

A Fall Preventive iTV Solution for Older Adults

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ABSTRACT

Declining motoric skills, along with visual impairment and other possible health deficiencies make life challenging for older adults, especially when they live independently at home. New suitable interaction paradigms need to be found to support this target group in ICT utilization, which will eventually have a positive impact on their quality of life. By combining the benefits of computer technology, interactive television and full body motion tracking, we designed an ICT-based training system featuring balance training and strength exercises to predict and prevent falls. Taking into account the specific needs of older adults, the system was designed and evaluated together with 58 users from three different Living Labs in Germany, Spain and Australia.

Author Keywords

Elderly; Kinect; GoogleTV; fall prevention; interactive TV; exergame.

ACM Classification Keywords

D.2.11 Software Engineering: Software Architectures, domain-specific architectures

INTRODUCTION

In almost all western societies, significant demographic change can be observed, characterized by an increase in the proportion of the population which can be described as elderly. The challenge of implementing active prevention and thus reducing health risks for older people has become a recognized issue in health care [5]. In relation to this, evidence suggests that physical exercise presents the most valuable approach for fall prevention and rehabilitation [3]. A promising approach for promoting older peoples' health can be seen in ICT-based 'exergames' and 'interactive television' (iTV). These solutions have a payoff in terms of fun and motivation and also with regard to long-term compliance/adherence and social inclusion [8]. Even though older adults have specific problems with current designs of ICT (e.g. complexity of applications/systems, readability etc.) [6], an explicit design focus on exergames is rarely found in literature. One exception is the work of

Ijsselsteijn et al. [4] that focuses on usability problems caused by aging and how design can overcome them. The recent work of [2] is arguably the first attempt to define design guidelines for exergames for the elderly. An interesting opportunity for exploring the affordances of new technology in respect of the health and lifestyles of older people is offered by an integration of MS Kinect [1] and GoogleTV as part of a health-related iTV solution that we developed in a fall-prediction project. Our approach offers new HCI modalities tailored to the needs of older adults living at home by providing a user interface dedicated to this user group and its specific requirements.

iTV SOLUTION FOR OLDER ADULTS

iTV technology clearly has potential for creating and sustaining access, especially for older people with special needs. Crossing the 'digital divide', however, implicates providing tailored services in a domestic environment via a TV-based interface [7]. Since elderly people watch more television and use less ICT in comparison to the younger generation [4], the acceptance of new technologies could be eased by using the TV as a point of entry.

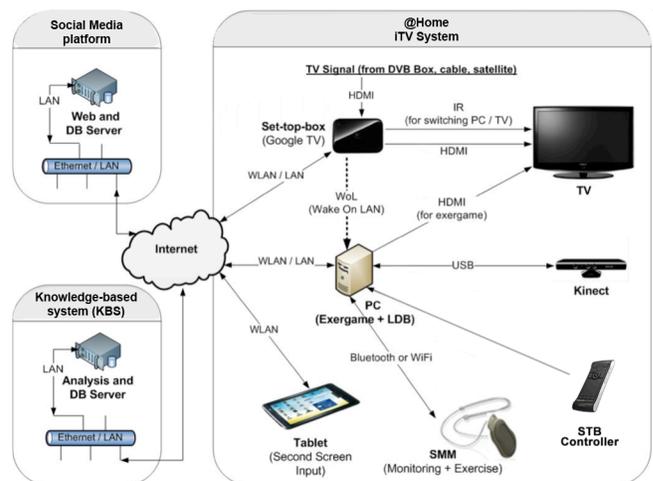


Figure 1: System overview of the iTV solution

The iStoppFalls research project aims to provide technologies for older adults that support not only strength and balance training but also fall risk assessment with discrete measuring technologies and adaptive assistance functions. iStoppFalls is based on an iTV solution with gesture and voice control and a tablet, providing an additional interaction and information channel, all tailored

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to the capabilities of older adults living independently at home (see Figure 1). The Senior Mobility Monitor (SMM) offers quantitative information on frequency, duration and type of mobility activity and qualitative information on balance function and muscle power. The MS Kinect-based fall preventive exercise training program (exergame) facilitates home-based preventative exercises, whereby data is acquired by unobtrusively sensing together with biomechanical modeling. A knowledge-based system for fall prediction and prevention correlates these two sources of mobility information, and in turn, provides sufficient data to perform a trend analysis.

TECHNICAL ASPECTS

Full Body Motion Tracking

Interaction via Kinect has enormous advantages over other gesture-based input devices for older adults. Users who are less familiar with controlling ICT devices are able to use their natural gestures to interact with the interface. Further, users suffering from arthritis are not required to hold a remote control. Thirdly, the entire body can be employed in the interaction, which can, for example, positively impact on the execution of therapeutic exercises [2].

System Architecture of the iTV Solution

The system architecture of the developed iTV solution comprises a GoogleTV set-top box (STB) as a basis for the iTV system, with the remote control as standard input device. To realize a voice and gesture control for the STB, a combination of a regular PC and the MS Kinect for Windows are used. Our prototypical application for fall prevention runs on the STB, which can be controlled by the remote control, or a tablet, and as an alternative, by gesture and voice recognition. The application itself consists of three fall prevention exergames, strength and balance training (Otago) and fall risk assessments, all using the MS Kinect and STB.

METHODS AND DATA

In our study, we involved a total of 58 participants from three Living Labs in three different countries (Germany, Spain and Australia). Workshops were conducted to gain insight into participants' daily routines and to derive first implications for the development of the iTV application. For the evaluation of the iTV system, we conducted semi-structured interviews combined with usability tests in the participants' homes. Participants were prompted to think aloud in order to obtain an articulated version of their experience. With the different tasks included in the tests, it was possible to examine the individual usability aspects as perceived by the participants.

RESULTS AND DISCUSSION

Our study has shown that participants who were involved in the usability tests prefer to navigate the system by using the voice control. Moreover, the results revealed that older adults did greatly benefit from the alternative gesture

control opportunity as it rendered the remote control with its unfeasibly small keys obsolete. Overall, voice control was easier to use and faster than navigating the system by gestures. In this context, the question of a suitable navigation concept becomes a central issue in the design of a full-body movement controller-free iTV system for older adults. Nevertheless, system navigation is no simple matter. In particular, our results have shown that navigating such a system is a difficult endeavor for older adults. Alternative input options may afford the means for older adults not only to participate in home-based training activities but also to become a user group in participatory design approaches. We argue here that designing appropriate iTV applications for older adults presents an interesting subject for UX research, reflecting the very specific issues that older adults are confronted with. Design for older adults has to take into account the specific needs of users in this target group who are often health-impaired. Alternative forms of interaction, as well as the option to switch between a variety of controls, have shown to be more appropriate than currently available systems which usually prescribe one particular form of interaction or respectively a control device. Most importantly, design has to take into account the in-situ shift between different control modes.

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