Context – Enabling New Ways in Human Computer Interaction

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Workshop on Context-Aware Systems
Stuttgart, 14 Nov. 2003

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

Vision of future environments

Traditional User Interfaces have been constraint by technology

• UI restrictions, design decisions due to technology
• The user’s model often is based on these constraints
• Always in context - however the context is static
• Context influences the design at construction time
Ubiquitous Computing Technologies are Available Now

- Processing cheaper, faster, smaller, more energy efficient
- Storage big and fast
- Networking global, local, ad-hoc, low-power, high bandwidth, low latencies
- Displays projection, flexible materials, power consumption
- Sensors types, speed, accuracy, price, robustness
- Actuators many, nowadays computer controlled anyway

Results in the Fact That many Constraints are gone…

- Freedom to create any interface
- Connections are a UI design choice
- Feedback becomes a central and critical issue

Designers Heaven or Curse of Freedom?

...and another real chance to create horrible interfaces!

How will the user ever get the model?

Physicality is the Key

Context the Enabling Technology

- We are in the world, we are a part of it
- Being-in-the-world
  Martin Heidegger, Philosopher (1889-1976)
  “the nature of human experience is based in engaged participation in the world

“The real power of the concept comes not from any one of these devices; it emerges from the interaction of all of them. The hundreds of processors and displays are not a “user interface” like a mouse and windows, just a pleasant and effective “place” to get things done.” (Mark Weiser, 1991)

- Context - acquisition and creation!

So what is different from traditional HCI and User interface design

- Creating Context - Output modalities
  - not just an audio visual channel
  - all senses!
- Acquiring Context - Input modalities
  - more than pressing buttons and moving an object in two dimensions
  - users activities and whereabouts
- Distribution – physical and conceptual

... Magic beyond the screen

Extending the Design Space

<table>
<thead>
<tr>
<th>Explicit Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Command line</td>
</tr>
<tr>
<td>GUI &amp; direct manipulation</td>
</tr>
<tr>
<td>Gestures</td>
</tr>
</tbody>
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</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Physical Interaction</td>
<td></td>
</tr>
</tbody>
</table>

Implicit Interaction (1)

Implicit Human-Computer Interaction (IHCI)
- IHCI is the interaction of a human with the environment and with artefacts which is aimed to accomplish a goal. Within this process the system acquires implicit inputs from the user and may present implicit output to the user.

Implicit Input
- Implicit input are actions and behaviour of humans, which are done to achieve a goal and are not primarily regarded as interaction with a computer, but captured, recognized and interpreted by a computer system as input.

Implicit Output
- Output of a computer that is not directly related to an explicit input and which is seamlessly integrated with the environment and the task of the user.

Implicit Interaction (2)

Invisibility & transparent use vs. traditional explicit human computer interaction

Some example...

… context is more than location
- Environment as Interface – Creating a digital mirror of the real world
- Minimal Wearable Computer – moving between implicit and explicit interaction
- Authentication System – Context acquisition & creation
- Context-Call – Sharing Context Information to create new services

The Environment is the Interface
(SIGGRAPH Demo)
- Everyday objects augmented with sensing – table – chairs – glasses – ...
- Each creating artefact related contexts
- Creating a digital shadow reflecting the interaction
The Environment is the Interface

Load-Sensing Surfaces

Concept
- Gravity is ubiquitous
- Surfaces: crossroads for human activity
- Pervasive load sensing
  - Not just weight
  - Position on surface
  - Object movement
  - Particular events
  - Traces
- Challenges
  - Context abstraction
  - Context correlation
  - Interaction Model

Force $F_1$ at $(0,0)$
Force $F_2$ at $x_{\text{max}},y_{\text{max}}$
Force $F_3$ at $(x_{\text{max}},0)$
Force $F_4$ at $(0,y_{\text{max}})$

Control Surface
Load Change
Position

The Pendle – a minimal wearable computer

A personalized, wireless, wearable device
(Realized using Smart-Its)
- processor, memory, sensors, communication, battery
- customizing the local environment
- support for explicit and implicit interaction

Smart-Its Platform

Boards with
- Microcontroller
- RAM
- Analog Inputs
- Digital I/O
- Wireless communication

- Small portable unit
  - $45\text{mm} \times 50\text{mm} \times 19\text{mm}$
  - 29g with battery
- Base station units
- Easily extensible

Physical prototypes are essential!
Functional prototypes are the only way to create and assess the user experience

New Sensors and Actuators
Add-Ons to the core smart-It

- Hardware
  - Much simpler
- Software
  - Build upon frameworks
- Communication
  - Basic functions available

Examples
- General sensors
- Vision / Camera
- Load sensing
- Weather board
- Motion sensing
- Actuator boards
...
Authentication Systems

Example application
Security

Prototype Implementation
- acceleration sensors
- IPAQ PDA
- RFID reader

Contexts acquired
- proximity (location)
- user activity

Contexts created
- Badge value (valid/invalid)

Context Call
(Follow up on TEA)
Sharing of context before the call is established

- In real life we have social protocols for initiating conversation
  - social skill – knowledge from both sides required
  - trained from early childhood on
- context matters - mainly implicitly
  - how important is it for me?
  - how convenient seems it for the other person?
  - relation between the communication partners?
  - what type of conversation will it be?
  - is it socially acceptable (topic/situation)?
- To avoid situations like:
  - "If I would have known that you are in a meeting I would not have called you."
  - "If I would have known that you are still at work I would not have called you."
  - "I would have known that the phone is off and I can only leave a message I would not have called."

Context Call cont.
Implementation example – extended phone book

- User experience vs. technology
- phone users can selectively share context
  - information about the situation
  - information about availability
- caller can decided
  - knows her own constraints
  - has some information about the other side
  - can judge if the call will be appropriate

Conclusions
- Context is not isolated in user interfaces – combined UIs are powerful and most difficult
- Its physical - You have to built it otherwise you can’t evaluate or even understand it!
- Need for platforms and tools (Smart-Its)
- Interaction Models, Metaphors, and Paradigms are missing
- If we get models and tools there is a chance to enable a new dimension in human computer interaction
- If you get it right interface may look just like magic

Location as an input device
(from http://www.gopodreaming.com/)
Context is more than Location
Context Art 😊
(from http://www.gpsdrawing.com/)