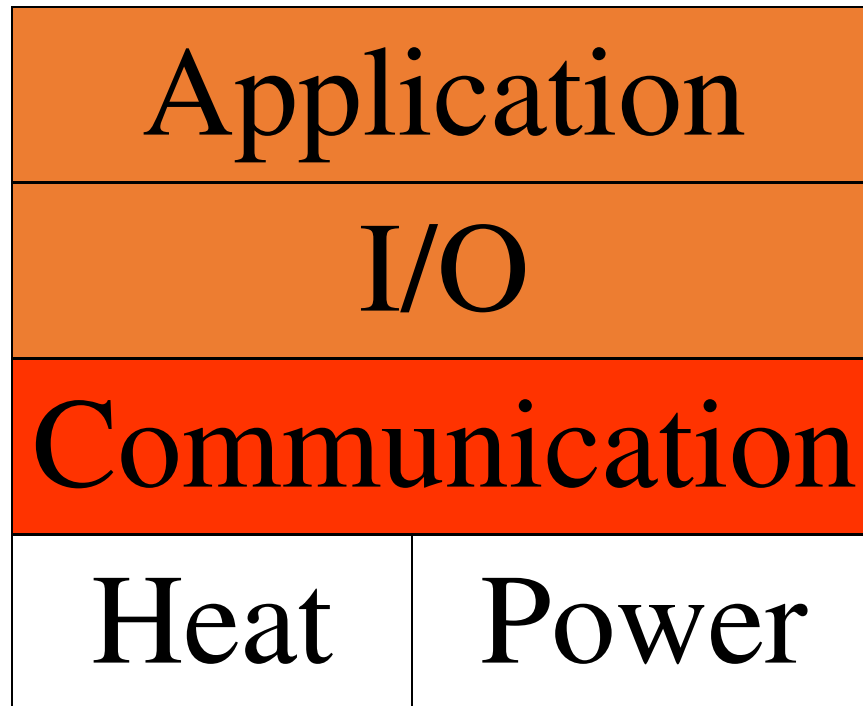


- n Speech as data
 - n efficient coding
 - n word spotting

- *Speech-driven user interfaces*
 - *large vocabulary recognition (Cambridge University)*
 - *dialog for interfaces (MIT)*



Big Picture



Communication Requirement

- *Security*
 - *short range -> low probability of leaking*
- *Energy*
 - *low frequency -> low power*

Far-field vs. Near-field Communication

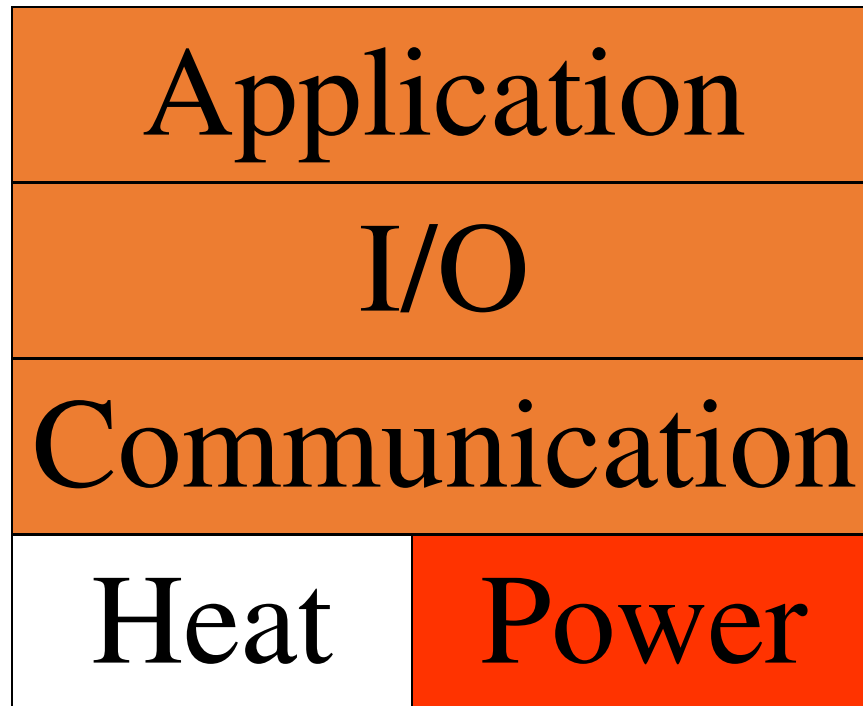
- *examples*
 - *radio vs. bluetooth (kind of)*
- *signal strength*
 - $1/d^2$ vs. $1/d^3$
- *carrier requirement for devices size of a watch or credit card*
 - *gigahertz vs. 0.1 to 1 megahertz*

Local Communication Examples

- *Transfer data between:*
 - *wearable and handheld*
 - *wearable and desktop*
 - *wearable and environment*



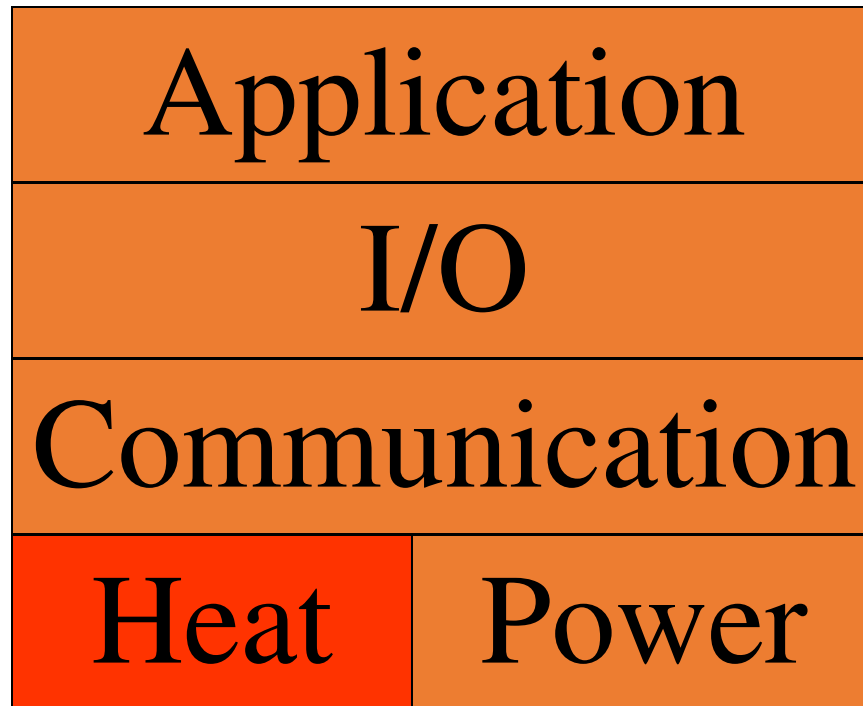
Big Picture



Power Requirement

- *The traditional bigger ones: 5 W*
 - *head mount display, 2GB hard disk, 133 MHz Pentium, 20 MB RAM*
- *The improved smaller ones: 0.7 W*
 - *MicroOptic™ eye-glass display, Flash memory (.5 GB), StrongArm microprocessor (.3 W at 115 MIPS)*
 - *without communication*
- *Must come with the person wearing the devices*

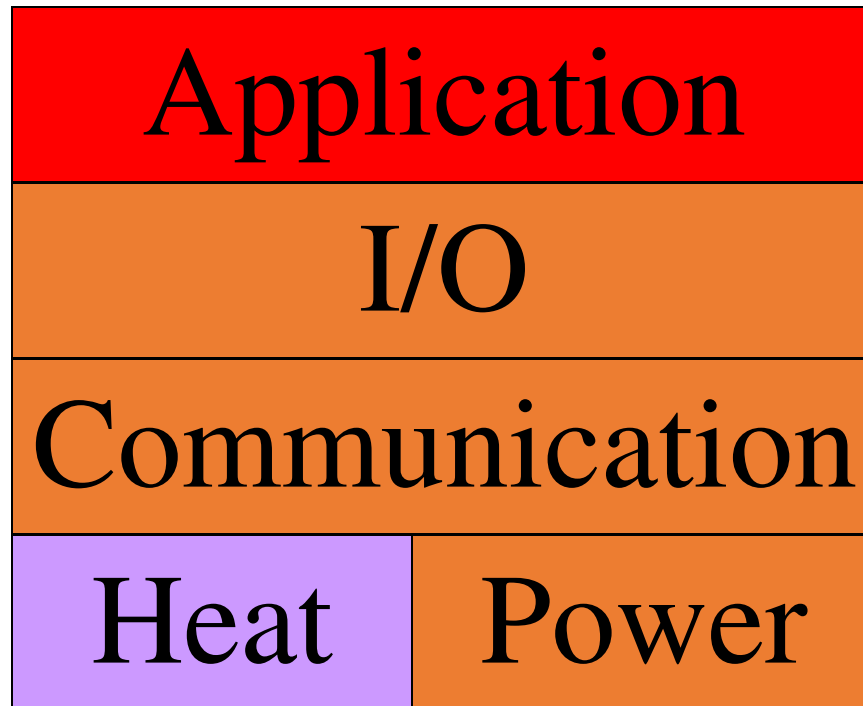
Big Picture



Heat Dispensing

- *requirement*
 - -15 *intolerably cold*
 - 15 - 34 *OK*
 - 34 - 39 *hot*
 - 39 - 43 *pain*
 - 43 - *tissue damage*

Big Picture



Application Examples: Miniature Head-up Displays

MicroOptical prescription
display eyeglasses



Application Examples: CharmIT Wearable Computer

- 266MHz Intel Pentium or 800MHz Transmeta Crusoe



(www.charmed.com)

Wearable Computer Definitions

- *Simple definitions*
 - *Packet or clothing based computing*
 - *Peripherals distributed around the sensors and actuators of the body, connected wirelessly*
 - *Runs entire day*

Wearable Computer Definitions

- *Formal Definitions*

- *Rhodes (1997)*

- *Portable while operational*
 - *Enable hands-free or hand-limited use*
 - *Capable of getting user's attention*
 - *Always "on"*
 - *Sense the user's context in order to serve him better*

- *Starner (1999)*

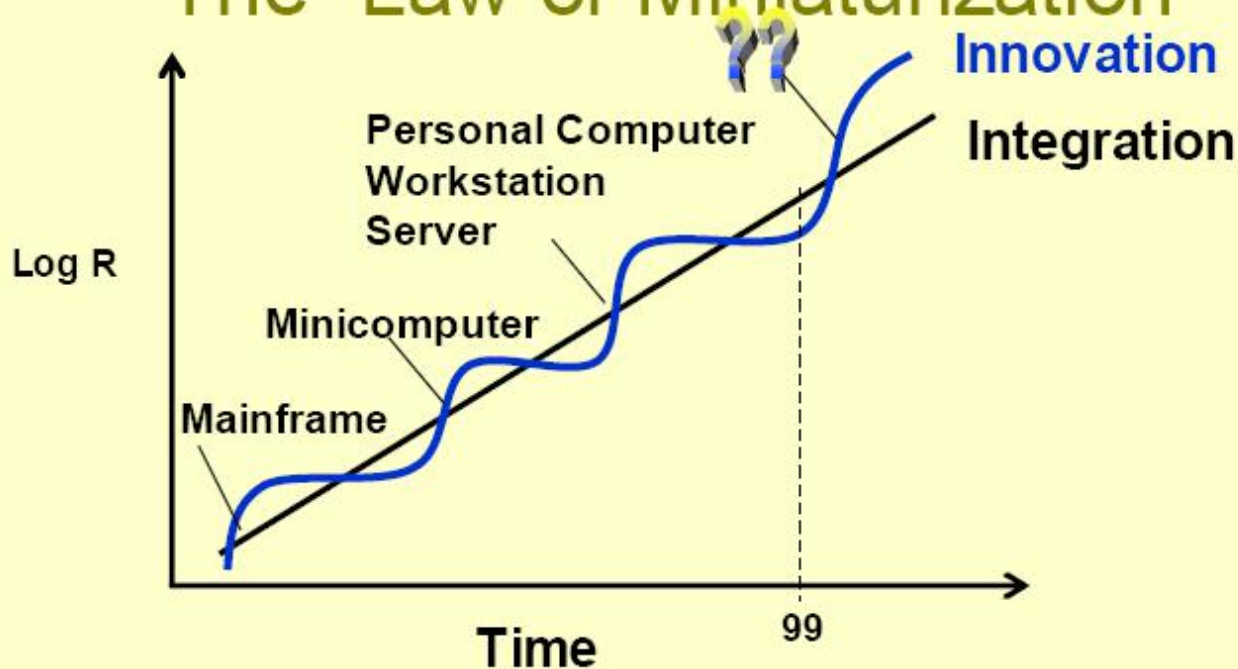
- *Persists and provides constant access*
 - *Senses and models context*
 - *Augments and mediates*
 - *Interacts seamlessly*

Human-Computer Evolution

- *Mainframe->mini->PC->wearable*
- *Initially lose on features*
 - *Less CPU capacity*
 - *Lower bus speed*
 - *Less disk storage*
- *BUT Gain on interface*
 - *Personalization*
 - *Interactivity*

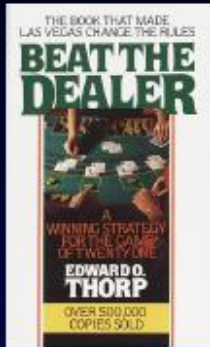
(Starner PhD 1999)

The “Law of Miniaturization”



- Each major generation is increasingly smaller, more deeply interactive, arrives when previous is at its strength
- Vast majority of computing will be small, embedded, devices connected to the physical world

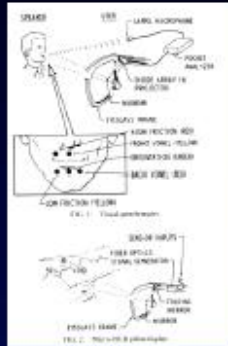
Current State of the Industry



1961



1966



1968



1977



1980



1981



1991



1991



1992



1993



1993



1996



2003

Application Areas

- *Warehouse picking*
- *Inspection*
- *Maintenance*
- *Repair*
- *Security*
- *Military (Land Warrior)*

Examples

Symbol Technologies WS series



Fashion



Music Jacket
(MIT)

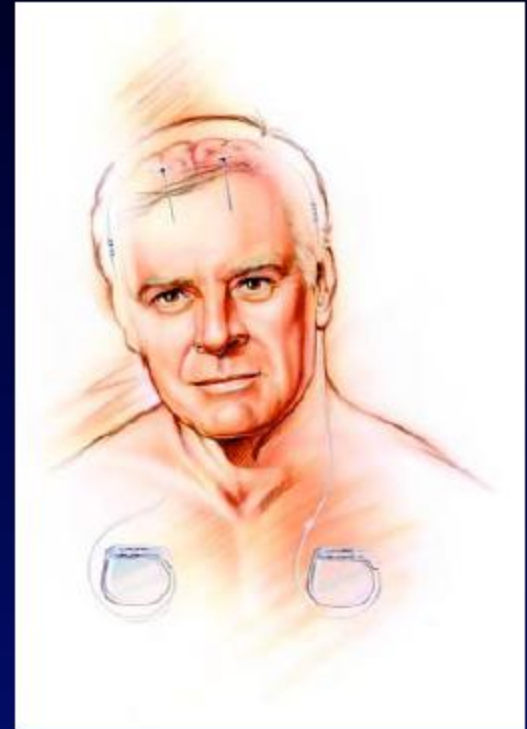


Galvactivator
(MIT)

Medical and Fitness Systems



FitSense



Medtronic

Trends

- *Computation in the wild*
 - *Working in hostile or uncontrolled environment*
 - *Continuous monitoring*



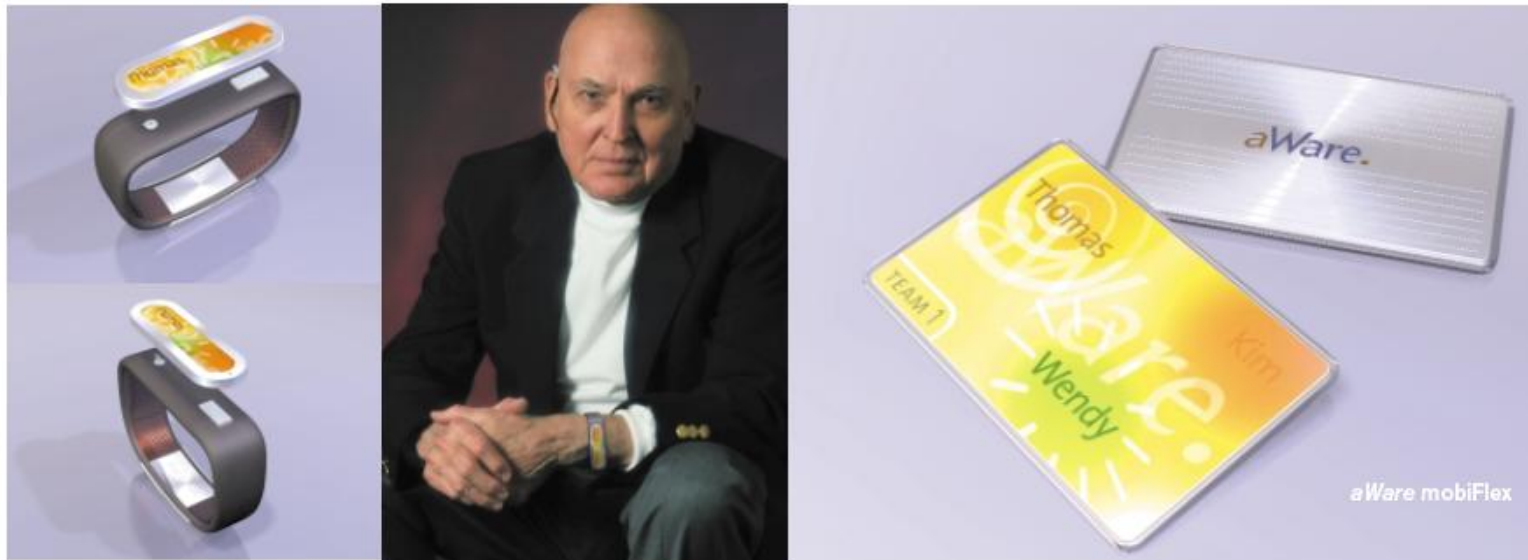
Trends

- *Personal Server (at Intel)*
 - *Always with you*
 - *Uses outside interfaces*
 - *Represents you to ubiquitous computing world*



Trends

- *Interactive lifestyle*
 - *Seamless integration into everyday life*
 - *Augment the senses and the mind*
 - *See as you see, hear as you hear*



Challenges for the Wearable PC

Connectivity

- *Seamless connection*
 - *across different kinds of network*
- *Occasional connection*
 - *in and out of range*
- *Local communication*
 - *ad-hoc peripherals*

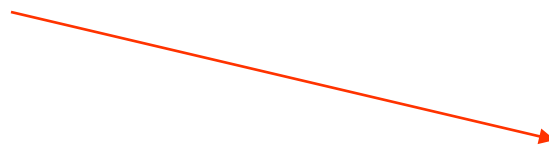
Usability

- n Modes of interaction
 - n visual and vocal
- n Health and safety
 - n strain on the senses
- n Unobtrusive
 - n socially acceptable

Situatedness

- n Awareness
 - n capturing context
- n Interpretation
 - n use of context data
- n Augmentation
 - n personal assistant

Technical



Social

Resources

- *Charmed Technologies* (www.charmed.com)
- *IEEE Wearable Information Systems Technical Committee*
- www.cc.gatech.edu/~thad
- www.bradleyrhodes.com
- www.zary.com