

6 – Ubiquitous User Interfaces

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May 3, 2016

Days and Topics

March 1	Administrative Stuff, Intro to Designing Interactive Systems
March 8	Understanding Context of Use – Assignment 1 Handed Out
March 15	Prototyping and Iterative Evaluations – Assignment 1 Deadline (before/in lecture) – Assignment 2 Handed Out
April 12	Participatory Design (Theory and Workshop) – Assignment 2 Interviews with Tutor (throughout the day)
April 26 (10-13)	Evaluations Workshop (Cognitive Walkthrough, Observation and post-hoc discussion of prototypes – Assignment 3) – Assignment 4 Handed Out
April 28 (9-14)	Android Sensing / Context-Aware Interactive Systems Tutorial Day (different room)
May 3	Ubiquitous Computing, particularly Ubiquitous User Interfaces
May 10	Questions on Programming to Tutor
May 24 (10-13)	Presentations 1 (Assignment 4)
May 31 (10-13)	Presentations 2 (Assignment 4)

Recap –Evaluations

1. Cognitive walkthrough

- Define key activity (goal of interaction)
- Define sequence of steps
- For each step ask:
 - Does the step fulfill the goal?
 - Does the user see that the action for the step is available?
 - Can the user recognise that the action is the right one?
 - After the action, can the user understand the system feedback?

2. Observation and Thinking Aloud

Recap – Participatory Design

1. Participation
2. Project Planning (steering committee + design team; project establishment – strategic analysis – work analysis – vision development – anchoring/ instantiation)
3. Design as communication process (users' present work – new system – technological options / concrete and abstract levels)
4. Combine ethnography and interventions
5. Co-development of IT, work organisation, and user qualifications

Ubiquitous User Interfaces

Today

- Ubiquitous Computing
- Ubiquitous User Interfaces

Designing Interactive Systems

- What functionalities provide value?
- What interaction is fun, aesthetic, provides value?

Learning Goals

After today's lecture and workshop you should

- Understand and explain what is ubiquitous computing (UbiComp)
- Understand and explain what kinds of research questions asked in the field UbiComp
- Understand different communication channels that are relevant for humans (and hence in HCI)
- Understand challenges for designing ubiquitous user interfaces
- Know classes of ubiquitous user interfaces
- Be able to give examples for systems that make use of different communication channels, or constitute different UUI classes

WHAT IS UBIQUITOUS COMPUTING?

Weiser 1991, Scenario: Sal's Day

- Coffee on Wake-Up
- Digital traces of neighbours' coming and going
- Awareness of others in the house (who is awake?)
- Finding a lost manual

- ...
- ...

The most profound technologies are those that disappear

Ubiquitous Computing is...

Computers are

- **In abundance**: Many computers in many places and at many times
- **interconnected**
- **aware** of their location, of users (monitoring, tracking), of each other, of environment (ambient intelligence)
- **Intelligent** (artificial intelligence)

A continuation of computer technology : from mainframe, to personal, to ubiquitous computers...

Ubiquitous Computing as Research Field is hugely heterogeneous

Hardware and software research

From human factors, to network protocols, to machine learning....

Systems: How to build software for ubicomp systems?

Experiencing UbiComp: How do humans experience existing / prototyped ubicomp systems? How could/should humans experience ubicomp systems?

Sensors – making UbiComp systems adaptive:

Sensor technologies, data analytics incl. statistical and machine learning methods, adaptive systems.

Experiences/HCI View Research Questions

How to **design and evaluate ubiquitous systems** (highly dependent on context)?

How to **interact with information via different surfaces, devices and tools?**

- How to make interaction / representation persuasive?
- How to make the many available data recordings intelligible, useful, and usable?
- Also: How to design devices with a dedicated functionality?

How to **create value for users from context-awareness?**

How to let **non-computer scientists assemble UbiComp systems** (combinations of sensors, interface and computational devices)?

Ubiquitous User Interfaces

Interface

Interface: Boundary between 2 Actors

Interactive Systems: Humans and Computers

- Traditionally: 1 Human, 1 Computer
- Increasingly: x Humans, x Computers (CSCW)
- UbiComp: 1 Human, n Computers – x Humans, m*x Computers

Communication mediated by interface

Actors have channels for communication (input/output)

What's new?

Multi-modal: Multiple communication channels

- Increased focus on input via speech, gaze, body movement
- Increased focus on output via

Implicit / invisible interaction: Context-aware, intelligent systems

Today we look at two (overlapping) classifications schemes

- According to sensory channel
- According to interface type

Communication Channels

Human Perception

Five senses

- Sight (fast, most accurate in the center of focus, sensitive to movement in the periphery)
- Sound (fast, effective in the background, e.g., selective hearing, noticing changes)
- Touch – temperature, pressure, pain (slow, different body parts have different sensitivity/resolution of receptors)
- Smell (slow)
- Taste (slow)

Other

- Equilibrium
- Kinaesthetic sense (relative position of body parts)

Communication Channels

Visual (Eyes - Text, Icons, Images, Movies, Gestures)

Acoustic (Ears – Mouth, Spoken Language, Music, Noise)

Tactile (Touch, Temperature, Kinaesthetic, Balance, Pain – Vibrating Devices, Haptic Interfaces)

Chemical (Taste, Smell)

Examples: Tactile

Mobile phone vibrations

Braille

ActiveBelt:

Koji Tsukada and Michiaki Yasamura. 2011. ActiveBelt: Belt-type Wearable Tactile Display for Directional Navigation. In *Proceedings of Ubicomp 2004*

- For navigation
- For making users aware of ubicomp information
- For reminding users of valuables left behind
- For moving in sync with music, or transmitting rhythmic vibrations to others

Example: Meta-Cookie as Pseudo-Gustatory Display

Takuji Narumi, Shinya Nishizaka, Takashi Kajinami, Tomohiro Tanikawa, and Michitaka Hirose. 2011. Augmented reality flavors: gustatory display based on edible marker and cross-modal interaction. In *Proceedings of SIGCHI 2011* <http://doi.acm.org/10.1145/1978942.1978957>

UUI Classes

Tangible User Interfaces

1. User manipulates a physical object
2. System senses this
3. ... and provides some feedback

Surface User Interfaces

Self-illuminated surface via which computation is controlled

- Smartphones, tablets, ambient interactive displays
- Input device: stylus, fingers...
- Often similar interaction paradigms than in traditional GUIs
- Via smartphones, touch-based interfaces have become very widespread, and a touch-gesture language has appeared (tap, double-tap, swiping, zooming)

Ambient User Interfaces

- ... are ignoreable or glanceable
- ... don't always incorporate input and output – or input may be very implicit

Other

Audio Interfaces, both input and output (e.g., telephone information services)

Gestures as input (e.g., Kinect)

Sensors as implicit input (e.g., FitBit)

CONCLUSION AND RECAP

Challenges

Novel interfaces: Outside known “interface language” (metaphors, icons, terminology...)

Disappearing interfaces: How to interact with an invisible system?

Technology Driven Design and User Value: Beyond being cool, what existing problem is solved?

Costs: How expensive will a widespread use of the system be?

Recap - UUI

- Communication channels and their usage in ubicomp systems (visual, acoustic, tactile, olfactory)
- User interface classes and input/output modalities (tangible, surface, ambient, audio/speech, gestures, implicit/sensor-based)

Readings

Further readings:

- Dix et al., Human-Computer Interaction, Chapter 1 “The Human” and Chapter 4 “Paradigms for interactions”
www.hcibook.com
- Krumm, Ubiquitous Computing Fundamentals, Chapter 6
“From GUI to UUI: Interfaces for Ubiquitous Computing”
- Human Information Processing Capacity: Miller’s number
(7 ± 2) - <http://www.musanim.com/miller1956/>