

AAL-Technology Acceptance through Experience

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ABSTRACT

Despite substantial research and development of Ambient Assisted Living (AAL) technologies, their acceptance remains low. This is partially caused by a lack of accounting for users' needs and values, and the social contexts these systems are to be embedded in. Participatory design has some potential to overcome these issues, but still a high threshold in commitment, (financial) investment and effort remains for potential users, who are often not familiar with the technology, its benefits and its user experience. Our goal is to reduce the threshold by allowing people to take a 'sneak peek' in a neutral setting to experience possible benefits of an AAL system and its interaction without the need to commit. In the paper we propose introducing AAL technology through mediator installations. We present three core design qualities for such mediators exemplified in a design case.

Categories and Subject Descriptors

H.5.2 User Interfaces.

General Terms

Human Factors, Design.

Keywords

Ambient Assisted Living, Technology Acceptance.

1. MOTIVATION AND BACKGROUND

The developed world is facing significant challenges around the health and care of aging populations. Technology is seen as a key enabler for meeting the challenges. Therefore, Ambient Assisted Living (AAL) is receiving increased attention from government, industry and research. Nonetheless, there is a "current gap between policy enthusiasm for [AAL] and its more limited uptake and impact in practice" [7]. In many cases a technology-focused development process lacks the embedment into a broader social context and consideration of users' needs and values. This leads to a lack of perceived usefulness [9], poor usability, lack of trust, and financial barriers like the absence of reimbursement arrangements [12]. Additionally, AAL systems are often 'imposed' on seniors by others (e.g. family, doctors, policy-makers), thereby putting

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seniors in the role of passive receivers of care. Seniors rarely get a chance to explore AAL-technology and are consequently not actively involved in the decision-making of acquiring it. This undermines their control and perceived independence [3].

Hardisty et al. [8] concluded that "[a]ttempts at implementation have paid insufficient attention to understanding patient and clinical needs and the complex dynamics and accountabilities that rise at the level of service models. A suggested way ahead is to co-design technology and services collaboratively with all stakeholders." (p.734). HCI researchers have recently turned to such participatory approaches, e.g. [11]. Participatory design indeed has potential to overcome the lack of accounting for needs and social contexts. We follow this approach in our projects, e.g. an EU project to develop a smartTV platform providing services to seniors' homes in many areas of life, including health, fitness, care, household, entertainment and safety in a modular way (i.e. different services can be acquired for each user). Making AAL more usable and useful alone, however, is not enough. A high threshold in commitment, financial investment and effort remains for seniors, who are not familiar with AAL, its benefits and the provided UX. Technology acceptance is a long-term process starting when seniors *become aware of a technology*, and ending when they embrace it and making full use of it [13]. Thus, making people aware and informing them are crucial steps.

To that end we propose a novel approach of introducing AAL to the public: by presenting possible benefits of a system for a diversity of needs via a mediator – a specifically designed semi-technical installation representing an AAL system that people can interact with – seniors can gain first-hand experiences and in-depth knowledge before committing to a system. We believe that this step between vague information and full commitment can lower the threshold of technology acceptance for seniors, who will become active decision-makers rather than passive receivers. Mediators are meant to provide a 'sneak peek' by enabling an active exploration of an AAL-system. In a safe and accessible environment, a mediator becomes a means for seniors to take initiative to explore and reflect on the possibilities of AAL at their own pace. Figure 1 shows the acceptance process based on [14] and marks the first phases as the moment for a mediator.

Although seniors would not interact with the real system, we expect that anxiety to approach it later can be reduced. After all, seniors would have actively discovered an AAL-system and

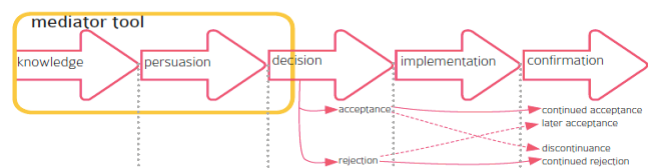


Figure 1: Acceptance Process

constructed knowledge about how its features may fit into their lives. Based on this knowledge they can decide whether to acquire the system and what services are relevant for them now and later. In this paper, we present our ongoing work on the design of such a mediator. We outline three design qualities that are exemplified in a design case and present user feedback on the concept.

2. DESIGN QUALITIES

A mediator should be closely coupled to the system it represents, e.g. in our case the smartTV service platform, to allow potential users to explore its benefits and to experience its interactional qualities. Thus, mediators could take different forms depending on the specific characteristics of the system. That said a number of design qualities that we describe as follows are considered essential for a mediator to be effective.

In the context of our project, we initially conducted exploratory semi-structured interviews. Nine independently living seniors aged 70-76 were interviewed in their own homes and probed about potential barriers and drivers to accepting our smartTV platform, which we showed to the users in form of a working prototype. We received several comments reflecting that the participants did not perceive themselves as being the target audience (e.g. *"I'm still pretty modern..., but when I'm older ... I think there might be some more things I'd want to use then"* (73, female)), that the usefulness of the services to be offered is key, and that seniors like the support of peers when considering new technology. To put this specific feedback for our system into a broader context, we conducted a literature review on factors influencing seniors' technology (i.e. smart homes, AAL) acceptance. Through analyzing the factors and subsequently turning each factor into several drivers for technology acceptance, we were able to identify 'tools' to support the drivers. E.g. user needs and perceived usefulness were identified in the STAM [13] as influential factors in the early phases of acceptance. In the context of user needs 'accepting physical decline' was recognized as a driver to accept assistive technology. Subsequently emphasizing the value of preventive measures was identified as a tool. In a last step we grouped the tools into the following three higher-level design qualities with their possible implementation using HCI tools (e.g. scenarios). These (not exhaustive) qualities were implemented in a concept prototype.

2.1 Empowerment through Active Discovery

Seniors' self-efficacy is an important factor for approaching technology in the first place. Seniors show more positive attitudes when they gain experience and build up confidence in abilities [1]. Therefore it is important to support seniors to experience potential benefits and construct scenarios of personal relevance, i.e. how the system can provide added value and be integrated into their lives. While technology savvy people may be able to construct such scenarios based on technical specifications or by trying out a system, it is more difficult for seniors with low technology literacy or even technology anxiety. To reach all potential users, we introduce the concept of active discovery. Instead of being informed passively or forced to try out the system itself, participants should be empowered to actively discover the system and its benefits. Next, we describe two examples of design elements scaffolding action and reflection in this discovery.

2.1.1 Tangibles as resources for action

While a fully digital artifact would be counter-intuitive to reduce computer anxiety, an analogue mediator adds little to introduce someone to a new digital system. Thus, we suggest a combination

of tangible artifacts for user input and interaction between users, and digital media to represent parts of the system or its output. The use of tangible artifacts has several purposes: they act as (1) resources for action [4], (2) boundary objects to communicate to peers, and (3) a means to induce ownership. Tangible artifacts that represent parts of the presented system can be manipulated and can trigger discussions between users about their meaning.

2.1.2 Visual Stories for Reflection and Envisioning

Actively discovering AAL also involves reflecting about potential benefits and how they could play a role in one's everyday life. Storytelling is a powerful tool to support reflection and envisioning. A mediator should be designed to trigger users to create personal stories of how (components of) the system could be incorporated in their lives now and in the future. Storytelling allows them to project their own needs and desires onto their imagined experiences. Finally, users should be invited to share their stories with peers to enrich their own knowledge about beneficial combinations of services.

2.2 Awareness of Changing Needs

Anticipatory living is another important factor for technology acceptance. Seniors' anticipated future changes in their physical, mental or emotional condition might influence their need for the technology [2]. However, a common misconception is that these transitions impact everybody in the same way and at once. Reality shows that people encounter different needs at different stages and have their own ways to cope and adapt. Similarly, the introduction of new technologies to assist such changes requires a personal and gradual process of adaptation. A mediator introducing features of a system across several stages representing the evolving needs of a person can lead the user to discover immediate relevance of the system to their current situation and explore future opportunities. In this way, features that are commonly stigmatized as being only relevant to frail people, might not affect the early acceptance and later scenarios could be seen as future opportunities rather than threats. Two tools may support awareness of changing needs.

2.2.1 Experiencing changes through spatial transition

To guide a person through the potential benefits of the system for different needs that may change over time, spatial transitions are a means to represent these transitions in life. Spatially separated exhibits force people to walk from one stage to the next, thereby experiencing a physical transition. This invites users to position themselves in the different situations and reflect on the impact the system could have at that stage.

2.2.2 Interactive visuals presenting system benefits

Interactive visuals could provide a rich experience of how a life stage could unfold and how the system could add value. For instance, scenarios provide visual experiences of how systems can be used and, given the characters are believable, allow people to empathize with the character in the scenarios.

2.3 Peer Support

Many seniors have low confidence in their abilities to use technology and perceive learning efforts as high [1]. They prefer to learn with peers because then they do not feel embarrassed to ask questions and pressured about their performance [10]. The mediator should offer peer support. If seniors explore mediators in groups with similar background, but some have technical skills, while others have more experience in the situations shown in the scenarios, each can contribute in a unique way. Through this give



Figure 2: Realization Pathway prototype

and take in the process, they increase their knowledge while at the same time their need of taking part in reciprocal activities is fulfilled [5]. Defining the group size is a matter of finding a good balance between having enough people providing technical knowledge as well as varying perspectives and experiences to trigger insightful discussions and giving everyone the chance to experience the mediator directly. Anything between two (co-discovery) and six (e.g. as in focus groups) is suggested.

3. DESIGN CASE

The developed design concept called Realization Pathway allows seniors to experience and create knowledge about our modular AAL service platform. Through iterations involving users, designers and experts of ageing, tangible and multimedia elements were designed to support the qualities.

3.1 Design Concept

The Realization Pathway invites groups of three seniors (*peer support*) to actively discover the benefits that the AAL service platform provides at different life stages. From early user research we derived several personas grouped into three life stages: (1) healthy, retired seniors with a need for new ways of staying in touch with others (2) seniors with mild chronic conditions that require regular self-checks and (3) seniors that require support in everyday activities. To show how transitions can be facilitated by the platform through the addition of new services, a scenario was created for each stage showing the same fictive character, Linda, using different services as she ages. The stages are implemented using three colored panels positioned next to each other to form a path (*spatial transition*), thereby inviting the seniors to experience transitions by walking through them. Each panel shows one of the scenarios matching Linda's life stage in a video on a TV, e.g. how she uses a service to get in touch with her community (panel 1) and how she uses a service to check her blood sugar levels to control her diabetes (panel 2). Per scenario break points bring the users' attention to certain benefits of the system. Interactive objects (*tangibles*) represent the benefits colored according to the respective panel. Each senior interacts with the mediator by selecting and collecting benefits perceived as fitting him or her. By taking the respective tangibles and arranging them on an openly visible but personal board a personalized view on the same system is created. At the end of the walkthrough, the personal collection is used to support reflection and team discussion on how the selected benefits relate to life situations. The tangibles can be placed on a touch screen interface, called reflection wall, while users create stories of different life situations in which the system would be used to bring the selected benefits. Images of possible locations, people and activities are offered on-screen to

encourage participants to link them with information about their own lifestyle to build and share personal and experience-based stories (*visual storytelling*) about the use of the system.

3.2 User evaluation

The goal of the user evaluation was to gain insights of the clarity and value of the concept of our mediator through qualitative research using a lo-fi prototype (Fig. 2). Instead of filmed scenarios showing interactions with the AAL-platform, printed storyboards were used and instead of the tangibles and interactive touchscreen, magnets and magnetic boards were provided along with a set of printed pictures to be used to create the stories. Nine seniors (aged 65-67) participated in groups of three (all friends except one). All lived independently and three had declared mild chronic conditions. While each group went through the Realization Pathway as described, data was collected through interviews, video recordings and observations to uncover users' experiences and reflections. First, we analyzed the text obtained from interviews and audio of the recordings by transcribing and categorizing the data according to feedback on the design qualities. We also matched people's subjective feedback with the observation of how they used the mediator to analyze whether the provided tools (tangibles etc.) were used as intended.

4. DISCUSSION AND FUTURE WORK

The user evaluation showed that a mediator is promising to introduce AAL-technologies to an older user group. Participants were able to increase their knowledge about the system (see first phase of acceptance, Fig. 1), identify personally relevant benefits for the present and future, and reflect upon these insights with peers. The advantages of peer presence were threefold: (a) participants supported each other regarding technical questions, (b) both intra-individual differences regarding the perception of useful features (emphasized by the life stage exhibits) and inter-individual differences led users to discuss the potential of the system's capability (*"It was fun that we were together. Because she (pointing to another participant) has a different question, a different need, then you can listen to and think (1.3)."*) and (c) exploring the system in a small group resulted in a pleasant social situation (*"Much more fun (1.2)"*). The tangible aspects of the magnets offered affordances for clustering and arranging, thus playing a key role in facilitating exploration and reflection of participants' own and others' priorities towards the system (*"Here I only have one green and you have four. I don't like to be monitored too much (2.1)."*) Interestingly, the most preferred feature came from the third wall, which represented life changes where more help is needed. The scenario described a task list connected to a social network

for helping each other; confirming the value of reciprocity mentioned earlier. (“*The way technology through TV is part of Linda's life, ... it is positive, and it increases her ability to be imaginative in running her life and reaching out to others - either to help or for help. It's an enrichment (1.1)*”).

What is the role of a mediator installation to increase technology acceptance? They are meant to empower seniors to acquire knowledge and to assess whether the benefits of a system are personally relevant or not, thereby focusing on the first stages of the acceptance process (Fig.1). Rather than convincing people to use a system they receive the means to take an informed decision. As one user said, “*it's important to be aware that this [the system] exists but...You don't really want to know...I know it's not the right attitude. It's better to realize what your future would be like (2.1)*”. Although trying to ignore future needs due to aging may be common, this shows the person's insight that anticipating changes and being aware of AAL solutions would be better.

Given that the main effect on technology acceptance might be an indirect rather than an immediate one, possible impacts of mediators would be in generating openness to new technologies, or creating more exposure by those who have already uncovered benefits. Additional steps required for the later stages of technology acceptance need to be investigated further (e.g. trial periods or customer support). However, given that a mediator creates awareness, knowledge and openness to AAL, the path to adoption of new technologies could be shortened. Still, it is questionable that technological innovations will immediately succeed in being introduced and accepted. Given the influence of perceived usefulness on technology acceptance, mentioning and integrating critical aspects into the discussion, e.g. through a list of frequently raised concerns and corresponding explanations could add transparency and trust.

Some practical issues need to be detailed. First, the setting of the mediator needs to be clarified. LivingLabs could be seen as a potential environment to set up the mediator as it offers real life environments that can be adapted to the needs of the research [6]. However, we think that it may confuse the role of a mediator with being a prototype, instead of being an interactive tool that is used to introduce a concept with the ultimate goal to facilitate own reflection and discussion on the possible benefits. User feedback indicated that participants would generally prefer a (semi-) private context to public space to avoid a “public spectacle”. A setting in a trusted environment outside the home, e.g. a community center, ensures easy accessibility, might attract people who would have otherwise not had the possibility, and facilitates to team up with peers. Second, while the lo-fi prototype had its limits, the development of a hi-fi version would enrich the experience, but the trade-off between the analogue, i.e. more accessible, and the digital, i.e. more experiential, needs to be handled with care. Tangible user interfaces might bring appropriate solutions that allow interactivity and adaptation. Possibly, the transition from analogue to digital could even be mapped to the walkthrough.

To conclude, the work presented here takes a first step towards acceptance of AAL by seniors. Although many questions remain to be subject of future work, we propose that a mediator that provides opportunities to get to know a system and its nuanced features through active empowerment, awareness of changing needs and peer support illustrates a promising path when introducing AAL to the public and to equip seniors with the knowledge and experience to make an informed decision.

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6. REFERENCES

- [1] Czaja, S. J., Charness, N., Fisk, A. D., Hertzog, C., Nair, S. N., Rogers, W. A., and Sharit, J. Factors predicting the use of technology: Findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). *Psychology and Aging* 21, 2 (2006), 333-352.
- [2] Courtney K.L., Demiris G., Rantz M. and Skubic M. Needing Smart Home Technologies: The Perspectives of Seniors in Continuing Care Retirement Communities. *Informatics in Primary Care* 16, 3 (2008) 195-201.
- [3] Draper, H., and Sorell, T. (2013). Telecare, Remote Monitoring and Care. *Bioethics* 27, 7 (2013) 365-72.
- [4] Fernaeus, Y., Tholander, J. and Jonsson, M. Beyond representations: Towards an action-centric perspective on tangible interaction. *Int. J. of Arts and Technology* 1, 3/4 (2008) 249-267.
- [5] Fyrand L. Reciprocity: A Predictor of Mental Health and Continuity in Elderly People's Relationships? A Review. *Current Gerontology and Geriatrics Research* (2010).
- [6] Følstad, A.: Living Labs for Innovation and Development of Information and Communication Technology: A Literature Review. In *Electronic Journal for Virtual Organizations and Networks*, vol 10, pp. 99-131 (2008).
- [7] Greenhalgh, T., Procter, R., Wherton, J., Sugarhood, P., and Shaw, S. The organising vision for telehealth and telecare: discourse analysis. *BMJ Open* 2:e001574 (2012)
- [8] Hardisty, A. Peirce, S., Preece, A., Bolton, C., Conley, E., Gray, W., Rana, O., Yousef, Z and Elwyn, G. Bridging two translation gaps: a new informatics research agenda for telemonitoring of chronic disease. *Int. J. of Med. Inform.* 80, 10 (2011) 734-744.
- [9] Huang J.C. Exploring the Acceptance of Telecare Among Senior Citizens: An application of back propagation network. *Telemedicine and e-Health* 17, 2 (2011) 111-117
- [10] IndependentAge 2009 Research Report: www.cisco.com/web/about/ac79/docs/wp/ps/Report.pdf.
- [11] Lindsay, S., Brittain, K., Jackson, D., Ladha, C., Ladha, K. and Olivier, P. 2012. Empathy, participatory design and people with dementia. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems CHI '12*. ACM, New York, NY, USA, 521-530.
- [12] Reginatto, B. 2012. Addressing Barriers to Wider Adoption of Telehealth in the Homes of Older People: An Exploratory Study in the Irish Context. In *Proceedings of eTELEMED 2012*, (Valencia, Spain). IARIA, 175-183.
- [13] Renaud, K. and Van Biljon, J. 2008. "Predicting technology acceptance and adoption by the elderly: a qualitative study." In *Proceedings of the annual research conference of the South African Institute of Computer Scientists and Information Technologists on IT research in developing countries: riding the wave of technology*, ACM, 210-219.
- [14] Rogers, E.M. 1995. *Diffusion of Innovations*. Free Press.