

5 – Context-Aware Computing

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Days and Topics

March 11	Intro
March 16	Designing Interactive Systems – Assignment 1 Published in Detail
March 23 (10-13)	Prototyping + Evaluating Interactive Systems - Paper Presentation and Discussion (Assignment 1) – Assignments 2-4 Published in Detail – Android Sensing Tutorial Day will be Announced!
April 20	Presentation Assignment 2/3
April 27	Presentation Assignment 2/3 – Submission Assignment 4
May 4	User Interfaces for Ubiquitous Computing - Assignment 5 Published in Detail
May 11	Context-Aware Computing - Details on Final Paper
May 18	Presentation Assignment 5
June 1	Presentation Assignment 5
June 8	Submission Final Paper

Recap

Designing Interactive Systems

Technology focus: Context-aware smartphone applications as approximation of ubicomp visions

Methodology:

- UCD Iterative Process (Analyse – Design/Implement – Evaluate)
- Stakeholder Analysis, Context Diagrams, Work Modelling, Storyboards, Mock-Ups, Cognitive Walkthrough

Technology

- User Interfaces for Ubiquitous Computing
- **Context-Aware Computing**

Today

Why Context-Aware Computing

What is Context and Context-Aware Computing

Design Steps

Architectures

Discussion - Challenges

Why Context?

... to improve human-computer
communication

Context-aware Computing – General Idea

1. Systems constantly collect contextual information (whatever this is)
2. Application developers make use of it where reasonable, so that systems are easier to interact with
3. Users need not make explicit what contextual information is relevant

... in Ubiquitous Computing: Relevance

Assumption: situations impact how users would like an application to behave

- > In ubiquitous computing, the situations of use are much more varied than in traditional computing
- > high need for context-aware systems in ubicomp settings

... in Ubiquitous Computing: Feasibility

Sensing technologies have become widely available (smartphones, FitBit, wireless blood pressure monitors or scales....)

Sensing infrastructure / devices are increasingly networked

What context-aware systems/services/
apps do you know?

What is Context?

- Spatial information: Location
- Temporal information: Time of day, season

- Environmental information: Temperature, light
- Identities of nearby people and objects
- Changes to people and objects

- Computing infrastructure: CPU, OS, memory, interfaces, available networks incl. reliability, executed software

- User's current status (e.g., emotion, focus of attention, location, orientation)

Physical

Environment

Computing

User

What is Context?

Current characteristics

Of a person/place/object

Of relevance to the human-computer interaction

- Who/what
- Where
- When
- What is happening

So what: System Adaptation

System determines context

- implicitly

Derives user intent from context

... with respect to itself (the system)

... and adapts its appearance and/or behaviour

Typical Functionalities of Context-Aware Systems

Provide information

- Emphasize most relevant information in UI
- Automatic preselection (filtering) of information

Execute commands

- Emphasize available commands that are estimated to be more relevant
- Automatically execute commands

Tagging information entities with contextual information for later retrieval

Adapt User Interaction


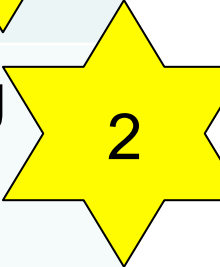

Typical Context-Aware Systems

Tour Guides (general: location-based information presentation)

Reminders (time, location, sleep cycle, ...)

Environmental controls (e.g., window control, heating, ...)

Design Steps

Reminder: System Adaptation	Implications for Design
System determines context	What sensors are necessary? 
Derives user intent with respect to itself	How to process sensing data in order to derive “intent”? 
Adapts appearance and/or behaviour	Adaptation rules 

System Architectures - Elements



Data Producers

Data Consumers

Storage

Widget-based architecture

Blackboard-based architecture

Challenges

Sensors - reliability

Power management

Interoperability (sensors, devices)

Privacy and Postprocessing impact system architecture

Data postprocessing: Rules, statistical analysis,
machine learning

Conclusions are often not 100% accurate

- Modeling ambiguity
- Sensor fusion

Understanding human intent is non-trivial

CONCLUSION

Recap

Context-Aware Computing is supposed to improve HCI

Context means relevant (to HCI) characteristics of persons/objects/places in the environment

Context-Aware Computing means adapting systems to context

Design Steps – adaptation rules, relevant context, postprocessing and sensors

Architectures – Widget-based vs. blackboard-based

Challenges

Readings

Key readings:

- Krumm, Ubiquitous Computing Fundamentals, Chapter 8
“Context-Aware Computing”