MindGym - IPTV for Elderly People

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Abstract. The aim of this research is to present a novel idea of interoperable, independent living ICT solutions using global standards that will improve the quality of life of older people in their home or community environment, by enabling them to stay active, mobile and independent for longer. The proposed innovation takes a multidisciplinary approach using both open source standards and technology for maximum interoperability and affordability, and user driven content development for sustainable care systems of tomorrow. In addition to the development of interoperable independent living technology solutions, guidelines for business models and methodologies to create appropriate content will also be developed.

Keywords: Cloud computing · IPTV · Elderly health care · Social inclusion

1 Introduction

Older people rely on TV for mind stimulation and recreation, therefore utilizing daily routines and activities, within their own environment and using technologies such as interactive TV, smart remotes, and other cloud based, seamless social media and medical plugins to enable new ways of actively engaging the elderly and enabling independent living and mental agility. Therefore, this research's specific objectives include design and development of methodologies to create content, personalized and self health care systems and social computing features, to organize human computer interfaces and cloud-based implementation of the system.

In the past, scientists have believed that the degeneration of the brain as the body ages was an irreversible process. Recent findings have identified that the brain can continue to rebuild itself for the duration of life. Mental activities can be extended to later life by the MindGym activities. Continuous usage of our brain for logical and cognitive processes will extend the active state of our brain and slow down the degeneration of brains. For this purpose the MindGym project will use several research methods (fMRI, achievement motivation measurement) to develop appropriate content

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for interactive system and integrate interactive TV, social and cloud computing to improve its applicability.

The proposed system aims to use generally available household ICT to keep older people in good intellectual shape. We plan to enhance the existing communication services that are popular with the target group such as broadcast TV by adding interactivity, personalization and social communication.

2 Background and Motivation

Older people lack of mind gymnastic, they usually stare at the TV, without any interest and limited mind activities. However, recent research shows that their brain will be used longer if they use it more in everyday activities. Past research attempts have focused on cognitive brain function activity enlargement, without any convincing evidence about its effectiveness. One important exception is the training of working memory that aims to maintain the ability to hold attention and to learn new concepts.

From the literature it is evident, that young people taking a three-week computer-based memory-training program, working on the program for 30 min daily, improves not only their work, but also their fluid intelligence. A convincing range of similar results have led scientists to conclude that memory can be trained to increase activations in the frontal and parietal cortices associated with working memory. Although other types of training have been disappointing in enhancing cognitive function, from the literature we know that cognitive stimulation is healthy and can help protect mental ability.

According to a study performed in the Balkan region, we acknowledge that older people love TV and resist on using complex technology solutions. In brief, we can state that the proposed MindGym system was also motivated by the following issues:

- Old people love TV.
- Project results adds interactivity to their daily routine.
- Social inclusion is motivated via technology due to limited physical abilities.
- Smart remote as a second screen application provides a possibility for personalized self care.

3 Related Work

Small et al. [1] identified the brains of middle-aged and older participants respond when using an interactive system like Internet search engine. They found that interactive communication like Internet searching increased activation in several regions of the brain. Based on the brain regions involved, they concluded that interactive communication alters the brain's responsiveness in neural circuits controlling decision-making and complex reasoning (in frontal regions, anterior cingulate and hippocampus) [2].

Degerman et al. have reported [3] that attention to audio-visual feature combinations produced stronger activity in the superior temporal cortices than attention to only

auditory or visual features. These modality-specific areas might be involved in attention-dependent perceptual binding of synchronous auditory and visual events into coherent audio-visual objects. At that level we can identify that the interactive audio-visual system like interactive Internet TV is more focused on stronger activity in temporal cortices than popular Internet system representing an uncontrolled task, where is difficult to know what cognitive processes the people were carrying out. Small and Vorgan [4] claim that even less experienced users of interactive Internet searching engine can after five days of training for an hour a day, produce similar activations as their more experienced partners. Small and Vorgan [2] raise a concern that if the five days trained beginners had already rewired their brains after a period of just five hours on the internet, what might happen to those users spending their more hours daily with their high-tech toys like interactive IP-TV. According to the results mentioned in the paper of Finish researchers, we can set a hypothesis that those users would also show changes in neural activity associated with the social networking involved in the interactive TV system. Also in this case the bases for anticipating changes beyond this are not clear. Changes in neural activation in different brain regions can be expected when searching and interacting due to the programs on the interactive MM IP- TV with their social network linked in one virtual society, discussing about the programs and theirs content.

For example, in adults after discussions about complex situations and scenes, the brain activity produced by carrying out this task shifted from frontal to posterior regions. All discussions in such social networks about on line interactive TV programs and all new experiences around interactive multimedia content and real time discussions in virtual society brings changes in the brain regions. Internet TV allows access to an effectively infinite educational resource. One outstanding characteristic of this resource is that its multimodality exceeds that of books i.e., it provides information in many forms auditory, images, video, textual, etc. This enhancement of memory may be linked to the additional brain activity produced by multimodal stimulus over and above that produced by each mode separately. Multimodality does not guarantee long-term improvement in memory; therefore the Internet TV-based learning resources require judicious design, with multimodality focused on the people linked together into the virtual social network.

Therefore, the proposed MindGym system is a completely new approach to traditional interactive Internet TV and social networks. Major innovations like introducing a personalized user model system based on users brain areas activity research, influenced by prescribed multimedia content, new human computer interfaces for interactive Internet TV and implementation of social networks will help to improve the brain activity of the elderly which can extend their independence and thus help them to improve the quality of life in their home environment.

Similar study but with different goal for Participatory Design was reported by Ognowski et al. about their 2.5 year experience of Living Lab [5]. Lehto and Leskela report the results of the “Caring TV” project [6] with goal to develop and evaluate eWellbeing services, mainly to establish monitoring systems and include eDoctor and eNurse services. Lehto [7] discusses the Interactive CaringTV® as a Finnish innovation to support the health and well-being of elderly people living in their own homes. A lot of EU research [9–19] refers to same or similar objectives, but not using the MindGym approach.

4 State of the Art

In this section we give and overview of similar ideas, commercial products and research projects, with analysis of their state and if they comply within objectives of the MindGym approach.

The MindGym system refers to the process of keeping the brain active through various activities like specialized TV programs, intellectual games, etc. Currently most companies mainly target youngsters with lots of interactive games. However, older people are not sufficiently targeted and this paradigm will have to change based on the findings that the human brain stays active if the person continues to play games or has intellectual exercise. Our goal is to identify what motivates older people to increase brain activity and deliver a methodology to identify the appropriate content. This research is multi-disciplinary and includes experts in psychiatry, neural sciences and bioinformatics. In addition complementary research will be undertaken to identify suitable human computer interfaces, as the conventional keyboard is not always appropriate for older people, because of the resistance to complex new technologies, and a preference for simple remote devices, touch pads or voice activated systems.

The Multimedia Home Platform (DVB-MHP) standard for interactive digital TV [8] will facilitate the development of the MindGym system. The MHP enables the reception and execution of interactive; Java based applications on a TV-set. These applications can be information services, teleconferences, games, interactive voting, e-mail, shopping and AV virtual societies, supported by additional IP return channel. The MHP platform specifies an extensive application execution environment for digital interactive TV, independent of the underlying hardware and software. This environment is based on the use of Java virtual machine and on generic APIs that provide access to the interactive digital TV. The MHP applications are running on top of APIs. The Navigator- application, allows the user the access to all MHP applications and DVB services like TV and radio.

The MHP is a part of a family of specifications based on the Globally Executable MHP (GEM)-Standard. GEM is a DVB specification of a Java based middleware for TV broadcast receivers, IP-TV terminals and Blu-ray players. GEM defines profiles for different device classes and the set of available features of GEM for device class. This formed the bases on which the Open Cable Application Platform (OCAP) was defined. It is an operating system layer designed for a cable television system, where the system provider controls what OCAP programs run on the consumer's terminal.

State of the art in using interactive TV, tablets and social networks is characterized only as a classical approach to a separated technology only and not as integrative solution. The innovative approach in this research combines these technologies to offer an entertainment and mind gymnastic system, keeping the brain active and enabling older people to stay active, mobile and independent for longer. In addition several new technologies will be integrated into this system like personalization to enable realization of a self health care system and establishment of Software as a Service cloud solutions.

5 General Overview

In this section we give an overview of the research, starting from background and motivation, and then explaining concepts and specific objectives.

5.1 Concepts

Currently older people are passive consumers of media and we aim, by careful design of technology and the corresponding content, to make the elderly take an active role. The final goal is to preserve the vital intellectual shape of the service users, prolonging independence of the elderly. This will be achieved by the objectives (improved mental agility, social inclusion, self care system, solution as a service), as presented in Fig. 1.

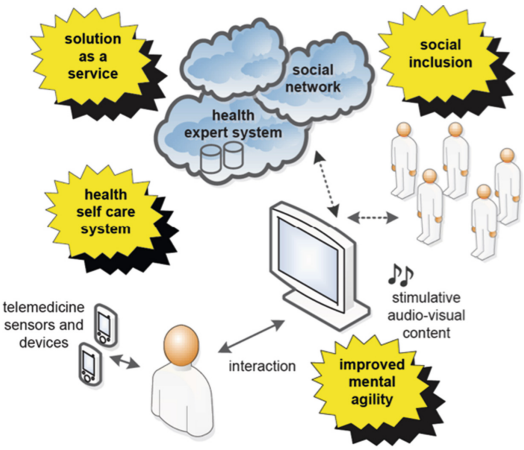

Fig. 1. MindGym objectives.

The design of the enhancement layer and corresponding user driven content, will enable the users to take an active role in the services, rather than the current passive media consumption. The idea is based on promoting independence, where the focus is on their natural environment and its impact on mind activities of older people. The MindGym system is expected to increase social inclusion of older people and enhance their quality of life by exercising the mind with interactive TV and personalized ICT support. User brain sensitivity to natural stimuli will be used to develop a platform for interactive TV based programs that include natural audio-visual stimuli, music, films, etc.

5.2 Outputs

The aim of this research is to design and develop a state of the art elderly health-care system, by following these predefined measurable outputs:

- a sophisticated interactive MindGym system with interactive TV, mobile and wireless technologies, capable to work with remote devices for telemedicine and entertainment;
- innovative and integrative usable social network solutions for older people;
- design principles and recommendations for content that results in increased logical and cognitive processes in older people to accelerate the active state of the human brain;
- a personalized health care solution using sensors and reminders to support telemedicine and self health of elderly people, with usage of self-evaluation tools to implicitly monitor progress and give feedback to technology and content provider; and
- a scalable, open source, cloud solution capable of withstanding increased computing and communication demands.

Interoperable ICT independent living solutions will be developed using global standards to improve the quality of life of older people in their home environment enabling them to stay active, mobile and independent for longer. Generally, physical activity has been promoted to increase intellectual ability; however we focus mainly on interactions with the natural environment and its influence on mind activities of older people. Therefore a platform based on the user model brain sensitivity on natural stimuli will be developed, where interactive TV based programs will be selected according the user model group. Also interactive social networking will form a part of this platform to increase the influence of social interactions and audio-visual natural stimuli like movies, music, concerts, etc.

Therefore the goal of this research is to develop an interactive MindGym system adopted for use by older people with intellectual disabilities, including use of sophisticated interactive TV, social networks, cloud solutions and adapted human computer interaction system. Specific outputs will cover design and development of methodologies for creating content, how to make personalized health care systems, how to realize and use social computing features, how to organize human computer interfaces and how to realize the proposed system on the cloud. Use of the proposed system will increase social inclusion of older people by ICT support and social networks, and increase quality of life of the elderly by creating brain exercises with interactive TV and personalized ICT support.

5.3 Specific Objectives

The following objectives describe what are the expected results and outputs to realize the research's goals:

- Improved mental agility - A new model and prototype will be developed as a home entertainment interactive system integrating new human computer interfaces adapted for older people's needs with interactive TV, mobile and wireless communications, touch pad, and other remote devices including telemedicine sensors.
- Social inclusion - Integrating Social Networking and IP- TV has strong synergies with the area of health care and interactive discussions and consequently mind

activities. However, it opens a very complex social space of new services achieving the best user acceptance. It indicates that social features in IP-TV services in general will be well accepted, even if they are quite immersive to the TV experience.
Future Internet and social networks will include a number of internet-connected sensors, including cameras, TV sets and microphone arrays. Based on these sensors, emerging applications will be able to collect, filter, analyze and store large amounts of data captured from the social networks, as well as related metadata captured as part of perceptive multimedia signal processing algorithms. The ability to search this information in a scalable, effective, real-time and intelligent way can empower a wide range of added-value applications in the areas of surveillance, social networking, smart homes, security and more. In addition multimedia search engines for user profiled content should be able to support ambient/intelligent synthesis of related content in real-time.

- Personal self care system - Mobile systems that recognize human activity in personal living environments will be developed. The systems will autonomously integrate all available sensors around the user and self-configure to recognize user activities. A system that follows the users' daily activities will be developed, to help users to communicate with interactive IP TV by gestures or voice, and also by keyboard. User heart beat rate and ECG signal analysis will be monitored in real time and with a virtual classroom for interactive discussions with users enrolled into virtual classes. The outcomes will be robust activity recognition systems. This will subsequently enable smarter activity-aware energy management in buildings, and advanced activity-aware health assistants.
  The research outcomes should be robust activity recognition systems. This may later enable smarter activity- aware energy management in buildings, and advanced activity-aware health assistants. The most important part of elderly health is mind health and willingness and joy in performing everyday activities. This research is intended to develop a system that will measure motivation to achieve a goal, arguably the essential part of human psychology. Concepts such as motivation, emotion, learning, adaptation, attention, and expectation will be measured with a device uses a small number of surface electrodes, as used modern mind controlled computer games.

6 Progress Beyond State-of-the-Art

The global impact and the objective of the research is to find a way to maintain the brain capacity of older users or even improve their brain activity by the natural audio-visual content stimuli presented by interactive TV system linked into the social communication network. Mentally active users remain physically active much longer and are self-contained, therefore minimizing the support and services needed for older people. This approach stimulates brain activity and therefore active thinking which is important for increasing and improving the quality of life and extending their ability to remain at home, independently. The method on how to achieve this goal is based on user interactive co-operation with audio-visual customized content and in the usage of

the social networks. The innovation that we aim to achieve is in the integration of all these technologies and exploiting research results with sophisticated ICT and neuroscience research methods.

The progress beyond state-of-the art means development of an interactive MindGym system based on presenting various content and collecting input via interactive TV. The role of a TV producer in the system would mainly be to manage and provide video contents (archive, etc.), AV program and interactive program production. The producer at the same time provides targeted advertising, follows the viewers' reactions and their profiles.

Technology suppliers in the system include an IPTV provider, a Set-top-box provider (applications developer), a sensor developer, mobile terminals' applications developers etc. An IPTV provider provides the transfer of a target program to the user's receiver (STB) through an IPTV system. Additional applications on a STB could be applications in the sense of supervision of one's condition (through sensors or video cameras), applications in the sense of an easier system management (through using hand movements or other signs instead of a remote control).

A target interactive TV channel for the older generation would enable a high level of interaction through messages, voting, quizzes, etc. The producer of a TV channel would be able to analyze ratings, responses to certain content and get real group or subgroup profiles in the sense of viewers' interests. The producer would as well be able to form concept TV content for a certain target group only and use the content from the archives for that purpose. The content could easily be enriched by interactive elements; voting, quiz, etc. ("Who won the 1961 Eurovision song contest?"). With the help of the system for watching the viewers' responses "LIVE", it would be able to analyze the responses and acceptability of the content for the target population.

Until now, consortia members were active on peer-to-peer networks and on automatic content recommenders and TV program adaptation according to the user modeling. Those experiences could be integrated together with the experiences of other researchers, working on machine communications, real time processing and distributed cloud computing. The integration of interactive media technologies with social networks and personalization for elderly people will be an innovation and achieve MindGym goal for increased quality of life of elderly.

Furthermore, our work will also involve research into the integration of telemedicine sensors and Technology, e.g. a bioharness; or reviewing where we can improve over current research efforts e.g. Set top boxes for IPTV telemedicine. A thorough study of existing/emerging technologies in the field will ensure that all design functionality has had due consideration and is delivering cutting edge technology.

7 Conclusion

In this paper we have presented a research aimed towards the development of a quality of life improving system, based on mind exercises including interactive TV and personalized ICT support. The planned state of the art elderly health care system will use user brain sensitivity to natural stimuli in order to develop a platform for interactive TV based programs. Never the less, the involvement of an IPTV-based model of care

assists older people to live independently and will help the elderly to manage change (introduction of new technology e.g. social media via a familiar media TV). However, our sustainability and exploitation strategy will refer to a special care that must be taken to manage the effect of possible disadvantages, such as the invasion of privacy. Our future work will consist of developing methods to improve the newly developed system, as well as constructing solid sustainability and exploitation of the prototype.

The initiators of this research idea are aware that the key components for maintaining one's cognitive capabilities at a high level lies not only in regular physical activities, but also in other, different mind activities. Therefore the MindGym system represents a wide range of system developments, methods of training and cognitive challenges for older people, including memorizing, orientation, recognition and more.

To achieve these goals, we aim to develop personalized interactive television systems, where the content and functions would fit the needs of the population in question. In addition to the television as a device for watching TV programs, the system would also include hi-tech plug-in devices such as tablet computers, video cameras and physiological sensors that would enable an older person to manage the system easily. At the same time this would help the nursing, care and medical staff to have better control over their patients' psychophysical condition and their possible needs long distance. Inclusion of quizzes and questionnaires will help not only to increase the cognitive challenges, but it will also provide entertainment in a relaxed manner.

Introduction of existing social media networking channels is impossible for elderly people due to three main reasons: (1) most older people resist using complex technology systems; (2) extensive usage of keyboard interface is not possible and finally (3) the complicated design of existing social networks. We aim to define a new user interface adapted for older people, motivating them to use it for everyday activities and necessities. The research on human computer interfaces will cover usage of remote TV devices, tablets with touch pads or voice generated input used in the interactive TV system.

The creation of a personalized self health care system will include research on design of a system, inclusion of simple telemedicine sensors and devices that will support everyday activities. It will be used as reminder for therapies and procedures offering advice and information for self health care. In the following part of this section we will explain all of the proposed system's main components.

In today's world of numerous sources of multimedia content, recommender systems help users find relevant content items. In our proposed research the reasoning behind the recommendations generated by such systems was explored to check whether presenting users with explanations of recommended content increases their trust in the system. A content-based recommender for television has been developed which focuses on item attribute values. The system predicts users' ratings by classifying the vector of similarities between user model and items attributes. Users' trust is increased by identifying most relevant attribute values. Users' feedback to the identified attribute values was used to improve the performance of the recommender algorithm. Tests in our experimental platform showed that the developed algorithms produce good results. The accuracy of the system was around 75 %.

In near future we plan to give results of realizing research based on the ideas presented in this concept paper.

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