Interaction Design and Studies of Ubiquitous Visual Computing

Giulio Jacucci, Professor, PhD
University of Art and Design Helsinki, and
Helsinki Institute for Information Technology, and
MultiTouch Ltd , www.multitouch.fi

Vienna, 9th September 2009 -
giulio.jacucci@hiit.fi

Content

- From Mobile to Ubiquitous Computing
- Interaction Design starts from Users
- Application Areas
  - Maps and orientation
  - Social networks
  - Energy awareness
  - Public Media
  - Installations
- Design and studies Cycles
- Summary

Key messages of the talk

- What is Ubiquitous computing and how it extend the “mobile” paradigm?
- Interaction is key, how and why to ground research on users ?
- Review of some trends and challenges looking at several application areas

Ubiquitous Computing 1990’

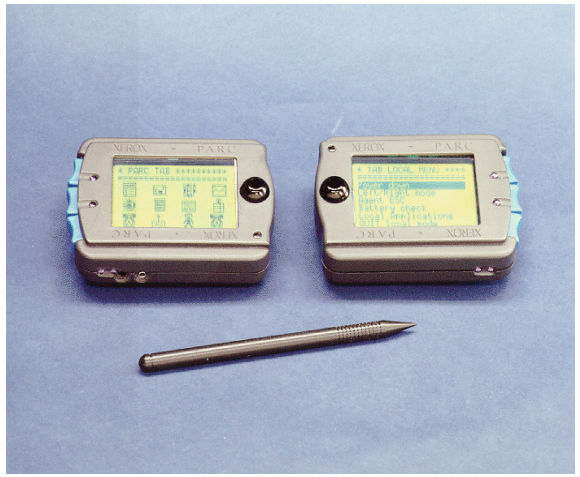
- Weiser et al. (1991-1999):

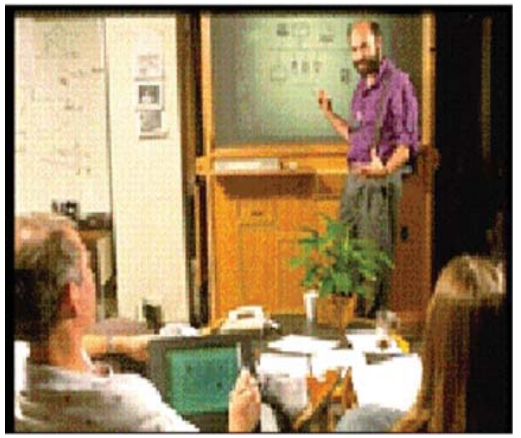
“…a physical world richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects of our lives and connected through a continuous network.”

Extreme portability. automatically turns itself on when interacting and off afterwards

Constant connectivity. always connected to the network infrastructure.

Location reporting.



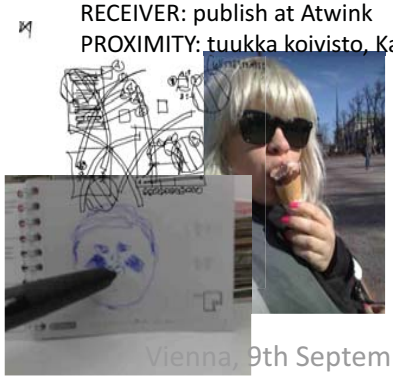


Ubiquitous Computing 2000’

- Abowd and Mynatt 2000 propose that ubiquitous computing supports the user with
  - Continuously present interface
  - Also addressing the periphery of the user’s attention
  - Connecting the physical and virtual worlds

Ubiquitous Computing 2010’

- Ubiquitous computing in everyday environments
  - Fragmented ecology of many devices and “seamfulness” require the active participation and creativity of the user
  - 24/7 connectivity which now has led to the emergence of social computing, the user is not only interested in automation but self expression



Content

- From Mobile to Ubiquitous Computing
- Interaction Design starts from Users
- Application Areas
  - Maps and orientation
  - Social networks
  - Energy awareness
  - Public Media
  - Installations
- Design and studies Cycles
- Summary

Design Ethnograhies at Events

Navigating
Exploring
Camping

Social encounters

Media items and mobile:
as collections
Part of group activities
Collocated use

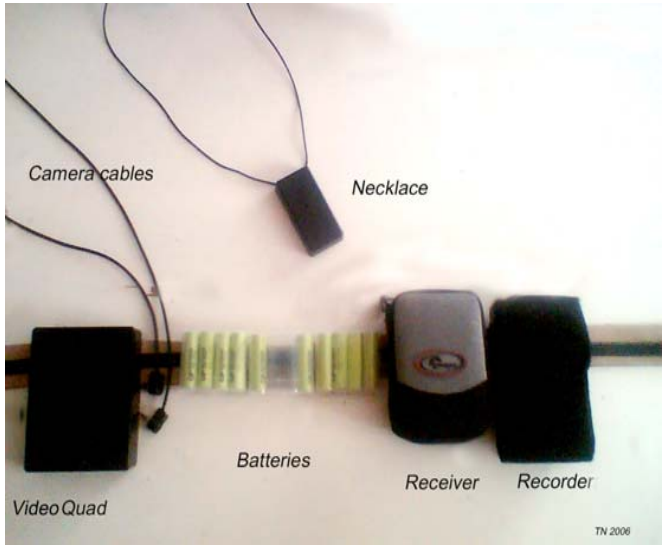
Content

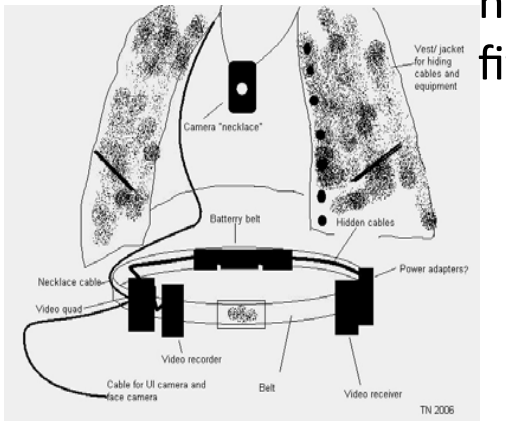
- From Mobile to Ubiquitous Computing
- Interaction Design starts from Users
- Application Areas
  - Maps and orientation
  - Social networks
  - Energy awareness
  - Public Media
  - Installations
- Design and studies Cycles
- Summary

Maps and Orientation

- mLoma , Antti Nurminen, www.hiit.fi/uix
- MapLens, IPCity, www.ipcity.eu

Field Quasi-Experiments





The construction of research equipment for data-rich field studies

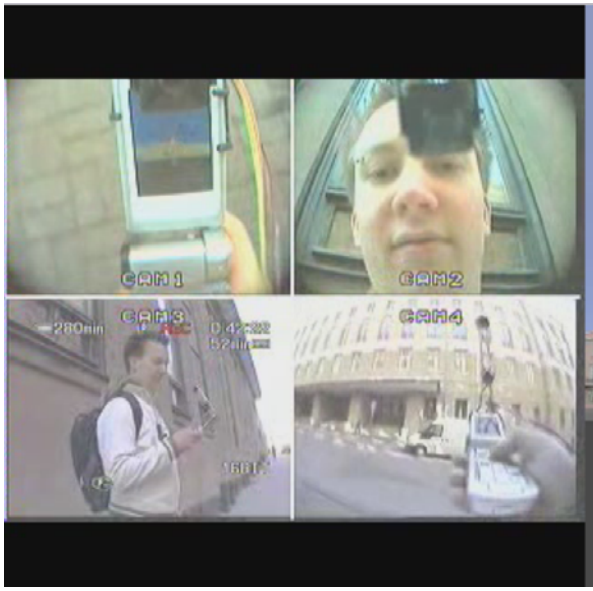
- A new version allows the use of both user-"implanted" and environmental minicameras with an operational duration up to 4 hours. The light-weight equipment fit to the belt of the user.

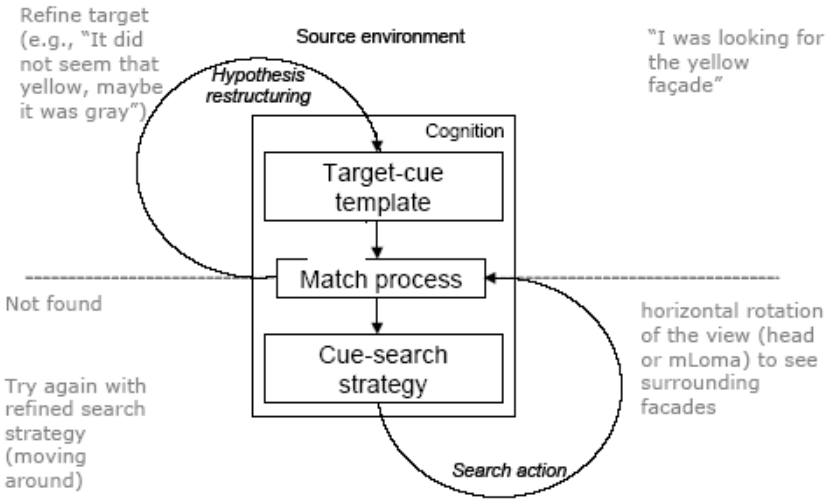
Data collection

- First experiment using the PASION project's mobile usability lab
  - 1: camera around subject's neck + microphone
  - 2&3: cameras on mobile device
  - 4: experimenter-controlled camera
  - 5: video and audio streams integrated and saved as .avi on the fly
- Think-aloud data, subjective workload ratings
- Software log

Analysis

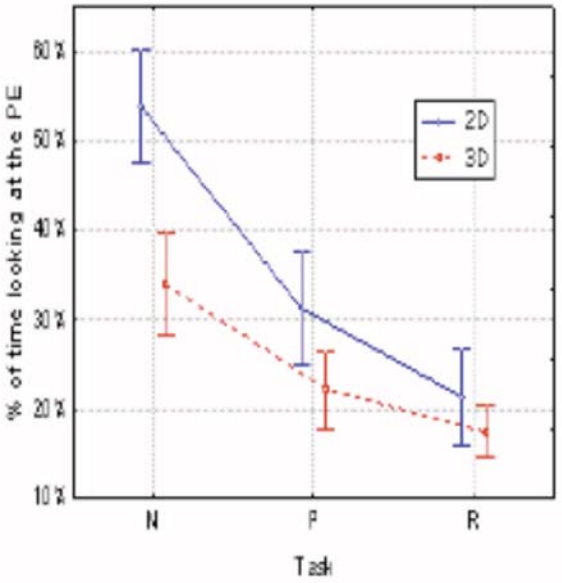
- Field data integrated with software playback based on logs
- Coding of behaviour → event log:
  - walking, stopping
  - looking around, at device
  - turning device
  - turning body
- Transcription of think-aloud





EXAMPLE EVIDENCE

- Time spent looking at the PE was higher in 2D than in 3D. Conversely, 3D users were more immersed in VE than 2D users. Taken together with the fact that 3D users were slower, we conclude that preferring interaction with the VE hampered performance. Good strategies allow users to concentrate on the boundaries and cross-overs.



SUMMARY OF OBSERVATIONS

- (1) Photorealism of the model does not help but distracts and misleads. Here, realism does not increases performance. This runs counter to one of VR research's findings.
- (2) Movement in 3D is not "realistic. Users prefer 2D-like strategies that are not realistic but which allow faster and more efficient finding of cues.
- (3) More "immersion" in VE means worse performance. "Presence" hindrance to performance. Efficient strategies rely on awareness of both VE and PE and thus are associated with switching behavior and focus on PE which is more information rich.
- (4) Navigating in the VE in 3D street-level view increases working memory load in this MR task as it increases the discrepancy between the VE and PE. Users rather go for direct perceptual matching or egocentric alignment to avoid this.
- (5) Bodily strategies in PE help performance. It is more important to align bodily engagement in two environments, PE and VE rather than immerse in acting only in only one environment, the VE.

Comparison study

- Twenty-six participants used MapLens to play a location-based game in a city centre.
- Comparisons to a group of 11 users with a standard 2D mobile map
- AR features facilitate place-making by creating a constant need for referencing to the physical, and in that it allows for ease of bodily configurations for the group,
- Encourages establishment of common ground, and thereby invites discussion, negotiation and public problem-solving.

Content

- From Mobile to Ubiquitous Computing
- Interaction Design starts from Users
- Application Areas
  - Maps and orientation
  - Social networks
  - Energy awareness
  - Public Media
  - Installations
- Design and studies Cycles
- Summary

Social Network

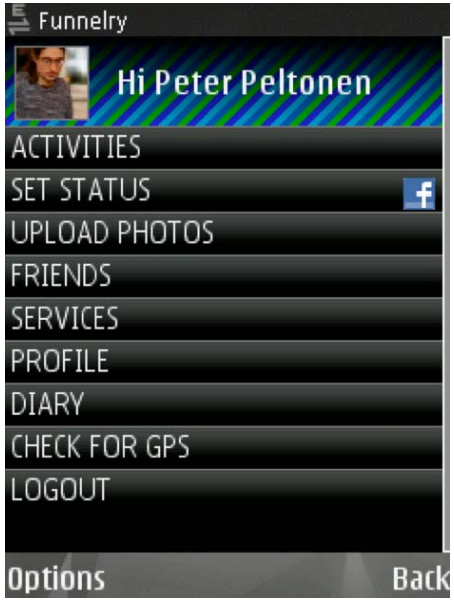
- ContextCues Oulasvirta A., Raento M., www.hiit.fi/uix
- CoMedia, Funnerly www.hiit.fi/uix
- Skypas PASION Project www.hiit.fi/uix

Visualising Awareness Cues

- Longitudinal field trials were conducted with a multi-cue mobile awareness system integrated into the contact book of a Nokia S60 smartphone.
- The studies reveal that three social cognitive processing goals dominate the interpretative activities related to the use of mobile awareness information: 1) coordination of communication and mobility, 2) expression and discussion, and 3) companionship.
- (*Human-Computer Interaction*, 2007)

Mobile Social Media Aggregator

- Funnerly:



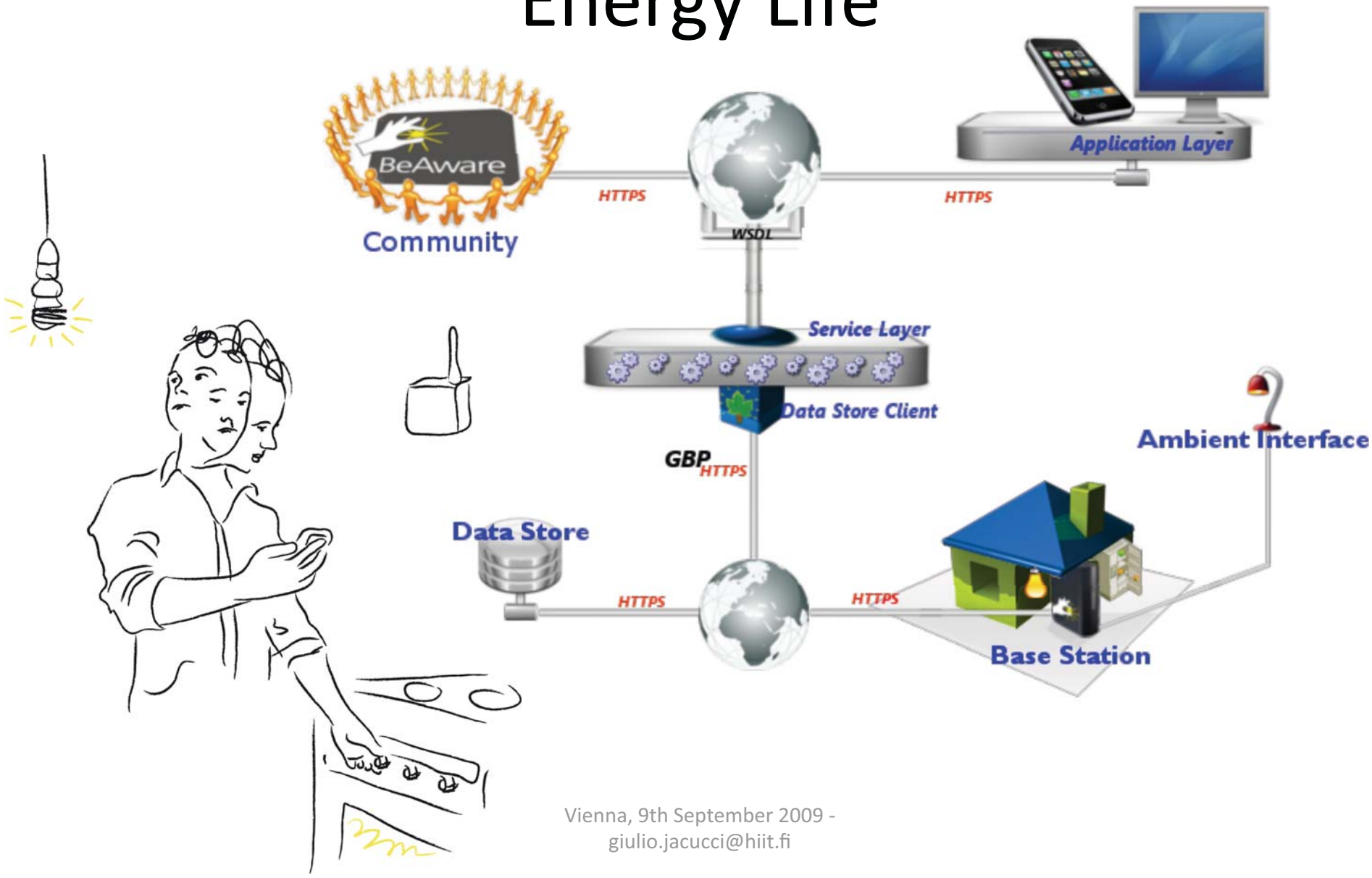
Content

- From Mobile to Ubiquitous Computing
- Interaction Design starts from Users
- Application Areas
  - Maps and orientation
  - Social networks
  - Energy awareness
  - Public Media
  - Installations
- Design and studies Cycles
- Summary

Energy Awareness

Vienna, 9th September 2009 -
giulio.jacucci@hiit.fi

Energy Life


BeAware
Community
HTTPS
WSDL
HTTPS
Application Layer
Service Layer
Data Store Client
GBP
HTTPS
Ambient Interface
Data Store
HTTPS
HTTPS
Base Station

Content

- From Mobile to Ubiquitous Computing
- Interaction Design starts from Users
- Application Areas
  - Maps and orientation
  - Social networks
  - Energy awareness
  - Public Media
  - Installations
- Design and studies Cycles
- Summary

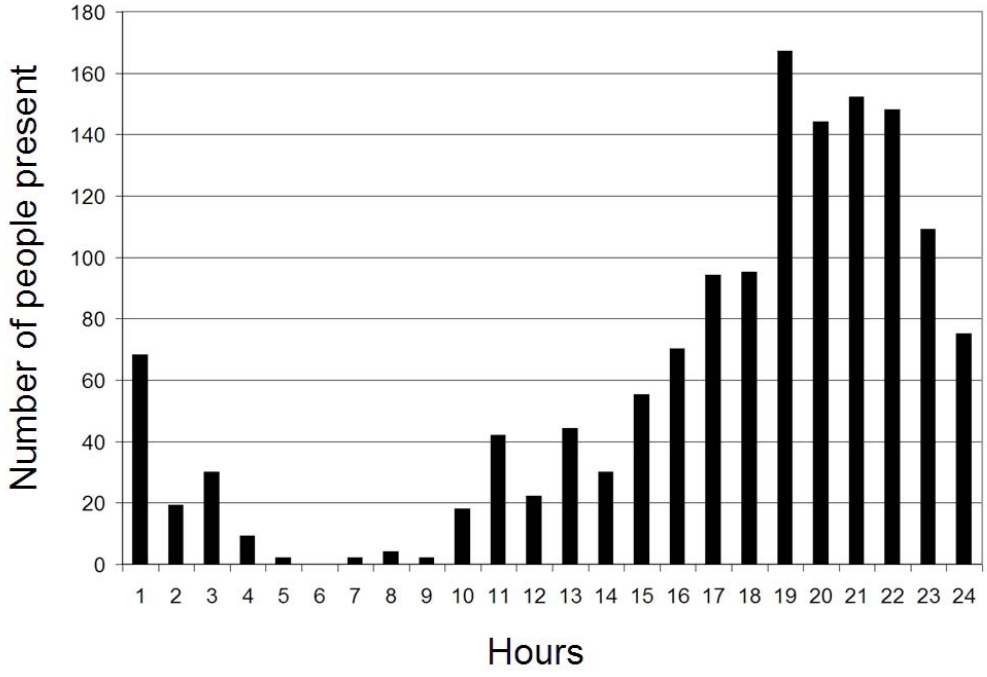
Urban Public Media

Vienna, 9th September 2009 -
giulio.jacucci@hiit.fi

Overview of data

- During eight days of analyzed use, 1199 persons interacted with the
- display in 516 sessions. The display was mostly used in the evenings.

Only 18% of the users were individuals. Of multi-user situations pairs were most common (72%). Groups of three (23%) were seen more rarely and groups of bigger size were even more uncommon sight.



Challenges

- Missing support for multiple and complex content visualisation
- Interface not designed for parallel or multiple territories
- Designing for engagement beyond playful and superficial use

Content

- From Mobile to Ubiquitous Computing
- Interaction Design starts from Users
- Application Areas
  - Maps and orientation
  - Social networks
  - Energy awareness
  - Public Media
  - Installations
- Design and studies Cycles
- Summary

Installations

Vienna, 9th September 2009 -
giulio.jacucci@hiit.fi

Galileo all'Inferno
(Galileo in hell)

- Theatre show developed by Studio Azzurro, 10th-11th-2th July 2008 in Teatro Arcimboldi of Milan.
  - First part: dance performance,the public attends the show in a classic way, sitting in the stalls
  - Second part: the audience can get on the stage and interact with interactive art installations: Galassie (Fig. 1) and Ombra di stelle (Fig.2)

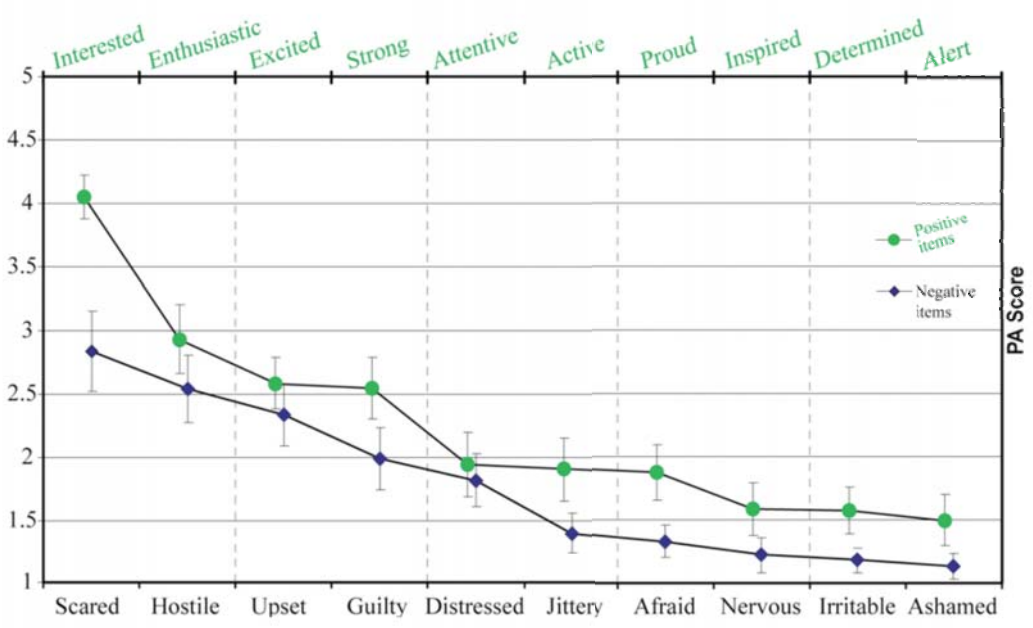
Figure 1 Galassie

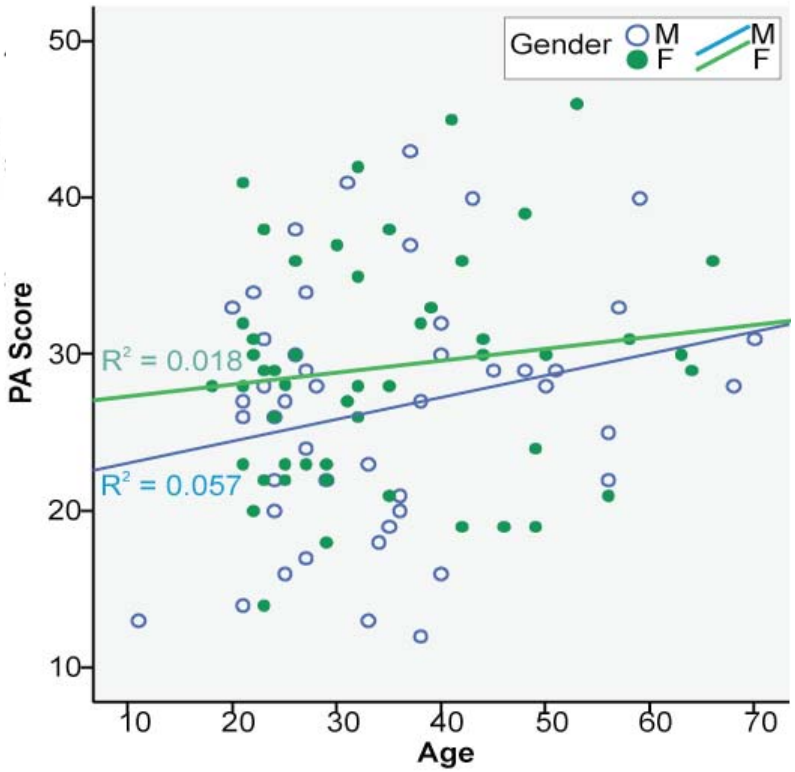
Figure 2 Ombra di stelle

Ombra di stelle

Galassie

PANAS results





Qualitative results

Positive Categories	Typical terms	Frequency
Interest	Curiosity, research, try to understand, interesting	19
Transport	In a surreal world, abducted, altered time dimension, lack of points of reference, sensorial isolation, "floating in a dream"	19
Ludic pleasure	Sense of play, amusing, creative game maker	11
Amazement	Astonished, surprised, amazed	5
Involvement	Participation, involvement	4
Creation	To create, to generate	4
Serenity	Peacefulness, peace, lightness	4
Freedom	Sence of freedom, "I was feeling to be on the sky, to be free"	4
Misc.	Attentive, happy	1 (each)
Negative categories	**Typical terms**	**Frequency**
Confusion	Feel confused, disoriented	6
Irritation	Annoyance, irritated	4
Indifference	Not involved, not interested	4
Frustration	Frustrated, feel nitwit	3
Boredom	Feeling bug, boredom	2
Distressed	Upset	2
Misc.	Unsure, disquiet, Embarrassed, Fear, loneliness	1 (each)

- We identified 14 categories that can be divided in Positive and Negative categories.

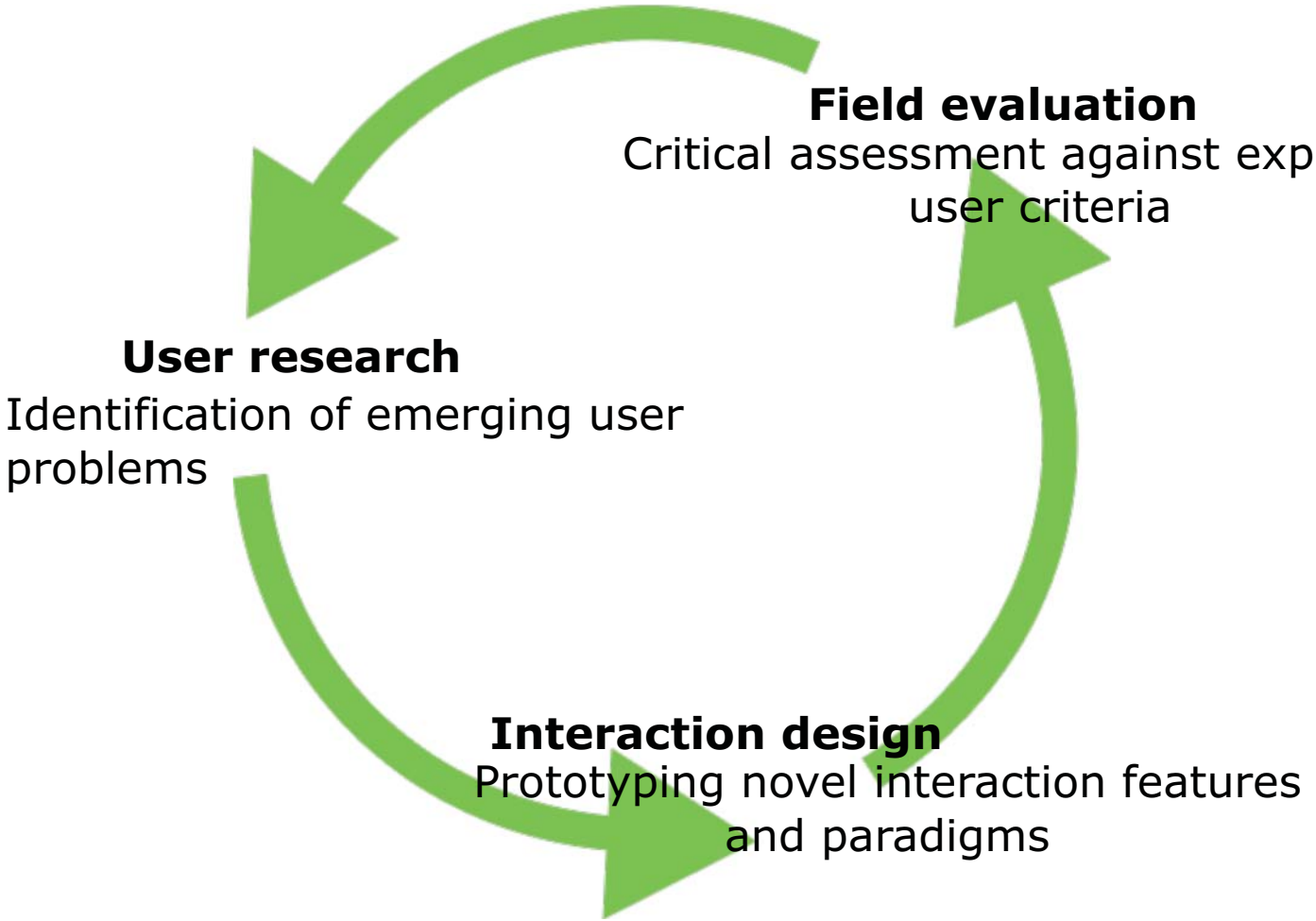
Video based Interaction Analysis

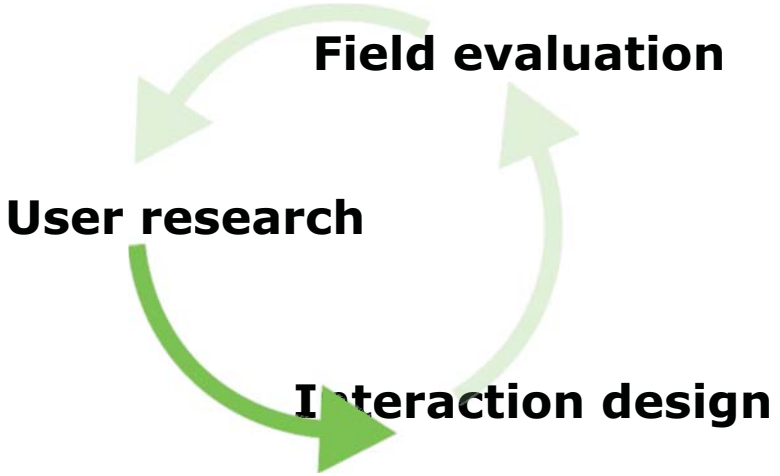
- A total amount of 6 hours of interaction were recorded during the three days of the theatre performance.
- We found three phases in the interaction:
  - *Circumspection*
  - *Testing*
  - *Play*
- Two pervasive features of these phases:
  - *Experience sharing (co-testing, co-play)*
  - *Imitation*

Content

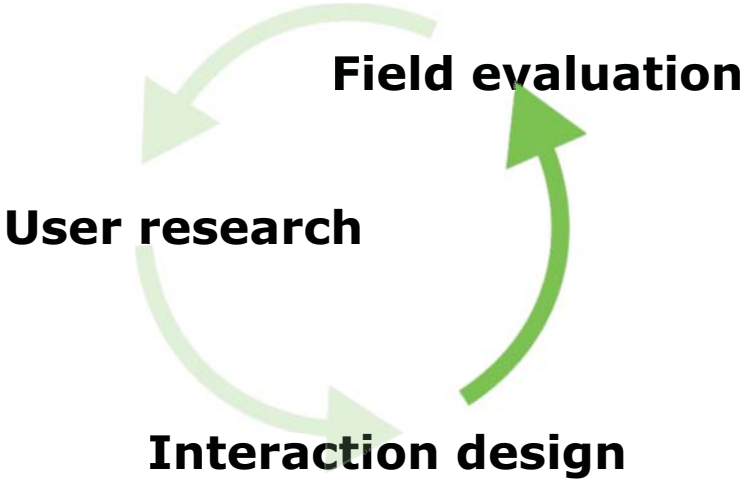
- From Mobile to Ubiquitous Computing
- Interaction Design starts from Users
- Application Areas
  - Maps and orientation
  - Social networks
  - Energy awareness
  - Public Media
  - Installations
- Design and studies Cycles
- Summary

Approach

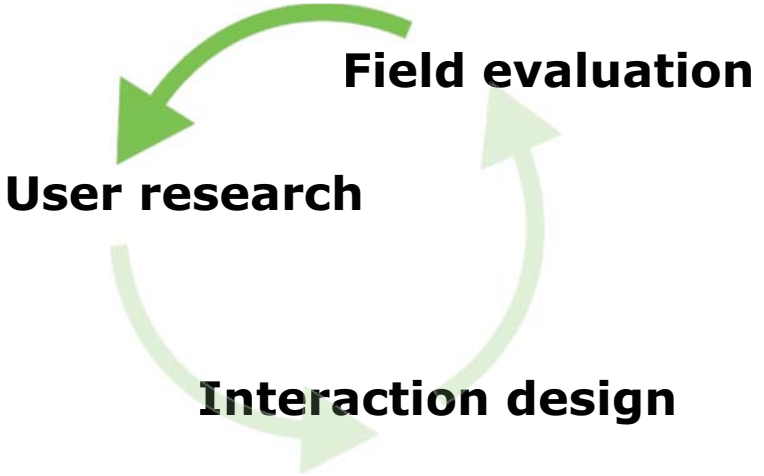

Field evaluation
Critical assessment against explicated user criteria
User research
Identification of emerging user problems
Interaction design
Prototyping novel interaction features and paradigms



- Ethnography
- Quasi-experimentation
- Needs analysis
- Concept innovation

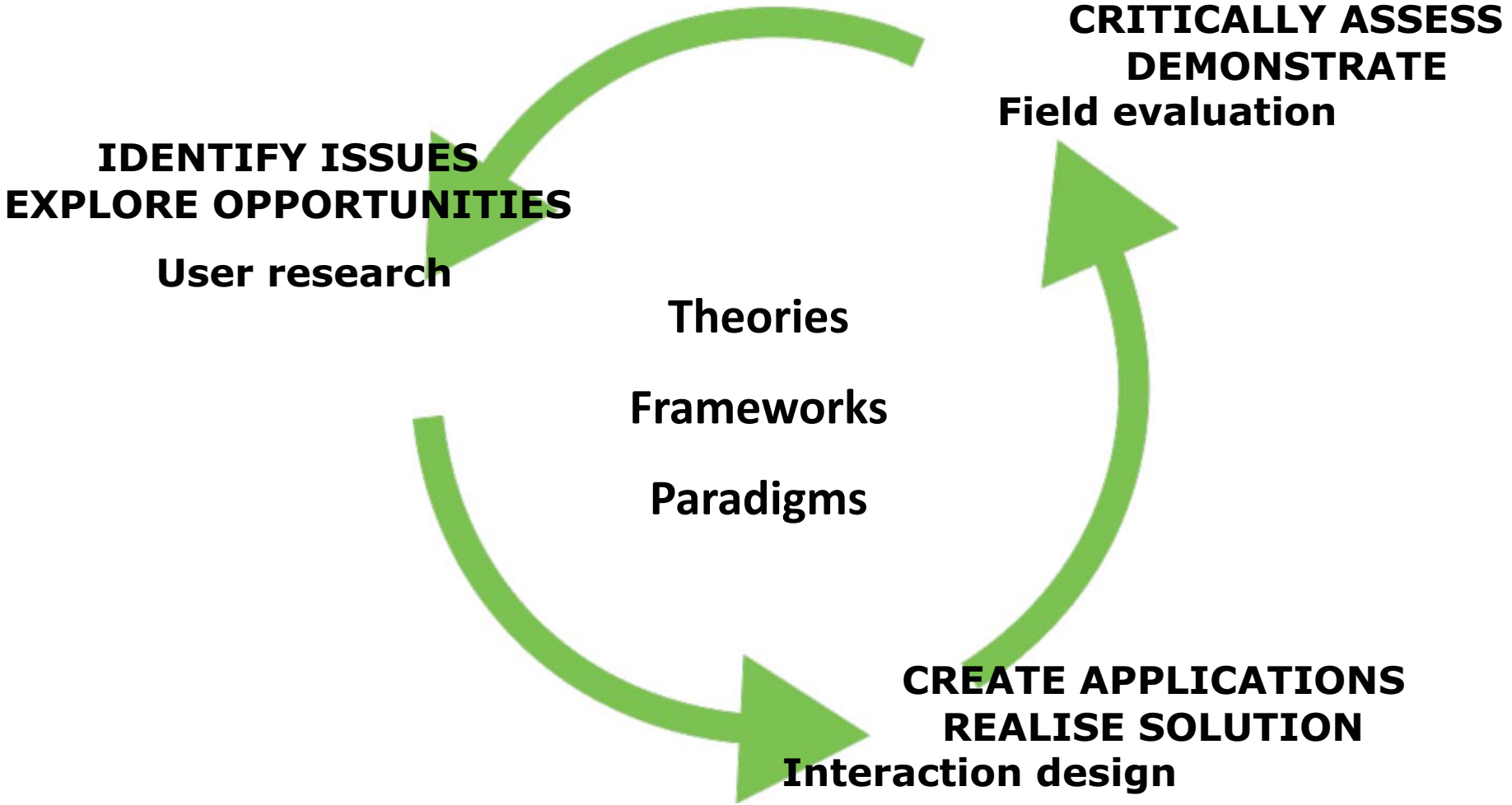


- Concept generation
- Interface design
- Prototyping
- Argumentative design



- Intervention studies
- Log analysis
- Interaction analysis
- Content analysis
- Conversation analysis
- Observations
- Contextual interviews

Ubiquitous Interaction –
as system for grounding innovation



Content

- From Mobile to Ubiquitous Computing
- Interaction Design starts from Users
- Application Areas
  - Maps and orientation
  - Social networks
  - Energy awareness
  - Public Media
  - Installations
- Design and studies Cycles
- Conclusion

Conclusions 1/2

- “Mobile” might providing a limiting vision
- Ubiquitous computing should be reconsidered
- Grounded development in cycles of Interaction design and studies

Conclusions 2/2

- Some application areas: orientation, social network, energy awareness, public and art installations

- Trends and challenges:
  - Combining , mixing functionality and modalities!
  - Textual to graphical ,2D to 3D
  - Collective and collocated use

Thank you!

- Giulio.jaucci@hiit.fi
- www.hiit.fi/uix
- www.multitouch.fi