Overview

- Why to look beyond desktop and mobile user interfaces?
- Embedded computers are everywhere
- Ubiquitous Computing is becoming reality
- Cars are Ubicomp environments – a case study
- Defining trends for the future
- A vision for computing in the future - unlimited perception
- Lessons learned

“I would imagine that by now developers specify user interfaces on an abstract level…”

“Software developers have moved from machine language and assembly to high level languages, toolkits, and frameworks – why are UI developers still talking about pixel spacing?”

“The ubiquitous pinch gesture on touch screens is the proof that content transformation has failed….”

Issues with HCl as a Scientific Discipline

Problems the discipline is concerned with are understandable by anybody

Solutions to the problem appear obvious once found (at least in an optimal case)

Once a solution is found it is not recognized that there was a problem

“Process from problem to solution is non-trivial…”

The quality* of desktop user interfaces in 2011 is way better than the desktop UIs in 1991

*and quality has many aspects including usability, learnability, and efficiency
Desktop and mobile is done... lets move on
Desktop computing in disguise?

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recently was going to a family event – having 3 GPS units with me ... and I was not the only one

Computing is everywhere
Many devices to come!
Everything that is valuable may include mobile communication and tracking.
Who will create the basic hardware platform?
How will the meta service platform look like?

Some Building blocks for Ubicomp
- When will a OEM-device that includes...
  - GPS
  - Acceleration sensors
  - 3G data connectivity
  - Battery
  - ... connectivity for I/O

...be less than 10€[3K] (in large quantities) and less than 50g[20g]?
(and perhaps we can do power harvesting, too)
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Engineering Novel User Interfaces
A Case Study: Gazemarks

- An idea to start with...
- Ethnographic observation
- Formative study
- Systematic design of the user interface
- Implementation of a working prototype
- Rigorous evaluation and analysis
- Provision of guidelines, components, toolkits

Gazemarks
Motivation

- Reading while you drive?
- Looking for your way while driving?

Gazemarks
Ethnographic Observation and Formative Study

- Study task: compare two telephone lists (40 names, one list on paper and one on the screen)
- 30 participants (volunteers; 10 female, 20 male; aged 23 to 61)
- Participants were not aware of the research question
- No time limit was enforced and time was not measured

- 22 out of 30 used fingers and/or objects to remember their last position on the paper list
- 8 out of 30 used fingers, objects, or cursor on the digital list

People use fingers and objects as markers in tasks that require attention switching.
Gazemarks
Create this functionality in the digital world

- Idea: provide a visual feedback on digital documents to ease attention switching
- Technology: eye gaze tracking

- Example Domains:
  - Multi-screen setups with simultaneous visibility of documents
  - In-car information and entertainment systems that are used while driving
  - Switching between multiple documents of which only one is visible at the time (e.g. tabs in a browser)
  - Information terminal in an operating theater, which is used while working on the patient

**Approach:** detect last gaze position before the attention switch and highlight this area till the gaze returns

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Gazemarks
Visual Representations

- Focus group with 6 people to choose the visual representation
  - Flag
  - Spotlight
  - Focus area

- Questionnaire to express a preference
  - Spotlight before Focus area and Flag

- Spotlight
  - Easy to find
  - Perceived a precise
  - Not hiding any information

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Gazemarks
Implementation

- Hardware
  - Commercial eye tracker
    - Tobii X120 (with a data rate of 120Hz),
    - PC with a 42” display and an 8” display
    - Networked over LAN

- Software/Middleware
  - EI-Toolkit (component based architecture)
  - Proxy for the Tobii eye-tracker
  - Message exchange via UDP

- Test Application
  - Java application implemented for the experiment

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Gazemarks
Experiment

- Setup
  - 2 screen setup
    - Map search task on small screen (6 letters with 8 numbers each)
    - IQ questions on large screen

- Design
  - Within-group, each subject complete both task in counterbalanced order
  - Procedure: Find given letter, attention switch, find given letter again
  - Independent variable: visualization (Spotlight vs. no visual aid)
  - Dependent variable: search time (limit 3000 ms)

- Participants
  - 16 volunteers (23 to 52 years old)

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Gazemarks
Results

- Participants were considerably faster in searching with Gazemarks
  - with Gazemarks: 625.75 ms (median)
  - without Gazemarks: 1999.50 ms (median)

- Comparing search times
  - non-parametric Wilcoxon signed-rank test
  - p<0.001

- Qualitative results
  - Preferences for Gazemark
    - Mean value 4.26, standard deviation 0.53, on a scale from 0 (completely senseless) to 5 (very sensible)
  - Reported benefits as perceived by the user: enabling rapid task switch and less attention required
From Engineering Novel User Interfaces

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...to Engineering Interactive Systems

Engineering Interactive Systems

- A new communication media
- Besides Interaction – understand:
  - all stakeholders
  - business case

Systems are part of people’s lives

Measurability!

- Increasing the efficiency of work processes
- Minimizing human errors in interaction with systems
- Increasing the efficiency of education and training
- Reducing the cognitive load (or stress level) for a task
- Making interaction more enjoyable
- ...
- Improving safety when using systems
- Creating systems that are “natural” and “intuitive” to use

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Ubiquitous Computing Trends

Enabling Smart Devices & Intelligent Environments

- **Processing**
  - cheap, fast, small, energy efficient
- **Storage**
  - big and fast
- **Networking**
  - global, local, ad-hoc, low-power
- **Displays**
  - projection, flexible materials, power consumption
- **Sensors**
  - types, speed, accuracy, price
- **Actuators**
  - many, computer controlled

“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]
Communication Networks
Ubiquitous & Global
driving new devices and applications

classical computing limitations will play very little role in the future for consumer devices
we will be so used to having bandwidth, memory and processing in excess that we may forget the terms...

Computing and infrastructure has become invisible to the user – at least as long as everything works

Innovation is in software
User Experience to differentiate

Software will become a main feature and value generator in many areas that are till now “non-electronically”
... the design and UI may be the only discriminating factors to work with

Our understanding of privacy, and what we consider private will radically change
our personal information will likely become a commodity that we trade...
Ethics & privacy become design material
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A Vision for Computing in the future

Perception beyond the here and now
... about perception and technology
What is the difference between driving 140 km/h on the motorway in a 10 year old VW Polo compared to at current model Audi A8?

Communities of the future
(selectively) sharing a one-room-apartment with all your “friends”

100 Million Experiences
collected and shared in real time

Scenario
100 million people stream their 1\textsuperscript{st} person view in real-time

Support for real-time as well as archive access
Indexed by location, co-location, events, context-information, …
Perception beyond the Here and Now

By the middle of the century the boundaries between direct and remote perception will become blurred. By the it will be hard to discriminate real-time perception apart from historic content or future predictions.

Masses of networked sensor-equipped computing devices are overcoming longstanding temporal and spatial boundaries to human perception.

Ethics and values are the central design material of this century.

What are the implications for the people working in HCI if computing becomes the window to and manipulator for the world?

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Lessons learned: implement it and try it out!

Novel Interaction Techniques on PDAs

Context-aware Phone  - my initial experience (1998)
Questions?

Comments?

Novelty may be about the values/ethics

Lessons learned:
Implement it and try it out!
20% who like the UI are a large market
Humans are smart and adaptive
Design for creative users
Visit my websites at:
http://albrecht-schmidt.blogspot.com/

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