Workshop on Context-Aware Systems
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Context – Enabling New Ways in Human Computer Interaction

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(includes work done with the Ubicomp Group at Lancaster University, UK)

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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

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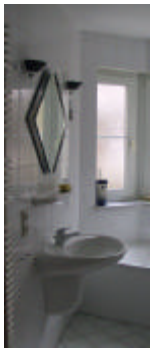
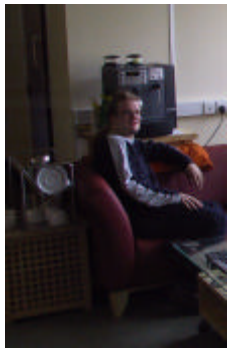
Vision of future environments





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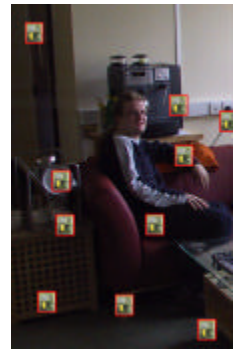
Vision of future environments



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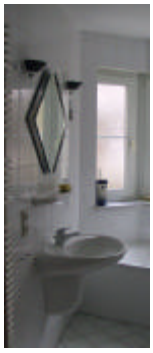
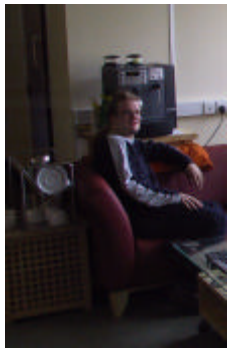
Vision of future environments





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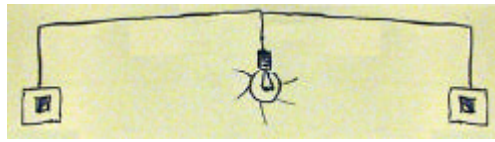
Traditional User Interfaces have been constraint by technology

- 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



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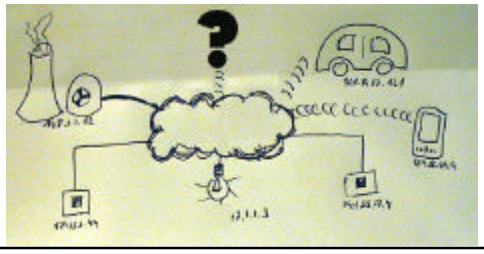
Ubiquitous Computing Technologies are Available Now

- 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

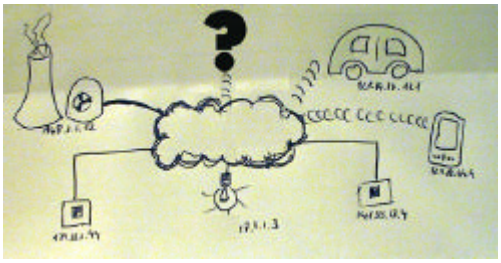
Results in the Fact That many Constraints are gone…

- 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?

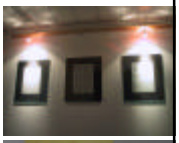
Physicality is the Key Context the Enabling Technology

- 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

	Explicit Interaction
Command line	
GUI & direct manipulation	
Gestures	

Extending the Design Space

	Explicit Interaction
Command line	
GUI & direct manipulation	
Gestures	
Physical Interaction	

Extending the Design Space

	Explicit Interaction	Implicit Interaction
Command line		
GUI & direct manipulation		
Gestures		
Physical Interaction		

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

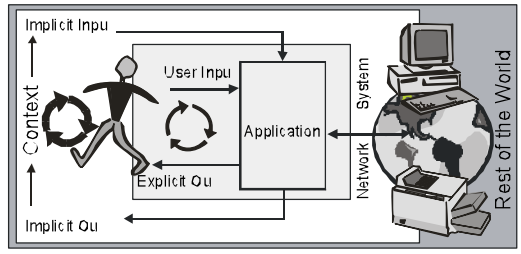
- Implicit input are actions and behaviour of humans, which are done to achieve a goal and are not primarily regarded as interaction with a computer, but captured, recognized and interpret by a computer system as input.

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



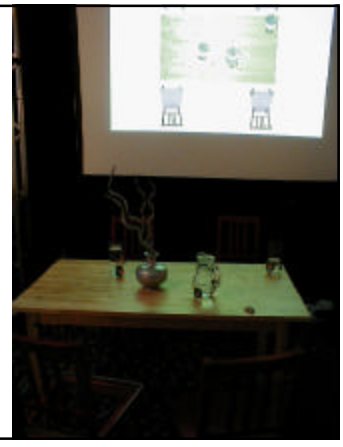
Some example…
… context is more than location

- 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

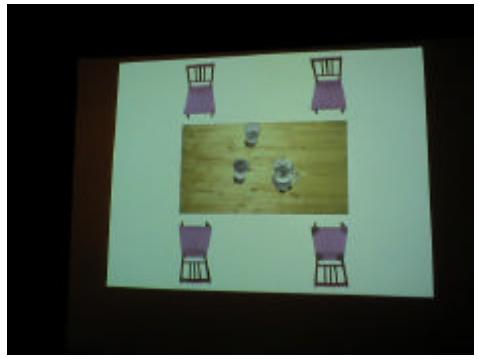
(SIGGRAPH Demo)

- 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

The Environment is the Interface

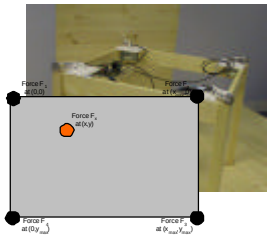


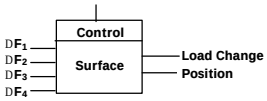
Load-Sensing Surfaces

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

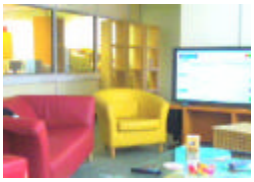




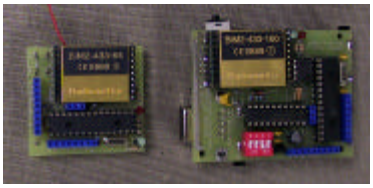
The *Pendle* –
a minimal wearable computer

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
  - 45mm x 50mm x 19mm
  - 29g with battery
- Base station units
- Easily extensible

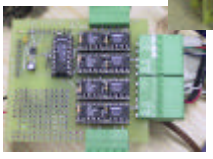
- Physical prototypes are essential!
- Functional prototypes are the only way to create and assess the user experience

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

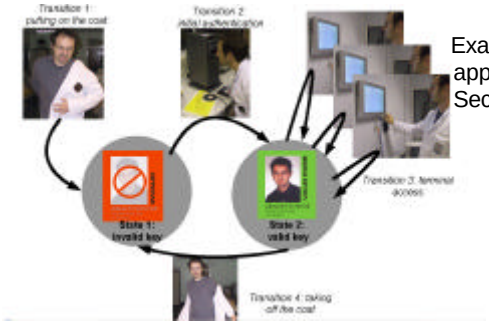
- Hardware
  - Much simpler
- Software
  - Build upon frameworks
- Communication
  - Basic functions available

Examples

- General sensors
- Vision / Camera
- Load sensing
- Weather board
- Motion sensing
- Actuator boards
- …



Authentication Systems



Example application Security

Authentication Systems

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 sites required!
  - trained from early childhood on
- **context matters - manly implicitly**
  - how important is it for me?
  - how convenient seams 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."
  - …
  - "if 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
  - context matters - manly implicitly

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 ☺
- A further option how to interact by context …

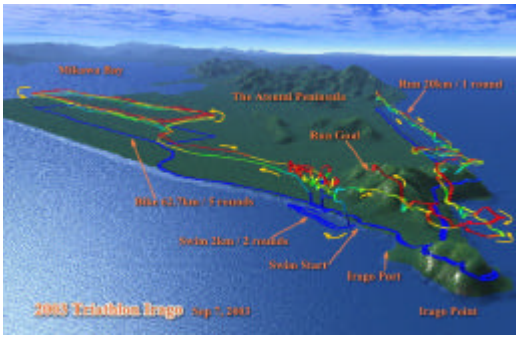
Location as an input device ☺

(from http://www.gpsdrawing.com/)

Context is more than Location

Context Art ☺

(from http://www.gpsdrawing.com/)



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Questions?

More information & email address