Considering older adults throughout the development process – The HCD+ approach

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With the demographic change, the percentage of older adults increases while information and communication technology (ICT) becomes ubiquitous and often indispensable. However, many older adults using ICT encounter usability problems, particularly if the ICT was not designed with them in mind. If older adults are considered, their participation is often limited to the evaluation of a finished product. Our approach called "human-centered design for aging" (HCD+), considers older adults' requirements and abilities throughout the development process, adapting established HCD-methods to accommodate the participation of older adults as experts for their own age group. This approach has been tested in a research project aiming to link older adults' life stories to historical events and appreciating their life experience. By conducting interviews, focus groups, workshops and evaluations with older adults, meta-guidelines were identified and integrated into the HCD+ approach. Following this approach, older adults can be better served by ICT, fostering their participation in society.

Introduction

HCD+ is an integrated approach to develop Information and Communications Technology (ICT) for older people (see figure 1 for an overview). As the name suggests, HCD+ is based on the Human Centered Design (HCD) process and the principles described in DIN EN ISO 9241-210 and complements it with its focus on user characteristics and their impact on the design process and results, just like DIN EN ISO 9241-210 complements other existing design concepts. HCD+ is still in its formative stage, with a growing empirical base to evaluate, confirm and select existing design practices, as well as to create new design methods and recommendations with a focus on designing for older adults.

HCD+ methods have been put into practice and further developed in the research project "History telling" (HT). HT aims to link older adults' life stories to historical events, appreciating their life experience and fostering their social integration on a web-based platform. So far, a total of 183 people (aged M = 66.6; SD = 7.5) have participated within the HCD+ phases of HT (focus group) workshops, interviews and evaluations.

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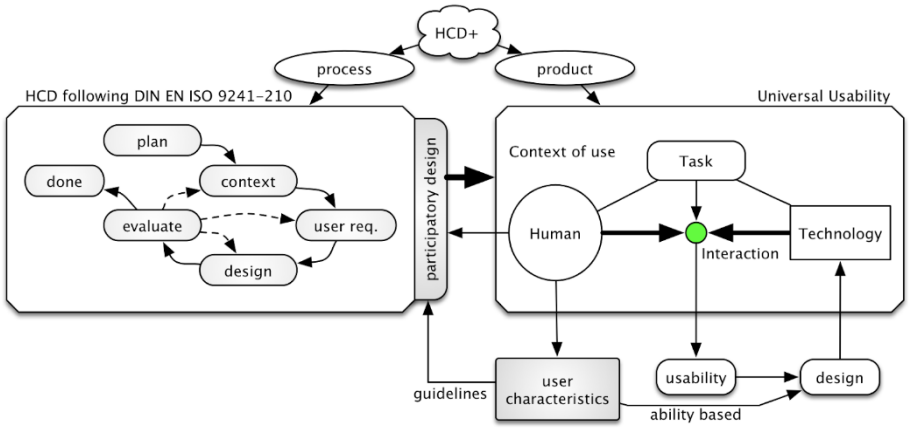

Figure 1. Overview of HCD+ as an integrated approach to develop ICT for older people.

HCD+

HCD+ started as age differentiated design, with the "+" indicating older adults, which were often referred to as the age group 65+. This was in line with numerous research efforts for age-appropriate design of Man-Machine-Systems (MMS) that consider age as key feature for the classification of users (e.g. Charness et al., 2016; Coelho et al., 2015; Fisk 2009; Kurniawan, 2007). Yet it became apparent that age itself was rather a meta-trait embodying different user characteristics with enormous variability (Fisk, 2009) and did not predict the quality of human technology interaction as much as more specific age-related user characteristics (e.g. Sengpiel, 2015). Focusing on such age-correlated user characteristics seemed more relevant to usability and design, as they can be addressed more directly, e.g. in ability based design (Wobbrock et al., 2018; Wobbrock et al., 2011) or more broadly, design considering relevant user characteristics of which not all are abilities (e.g. attitudes, control beliefs, see Sengpiel 2016). Thus, the "+" became an indicator for the consideration of user characteristics in the design process with a focus on older adults. Of course, other age groups (e.g. children) might require special consideration as well. This is in line with concepts like Universal Usability, claiming that improving the usability for older adults will improve it for younger people as well (Shneiderman, 2000). Here, the History Telling (HT) project promises further insights, since it aims to bring together people across generations on one platform, e.g. grandparents and their children and grandchildren.

Overall, HCD+ addresses the *design process* as well as the resulting *product*. As Figure 1 shows, the iterative process follows DIN EN ISO 9241-210 with its focus on context of use, user requirements, design and evaluation (left side), and the goal of creating a universally usable product (right side). The green circle marks the interaction between Human and Technology to achieve a task or support an activity. One measure of the quality of that interaction is the usability, and in a broader sense, the user experience. Ensuring high quality of this interaction can be very challenging and calls for thorough research and design. Fortunately, there is a large body of knowledge, methods and design principles available to work towards that goal and

HCD+ aims to build upon these with a focus on age specific changes in user characteristics over the life span, trying to incorporate them into a research based design approach that appreciates older adults as users and designers (Jochems & Sengpiel, 2016).

Humans differ in many ways, yet some characteristics are more relevant to the interaction of Human and Technology, e.g. they can predict the quality of the interaction and inform design decisions more than others. Relevant user characteristics can inform the *design process* (especially if it is participatory) as well as the design of the technology itself (as product or service). Here it becomes apparent, that such user characteristics include but are not limited to abilities: Let us assume, we have learned throughout our research that older adults appreciated a comfortable user testing atmosphere with „coffee and cookies“ more than younger adults, and hence we try to provide it in testing and incorporate it into our guidelines as a direct consequence for the participatory design process. This preference is not an ability, but it is a user characteristic. Likewise, user characteristics that are not abilities, such as attitudes and control beliefs can inform product design itself, thus extending the concept of „ability based design“(Wobbrock et al., 2018; Wobbrock et al., 2011).

Finally, just as older adults have the right to have products made for their abilities and preferences, they also have a right to decide not to use a product that does not fit their needs. People usually have a choice whether to accept and use a product. Ideally, they know about available alternatives to accomplish their goal or support them in their desired activity and can assess their potential risks and benefits. Yet that alone is not an easy task, as can be seen in paper titles such as „Online T & Cs longer than Shakespeare plays—who reads them“ (Parris 2012) and „Big Data and The Phantom Public: Walter Lippmann and the fallacy of data privacy self-management“ (Obar, 2015). Once they have chosen a product, they need to know how to operate it. This distinction of knowing what to use and knowing how to use it is also reflected in the terms awareness and competence as constituent parts of computer literacy as defined by Mason and McMorrow (2006).

Many design solutions for older adults address the competence issue and age-related decline in sensory, cognitive and motor abilities, and it is important to consider them in the design process. However, ageing encompasses more than decline and life experience might also lead to changes in preferences and motivation to use a product. Yet, in particular for older adults, non-use is often viewed as a deficit that needs to be corrected with training and instruction, whereas older adults might have good reasons not to use (new) technology. On the one hand, these reasons may be found in the technology itself (e.g., bad usability or privacy risks of Big Data in social media) and, on the other hand in age-driven changes of cost-benefit-functions as described in the SOC-model of successful ageing by Baltes and Baltes (1989).

The HT project aims to fit older adults' needs by compensating age-related deficits and by playing to their strengths when tapping into their wealth of life-experience as a means of social integration. The next section describes the History telling Project as well as the methods used.

The History telling Project

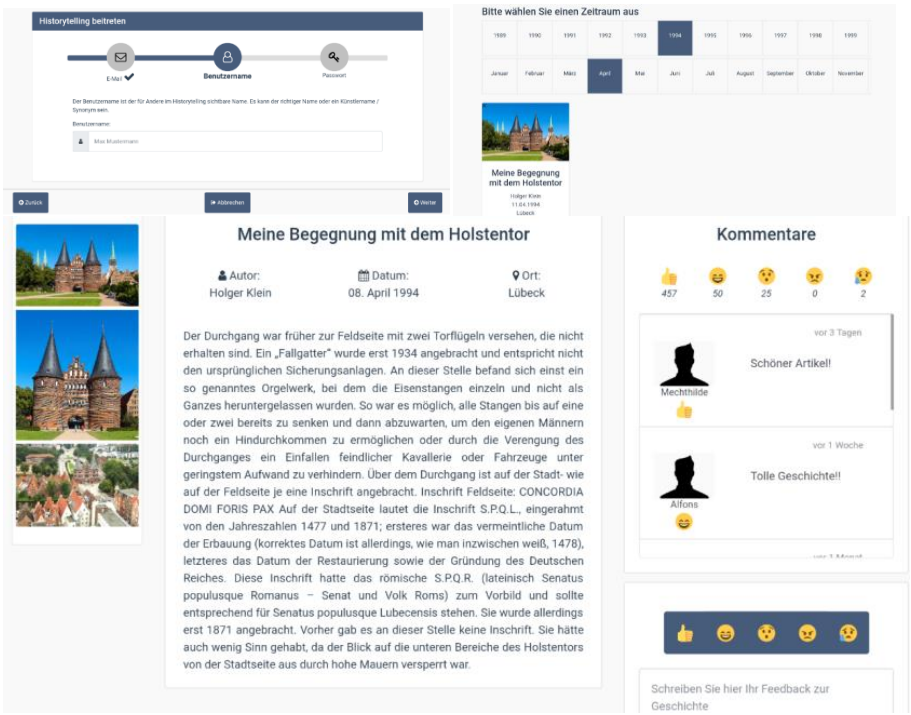

Figure 2: Screenshots of the current state of the History telling project. Top left: registration process; top right: selection of a story; bottom: story presentation

The History telling (HT) project aims to empower older adults by giving them a tool to tell life stories on a digital platform and share them with other people. Thus, it has implications on the personal and the societal level. On the personal level, HT offers a possibility for reminiscence and biography work and can strengthen the contact to one's own story and to family and friends and new people. On a societal level, HT offers the possibility to experience history, first-hand from multiple perspectives and enriched with multimedia, spreading experience-based knowledge across generations.

At the core of the HT project is an interactive social network site, on which users can record their life story, enrich it with multimedia content and embed it in a spatial and temporal context. Furthermore, stories can be shared in a family or public space, so that vivid interaction between users of the platform can emerge through the stories, providing a powerful incentive to write more stories. See figure 2 for screenshots of the current state of development.

Participatory design within History telling

For the development of History telling, it was a key goal to integrate potential future users from the very beginning in the development process. Thus, 19 interviews with older adults were conducted in the ideation phase to establish acceptance by creating

something useful and to derive the project's roadmap for a minimal viable product before the development itself began (Volkmann et al., 2016) and to ensure that a system was to be developed that suits the needs and interests of older adults.

Following the HCD+ approach, component-based development was used to realize the roadmap step by step. With the use of modern web technologies, it was possible to develop a usable prototype first and then add new functionality component by component. This approach also promised faster development of the whole system and replaceable parts of components for better and more focused evaluation. Every new component starts a new HCD+ cycle, in which users are considered and integrated as early as possible. To accommodate the challenge of consistency, which this software development approach has to deal with (Crnković, 2003), a living style guide was developed based on the CSS framework Bootstrap and age differentiated guidelines were established (e.g. Zaphiris et al., 2005; Hodes & Lindberg, 2002). At the current state of development, we have a frontend system with the following components: (1) *Registration* to assign published stories and comments to users; an (2) *input* component to write the stories; a (3) *feedback* component to display and write comments for stories; a (4) *timeline* component to display stories. Furthermore, a (5) *speech* component to interact with an avatar and to provide speech to text input and a (6) *stimulus material* component to stimulate the users' imagination was developed. Finally, a (7) *backend* was developed to store and provide the necessary data.

Participants and Recruitment

So far, 183 participants took part in the different phases of HT development (125 female, 51 male, between the age of 46 and 93 (M = 66.6; SD = 7.5). They were recruited through managers of assisted living facilities, by speaking with local groups such as the "Frauenring" (Women's ring) and "Landfrauen" (Country women) and through personal contacts. Because of different questionnaires used to assess affinity to technology, computer literacy and technology adoption in various contexts, there is not data for all participants, but most of the participants used a computer or a smartphone at least weekly. Computer literacy was assessed for 35 older adults which showed that the computer literacy of these participants was above average regarding older adults (Sengpiel & Dittberner, 2008). Also, there was a high range of computer literacy within these participants (min=11; max=26; SD=18.6; SD = 3.1).

Atmosphere and procedure

Whenever possible, the participants were free to choose the location. Thus, most of the interviews and evaluations were conducted in their private homes, and workshops were mostly conducted at the university. There were a few exceptions, e.g. for the observation study, which was conducted in the rooms of an adult education centre and one workshop which was held in a church room. We provided breaks that were longer than necessary to allow more time to socialize. For some of our focus group workshops, we used a moderator within the age of the target group.

Methods

Different methods in all stages of the HCD+ life cycle were used to develop HT components: semi structured interviews in the *ideation* phase, observation, group

interview, focus group workshop and semi structured interview in the *analysis* phase, focus group workshops in the *design* phase and field study, task completion with think aloud, wizard of oz and semi structured interview in the *evaluation* phase. Evaluations were conducted in two loops, conducting formative evaluations with low-fidelity prototypes first and summative evaluations with refined prototypes later (see table 1).

Table 1. Number of participants in the development of History telling assigned to HCD+ phases

	Participants				
		Gender		*Age*	
Phase	*#*	*f*	*m*	*M*	*SD*
Ideation Phase (semi structured interview)	19	12	7	72	5.5
Analysis Phase (observation, group interview, focus group	43	34	9	66.7	7
Design Phase (focus group workshop)	19	16	3	68.7	6.3
Evaluation Phase (task completion and think aloud, Wizard of	102	63	32	66.3	7.3

Lessons learned

This section presents the lessons learned for HCD+ working on the HT project.

Recruitment

It became apparent that it is important to invite participants to activities with a fixed date as early as possible due to full schedules, a point that Lindsay et al. (2012) also indicate, although it cannot be confirmed that it is important to recruit more older adults than required. It was easier to recruit groups of people and stay in touch with the most engaged persons in these groups as they could be considered as a pull factor for other group members. In the conducted methods it worked well to recruit older adults based on mutual give and take, although monetary incentives may also work (Voorberg et al., 2015). Therefore, focus group workshops were combined for example with a technology introduction part which sometimes became a key driver to participate in the events. The recruitment process showed that only those participants attended who had a higher technology adoption than the average older adults' population.

Atmosphere and procedure

Participants often appreciated activities as social events. Thus, long breaks were provided to give enough time to socialize, which was well received (see also Lindsay et al., 2012; Massimi & Baecker, 2006; Ellis & Kurniawan, 2000; Newell et

al., 2007). Participants stated the importance of a comforting atmosphere within workshop sessions and evaluations. Lindsay et al. (2012) stress that this can also enrich the creativity and overall output. Participants used the sessions to learn about technology and asked many questions, especially in the breaks. Workshop leaders were included into the social group to provide information to the participant, a practice also stated by Newell et al. (2007). Because of these special considerations and the diverse group of participants, the exact timing was difficult and nearly all methods took longer than predicted. Figure 3 shows different situations within a workshop.

Figure 3: Atmosphere within a conducted workshop. Top left: introduction to technology; top right: simulation game as part of the workshop; bottom: socializing break

Methods

Older adults are a very heterogeneous group, especially regarding technology experience and adoption. Therefore, fall-backs had to be established if technology experience was crucial, e.g. using abstract description of technology or low-technology fall-backs. Also, parts of the conducted workshop were accommodated to participants' wishes, such as addressing the question "how does communication with emails and other software on a smartphone work". Finally, for some tasks the researchers had to explain repeatedly the scope and reasoning for both the particular method and the technology, e.g. to address privacy concerns.

Resulting Guidelines

Findings thus far resulted in the following guidelines, which are instrumental for the development of the HT Project can be found in table 2. It is important to note that

these guidelines are still work in progress and actively developed further within the overall process.

Table 2: Resulting guidelines for HCD+ based development

	Guideline	*Description*
Recruitment	Engage with group leaders	Group leaders can pull the whole group to participate in activities
	emphasise reciprocity when recruiting	As the elderly like to help, they also like to get help. Instead of monetary incentives, technology adoption workshops often work as incentives in itself.
Atmosphere and procedure	Plan for social engagement	Giving time and space to socialize is always appreciated by older adults as is a comforting atmosphere ("provide cookies and coffee").
	overestimate the scheduled time	It is difficult to estimate time for methods like workshops and interviews because of older peoples' diversity
Methods	Accommodate participants' wishes	Within a workshop or evaluation setting, unplanned wishes, e.g. to get more information can occur. Accommodating these wishes is much appreciated.
	Establish fall-backs	Sometimes activities do not work out as expected, e.g. because of little technology experience and adoption. Planning for low-technology fall-backs helps.
	Use abstract descriptions of technology	To envision tasks, abstract descriptions of technology work best to stimulate the creativity of older adults.

Discussion and outlook

As shown within the History telling Project, the HCD+ approach can guide the development of software towards universal usability for older adults and their children and grandchildren. At the same time, HT provides feedback towards improving the HCD+ methodology. For the HT Project it will be important to broaden the usage of various technologies such as new input and output technologies and to broaden the context of use to assess the experience of the HT core idea within other settings. Also, a longitudinal evaluation should be conducted to assess real usage data over time, such as number and length of postings, time spent on the website and frequency and severity of usability issues. This might lead to the development of new components and to an improved utility, usability and user experience of the History telling system, increasing its value for the individual and

the society. One such development has been to find more stimulating storytelling and -sharing environments, which has already been realized as a student project with the museum “Günter Grass Haus” in Lübeck (see figure 4) and will be described in detail in future publications.

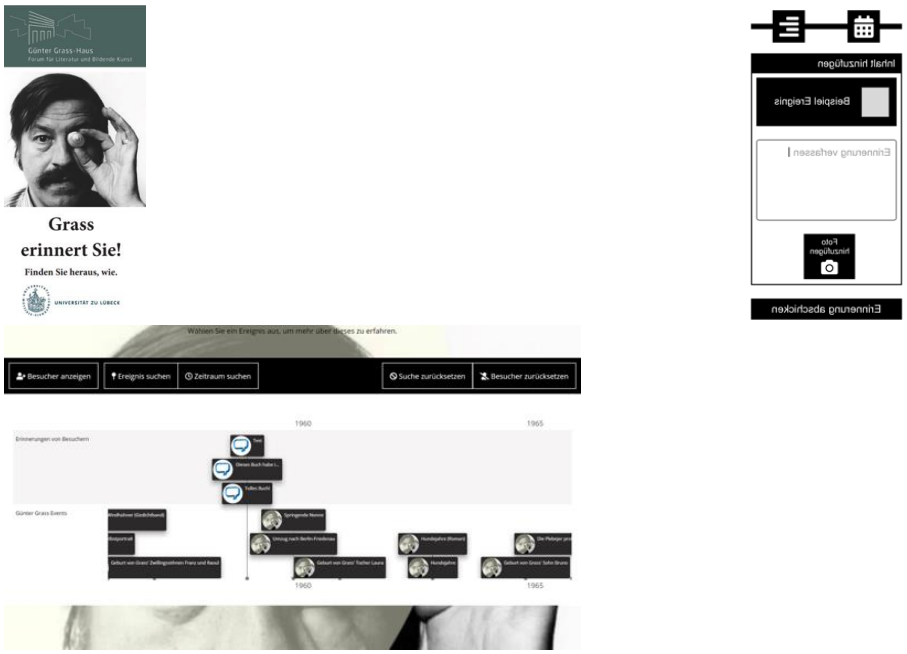

Figure 4: History telling at the Günter Grass Haus in Lübeck, consisting of flyer (left), mobile app (middle) and website (right)

As HCD+ is still in its infancy, there are various plans to improve it continuously alongside History telling and other projects. Central to these efforts is the fast, reliable and valid assessment of user characteristics and their impact on the design of products and services and the design process itself. These user characteristics encompass abilities and skills such as eyesight and computer literacy as well as attitudes and motivational aspects such as control beliefs and preferences. One of the process related outcomes will be the continuous revision and extension of the practical guidelines described in this paper. Naturally, HCD+ will also test, evaluate und incorporate applicable methods found in the literature to converge further towards its goal of universal usability with a focus on older adults and welcomes pointers and cooperation in this direction.

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