MindGym Strategies for Elderly People

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Abstract: MindGym approach aims at providing an interoperable, independent living ICT solution to improve the quality of life of older people in their home or community environment. The concept is to develop such a solution that will enable elderly to stay active, mobile and independent for longer, keeping them in a good mental shape. This paper addresses the strategies on how to achieve this innovation by integrating social networks, IPTV, personalised self-care and cloud computing into an unique solution using both open source standards and technology for maximum interoperability and affordability.

1 INTRODUCTION

Experimental studies show that older people rely on TV and avoid complex technology solutions. However, their attitude is mostly for entertainment without any interests, mostly expressed as "stare at TV", and with limited mind activity. Recently, scientists have reported that mind stimulation content is advisable for elderly, since it initiates regeneration of brain.

In our earlier paper (Gusev et al., 2014) we elaborate the MindGym concept to build an ICT solution that will aim at mind stimulation and recreation, therefore utilising 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 plug-ins to enable new ways of actively engaging the elderly and enabling independent living and mental agility. 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, personalisation and social communication.

In this paper we describe strategies that will achieve outcomes of the MindGym concept. The overall realization is based on the following issues:

- The results will be offered via TV sets adopted for elderly needs, avoiding complex technology

- Adding interactivity to daily routine of elderly

- 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

The rest of the paper is organized as follows. General overview of the concepts, objectives, outputs and specific objectives of the research project is given in Section 2. Strategies to develop a MindGym system are presented in Section 3, along with identification of success indicators, benefits, contributions and possible obstacles. Finally, Section 4 gives the conclusion.

2 THE MINDGYM CONCEPT

2.1 Motivation

Many published articles show that cognitive stimulation is healthy and can help protect our mental abilities. Recent research addresses effects of interactive systems. For example, Small et al. (Small et al., 2009) found that interactive communication like Internet searching increased activation in several regions of the brain. It alters the brain's responsiveness in neural circuits controlling decision-making and complex reasoning. Based on this conclusion, Small and Vorgan (Small and Vorgan, 2008) raise a concern that if the five days trained beginners had already rewired their brains after a period of just five hours on the
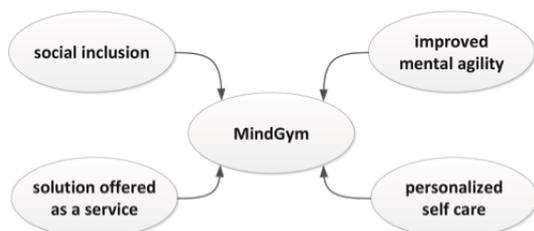
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Figure 1: Objectives of the MindGym concept (Gusev et al., 2014).

Figure 2: Scenario of the IPTV system for content delivery.

internet, what might happen to those users spending more hours daily with their high-tech toys like interactive IP-TV.

Researchers from Department of Psychology, University of Helsinki, Finland and from Advanced Magnetic Imaging Centre, Helsinki University of Technology, Finland (Degerman et al., 2007) scanned a stronger activity in the superior temporal cortices, which is produced by attention to audio-visual feature combinations than attention to only auditory or visual features.

Based on previous research results, we expect that elderly would also show changes in neural activity associated with the social networking involved in an interactive TV system. The interactive audio-visual system, such as the interactive Internet TV is more focused on stronger activity in temporal cortices than popular Internet system representing an uncontrolled task, where the level of cognitive processes the people are carrying out can not be determined.

2.2 Objectives

The MindGym concept, as discussed in our earlier paper (Gusev et al., 2014) is a completely new approach to traditional interactive Internet TV and social networks. Major innovations include a personalised 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. These innovations 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.

The overall objectives of the MindGym concept, as an IPTV system for elderly are presented in Fig.1.

The idea behind this IPTV system for elderly is based on preservation of the vital intellectual shape of the service users, prolonging independence of the elderly. The objectives realised by this system include improved mental agility, social inclusion, self care system, and solution as a service.
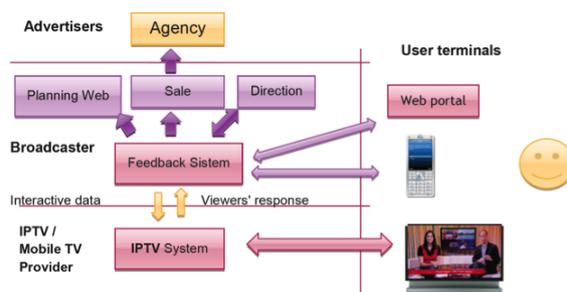
The basis to achieve improved mental agility is in provision of an interactive environment and mind stimulating content. The interactive environment does not mean just making the existing technology more complex, but to integrate minimalistic design and cloud-based devices with proper user interface especially designed for elderly.

Social inclusion is provided by adoption of existing social networks in the MindGym concept. Adding a set of sensors and other add-on devices to the core MindGym system will enable a more powerful integrated system that can provide a self-care system personalized and customized for each user.

Overall realization will be provided as a service, with high integration of third party solutions and services. This gives enormous business value, since a lot of hardware, software or content providers can easily integrate the MindGym concept, offering them a possibility to expand application of their products and services.

2.3 Technology

In the frame of the 4-year European project called Live Staging of Media Events (IST-LIVE, 2013), the members from University of Ljubljana, LDOS laboratory have developed a system of personalised interactive television with a return channel, which enables an interaction with the viewers live or off-line, checking their profiles, sending them interactive messages and analysing their responses. The system of interactive television developed by the LDOS laboratory program is based on the scenario presented in the Fig.2.

In addition, the LDOS laboratory is developing a system of social television that would enable interaction and communication among the viewers; chatrooms, videoconferences, etc. Through including additional interactions, the system will encourage their cognitive and social activities. Along with that the producer of the TV channel would be able to follow, encourage or supervise their activities. The system presented in Fig.3 includes producing compo-

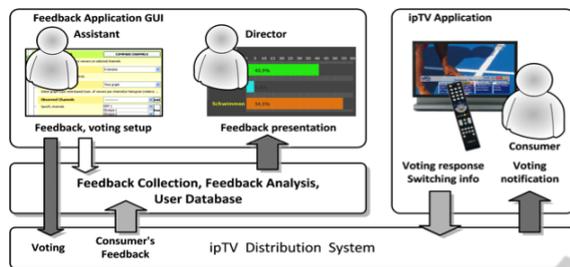nents that allow personalisation, interactivity, monitoring and diverse applications on the user's side.

Figure 3: Architecture of the IPTV based system for content delivery.

3 MINDGYM STRATEGIES

Our earlier paper (Gusev et al., 2014) discusses related work and analyses several on-going and finished EU projects in the area. However, none of these projects covers the integration of strategies to realize the overall MindGym concept. This section presents details on analysis of approaches, success parameters, obstacles and limitations.

3.1 Approaches

Both business and technology aspects are subject of the strategy for cost efficiency of the developed product.

Three main technological aspects of the MindGym concept are specified as follows:

- **Hardware** - including a specification of interactive TV, telemedicine sensors, remote control devices and other add-ons,

- **Content** - based on a methodology to realise relevant motivation and content that stimulates most active participation of elderly people, and

- **Software** - including a specification of corresponding social network adapted for elderly people and development of a SaaS (Software-as-a-Service) solution (and partly with definition of self care system).

Our vision is to set a new paradigm of ageing using recent research about active mind exercises based on model based recommender system. It will provide innovation in service of the elderly people by introducing interactive MindGym system based on interactive TV, tablets and remote devices as technology to access the content in an interactive personalised way with additional plugins such as self health care system. The realisation of this innovation is based on a multidisciplinary approach using both technology and

content user driven development of sustainable care systems of tomorrow. Realisation of this innovation is not just based on development of interoperable independent living technology solutions, but also includes guidelines for business models and methodology to create user profiled content.

Transforming the social networks according to the needs and capabilities of older people to access and communicate with the new technology is another innovative approach to enable new ways of organising society around active ageing and independent living for older people. It will empower older people to stay independent and autonomous for longer in their preferred home and community environment and to remain socially active.

The foreseen consortium realisation is based on extensive involvement of end-users in system design and even supported by a form of agile development. Special attention is paid to older people's needs. Usage of open source standards will ensure better interoperability, as well as limited availability of affordable and commercially viable solutions, as key to the successful implementation of actions in this area.

From the social point of view, the project represents a new sophisticated virtual network, which is opening its users, an additional possibility of social access and inclusion, a new social opportunity for more informative and communicative way of life in spite of spending the most time in their home environments. As such supports the autonomy and enriches activities' diversity of excluded or disabled older people. The included users can broaden their knowledge about the daily practices of their peers either in urban or rural surroundings. The practical value of the proposed project is equally suited to users in both urban and rural (or remote) environments that are of particular social importance.

3.2 Expected Impact

In this section we explain the predefined objectives MindGym concept is intended to reach, in order to achieve the overall expected impact on elderly health, medicine advancement and market growth.

First and foremost, the MindGym concept intends to improve the health statistics among the elderly population. This will be achieved by understanding the impact of natural audio-visual content stimuli presented by an interactive TV system linked into the social communication network, thus resulting in improving the brain activity of the elderly. With its efficiency being based on developing simply designed and user-friendly interfaces, the proposed system is completely adapted to older people's habits. At last,

the MindGym system significantly improves independent living and social integration of the elderly and the disabled people by using social communication scenarios, which encourages them to strengthen their personal healthcare and allow them to live in their preferred home environment, thus reducing admissions and days spent in care institutions.

Secondly, the MindGym system promotes engagement in the selection of data and materials to enable them to be involved in social experiences and stimulation aimed at promoting individuality uniqueness and choice. Also, the MindGym concept promotes experiences that will enhance activity and offer stimulation whilst additionally nourishing cognitive abilities, emotional experience as well as sustaining intellectual abilities. It is intended to be a new approach to increase the mind capacity of elderly by natural stimuli realised on interactive Internet based TV platform linked into social networks of elderly and their cares may have major impact on behavioural pattern of elderly people. The research is set towards achieving significant progress on accessibility of ICT, understanding of brain functions and stimulations by natural AV signals, advance human-machine interaction and intelligent computing by strong involvement of user and content model based approach and social interaction among users.

Also, the MindGym concept improves the accessibility of ICT communication solutions for the elderly population by developing the video-communication system adapted to the abilities and habits of elderly population based on their mind models. Special care is taken also to design simple and intuitive user interfaces on interactive IP TV platform, together with advanced sensing devices, which provides simple and efficient usage of the system.

Extensive testings including more than one hundred of end users are planned for the developed MindGym platform. It is necessary condition for effective utilization (for independent living and social integration) of ICT for elderly. The testing will include at least the following elements: adapted user interfacing, specially designed communication scenario regarding first and secondary users and regular training of all involved.

Furthermore, the MindGym concept intends to increase user ability, notably of persons with disabilities, to carry out daily life activities and to interact with ICT, given the fact that the proposed ICT system together with communication scenarios will significantly improve independent living and social integration of a large subgroup of elderly and disabled people by allowing them living in their preferred home environment. Through the use of communication in-frastructure they will be able to instantly contact their carers or supporting persons in case of any obstacle preventing normal daily routines. The ICT based communication does not replace only live communication; it enhances the feasible intensity of communication according to elderly people wishes and needs. Therefore, the MindGym concept extends the independent living of its users.

One of the most important objectives is also achieving improved competitiveness of Europe's mainstream ICT industry, including appropriate standardisation. Thus, MindGym aims towards carrying out a series of user testing activities, which result in a thorough evaluation of the concept and the actual system. The evaluations of the user response provide a set of guidelines on implementation and design of large-scale supporting systems for elderly population. These guidelines are a valuable result of the MindGym concept and input to the actual elderly care organisations, helping them to develop and implement similar ICT-based supporting systems. It allows the ICT industry to participate in the elderly support programs on the national and international level, and to develop a new competitive market for software and hardware solutions for elderly care and support. In order to support this goal, MindGym system aims at standardisation of the procedures, system components, software interfaces, and interaction technologies. The results provide an input to standardisation of protocols and services, allowing interoperability of conforming products from competing vendors.

Furthermore, higher levels of user empowerment and richer social interactions through personalised web-based assistive and social computing solutions are designed within the MindGym system, by the system's many features of today's social networking, allowing instant communication within closed groups of people. The user interface will be personalised to the habits and abilities of the individual person.

The planned development of the MindGym system is based on guidelines of system's design and functionalities, and provides an evaluation of the usability of the system. From the beginning, the requirements and limitations of elderly persons are considered to provide much more usable solution compared to standard devices which are intended for general population (remote controls, mobile phones, video phones, web portals etc.). This approach gives them the power and control to maintain richer social interactions with their friends, relatives and carers.

Based on standardised interfaces, the core of the MindGym system can be extended by a range of hardware add-ons, sensors and software modules provided by third party providers. These sensors add spe-

cialised functions, like monitoring vital biometrical parameters (ECG, heart rate, fall sensors, blood sugar monitoring), physical activity, coaching etc. The proposal opens a new market for specialised channel production dedicated to a group of elderly people. These channels can be supported by content recommender systems, helping them to produce attractive channels for the dedicated target groups. The result are programs optimised to stimulate brain activities at a convenience of a linear broadcast program. Interactive services can complement the main content delivery channel. In addition, monitoring brain activity by means of fMRI and EEG signals, while watching movies, encourages content producers to develop more stimulating productions. Understanding these processes may lead to a more challenging content production, which would not only stimulate cognition among users but also make the production more attractive to the consumers.

Development of the MindGym system arises new business opportunities, such as new market for third party service, content and equipment providers. Medical care in recent decades has significantly extended the life expectancy of people, but also a probability of developing age-related medical conditions. Dementia not only prevents people from living an independent life, but also requires uninterrupted/permanent supervision. These conditions not only put an enormous burden on the relatives, despite the efforts usually call for an institutionalised care. The influence on active population responsible for these conditions and also the required social and medical assistance can severely be reduced, by keeping the elderly in good intellectual shape for as long as possible. This results in increased productivity of active population and at the same time cost reduction for social and medical services to the entire society.

Finally, MindGym reduces overall costs for the society. Since a great majority of aged people have different chronic health conditions, mostly of multiple nature, the MindGym concept offers a development of a new kind of public health interventions from preventive, educative and therapeutic point of view. Next to all positive consequences of brain training and support of intellectual condition, the users can be offered avoidance of most important risk factors, regular and proper usage of drugs, regular self-control of their health status and physical exercise, thus improving their health literacy and culture and positively influencing their behavioural patterns. Also, the number of caregivers and doctors' visits can be reduced, health problems and falls timely detected, periods of institutional treatments shortened and their effectiveness increased. Also health expenses can be reduced by sav-

ings via reduced drugs usage, drug interactions, visits at doctors and hospitalisations. Health and social politics will gather more objective data, which can be of great use and importance in creating strategic planning and decisions in social and health governance.

3.3 Identification of Success Parameters

MindGym concept aims at different groups of end-users and the success criteria must encompass various aspects. In case of the elderly people, the criteria is mostly based on how many of the elderly participants will continue to use the application after the initial prototype presentation. Collection of this kind of feedback can be realised via interviews and questionnaires measuring various aspects of social integration of end users. A longitudinal comparative study involving experimental and control group of end users will provide basic information to measure the below listed success parameters.

Volunteers are also planned to be monitored for their use of the video-conferencing system and their direct user feedback. Another indicator is to monitor how many of them stay for a longer period of time when compared to the control group (thus addressing the problem of de-motivation without proper communication and experience sharing amongst them). The same analysis can be applied for first level users.

The effects of using new technology and MindGym concept in the groups will be discernible from the comparison of communication in the group before and after the introduction of new technology. Additional comparisons can be made with other groups that will not be involved in the pilot application.

Different stages of MindGym system development are evaluated based on the following success criteria: Creating the appropriate hardware to offer the video-conference service to the primary level users; Establishing a control and test group of sufficient size for statistical testing of future results, considering various socio-economic factors, attitude and backgrounds, Implementing the pilot service in more than one country, considering various stages of country development and size, Gathering user feedback via various mechanisms (tracking device activity, direct user feedback etc.), Qualitative and quantitative (statistical) evaluation of results, Improving the pilot service based on provided feedback, and The developed service is successfully promoted on various public events (workshops, promotion events etc.).

An exact measure of some of the above list criteria is defined in terms of statistical based qualitative comparative analysis.

It is also very important to mention that the MindGym system uses inexpensive appropriate technology to reach the objectives, based on interactive TV and cloud enabled devices, offering satisfactory level of inexpensive devices and their interaction.

Mainly, MindGym system is intended only for those interested and capable of working with computers. All necessary equipment and gadgets are not cheap and there is a danger, that only users who are well off will be able to afford the necessary and complete infrastructure. Therefore, a careful design is planned to activities that will not increase the social gap and health inequalities, i.e. there will be a solution for users from the lower part of social scale. The psychologically altered individuals are excluded from its usage as well.

Finally, since the MindGym system establishes a network of virtual users, it develops distant relationships without personal and physical contact. From the social and human point of view periodical opportunities for personal meetings, discussions and eye contacts are welcomed. It would give the system an additional human value, which is normally more or less neglected by technical and instrumental educated experts. This will be also addressed in the methodology for content creation and in sustainability and exploitation strategy.

4 CONCLUSIONS

This paper presents strategies for realisation of the MindGym concept and development of a relevant system aimed to increase the quality of life. The overall idea is based on provision of mind exercises including interactive TV and personalised ICT support.

The strategies concern three dimensions: provision of necessary hardware, development of software that integrates the services in a unique solution and realisation of a methodology for provision of mind stimulating content. Both business and technology concepts are considered in the overall design of the MindGym system.

The overall benefit is not just in provision of a corresponding interactive hardware, integrated in an IPTV or related technology solution with addition of cloud-enabled devices, and in an integrated SaaS solution, but also in developing a corresponding methodology to develop a content that realises mind stimulation. We plan to realise a specific research as a future work aiming to develop recommendations for realisation of appropriate content that will keep active the brain and enable conditions for prolongation of life expectancy and increasing the quality of life.

Adding the plug-in devices and medical sensors to the core MindGym system provides an environment for personalised self-care systems. The ability to measure some essential health related parameters integrated with various health-related services for provision of corresponding medical expertise is basis of a personalised self-care system that will have a lot of benefits and cost reduce.

Planned testing of the developed MindGym system, as a part of future activities, assumes that the system needs to be tested with users from various socio-economic groups, and belonging to different countries with corresponding levels of development, including various educational background, cultural and religious attitudes, etc.

The MindGym concept and presented strategies need to be evaluated for its applicability, usability and user satisfaction, along with identified success parameters. Relevant indicators are basis of a corresponding performance and functional analysis. In this paper we have identified a huge impact by increased brain activity with mind stimulating content delivered by the MindGym interactive environment, including improved mental health of elderly, and independent living.

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