Ubicomp Beyond Devices: People, Objects, Space and Meaning

Jörn Hurtienne
Julius-Maximilians-Universität
Oswald-Külpe-Weg 82
97074 Würzburg, Germany
hurtienne@acm.org

Nicolai Marquardt
University College London
UCL Interaction Centre
Gower Street, London, UK
n.marquardt@ucl.ac.uk

Hans-Christian Jetter
Intel ICRI Cities
University College London
Gower Street, London, UK
h.jetter@ucl.ac.uk

Thomas Pederson
IT University of Copenhagen
2300 Copenhagen S
tped@itu.dk

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Workshop Theme
We think that the time has come to move away from a traditional device-centric Ubiquitous Computing (Ubicomp) view of "spatial context" (e.g. location and orientation of a device) towards a more human- and meaning-centered view. Among other things, this includes the many meaningful spatial configurations of non-digital and digital objects and tools around us and also the presence and position of other human actors.

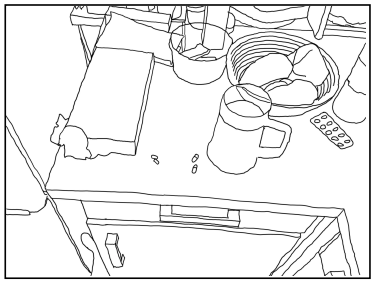

Figure 1. Example scenario: Preparing pills for breakfast.

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Although most people are unaware of it, we constantly use space and spatial configurations as a cognitive resource for guiding human thought and action [8,13]. Depending on our goals, we move in space and alter spatial configurations of everyday objects around us, e.g., tools, artefacts, or other domain objects ranging from paper cups to rolling tables. With few exceptions (e.g. [4,16,17]), these himan made configurations and their meaning have rarely been considered in Ubicomp and Context-Aware system design. Time for a change!

In this workshop, we will rethink spatial context from a human perspective: This includes, but also extends, the notions of proxemic interactions for Ubicomp [4], cognitive theories of distributed cognition and the intelligent use of space [8, 13], image-schematic metaphors [10] as well as new ethnographic observations of how humans put meaning to the spatial relations between objects, tools, and devices.

Goals
This NordiCHI full-day workshop seeks to identify how the arrangement of physical objects in space are pointing out the goals, intentions and likely future

Example scenario from the household of an elderly lady and her husband: The kitchen top is prepared for the morning intake of medicine and a meticulous ritual has evolved that is partly reflected in the arrangement of things on the kitchen top. The surface of the kitchen top is divided in a front area where mandatory medicine can be found and a back area that holds medicine that is taken on demand. Other edible items like bread-rolls and cookies in this area indicates the purpose of this kitchen top as one for "items to be ingested".
The breakfast ritual starts with taking a bread-roll from the bowl to the right in Figure 1, together with jam and butter from the fridge. The medicine is taken from a cupboard above the worktop in the picture. It is stored outside of view (and reach) of her husband, who, she claims, is a hypochondriac and envious of her medicine. The pills and the water glass are arranged in a way that reflects the time course of the breakfast. First, the elderly lady takes the two pills that are closest to the water glass and drinks exactly half of the water. Then she eats half a bread-roll, followed by the second pair of pills and the rest of the water in the glass. She finishes breakfast with the second half of the bread-roll and her cup of coffee.

actions of human actors in everyday life and how this knowledge may be formalized into conceptual and practical tools that (1) facilitate the analysis and ***understanding*** of existing spatial situations, (2) address the technological challenges involved to ***sense*** these, and that (3) can be embedded into the architecture of future interactive systems to improve how they ***react*** and to open up new application areas.

Example Scenario
The example scenario presented in the sidebar and in Figure 1 draws us into the non-digital scenario in the household of an elderly lady and her husband.

What can be ***understood*** from this scenario? Note how the spatial arrangement of objects on the kitchen top reflects action: 1) Mandatory medicine is arranged closer to the person than the on-demand-drugs that are further away. 2) Pills are arranged in a way that builds a timeline from right to left. Those to be taken first are closer to the water glass. 3) The water level in the glass indicates progress. 4) The progress of eating, the level of water in the glass and the spatial arrangement of pills make sure that the right medicine is taken at the right moment, even if interrupted. 5) The mandatory medicine is well protected – hidden from the husband in the cupboard.

What can possibly be ***sensed*** in this situation? Current technology would suggest taking a visual sensing approach of the whole scene, making it possible to classify the objects and their arrangements in space. If objects had a sense-able identifier, this would be even better. Given sufficient technology, also the kitchen top or the objects themselves could sense the identity and arrangement of nearby things.

How should the system ***react***? Because the safety of the pill-taking procedure is foregrounded in this scenario, the system could issue a warning if the wrong pills are taken, if the wrong person takes the pills, or if there is an error in the sequence of taking the pills. The warning could be issued towards the person committing the error or to a caregiver. Note that the system needs to react differently according to the exact place where something happens. If, for example, medicine located at the back of the kitchen top is omitted from being taken, this would not pose a problem.

This scenario illustrates our meaning-centered approach. Starting from understanding the spatial practices and intentions of people we try to conclude what a Ubicomp system can sense in this situation and how it can react. Thus, technology is not the initial focus, but seen as an enabler of different reactions to sensed spatial arrangements.

Relevance to the field

The topics discussed at the workshop span the three areas of UNDERSTAND, SENSE and REACT.
Understanding might be achieved through two major routes: The first includes exploring scenarios in which people in their everyday environments and activities use space and the arrangement of objects in space to construct, convey and interpret meaning. The second route involves looking at research findings and theories that may enhance our understanding of how people use objects in space such as distributed cognition and the intelligent use of space [8,13], proxemics in Ubicomp [4], image schemas and conceptual metaphors [10], blended interaction [12], embodied cognition and interaction [2], tangible interaction [9] and even

The three workshop sub themes

Understand: How do people use space in everyday scenarios? What can the arrangements of objects tell us about their meaning? What can be known from these arrangements about the past and future of the interaction with these things? How can this benefit the actors in these scenarios?
Sense: How can computers sense these properties and interpret these correctly? Do we need systems with a God's eye perspective or can the participating objects sense and communicate everything necessary?
React: How can we model the meaning of spatial arrangements in order to draw the right inferences? What are appropriate reactions, given current and future technologies, interaction paradigms, and stakeholder relationships? How do these new interaction paradigms change the spatial practices of their users?

Workshop Outcomes

Broadening Ubicomp: Putting everyday object usage on the research agenda
Community Building: Integrating the technical and social science communities in Ubicomp
Dissemination: Publishing the results in a journal special issue

borrowings from science and technology studies, anthropology and sociology [14].

A more technological topic is the **sensing** of spatial configurations of objects, devices, and users. Today's approaches include Kinect depth cameras to sense everyday objects and to repurpose them as physical input devices [1] or 3D motion capturing systems used to sense proxemic dimensions such as distance, orientation, movement, identity, and location [16]. But what are possible alternatives and future uses? Could we use wireless radio signals to track tagged objects, devices or users, for example using NFC or Qualcomm SRCT [15,17]? What can we expect from using ultra-sound or magnetic sensors? Or can we use mobile low-cost depth cameras to create real-time spatial representations of our physical environment [3,11]?

Knowledge about spatial configurations can lead to systems that **react** and adapt more gracefully to ongoing activities by more accurately recognizing them (e.g. [20]) and by more precisely being able to spatiotemporally present information (e.g. classical Augmented Reality) even in the periphery of human attention (e.g [6]). Systems can also react to the natural spatial configuration of people in front/around displays [19] and to how devices are arranged relative to each other [4,7,15,16]. They can also change representation or even interaction modalities based on such information. Examples of useful system reactions are many and will be explored as part of the workshop.

Workshop attendance and organization

Intended Audience
We expect 15-25 participants from diverse disciplines such as HCI, ubiquitous/mobile computing, embedded systems, cognitive science, science and technology studies, anthropology, and sociology.

Before the Workshop
The call for papers will be distributed to several research communities (e.g. HCI, Ubicomp, cognitive science, interaction design) including explicit invitations to selected experts and their groups. We will maintain a dedicated website and also use Twitter and Facebook to spread the word and keep people updated.

Participants will be selected based on their submission in either of two categories: (1) short position papers (up to 2 pages), in which they have to demonstrate informed positions about the topic, or (2) research papers (up to 4 pages) describing their on-going research. All contributions will be peer reviewed by at least two reviewers from an international PC.

At the Workshop
The workshop will adopt a one-day format with the morning dedicated to a one-minute madness and a demo session in which posters, videos, or devices can be shown. Then, in an open space format all participants (including the organizers) will suggest topics to work on. Topics could include sample scenarios from different domains (e.g. medication, mobile collaborative work, maintenance and repair) and/or relate to the three pillars of the workshop: understand, sense and react. Topics will be clustered and assigned to groups before lunch and worked on in the afternoon, and later discussed in the plenum. A summary will look at future activities (e.g. writing a synthesis journal article, preparing research proposals for funding). The planned schedule in detail:

Workshop organizers

Jörn Hurtienne is full professor of Psychological Ergonomics. He is interested in studying methods for designing intuitive use, i.e. the subconscious application of prior knowledge. He has organized workshops at British HCI 2009, German HCI 2009 and standalone workshops on intuitive interaction and usability (2006, 2007, 2013).

Hans-Christian Jetter is a research associate working on the cognitive foundations, design and engineering of ubiquitous computing user interfaces. He has organized workshops at Ubicomp 2013, CHI 2013 and AVI 2012.

Nicolai Marquardt is Lecturer in Physical Computing at University College London, working on projects in ubiquitous computing and proxemic interactions. He organized tutorials/workshops at ITS 2012, 2013.

Thomas Pederson is associate professor with research interests in context-aware mobile and wearable interactive systems. He has been co-chair for NordiCHI 2012, co- program chair for TEI 2010, and organized workshops at MobileHCI 2006 and UBICOMP 2005.

09:00 Introduction and organizers' keynote
09:45 1-minute madness presentations by participants
10:15 Demo session, including coffee break
11:15 Collecting and clustering focus topics
11:45 Forming break-out groups, going off to lunch
13:00 Break-out group activities
15:00 Coffee break
15:15 Reports on break-out sessions, Q&A with groups
16:45-17.30 Identification of future actions + closing

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The idea for this workshop emerged at Dagstuhl seminar 13452 on "Proxemics in Human-Computer Interaction", Nov 3-8 2013. http://www.dagstuhl.de/13452

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