Prototyping Physical User Interfaces

Short Course @ IT University of Göteborg

September 2003

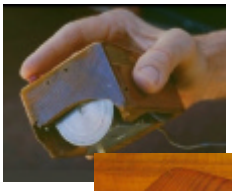
Albrecht Schmidt
Media Informatics Group
University of Munich, Germany
http://www.medien.informatik.uni-muenchen.de/en/team/schmidt

Brief Course Outline

- **Breaking Interface Conventions?**
- **Exercise – creating a cooperative multi user game**
- **Nature and Value of Physical Prototyping**
- **Break**
- **Smart-its basics**
- **Smart-its enhanced light**
- **Lunch break**
- **Students project (afternoon) Smart-its enhanced light**
- **Smart-its enhanced light – results**
- **Building Smart-its hardware**
- **Break**
- **Developing Smart-its Software**
- **Smart-its Examples**
- **Wrap-Up**

Nature and Value of Prototyping

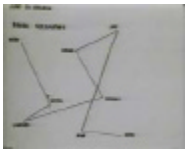
Mouse and other input devices Douglas Engelbart



Inventing & Demonstrating the Mouse
http://www.superkids.com/aweb/pages/features/mouse/mouse.html

Mouse and other input devices Douglas Engelbart (cont.)

http://sloan.stanford.edu/mousesite/1968Demo.html
(videos)



Mouse and other input devices Douglas Engelbart (cont.)

- Douglas Engelbart
  - Mouse
  - Two handed input
- Methodology? – Demo!
- Devices design has implications on user action
  - Two wheels → lift one an go straight
  - Wheels that keep going → accelerate, lift and put down to stop
- Input devices and output devices have implications on the applications possible
- Was a really novelty that allowed major advances in HCI
- Has been perfected since…

Which Application became possible after the introduction of the GUI

- … take 2 minutes and write it down

Why Prototyping?

Approach

Prototypes are essential to learn and understand and experience interaction in ubiquitous computing

From the idea to knowledge

- Prototyping has been central to hallmark research in the area (e.g. ParcTab, ActiveBadge)
- Learning occurs when along the prototyping process as well as in use

Towards a Methodology

- Analysing artefacts and how they are used
- Prototyping context-aware artefacts (recording issues in the process)
- "Confronting" **real** people with these enhanced artefacts (version 0.001)
- Deployment in a living lab environment
- Facilitating everyday environments with real users

Evaluation

- Prototypes can be the means for evaluation

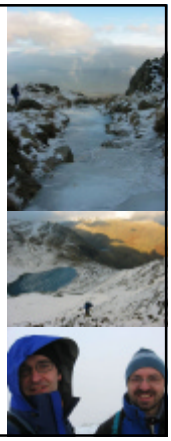
Experience…

… requires engaging with the world around us!

The easies and quickest way to the top is not always the best!

What does this teach us on UIs?
What is the metric?
What is the application?

Examples:
- moving up and down in the rain forest
- football interface – really exhausting



Getting Physical

Initial experience (1998)

Context-Aware Computing
- location is just one dimension…

Extremely simple, but still it creates a new experience
- 2-Bit Input
- Not an input device
- Very specific function

Project TEA

Technology for Enabling Awareness

Project goal

building an add-on component that supplies awareness to a mobile device

Project TEA II

- Technology
  - sensor and processing board
    - acceleration, light, temperature, noise
    - low power micro-processor
  - phone as host that uses context awareness
- Applications
  - user interface adapts to situations/context (automated profile change)
  - remote sharing of context (*if I would have known that you are not at work ...*)

The MediaCup Project

Computerized and Aware Everyday Object

Project goal

investigating what happens if everyday devices have processing power, communication and awareness

The MediaCup Project II

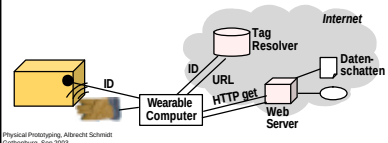
- Technology
  - sensors and processing
    - movement, location and temperature
    - recognition of high-level events (e.g. drinking)
  - power and wireless recharging
    - minimal power consumption
  - IR and/or RF communication
    - for communication and location
  - backbone
    - short range RF and IR to transceiver-stations
    - interconnected transceivers (e.g. CAN bus)
    - gateways into the Internet
    - shared for other devices (e.g. PalmPilot, OnHandPC)

Embedding Interaction

(CeBit2000 Demo)

Wearable Computing
- input by handling goods
- based on RFID
- integration with SAP System

"not using a computer – doing a job"
- not viewed as a computer
- … creates a new set of problems!

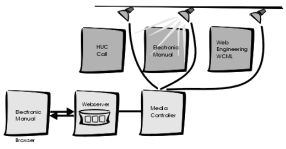


Ambient Display

Concept
- **Provide information in the ambient environment for peripheral awareness**
- **Using physical artefacts as display substrate**

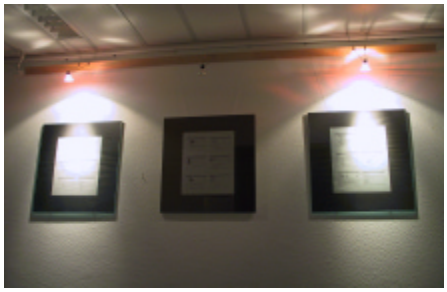
Application: Web Visitor Awareness
- **People have places in the web ("home", "site")**
- **But visitors come and go unnoticed**
- **Application concept**
  - make activity in your web places visible in your real environment

Web Awareness



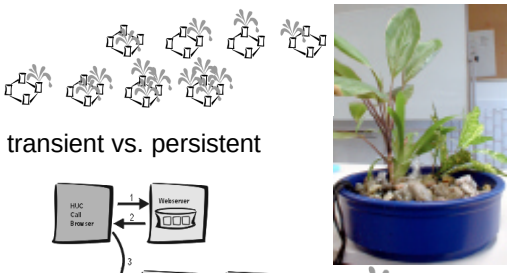
- feedback on web activity projected into physical work environment
  - poster lighting reflects web access
  - blending of virtual workplace (web) and physical workplace

Hallway Posters



Hallway Posters

A fountain for immediate notification

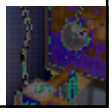


transient vs. persistent

Load-Sensing Surfaces

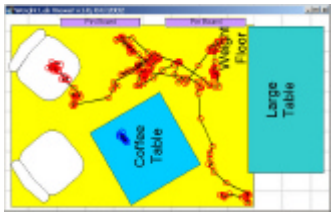
Concept

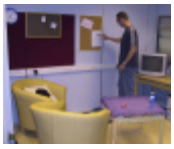
- Gravity is ubiquitous: no physical thing can escape it
- Use this force to build interfaces between the physical world and computing
- Augment common surfaces (floors, tables, shelves):
  this is where gravitation pulls objects to
- Technology: variety of load sensors and pressure gauges with different characteristics



Load-Sensing Surfaces

- **Weight of objects**
  - Detection depends on sensor range (i.e. small weights not detectable on heavy-load surface)
  - Application: object identification (classes/ instances)
- **Position of objects**
  - cm-level accuracy (depend. on surface size)
  - Table can be pre-loaded
  - Multiple objects can be positioned if placed non-simultaneously



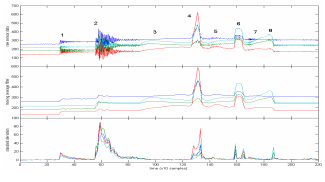


Context Acquistion

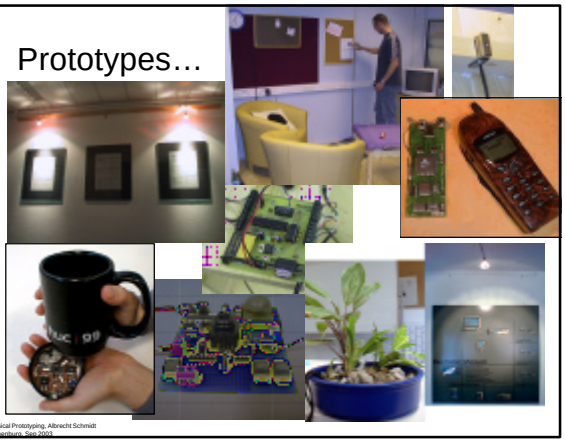
- Tracking of people/objects
- Prediction of activities

Load-Sensing Surface

Surfaces as Interaction



Prototypes…



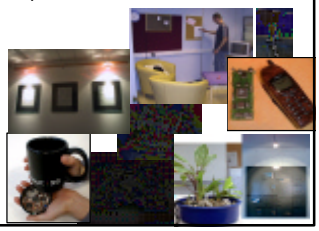
Lessons Learned from Prototyping

About the process

- Valuable, allows new insight
- Chance inventions / side findings
- It is expensive and time consuming
- The wheel is reinvented and re-implemented over and over
- Need for building blocks and platform

About the prototypes

- Prototypes are similar for
  - processing
  - communication
  - Debugging I/O
- … but differ greatly in
  - Sensing
  - Actuators



Smart-Its –
A new Computing Platform
YAP - Yet another platform?

Means for exploring applications

- Building scenarios
  - Rapid-prototyping of context-aware computing applications
  - Assessing the potential as an enabling technology for ubiquitous computing in various application domains
- Why a new computing platform?
  - Investigating the difference between Smart-Its and an iPAQs with Bluetooth and a sensor board.
  - Price, size and power consumption matters now – even if the future brings it anyway!
- Understanding and refining the requirements

Smart-Its Idea and Objectives

- Sensing, processing and communication
- Enabling technology to make everyday objects smarter
- Post-it metaphor
- Building context aware applications

Developments

- Hardware
- Communication
- Firmware & software
- Backend

Objective

- Simple (development and use)
- Robust
- Extensible
- Cheap

Break