Human-Computer Interaction IS4300

Prof. Timothy Bickmore

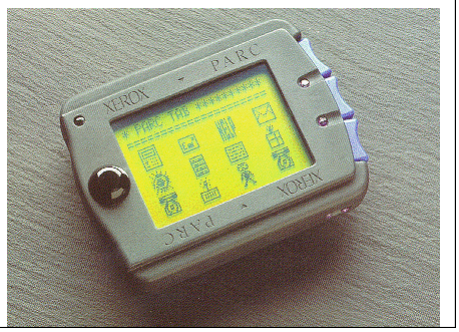
Ubicomp

- Ubiquitous Computing, aka
- Pervasive Computing

- "Computing off the desktop"
- Mark Weiser @ Xerox PARC 1990's

Xerox PARC Projects

- PARCtab (’90s)
  - Location sensitive mobile computing
  - IR communication with each room



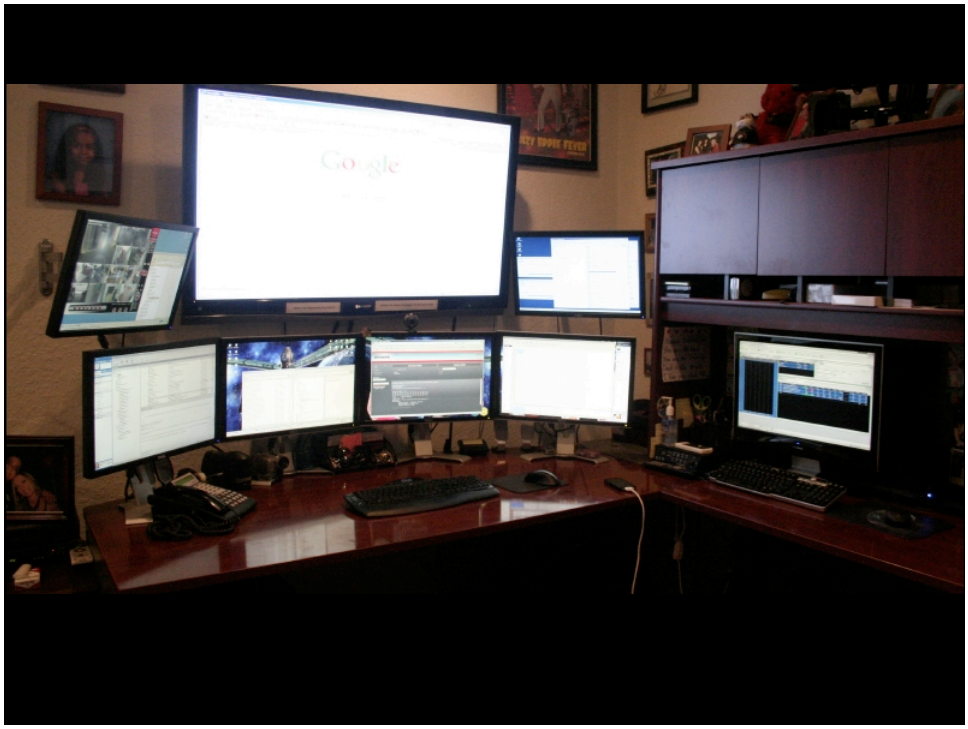
Professional Conferences

- ~CHI
- Ubicomp
- MobileHCI
- Pervasive Computing

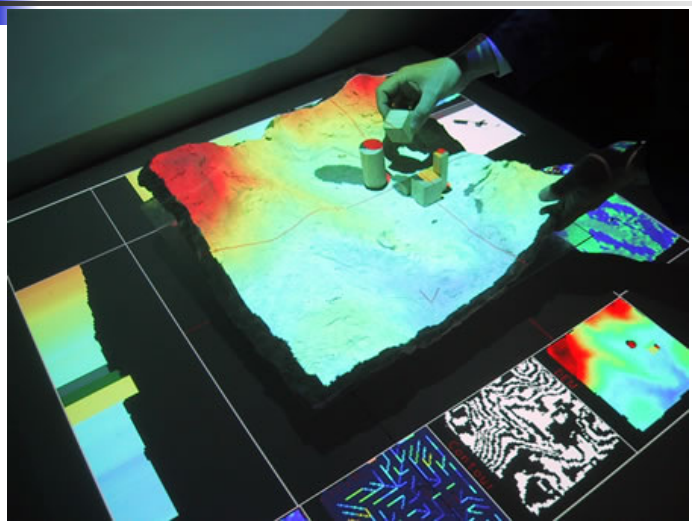
Ubicomp

- Anticipates when computing and communication technologies disappear into the fabric of the world.
- HCI concerned with many computing devices interacting with many others.

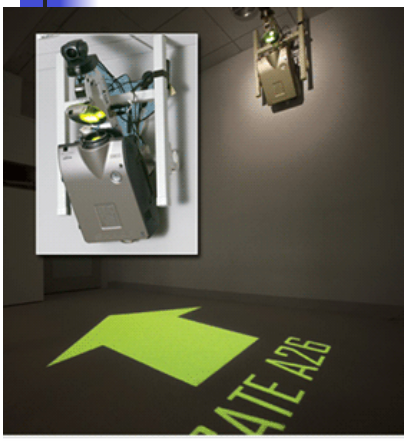
Fundamental Question: How do we interact with all of these devices?

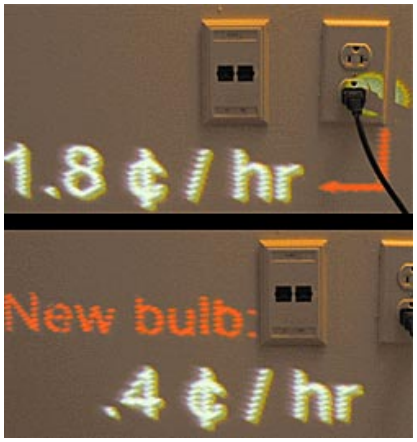


Blending physical & digital e.g., tangible interfaces



ubicomp environment displays
IBM Anywhere Display





Ambient Interfaces: Ambient Orb

Ambientdevices.com

Smart Homes – ubi sensing e.g., PlaceLab

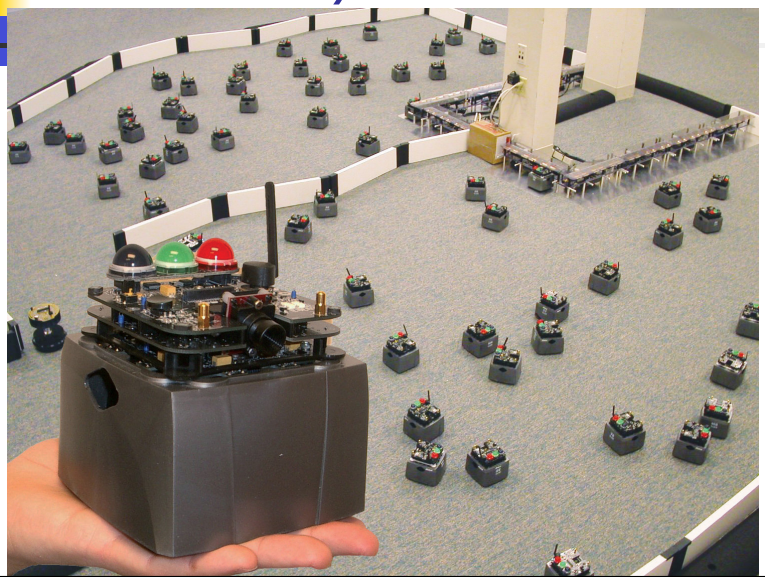
Ubicomp environment sensing e.g., Full body interaction

- Concerns the wide range of techniques that can be used to track body movement in a space and how those movements can be interpreted.
- Many games and home entertainment systems make some use of body movement.
  - Wii, Kinect
- More sophisticated system require a whole room to be equipped with sensors and tracking devices so that complex movements such as dance can be monitored and used as input.

Wireless Sensor Networks

- Environment densely filled with small, networked sensors.
- What could you do with this?
- Issues?

Wireless Sensor Networks
What if they can move?

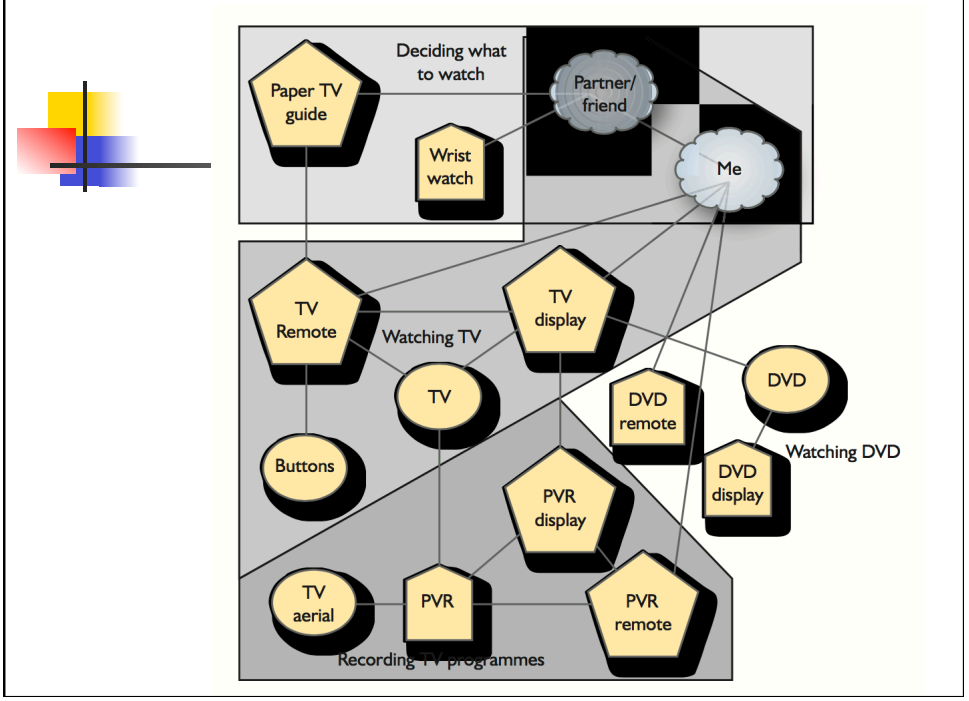


How do we design interactions for ubicomp environments?

Information Space

- In physically distributed ubicomp environments information and interaction is distributed through physical space.
- The physical architecture of an environment will affect the interaction as will the existence of signs, furniture and other people.
- Three types of object are found in information spaces;
  - agents,
  - devices
  - information artifacts.

Info Space/Hybrid trajectories e.g., home a/v



Info Space/Hybrid trajectories e.g. science museum

Info Space
e.g., Command & Control

Info Space
e.g. kitchen of the future

Ubicomp Design Issues

- Ontology
- Topology
- Volatility
- Media
- Agency

Other ubicomp issues?

- Design for physical space
- Distribution of information across devices
  - One large display vs. Many small ones
- How do we signal what systems and services exist (as they become invisible)?
  - Seamless vs. “Seamed”
- Privacy
  - Sensed data
  - Displayed data

Design approach *how?*

1. Conceptualize overall experience
2. Determine activities
3. Determine content & relationship with space
   - Transitions, awareness, narratives
4. Design of digital & physical space
   - UI, social interactions, flow, etc.

How do our models of interaction need to change for ubicomp?

- Model Human Processor / Norman's Interaction Model, Assumes:
  - single user
  - uninterrupted task
  - state either on screen or in working memory
- Alternate theoretical frameworks
  - Activity theory, Distributed cognition, Ethnography

Ubicomp Exercise

- Project teams
- Think about an information space your project would be used in.
- Design an overall user experience.

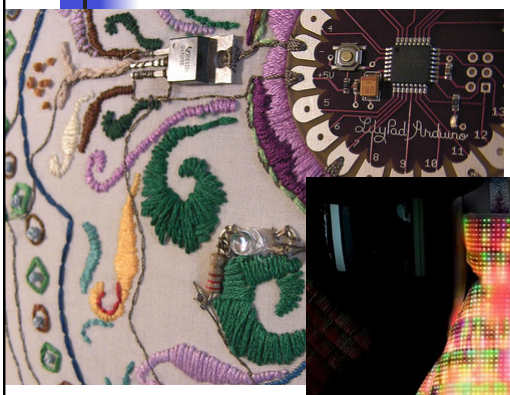
Wearable Computing

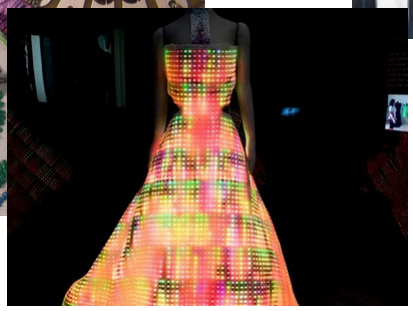
Mainstream Wearables

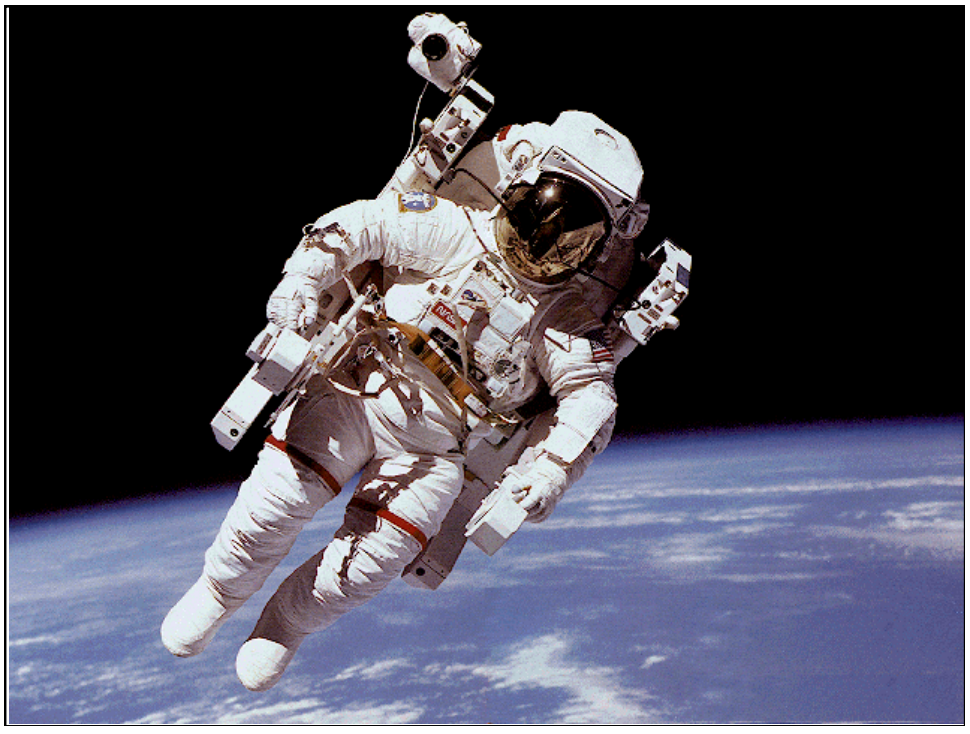
Affective Computing Group

Prof. Rosalind Picard

Digital Clothing







Prosthetics

Implantables

Implantables

What are design issues that are unique to wearables?

Steve Mann Information flow paths

- Unmonopolizing of people's attention
- Unrestrictive
- Observable
- Controllable
- Attentive to environment
- Communicative to others

Siewiorek UCAMP Framework

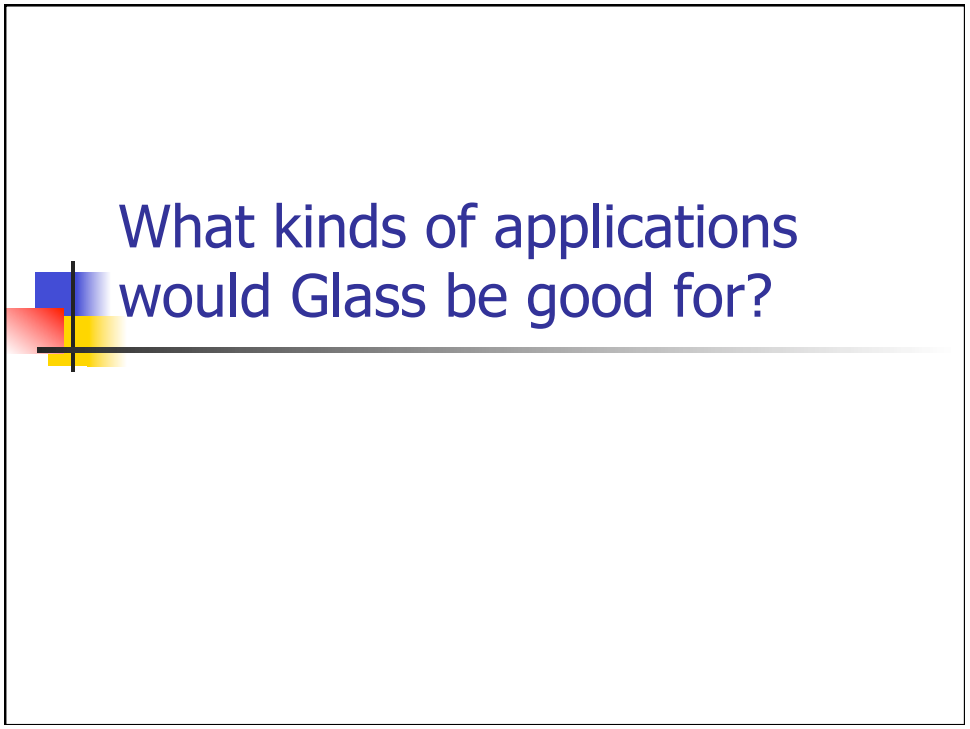
- Users
- Corporal
  - Weight, comfort, location, interaction
- Attention
- Manipulation
  - Controls quick to find, easy to use
- Perception
  - Simple, distinct, quick

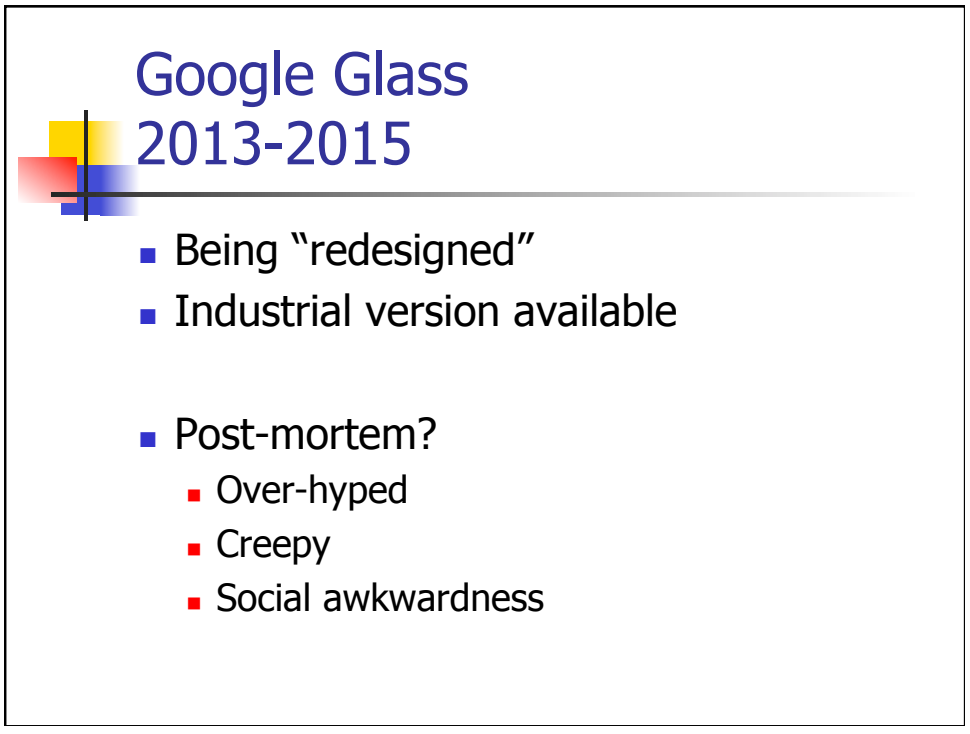
Other Unique concerns for Wearables

- Comfort
  - Weight, fit, heat, noise, vibration
- Aesthetics
  - Would users want to be seen with it?

Google Glass

- Touchpad
- 720p HD video / 5MP camera
- Liquid crystal on silicon (LCoS) display
- Microphone
- 802.11b/g WiFi, Bluetooth
- Bone conduction transducer (speaker)


What kinds of applications would Glass be good for?


Google Glass 2013-2015
Being "redesigned"
Industrial version available
Post-mortem?
Over-hyped
Creepy
Social awkwardness

Example: Microsoft Hololens

Microsoft Hololens

- Optics
  - See-through holographic lenses (waveguides)
  - 2 HD 16:9 light engines
  - Automatic pupillary distance calibration
  - Holographic Resolution: 2.3M total light points
  - Holographic Density: >2.5k radiants (light points per radian)
- Sensors
  - 1 IMU
  - 4 environment understanding cameras
  - 1 depth camera
  - 1 2MP photo / HD video camera
  - Mixed reality capture
  - 4 microphones
  - 1 ambient light sensor

Microsoft Hololens

- Human Understanding
  - Spatial sound
  - Gaze tracking
  - Gesture input
  - Voice support
- Input / Output / Connectivity
  - Built-in speakers
  - Audio 3.5mm jack
  - Volume up/down
  - Brightness up/down
  - Power button
  - Battery status LEDs
  - Wi-Fi 802.11ac
  - Micro USB 2.0
  - Bluetooth 4.1 LE

Microsoft Hololens

- Processors
  - Intel 32 bit architecture with TPM 2.0 support
  - Custom-built Microsoft Holographic Processing Unit (HPU 1.0)
- Memory
  - 64GB Flash
  - 2GB RAM

Designing for Mixed Reality Microsoft

- The User is the Camera
  - Always think about design for your user's unique point of view as they move about the world.
  - Is the user sitting, reclining, standing, or walking while using your experience?
  - How does your content adjust to different positions?
- Let the user drive.
- Don't shake the camera
- Avoid abrupt movement.
  - If you need to bring content to or from the user, move it slowly and smoothly toward them for maximum comfort.

Leverage the User's Holographic Frame

- The corners of the frame may be uncomfortable for the user to access.
- The center of the holographic frame is the prime location for content.
- The user may need to be guided to help locate important events or objects outside the frame.
  - use arrows, light trails, character head movement, thought bubbles, pointers, spatial sound, and voice prompts

Exercise – 15 mins

- Break into teams
- Design your project (or something related to it) for Hololens or Glass
  - How do you take advantage of its unique affordances?
  - How is your design different from a desktop app?

To do

- Read
  - Motivation for Usability (Nielsen Ch 1).
  - Case study (Gould).
- Review for Final (sample exam)

- Finish P8 (user testing)
- Start on P9 (final report)