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Third Spaces in the Age of IoT: A Study on Participatory Design of Complex Systems

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Abstract. The vision of the Internet of Things (IoT) poses chances and challenges for participatory design. In this paper, we report experiences from a research project that is building a system for supporting the autonomy of elderly users at their homes at well as in their neighborhoods. The complexity and invisibility of the underlying technological infrastructures made it challenging to engage potential users in constructing legitimate third spaces for co-design and led us to adapt our initial approach. Based on a discussion of our experiences we argue that the increasing complexity of both the problem as well as the solution space in the age of the IoT has implications for Participatory Design (PD) approaches and hint towards future research directions.

1 Introduction

The rise of the Internet of Things (IoT) does not only affect work practices, but also lifestyles and sensible areas of human being such as health, personal safety, and social life. Participatory Design (PD) is interested in giving users a voice in technology design, not only with the aim of designing "better" tools, but also to enable and legitimate users to bring in their expectations, fears and concerns. In this article, we want to report experiences from a research project that is focused on designing a system for supporting the autonomy of elderly users at their homes as well as in their neighborhoods. Apart from being based on an invisible, distributed system including various IoT sensors, actors and devices all connected by a shared middleware, this system is additionally complex in the sense that it is meant to adapt to the individual needs and routines of the users based on a machine learning component. The high complexity of this system in combination with our target audience of rather technically-unapt users led to a field of tension that resulted in several challenges in implementing a PD approach in this project and creating a legitimate third space for user participation. In the following, we will report how we attempted to overcome the challenges of engaging users in the design of such as system, and what we learned in the process.

2 Related Work - Involvement of users in design

Creating systems that support a broad range of users and contexts can be challenging. In software design, one way to address this challenge is the involvement of users in order to fit systems to their needs (Bødker, Kensing, & Simonsen, 2004; Finn, Jesper, & Keld, 2004; Kensing & Blomberg, 1998). Participatory Design (PD) in this sense offers a long tradition of involving future users in a design process, giving them a voice and empowering them to influence the design of their own future tools (Greenbaum & Kyng, 1991; Muller & Kuhn, 1993; Schuler & Namioka, 1993). The involvement of the users historically had a political notion (Beck, 1996; Gärtner & Wagner, 1996) and tried to foster a democratization of the workplace. In more recent works, PD is mainly understood as a design approach, used in industry and research (Bødker et al., 2004; Muller, 2003). A challenging task when making use of a PD-oriented approach is overcoming an “asymmetry of knowledge” or “symmetry of ignorance” (Fischer, 2000; Rittel, 1984) and creating a “symmetry of knowledge” (Fowles, 2000) between the designer / developer and the involved users. What it takes to create this symmetry is a process of mutual learning (see Muller (2003) for an exemplary summary of relevant works) in order to create a hybrid space, or “third space” (Muller, 2003). In this hybrid space, developers and users learn from each other and question their own assumptions (Bhabha, 1994; Muller, 2003).

Working with technologically unexperienced users, such as (our) elderly users has led to different understandings of how participation in the design process should be structured. Coleman et al. argue that the limited experience of the elderly can lead to more creative designs since the elderly will not align with current solutions (Coleman, Gibson, Hanson, Bobrowicz, & McKay, 2010). In contrast, Güldenpfennig and Fitzpatrick argue in favor of allowing inexperienced elderly to explore the design space beforehand by introducing market-ready standard solutions before involving them. Their argument is rooted in a “Research through Design” approach (Zimmerman, Forlizzi, & Evenson, 2007). They argue that certain practices, that potentially can provide benefit and should be supported, need to be evoked by introducing technology (Güldenpfennig & Fitzpatrick, 2013).

Both approaches have in common, that they expect a “design space” or a space of opportunity with regard to the design goals that can be either created by the users themselves (Coleman et al. 2010) or that can be understood by exploring technologies (Güldenpfennig and Fitzpatrick 2013). Yet increasing complexity in ICT, invisible technologies (through advancements in ubiquitous computing (Abowd & Mynatt, 2000)) as well as adaptable systems based on machine learning make it harder to envision potential solutions without actually experiencing them. Instead of envisioning a mobile app or a single artefact, users now have to envision whole infrastructures and understand their relations at least so far that they can give informed feedback. Thus, it remains an open question how PD should address situations in which a given design challenge may be feasible on a technological level, yet its implementation requires a complex understanding of how technologies of different kinds (sensors, computers, mobile phones, data sources, etc.) need to be combined in order to meet the given design challenge.

3 Background and Approach

The focus on the tension of highly complex systems and unexperienced users was established within a nationally funded research project that aims at prolonging the time elderly people can live in their own homes autonomously. A challenge of the project is to identify potentials for support and provide technological compensation for physical decline as well as tools to foster wellbeing in older age. The field we are working in comprises of three different neighborhoods (one in a rural area and two semi-urban areas) all administered by the same housing agency. The agency is involved as a project partner in our study. They allowed us to present the project in one of their regular meetings, and helped us to get in touch with several of the elderly tenants in order to invite them as participants to our study. The participants age ranged from 65 to 75 years and they were not experienced with new technologies. Nevertheless, as it was a voluntary workshop their attendance can be ascribed to their rather active lifestyle (Participants mostly take care of their daily tasks on their own). Our approach combines several empirical methods ranging from ethnographic observations, semi-structured interviews, and various forms of participatory design workshops. For this study, we are focusing on a particular sub-set of these methods in form of a series of “future workshops” (Müllert & Jungk, 1987) that will be described in the following.

The aim of the future workshops was to sensitize researchers (researchers from the fields of HCI, computer science, architecture, social sciences took part in the workshops), landlords and other stakeholders for the issues of elderly people. In total we conducted three of these workshops, one in each neighborhood, each of which consisted of several phases: a preparation phase where we introduced the topic and methodology of the very workshop in detail; a critique phase where users were asked to formulate critical questions and voice their concerns about the idea as well as their current situation; a visionary phase where participants were invited to generate ideas about what an ideal situation would look like, without being concerned about financial or practical limitations; due to reasons outlined below, we skipped the implementation phase which is usually the last part of the method.

Due to the broad scope of the project, this phase openly aimed at identifying the most striking issues affecting their everyday lives the participants could think of. Exemplary issues mentioned were, noise and other disturbances in the neighborhood, complaints about maladjusted or not permitted use of shared trash bins, general lacks of decency, kindness and help in society or inappropriate design of in- and outdoor infrastructures (e.g. showers or bus stops). As expected, issues varied in terms of specificity and were not of focused on a specific technological nature or subject to a particular technological solution. At the same time, it became increasingly clear that the integrated vision we had for our system felt rather disruptive and hard to relate to mundane daily issues, which participants were interested in. The benefits of addressing issues in a more elaborate, integrated way did not become clear. This increasingly visible mismatch led us to stop the workshop at this point and skip the implementation phase.

As follow up to the context study we wanted to bridge the apparent mismatch. The idea was to come up with design ideas that could serve as an entry point for the users and be relevant in their daily lives even though they did not yet need or want the full package of ambient assisted living technology. For doing so, we combined the methods of Brain writing (Arthur B. VanGundy, 1984) and Design Studio as creativity methods. The Design Studio method typically consists of an illumination phase to get a shared understanding of the problem space across participants (we used Brainwriting in this phase), an ideation phase, which consists of rapidly crafting potential design solutions, and a presentation and critique phase to discuss the solutions. This combination of methods was used in order to transform identified issues of the first phase into possible solutions. In this phase participants belonged to the fields of HCI, computer science, architecture, health, and social science. This set of interdisciplinary participants was chosen in order to include technological expertise but also explore solutions without technological focus. In order to include the future users of our system, we also made use of interviews which we had conducted with almost all participants of the future workshops, so that the participating researchers were able to take the role and perspective of the users as much as possible.

This phase resulted in the creation of different assisting technologies, e.g. little helpers (such as smart buttons that trigger certain predefined tasks, like putting things of a shopping list or shopping assistance to track what needs to be bought), different awareness tools (such as bracelets, that inform users about events or people nearby), safety, health and emergency tools (video surveillance, smart medication boxes or fall detection) and features to enhance wellbeing (such as social gaming in public spaces or evoking memories of happy moments).

To evaluate our ideas, we conducted a shared workshop with participants from all neighborhoods in order to present our ideas to the users and finally to allow them to participate in the implementation of the project. We grouped our ideas into areas that we had identified as being of interest for the users: health, living at home, and social participation. Each of these areas consisted of 4-6 ideas that we had generated in the second activity, each of which was discussed with participants of the workshop, again allowing them to voice concerns and suggestions. In order to engage the users and make participation easy for them, we tried to make the presented ideas as tangible and concrete as possible—a challenge especially with regard to the underlying system as well as the adaptive, learning nature of the project. It was hence no surprise that the discussions about the greater picture required more moderation and input from the present researcher as compared to the more direct, lightweight discussion of singular components. It was surprising to see that especially the safety related ideas were received positively (e.g. triggering emergency calls, surveillance of garages, etc.). Rather concrete concepts, like the smart buttons or shared bulletin boards were also deemed useful. Cross cutting ideas (e.g. a timeline to organize events and control the system or features based on pattern recognition), that were not as focused as the “single purpose” concepts were questioned in terms of usefulness and feasibility, even though they addressed specific practices of the participants.

4 Discussion & Conclusion

While the tension between the design and problem space is not generally new (Muller, 2003), we argue that the gap between available technological opportunities and awareness about and experiences with these opportunities broadens. As technology represents an integral part in an increasing number of daily situations, the scope of the problems that technology addresses broadens and is harder to grasp for developers and designers. Addressing these more complex problem spaces resulted in adaptable, learning and connected technological infrastructures, which in turn are very hard to grasp for regular users.

First, the degree of technological complexity that we bring into the lives of users requires staging. While PD has initially been concerned with rather focused issues of specific tasks with the workplace, we are now dealing with technical systems that span across different spheres of life. This requires systems to be distributed, emergent, and more and more autonomous in their nature. The vision of the IoT, combined with approaches from ubiquitous and pervasive computing, leads to a situation where we are not so much dealing with systems anymore, but rather need to think about designing of, for and with systems of systems (Liegl et al., 2016). Such increasingly flexible assemblies of components imply very steep learning curves and demand new concept to foster learning of the design space within PD.

Second, for the developers and designers the issue of more interrelated problem-spaces. With ICT increasingly permeating the everyday life of users, and the rapid technological development that affect very different areas of human life, we are dealing with fields that are under constant change and characterized by a high complexity and interdependencies. As all sorts of technologies are already playing a role in the practices of users, it will be necessary to acknowledge them in PD, pushing the issues outlined above even further. As ICT is becoming more and more like an infrastructure for users, it moves more and more into the background; making it visible and addressable in PD thus can be hard despite or in fact because of its ubiquitous and pervasive character. From our perspective, this indicates a need for new approaches and tools to make technology and its effects more visible for the users, again allowing them to reflect what the changes in these systems mean for their life—not only on the level of the interfaces and applications, but also on the underlying infrastructures (Pipek & Wulf, 2009).

For future work, one opportunity might be to develop a more transparent design of ubiquitous ICT, in a way that it is not invisible to the user, but rather includes him/her in order to allow the discoverability and learnability of infrastructures for design in a similar sense as existing tools for appropriation support of users (Boden, Rosswog, Stevens, & Wulf, 2014). With regard to the idea of PD, it remains open how participation can be fostered on the backdrop of the presented issues of infrastructural complexity. For example, it is interesting to explore how to enhance the process of mutual learning. Our case serves as an example on how very complex technologies can be designed together with users. Yet, it is still and open question in how far exploiting user's problems and critique as a resource rather than a boundary for design still holds up to the concept of PD, and in how far ethical and social issues can then still be acknowledged and turned from matters of fact into matters of concern (cf. Liegl et al., 2016).

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