A SmartTV Platform for Wellbeing, Care and Social Support for Elderly at Home

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Abstract. This paper presents Care@Home, a smartTV platform integrating assistive living services for elderly in their homes. The SmartTV is acting as a user-centered 'hub' providing communication that connects the elderly to their formal care network, family, friends, communities, and provides services including household help, healthcare, exercise programmes and entertainment. The paper highlights Care@Home as a low-cost, personalized and open platform that is flexible and easy-to-use. We describe the human-centered design and first results from user studies.

Keywords: Active aging, gerontechnology, wellbeing, care, social support.

1 Introduction

The increase in global population over the age of 60 is a highly foreseeable long-term trend [23]. While the number of elderly rises, fertility rates have been falling from 5 children per woman in 1950 to roughly 2.5 in 2012. This leads to an imbalance in working to retired population. These demographic changes present new challenges to society including (1) pressure on public budgets and fiscal system, (2) strains on pension and social security systems, (3) adjustments of workplaces to an aging labor force, (4) higher rates of non-communicable diseases and disabilities that restrict lifestyles, which lead to: (a) the need for increased number of healthcare professionals and (b) higher demand for healthcare services and long-term (institutionalized) care and, last, (5) potential conflict between generations over the distribution of resources. [5,9,23] The demographics changes also bring new opportunities due to a steady increase in life expectancy across the world leading to increased longevity. With years of experience, older people become indispensable resources of knowledge for their family and communities [5]. The concept of "active aging" is promoted by the World Health Organization (2002) and is defined as the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age. Within this context, the European Union has taken initiatives to (1) help elderly play an active role in society and (2) encourage healthy aging and independent living [9].

In line with these initiatives, the goal of our work is to improve the quality of life of elderly and their carers by supporting them to stay independent longer in their own

homes. In this paper we present a smartTV platform acting as a user-centered 'hub' to provide communication and services aimed to increase the elderlies' wellbeing, healthcare and social support at home. As an open platform that is implemented on consumer-driven products, it presents a cost effective and easy-to-use solution. In this paper we focus on the human-centered design process and the modular architecture of the system and present first results.

2   Challenges and Opportunities for Designing for the Elderly

2.1   Defining Old

The UN accepts the age of 60 years as a definition of 'elderly' or older person, while the EU categorizes 65+ years to refer to the older population. However, there is no general agreement on the age at which a person becomes old and more important when people consider themselves old. Brant et al [6] found that almost nobody among the group of people between 55 to 75 years old appreciated being stigmatized as 'elderly' or 'senior citizen'. Rather they tend to refer to 'the others' or even to their own parents.

Research found that older adults are a less homogenous group than younger generations [14]. Individual differences exist in the severity of mental [1, 21] and physical [2, 7, 16, 20] debilitation and we cannot predict exactly which components will be affected first or how quickly. These effects of ageing and their diversity in end-users need to be handled by technology for the elderly. In our project we, therefore, develop personalized services and interfaces that are adaptive to the end-users.

2.2   Economic and Social Changes

Retirement marks a major step in people's lives. Risk of poverty or social exclusion depends highly on the pension systems applied in the countries [3]. High medical costs, family models and low personal savings can cause the inadequate income for the elderly [11]. Because of their lower income and lower opportunity cost of time, retirees spend more time doing household productive activities, personal care (e.g. eating and sleeping), watching TV, and sports than employed individuals [13]. They also become a source of support for others, e.g. childcare and volunteering, while 70% of the population age 15+ thought that people aged 55 and over played a major role in the local community and in politics [9].

Care for dependent elderly is often provided on an informal basis, by spouses, relatives or friends [9]. Only about half of the dependent elderly are attended by professional caregivers. However, changes in family structures, higher labor force participation, and increased geographical mobility may reduce the provision of informal care in the coming years. As people age, the loss of a social network is especially noticed due to work colleagues being encountered less often, friends bring more remote or dead, or family visits becoming less frequent. Moreover, in addition to physical disability the loss of a spouse or the loss of social network reinforces the

feeling of loneliness [17]. The need of support and care facilities for the old within the community become prominent.

2.3   Elderlies' Attitude Toward Technology

The lack of technological experience has been identified as a reason for low adjustment to the advent of new technologies by elderly [8]. Complying with this, Morrell [14] pointed out that older adults born after World War II, who have often been using ICT at work, might have greater ability than the current elderly.

Self-image, self-perception of health, and awareness about own vulnerability and changes to the aging process can also be factors that influence the acceptance of technology, which causes the elderly not to be able to perceive a direct benefit [21]. Other important factors are value-related consideration, such as privacy and trust [18]. Most elderly people initially show anxiety using a new technology. When having gained experience in using the technology, elderly people show a less negative attitude. The promotion of technological solutions through trusted sources could enforce inclusion.

Problems with usability and perceived ease of use are higher with older than younger users and lead to dissatisfaction quickly [15]. Often technologies are designed without consideration of the cognitive and physical challenges older users may have. Various research attempts to deliver basic sets of design guidelines for technological development for elderly, e.g. Arch [4].

3   Care@Home: A Low-Cost User-Centered Solution

The Care@Home project aspires to design and develop ICT-based solutions that: (1) encourage healthy aging and independent living for elderly people with degrees or types of impairment and technological literacy, without the prohibitive costs of retrofitting existing dwellings; (2) improve social inclusion of the elderly; (3) allow carers to remotely monitor real time emergencies and lifestyle changes over time in order to manage the risks associated with independent living; and (4) allow family members to remain active with their roles in society while at the same time be able to continuously remotely monitor, communicate and support their elder relatives.

Interactive multimedia on an internet-connected SmartTV platform that integrates personal services for elderly and connects to formal/informal care network and communities, has been chosen to enable higher quality of life, wellness, and social care provision to the homes of the elderly at low cost. As a familiar interface, TV provides media that encourages elderly users to use the services toward attaining a 'self serve' society. Reports showed that the elderly dedicated a great part of their time to watching TV [13], three times more than did younger adults [12]. A study in Portugal involving seniors 65+ found that iTV and social media have great potentials to improve elderly participation and sociability [19].

3.1   Architecture

To achieve the aforementioned goals, Care@Home provides an innovative and open infrastructure that includes:

- *Services*, delivered to the elderly users, e.g. facilitating communication and scheduling capabilities, activity coordination, physical activity, community involvement, and wellness monitoring. The open platform creates possibilities for continuous deployment of new services without installation of new infrastructure.
- *Services Portal*, offering the users to access the available services and providing a platform for the service providers to deploy and advertise services.
- *Sensors and Sensor Network*, facilitating broad acceptance of monitoring procedures and novel sensing systems.
- *Device Portal*, offering a safe and robust access to devices (e.g. personal and home sensors) for the elderly users and allowing the carers to remotely update and configure the devices.
- *Communication Devices*, providing access to services and seamless switching of communication platforms using consumer products such as SmartTVs, PC, tablets, etc.
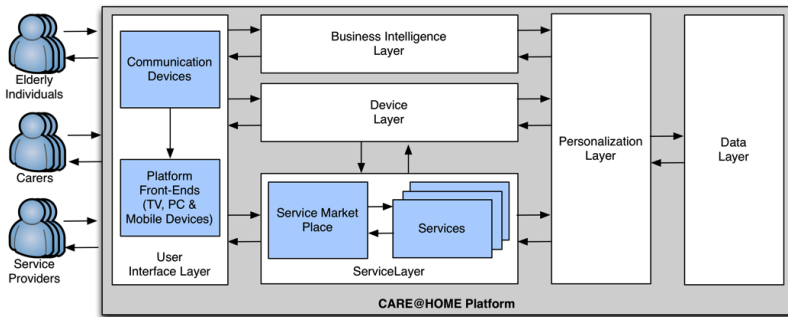

Fig. 1. Care@Home Conceptual Architecture

The modular architecture of Care@Home allows ad-hoc deployment of services and devices. Fig. 1 shows the layers of components with discrete functionalities described in the following.

The *Data Layer* is responsible for handling all the data exchange and storage that takes place within the Care@Home platform. This includes both internal- (i.e. data exchange within the platform) and external communication (e.g. web services). This latter allows the Care@Home services to access any external services on the web.

The *Personalization* Layer is responsible for handling user interaction that is tailored to the needs, views and current contexts of the users. This layer includes components of (a) knowledge representation that models the user's functional capabilities, behavioral pattern, and wellness factors; (b) context awareness acquisition that collects and compiles information about the user, his/her task and the

user's environment from various sources including dynamic user profiles, user interaction logs, real-time sensor input, and historical information stored in the system; and (c) adaptive procedures that perform reasoning toward dynamic, context-dependent output adaptations.

The *Business Intelligence Layer* is responsible for implementing and delivering the necessary mechanisms for service providers to publish and advertise services. The input from the Personalization Layer is incorporated to deliver personalized offers based on the user's profile and preferences.

The *Device Layer* is responsible for handling the information exchange with sensory devices that will be utilized for acquiring contextual information about the user, his/her task and the situation of his/her environment. This layer includes components for (a) aggregating information from various devices, (b) configuring these devices, and (c) monitoring their performance.

The *Service Layer* is responsible for handling the operation, communication, information exchange and the overall management of services offered through the Care@Home platform. The *Service Market Place* component within this layer handles the registration and authorization of users on the available services.

The *User Interface Layer* has the *Platform Front Ends* component that responsible for handling the display of the information to the users through different devices, including a SmartTV, a PC/laptop and a mobile device. The *Communication Devices* component handles the user interaction with the platform. Currently, this component includes modules for the remote control and the tablet-based input device. Both are targeted for the TV Front End.

3.2   Research and Development Methodology

The research and development of Care@Home follows a human-centered approach. Methods focus on understanding all stakeholders and organizational and societal structures. In order to ensure human-centeredness at all stages of the incremental design process (see Fig. 2) we build on principles and employ methods from Value
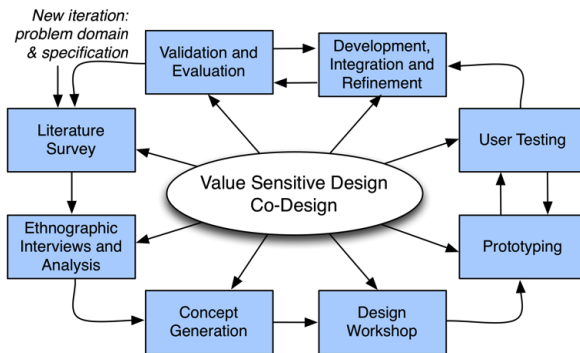

Fig. 2. Care@Home research and development

Sensitive Design and Co-Design. Value Sensitive Design is "a theoretically grounded approach to the design of technology that accounts for human values in a principled and comprehensive manner throughout the design process" [10]. We apply the VSD approach to identify both direct and indirect stakeholders, which expands user-centeredness to considering all people affected by a technology. This distinction helps to understand the perspectives of the elderly, carers, and service providers as well as all other affected by the development of ICT-services for the elderly. Harms and benefits are identified for each group, and satisfying value trade offs are aimed for.

Co-design [22], is an approach to involve stakeholders. It uses joint creativity of designers, end-user untrained in design, and other stakeholders in the domain who are working together in design processes. We use Co-Design to involve stakeholders in *concept generation* activities to collect views, ideas and wishes, and formulate them into design concepts of services available in the platform.

In the *design workshop* we develop the concepts into concrete visual designs with defined functionalities together with the stakeholders. We develop *prototypes* based on the developed designs. *User testing* assesses the usability of the prototypes. In this activity, we involve the same participants of the previous activities plus a new set of participants to compare the results for users who were involved in the design process and users who are new to the system. The prototype is *integrated* into the Care@Home platform and *evaluated* in field tests. The findings of each iteration are used to *refine* the previous.

3.3   Results of User Studies

We have identified elderly individuals, formal and informal carers, and service providers as our direct stakeholders, while the municipality, designers, technology providers, home care organizations, institutions (medical and educational) and real estate companies are our indirect stakeholders. Focusing on the elderly users for now, the ongoing development has resulted in a prototype of the Care@Home portal for SmartTVs (see Fig. 3). The current version offers messaging, video calling, scheduling and activity coordination. The infrastructure of the Care@Home platform allows synchronization of multiple messaging and agenda accounts, and sharing the to-do list with specific Care@Home users, i.e. his/her carers. The carers are able to check the to-do list and offer him/her to assist his/her task on a specific date. A new planned task is added automatically on the user's agenda.

(a)   (b)

Fig. 3. The interface of (a) the main page of the Care@Home portal on SmartTVs and (b) the main page of the Messaging service

In these activities we found that all participants were enthusiastic about video calling and agreed that notifications, agenda reminders and the to-do list should be placed on a prominent place. Smart functions were perceived as overwhelming. However, if they became familiar with the system, they would like to try such functions. Thus, we decided on designing subtler visuals and user interaction of the automation aspects of the offered services. We also developed a simple menu by limiting to two options on each page (see Fig. 3(b)). The User Testing of the prototype involved 14 participants aged 75-85 years, which included eight participants from the previous activities. Previous participants appreciated that their collected ideas were used on the developed prototype. Several suggestions were prompted (e.g. a reminder of overlapping agendas), but generally it was easy to use.

We also found issues related to technology acceptance. Almost all our study participants made references to the usefulness of the envisioned system for older people but not themselves. Moreover, some participants thought that the current ways, e.g. paper scheduling and calling people, were more suitable instead of making them possible on the TV. Others thought that they did not have the infrastructure (e.g. lacking an informal care network) to make the technology possible. We found that our methods involving end-users in the development process were well suited to reduce gaps between the perspective of the researcher and of the elderly.

4   Conclusion

Our work contributes to current research on technology for the elderly in these ways: Care@Home provides an (1) *open platform allowing new service development, (2) context-based services and adaptive interaction, and (3) integration in existing consumer products.* The R&D of Care@Home follows a human-centered design approach focused on understanding all stakeholders and their values in context. Value Sensitive Design and Co-Design principles are applied to tackle usability, user experience, and ethical issues systematically through early user involvement and iterative integration of research, development, and evaluation. We believe that through this approach we can increase the acceptance of the developed platform and its services, which would lead to a sustainable care system, social inclusion, higher quality of life, and reduced healthcare cost in the long term.

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