Rethinking Smart Objects: The International Workshop on Interacting with Smart Objects in Interactive Spaces

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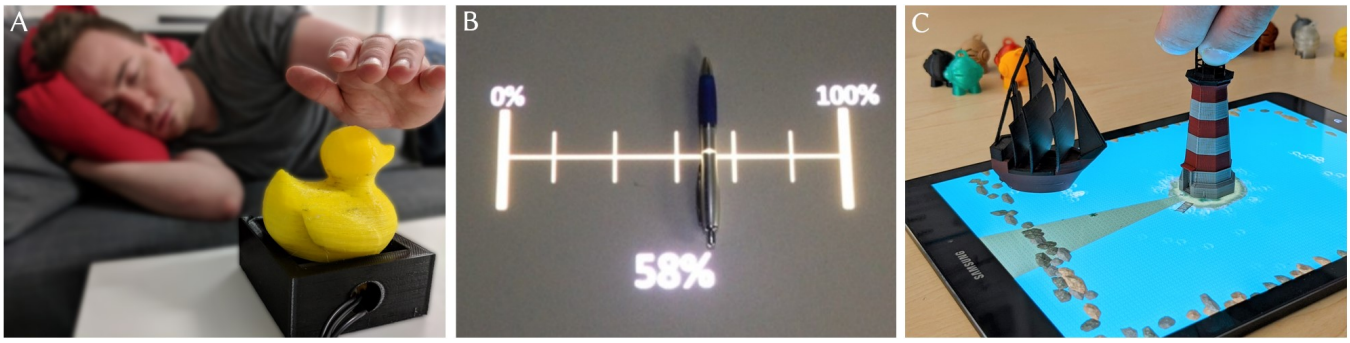

Figure 1: A smart object can manifest in a plethora of different ways, ranging, for instance, from custom ubiquitous devices (A) and interactions with everyday objects (B) to augmenting existing interactive devices (C).

ABSTRACT

The increasing proliferation of smart objects in everyday life has changed how we interact with computers. Instead of concentrating computational capabilities and interaction into one device, everyday objects have naturally integrated parts of interactive features. Although this has led to many practical applications, the possibilities for explicit or implicit interaction with such objects are still limited in interaction spaces. We still often rely on smartphones as interactive hubs for controlling smart objects, hence not fulfilling the vision of truly smart objects. The workshop *Rethinking Smart Objects* invites practitioners and researchers from both academia and industry to discuss novel interaction paradigms and the integration and societal implications of using smart objects in interactive space. This workshop will include an action plan with leading questions, aiming to move the research field forward.

CCS CONCEPTS

• **Human-centered computing** → **Ubiquitous and mobile devices**; *Interaction techniques*; *Interactive systems and tools.*

KEYWORDS

Ubiquitous Computing; Smart Objects; Tangible Interfaces

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1 INTRODUCTION AND BACKGROUND

The 2016 published *Hype Cycle for Emerging Technologies* expected *"smart technologies to be the most disruptive class of innovations over the following years due to their computational power, scalability in analyzing large-scale data sets, and rapid advances in neural networks"* [24]. Since then, researchers have made considerable efforts to continuously integrate smart objects into the user's natural environment so that they can explicitly or implicitly interact with the smart objects. This trend is strengthened through embedding computational capabilities into conventional objects [17, 18]. Such ubiquitous and distributed devices will replace previous dominating devices as a future trend. For example, the functionalities provided by a smartphone, a commonly used centralized device, can be modularly integrated into the user's environment to enable natural communication.

Examples of smart objects are omnipresent and range from tangible objects [4, 14–16, 25], fabrication [1, 10, 11, 20–22], smart cars [26], spaces [2], mobile and wearable on-body interfaces [3, 19], and musical instruments [9, 12, 13] to education [6, 7] and large-scale urban infrastructures [23]. We expect this trend to increase with further developments in the fabrication sector. Although many technical challenges of implementing smart objects have been overcome, far less research has been conducted regarding smart objects' explicit or implicit interaction. This includes the design, user interaction paradigms, social aspects, matching of user expectations, and ethical challenges when deploying smart objects [5, 8].

The *Rethinking Smart Objects* workshop provides a platform for researchers to discuss the development of smart objects and novel techniques for interacting with smart objects in interactive spaces, as well as to discuss what steps are needed to make smart objects in interactive spaces more viable and practical for the masses. This full-day hybrid workshop will address researchers from industry and academia to pinpoint the implications and interaction paradigms of smart objects. The workshop engages with group discussions for researchers and practitioners working in these research areas but also encourages the exchange with aspiring researchers. During the workshop, we will elaborate on recent approaches on how to design smart objects and interacting with them. In addition, participants will have the opportunity to discuss in interactive sessions the entire creation process from the idea to the design and optimization to the evaluation of such smart objects. This workshop aims to connect the provided benefits of smart objects and the interaction paradigms, leading to natural interaction with smart objects. The result includes an action plan with leading questions moving the research field forward.

The *Rethinking Smart Objects* workshop will discuss how intelligence embedded in smart objects can be used to foster more natural, efficient, and enjoyable interaction. The topics cover the design of smart objects from various perspectives, including technical aspects, such as the processing of data from sensors embedded in everyday objects, the actuation of such, the self-representation of their behavior, interaction concepts, and techniques to control and query intelligent objects, and also their ethical aspects and privacy challenges. Further, we will discuss current design methods, processes, and tools to design and fabricate smart objects in interactive spaces.

2 TARGET AUDIENCE

This workshop targets practitioners and researchers from both academia and industry. We will focus on the interactive aspects when designing and implementing smart objects. However, we are open to any audience considering participating in this workshop.

3 ORGANIZERS

Martin Schmitz is a postdoctoral researcher at the Saarland University. His research interests include extended reality, haptics, and fabrication. He is experienced in building devices for sensing and various prototyping techniques.

Sebastian Günther is a doctoral researcher at the Technical University of Darmstadt focusing on haptics in VR and accessibility for persons with visual impairments.

Karola Marky is a professor at the Leibniz University Hannover. Her research focuses on the intersection of cybersecurity and human factors, explicitly considering privacy aspects of ubiquitous technology and novel security interfaces based on tangible interaction.

Florian Müller is a postdoctoral researcher at LMU Munich. His research courses on AR, VR, and body-centric interaction in and with the physical world.

Andrii Matviienko is a postdoctoral researcher at the Technical University of Darmstadt. His research focuses on assisting technology in urban environments, particularly designing, constructing, and evaluating multimodal and mixed-reality interfaces for vulnerable road users.

Alexandra Voit is currently working as a Senior Consultant at adesso SE in Stuttgart. In her Ph.D., her research focused on smart home notifications, including designing, prototyping, and evaluating smart home appliances providing everyday information to their users.

Roberts Marky is a software engineer that is involved in core services development activities at BlackArrow Financial Solutions Ltd. There, he leads the backend development of financial apps that can be used on smart objects.

Max Mühlhäuser is a full professor and head of the Telecooperation Lab at the Technical University of Darmstadt. He has published over 600 articles, chapters, and books on Ubiquitous Computing and related fields.

Thomas Kosch is a professor at the HU Berlin. His research focuses on physiological interaction, including designing, prototyping, and evaluating physiological user interfaces embedded in smart objects.

4 PRE-WORKSHOP PLANS

We will distribute information and materials on the workshop website. Information includes the intention, motivation, and potential outcomes of the workshop. Furthermore, the website serves as a platform to advertise and acquire potential workshop participants. Finally, workshop participants will regularly receive updates about the workshop via email.

5 WORKSHOP STRUCTURE AND ACTIVITIES

We plan a full-day workshop for ten participants using the following schedule:

(1) **Workshop introduction** (15 min): the organizers introduce themselves, the workshop topic, and the schedule.
(2) **Moderated speed dating** (approx. 15 min): the workshop attendees participate in speed dating sessions to get to know each other.
(3) **Keynote** (20 min + 10 min discussion): keynote presentation.
(4) **Coffee break** (10 min)
(5) **Interactive demo and video presentation** (60 min): presentation of interactive demos and videos
(6) **Lunch break** (60 min)
(7) **Talks** (10 + 5 min each): presentations of each participant
(8) **Coffee break** (10 min)
(9) **Moderated discussion and closing** (60 min): the organizers moderate a discussion based on the presentations, interactive demonstrations, and video presentations. Participants in Zoom will be projected to foster their engagement in the discussion if they wish. Questions and comments from the live and online audiences will be discussed and collected via an online brainstorming tool (e.g., a Miro board). Finally, the workshop is closed.

6 OPERATIONAL REQUIREMENTS

We will require a room with a projector to present the talks. In addition, we will need either a whiteboard or a flip chart for the discussion at the end to ideate new research directions. We will also need additional tables for the interactive demos and video presentations.

7 ADVERTISING PLAN

We will do advertising via mailing lists, social media, and the workshop website. The website includes a workshop description, objectives, and possible topics for submissions. It also hosts the call for participation, a link to the submission system, the workshop schedule, further organizational information, and information about the workshop organizers. Accepted papers will be made publicly available on the website before the conference to maximize the preparation time for the workshop and foster discussions.

8 POST-WORKSHOP PLANS

After the workshop, we will encourage researchers to rework their research statements and position papers based on the discussions and feedback from the workshop. We will support researchers in submitting their final statements and papers to either arXiv or preprints on our website. If desired, we will record the pitches and the keynote uploaded on YouTube after seeking the presenter's permission. Based on the group work and moderated discussion, the organizers plan to distill critical aspects and the workshop's outcomes into a position paper published open access. The anticipated results promise to spur research questions on prototyping, the study design, and the evaluation of Smart Objects. The feedback from the workshop attendees accompanies these research questions to inspire researchers who are interested in tackling the research questions. Based on the interest of the workshop attendees, we plan to organize regular meetups and establish a long-term format with a potential future invitation for the authors to contribute to a journal.

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