UBIQUITOUS COMPUTING

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"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it."

- Mark Weiser, "The Computer for the 21st Century", *Scientific American*

PERVASIVE/UBIQUITOUS COMPUTING

- Move beyond desktop machine
- Computing is embedded everywhere in the environment

Nike + iPod interface for running shoes

INTERNET KITCHEN

- Internet refrigerator and cooking appliance
- Download recipes from web directly to device

http://www.dreamlg.com/en/ref/internet/introduction_tv.shtm

UBICOMP NOTIONS

- Computing capabilities, any time, any place
- "Invisible" resources
- Machines sense users' presence and act accordingly

Automatic hand soap dispenser

VIDEO EXAMPLES

- Ambient Room - H. Ishii

- Beyond the Desktop –
  J. Rekimoto

FOUR THEMES

1. Automated capture of experiences with easy access
2. Context-aware/sensitive interactions and applications
3. Ubiquitous services independent of devices/platforms
4. Natural/Implicit interfaces

1. AUTOMATED CAPTURE

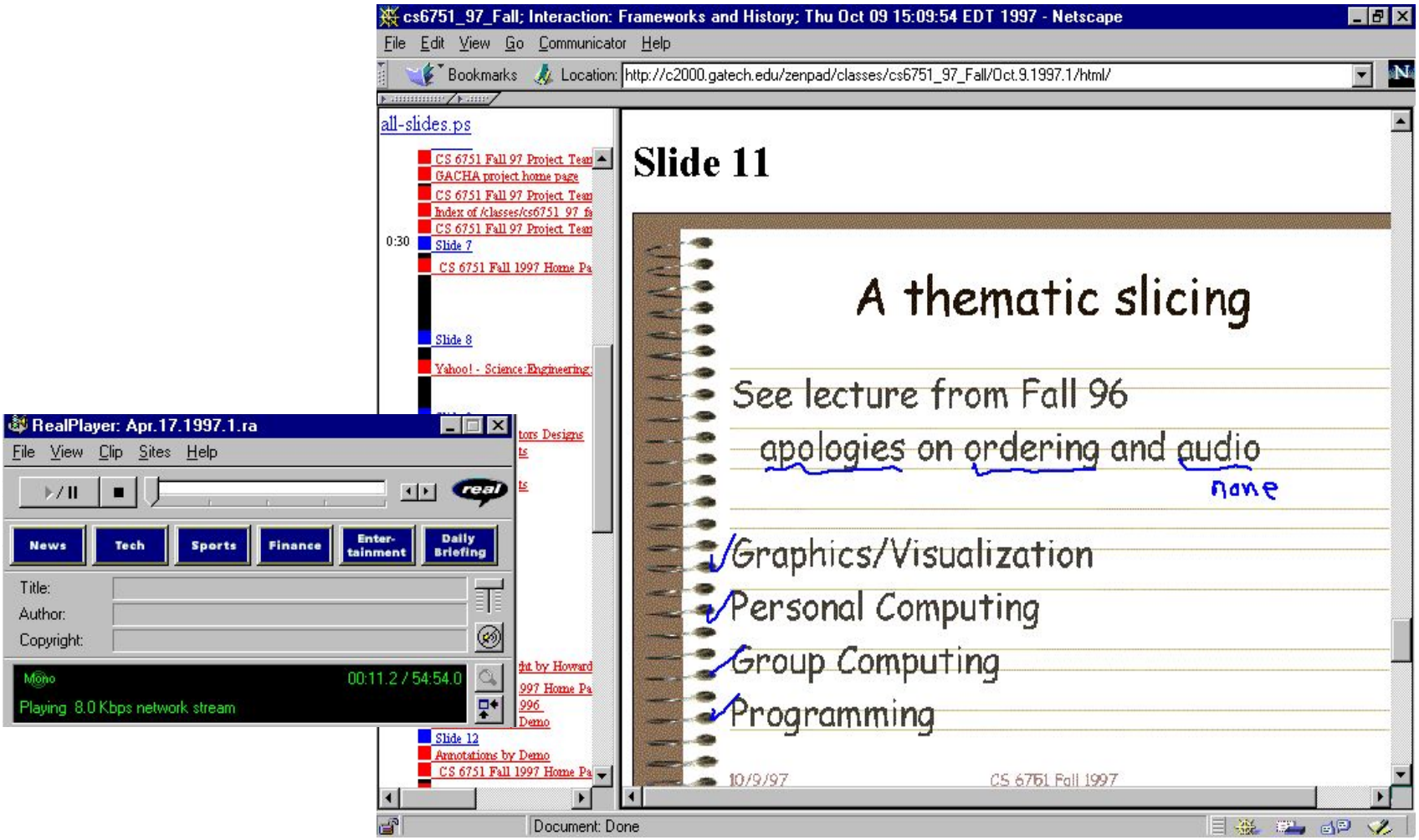
- Motivation
  - Record-taking is hard
  - Multiple streams of information need to be captured
  - Machines are better at some of these things than we are

EXAMPLES

- Meeting capture (scribe at Xerox PARC), Mark Weiser

LIVEBOARD

CLASSROOM 2000/ECLASS



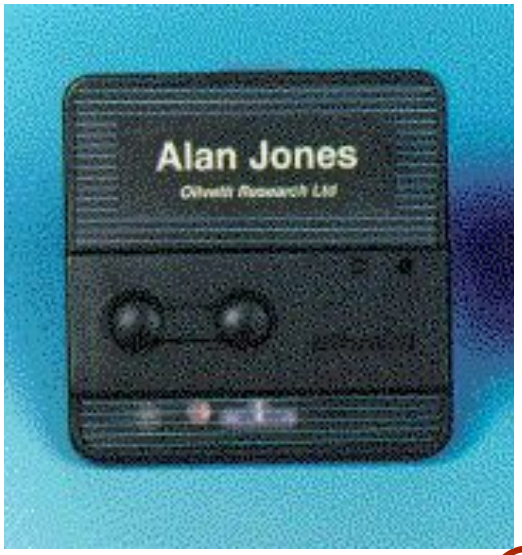
2. CONTEXT-AWARE COMPUTING

- Computing services sense aspects of environment (location, user emotion,…) and tailor provided services

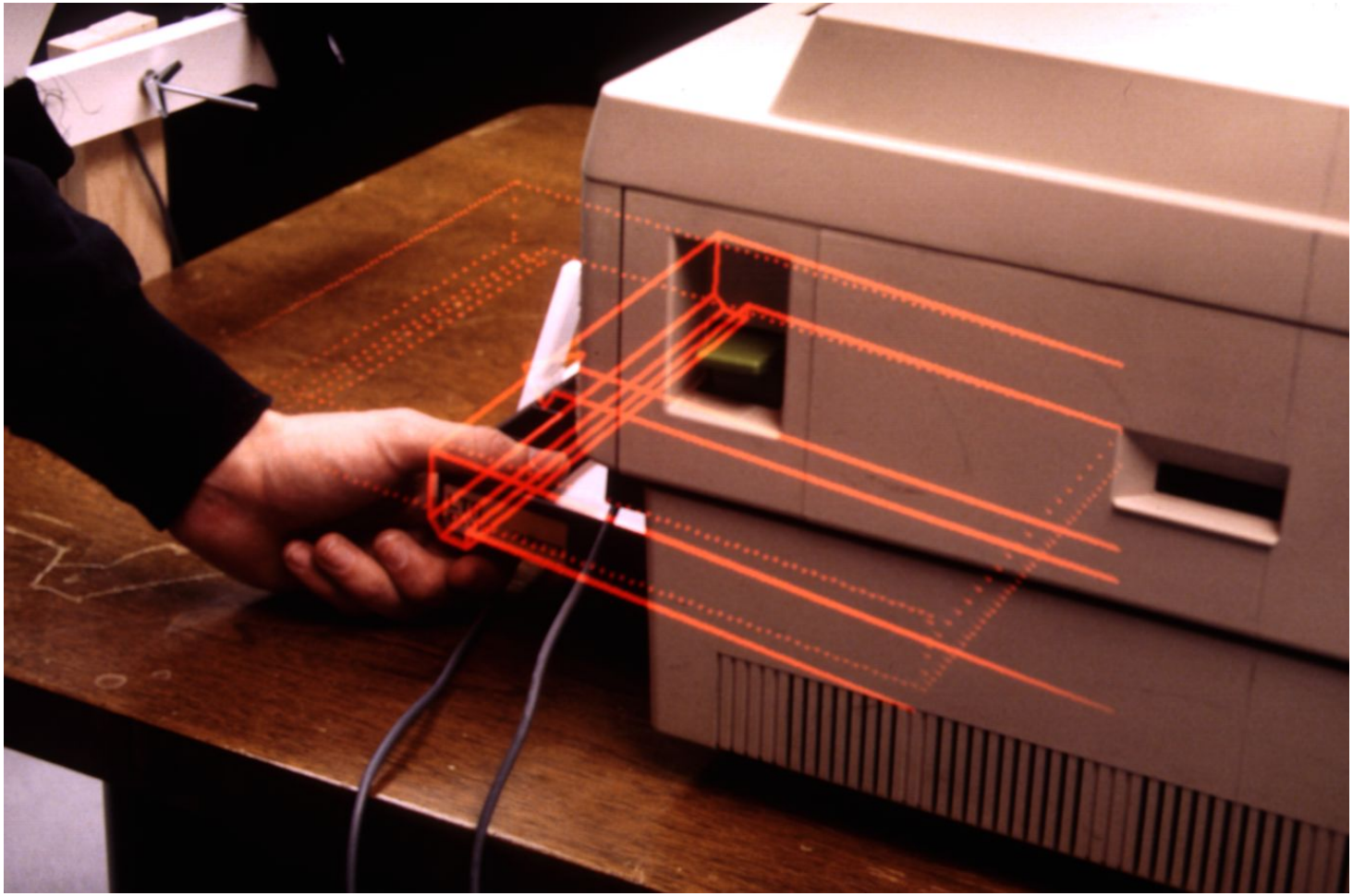
- Walk into conference room, my email is projected on a big screen there

EXAMPLES

- Active Badge & PARCTab
- Shopping assistant
- Cyberguide
- Perception system for recognizing user moods from their facial expressions
- House where position is sensed and temperature adjusted automatically



AUGMENTED REALITY



ISSUES

- How to integrate all the different aspects of context?
- What about the loss of privacy?

INTEGRATE DIFFERENT ASPECTS OF CONTEXT?

- Consideration of the human factor and placing of the paradigm in a human, rather than computing, environment.
- Use of inexpensive processors, thereby reducing memory and storage requirements. Capturing of real-time attributes

3. UBIQUITOUS SERVICES

- Care about service, not application
- Want to receive a message using whatever device is handy nearby
- Message is tailored to work according to device(adapt)

ISSUES

- What is software infrastructure for integration?
- Do we get it by just adopting some standard?

4. NATURAL/IMPLICIT INTERFACES

- Computer interfaces and devices are more natural interaction tools
  - Pen input
  - Speech
  - Gesture
  - Tangible interfaces

EXAMPLES

- Pen applications
- Speech applications
- Gesture pendant

GESTURE PENDANT

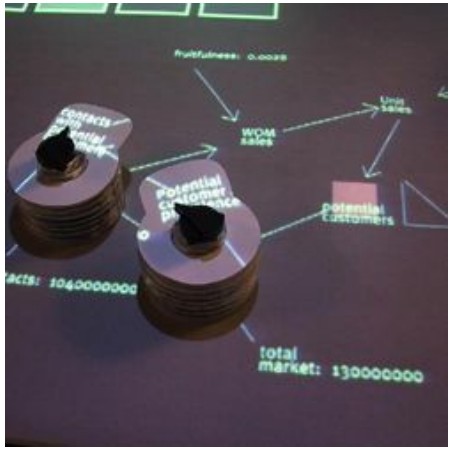
PERSONAL AMBIENT DISPLAYS

Personal Ambient Displays are small, physical devices worn to display information to a person in a subtle, persistent, and private manner. They can be small enough to be carried in a pocket, worn as a watch, or even adorned like jewelry. In our implementations, information is displayed solely through tactile modalities such as heating and cooling, movement and vibration, and change of shape.

PINS AND SUPER CILIA SKIN

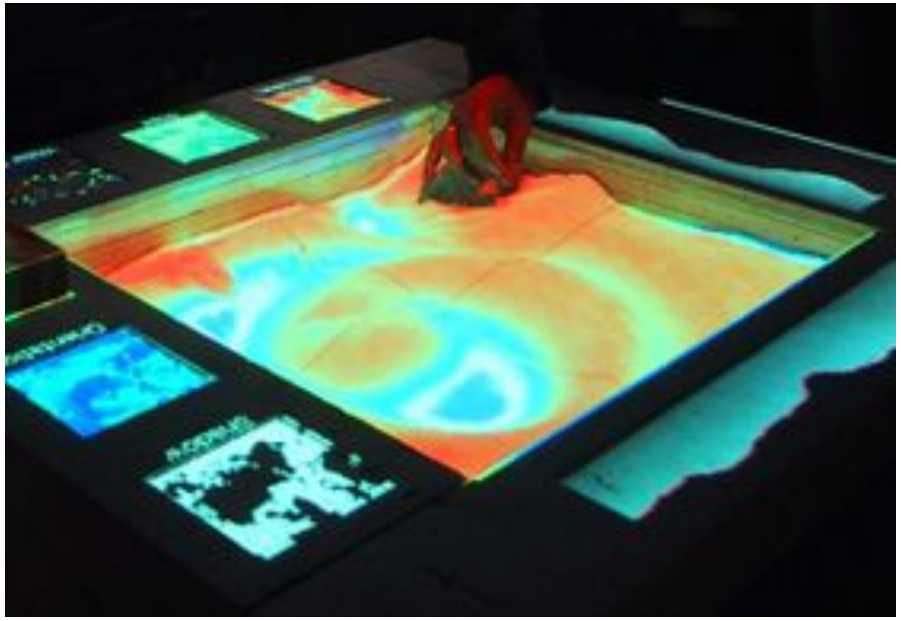
Super Cilia Skin is a multi-modal interactive interface, conceived as a computationally enhanced membrane coupling tactile-kinesthetic input with tactile and visual output. An array of individual actuators (cilia) use changes in orientation to display images or physical gestures as physical or tactile information.

WORKBENCHES



SANDSCAPE

Sandscape is a tangible interface for designing and understanding landscapes through a variety of computational simulations using sand. Users view these simulations as they are projected on the surface of a sand model that represents the terrain. The users can choose from a variety of different simulations that highlight either the height, slope, contours, shadows, drainage or aspect of the landscape model. The users can alter the form of the landscape model by manipulating sand while seeing the resultant effects of computational analysis generated and projected on the surface of sand in real-time.



ISSUES

- Errors are more likely (handwriting recognition, speech, …) How to discover and correct them?
- Is there truly value added?

WEARABLE COMPUTING

- Computation devices accompany you, rather than you seeking them out