User Centered Design and User Participation in Inclusive R&D

Introduction to the Special Thematic Session

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Abstract. This session reflects R&D on User Centered Design and Development and User Participation (in short UCD in the following) for/with people with disabilities. Better guidelines, methods, techniques and tools are needed to improve the quality of R&D and practice both in the domain of Assistive Technology (AT), eAccessibility and eInclusion itself but also for improving the quality of mainstream R&D through UCD and participation of people with disabilities. We analyze the state of the art, identify gaps and problems as well as discuss examples and new approaches presented in 5 papers. The introduction integrates the topic into the broader context of UCD in Information and Communication Technology (ICT) and Human-Computer Interaction (HCI) playing a major role for AT, eAccessibility and digital inclusion. We underline the need for ongoing and more intense R&D on UCD to improve quality and usability. By promoting this session in the ICCHP conference series we aim at establishing a comprehensive point of access to scientific work in this domain.

Keywords: User Centered Design • Participative research • People with disabilities • Accessibility • Assistive Technology

1 Introduction

UCD is recognized as important success factor for R&D to reach a high level of usability and good user experience (UX). It has a profound impact on the quality of products, processes and services. UCD thereby provides a very level of high return on investment (ROI) [1]. We can expect that this also holds true for the domain of AT and eAccessibility. A number of success stories underlines the potential [2]. But besides singular examples, considerable gaps are identified. Guidelines, methods, techniques, tools and practice for UCD in R&D still show problems in efficiency, effectiveness and usability. This relates to inclusion of people with disabilities in UCD for mainstream
R&D and application, but also for R&D in AT and eAccessibility itself. For example, only rather recently cognitive accessibility got taken up for WCAG [3].

UCD in practice is often an add-on to the R&D process, restricted to initial user requirements studies and final evaluation. Because of a lack of concepts and methods of cooperation with different user groups, UCD is often regarded as an additional burden in R&D projects, despite the proven benefits for usability and accessibility [4, 5]. Holistic approaches also facilitating participation of people with disabilities throughout the process, contribution to ideation, planning, decision making and leadership are not considered, as successful examples of UX based design would propose. R&D still tend to be more “about” then “with” people with disabilities what risks lower quality of output and restricted uptake. Recent studies provide evidence both on these gaps but on the other hand also on the benefits of UCD leading to increased quality of R&D [6].

This STSs intends to provide an open and creative platform for further evaluating and reflecting this state of the art and discussing new and innovative ideas and concepts. It intends to provoke and support more R&D. As an ICCHP series over the next years it should lead to a comprehensive point of access to scientific R&D.

2 ICT, HCI, Assistive Technology (AT) and Accessibility

UCD is the result of a fundamental paradigmatic shift taking place over less than a century. In 1933 the motto of the world exhibition in Chicago “A Century of Progress”, was: “Science finds, Industry applies and Man conforms!” [7]. Only a few decades later, this has been turned around into “People Propose, Science Studies, Technology Conforms”, as expressed by Donald A. Norman [8]. ICT and in particular the HCI in the second half of the 20th century have been playing a key role in this turnaround [e.g. 9]. More and more resources are invested to bridge the gap between the conceptual models of computing systems, and the mental models of the growing diversity of user in differing contexts and situations. Besides technical functionalities, overcoming the “gulf of execution” in terms of understanding what functionalities the interface provides and affords, and the “gulf of evaluation” in terms of understandability of the reactions/output becomes a challenge [10]. Four steps describe this development: [8]

- **Utility:** “It fulfils the task, provides functionalities needed.”
- **Usability:** “I can use it, it’s easy, efficient, effective.”
- **Desirability:** “I like the style and look&feel.”
- **Experience:** “It is part of myself/my lifestyle.”

Each step requires and builds upon what was learned and achieved on the steps before. And with each step the complexity and interdisciplinary challenge increases. Statistics underline that more and more resources, even up to 50% in ICT projects, are invested in HCI and usability due to the high level of ROI [11]. UCD is a key answer to this increased need of addressing usability and a profound set of guidelines, principles, methods and tools for UCD gets available [e.g. 12, 13].

AT and accessibility can hook on this state of the art. Three qualities of ICT/HCI facilitate this progress and have enormous potential for people with disabilities [14]:
1. First, even if computing entered into a fast and ever accelerating development with more and more hard- and software, the basic principles of HCI are considerably stable, standard, universal and sustainable. Once learned, one can use the restricted number of elements (e.g. windows, icons, menus, pointer – WIMP, but also speech output, haptics, images, videos) and interactions (e.g. point&click, drag&drop, touch, gestures) in all situations and on the diversity of devices, what makes HCI a basic cultural technique. We change or devices and application faster and faster, but only because we can trust that the basic principles of interaction are still there. Only slight changes taking place as otherwise users would not follow. And this offers an enormous potential to AT, Accessibility and inclusion. The more digitization, the more systems and services integrate into the standard HCI. Instead of running behind the numerous interfaces with their particular and proprietary features, we can focus on one global standard [14]. There is strong evidence that this has been forming the base for the sustainable development of standards as WCAG [15].

2. Second, standard and stable HCI, when running in a digital virtual environment with more and better tools and techniques, is considerably flexible and adaptable to the user, their tasks and their environmental settings. We might use only a few operating systems with a similar look&feel and applications using the same features etc., but each personal interface is different, adapting to personal, tasks and environmental factors. And this holds also true for people with disabilities. As all other users, people with disabilities can expect that the HCI adapts and supports their AT and interaction preferences. And we can expect more form the upcoming user tracing and Artificial Intelligence (AI) trends. We see a lot of impact on mainstream as many features for adapting the HCI origin from AT and Accessibility R&D.

3. Third, this makes usability and UCD a key factor for the success and progress also for AT, eAccessibility and eInclusion. Systems are requested to react and adapt on the fly to users including those with disabilities, tasks and situations when computing becomes ubiquitous including things and processes in the environment (e.g. IoT).

3 AT/Accessibility/HCI/ICT and UCD

Progress can be seen for most groups of people with disabilities. Studies underline that UCD is an indispensable aspect of R&D in accessibility, AT and digital inclusion [e.g. 16]. First approaches to and examples of targeted guidelines, methods, techniques and tools are at hand to reach a high level of usability for people with disabilities [15]. But the state of the art also underlines, that UCD is not taken up and widely used in a comprehensive manner due to lacking understanding of the benefit, lack of know-how and support for efficiently facilitating UCD. Also, the cost of UCD are not valued against its ROI. Therefore, UCD stays more an add-on than the guiding principle of R&D.

For people with cognitive disabilities in particular the situation is even worse. Considerable obstacles are reported relating to a lack of methods and tools for including the group due to communication issues [6, 17]. UCD here goes beyond adapting content, methods, techniques and tools in the UCD process. Cognitive
disabilities demand for approaches of decoding, processing, understanding content and processes perceived and making it part of a mental structure to allow people becoming active and participating in UCD. This goes beyond standard sensory and physical accessibility issues [18]. It is underlined that R&D for this target group mostly works based on expert opinions and a mediated understanding of the user. The core demand of participation is much less reached for this group [17].

But also new and innovative R&D and experimenting on methods, technique and tools/ATs for UCD can be identified for people with disabilities also including those with cognitive disabilities. Participatory Action Research (PAR) [e.g. 19], which is well established in social and educational sciences, is considered and tested for inclusive R&D. Inclusive PAR (IPAR) [20] aims at adapting guidelines, methods, processes and tools for people with disabilities. IPAR involves people with disabilities in all steps of action research and therefore also addresses complex communication barriers. Combining IPAR with UCD, as proposed by Edler [21], provides a holistic approach for innovative and new R&D worth being discussed and explored.

This shows the broad domain of UCD in R&D. Guidelines, methods, techniques and tools are to be analyzed, evaluated and adapted for inclusive settings, new approaches are needed. This session as part of the ICCHP conference series addresses:

- UCD in inclusive and participatory R&D and design processes and settings, e.g. phases, timing, role & task allocation, room
- Accessible and supportive R&D and communication environments: respecting, expressing, discussing, influencing, noting, evaluating, understanding at same level
- New and adapted guidelines, methods, techniques and tools for inclusive and participatory R&D and design
- New approaches in supporting user tracking and understanding, also based on AI, supporting better UCD and user participation
- Impact, outcome of R&D based on UCD

4 Contributions to Inclusive R&D in Inclusive UCD

The contributions to this session integrate into this context and demonstrate the importance of progress in this domain. The critical reflection is done against the above-mentioned holistic participation of users in all steps of the process. From the numerous submissions received, five got accepted for this session. It is also to be mentioned that many of the scientific R&D presented at ICCHP and in other literature is worth to be reflected against this state of the art.

- The first paper discusses accessibility support for mobility by an app, in particular when doing a train journey by blind and low vision users. The problem is outlined by a service provider (Swiss Railways) and negative experiences expressed by disabled clients. Beyond the basic accessibility of the systems an emphasis is given to the user experience. The core UCD method used is a hackathon (action research), where in all cycles of the event end users are involved. During the cycles, observation is used for eliciting requirements, followed by a final survey. Important
aspects of UCD are addressed, but not yet a holistic approach as discussed above. The problem definition enters directly into a UCD approach with strong user participation but user participation in the following phases is unclear, except the evaluation at the end.

- The second paper focusses on eliciting the requirements and expectations of older people from supportive robots. The approach is based on the review and analysis of the state of the art in this domain and provides evidence that the obvious potential fails in raising interest for integration into application and practice. This provides a fine example for user participation in requirements studies using interviews and coding the results (NIVO), but does not discuss the following R&D regarding UCD.

- The third paper presents the process of implementing a prototype for a visual/tangible environment for developing programming skills, in particular for children. The state-of-the-art analysis provides evidence that the manifold approaches and tools in this domain are inaccessible. In a usability study, including pre-training, accessibility, problems and challenges are identified using a training and an evaluation session. UCD is concentrated in these initial studies and a survey at the end.

- The fourth paper presents a new method for evaluating accessibility with/by people with disabilities. The consigliere evaluation method is proposed for situations where very specific domain knowledge is needed and no or very few users with disabilities can be found. To overcome this limitation in UCD, three people are to be employed to play three roles: the participant with disability (end user knowledge), the consigliere (domain knowledge) and the enforcer (domain accessibility expert). A case study for using the consigliere methodology is presented (university system management) employing 8 blind and visually handicapped users. The case study proves the concept of an innovative approach helping to overcome a key restriction in UCD with/for people with disabilities, what should meet with considerable interest for other domains and target groups.

- The final paper presents the IPAR-UCD method (Inclusive Participatory Action Research for User Centered Design). The method proposes to educate and involve people with disabilities, in this case people with cognitive disabilities, as co/peer-researchers. They take part in the whole process of R&D and influence/direct decision making in all phases. The method is developed and tested in the frame of a bigger R&D project. For the selected target group IPAR-UCD provides a fine example of a holistic UCD approach of interest for other domains and also target groups.

These examples show a broad and interesting mixture of approaches, where the first are more focused on examples of applying UCD to proof the scientific value of R&D. The methodological setting is mostly defined on base of restricted available resources and the pressure to deliver results underlining that there is still a need to improve the understanding for the contribution of UCD to R&D. Even if UCD is outlined as essential for R&D, the selection of the methodology is often not reflected and appropriate for the intended R&D. The last two papers are exceptional in this sense in terms of addressing UCD methods at a meta level. This invites to more research to increase the quality of AT and accessibility products and services. Monitoring and
analyzing the methodological approaches in much more detail is needed to better understand if and how a more holistic and comprehensive UCD and participation of end users in all steps of R&D could be beneficial for procedures, results and uptake.

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