

Muntermacher – “Think and Move” Interface and Interaction Design of a Motion-Based Serious Game for the Generation Plus

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Abstract. This paper presents a holistic approach to design a media system based on a new user interface and interaction device aimed to motivate seniors of the generation plus enhancing their daily physical activity. As a result of the newly designed game, the senior finds himself within a colorful world of a game in which he interacts with small lively figures using a newly designed interaction device accounting for physical activity. The combination of both design elements, lead to a gameplay that provides adequate mechanism for cognitive and physical activity, challenging representatives of the generation plus to exercise more.

Keywords: Game, ICT based inclusion, Generation Plus, Interaction Device.

1 Introduction

With increased life expectancy in recent decades, the individual esteem and social importance of good health has increased with age [1], [2]. If health can be maintained, personal skills to enable an independent and autonomous life can be improved. However, less than 10 percent of the above 60-year-old persons perform the recommended weekly amount of exercise. Although there is a general awareness about the importance of physical activity within the generation plus, the level of activities decreases rapidly [3]. Recent intervention studies show, that an increase of physical activity within the generation plus, nevertheless, is possible [4]. New instruments to motivate seniors and raising their activity level are needed. Aside senior and motivation specific training programs, new ICT technologies have been deployed recently, most of the time concealed within games. Game based design makes use of sophisticated storytelling approaches to attract a broad range of people. Diverse surveys show, that products with a similar focus on sports and fitness like Nintendo’s “Wii” or “EyeToy” as well as Sony’s “Playstation 2/3” or Microsoft’s “Xbox” do indeed effect end users motivation, due to entertaining elements. A sustainable long-term motivation, however, in most games is questionable, which was also revealed in our survey, we conducted as motivation for this work. Instead, it is important to put the focus on

specialisation for the needs of elderly people. As the most competitive manufacturers have to cover a wide range of groups of players, no system is developed specifically targeting seniors. As a consequence, a completely independent use by older people without support is almost impossible. Even worse, badly realised access to game content and its storyline makes games appear to seniors as irrelevant or too complex. Aside motivational aspects also technology barriers influence the adoption of new media systems within the generation plus [5].

2 The Generation Plus

The worldwide population experiences an enormous change. Due to higher life expectancies and the rapid increase of elderly people in western countries, many of them experience a new activity phase beyond 50 years of age, the so called second dawn [6]. Those “youngsters” or active elderly people are much more likely to be identified with the homogenous crowd of “the seniors” rather than the senile, multimorbid and aged patients. Some characteristics for a segmentation of the target group addressed during this research exercise should be given here.

2.1 Stage of Life “Seniority”

Boosted by the continuously increasing life expectancy, people experience nowadays not a traditional biography with strictly defined phases “Youth/Education”, “Employment/Family Life” and “Retirement”, rather consider themselves at early 50 to be part of another phase, the “Second Awakening” [7]. Within this phase many people review their previous and plan their future life. The transition into this new phase of “active aging” is at the same time the dawn of the “Generation Plus” [6]. The next phase of life “retirement” is distinguished in Gerontology often as “third and fourth age”. In practice, research and social reporting the so called fourth phase of life is specified as to 80 to 85 years [8].

However, it should be noted that there are 75-year-old people that are still active in life and about 60-year-old people who need daily help by others [9]. Thus, a pure classification of the elderly according to their biological age is typically not appropriate, because the physical and mental fitness vary quite strong in some cases. According to recent statistics, the first years are spent in fairly good health after retirement (“younger” age - seniors). Here, the likelihood of diseases and functional limitations are reduced but change quickly in higher ages.

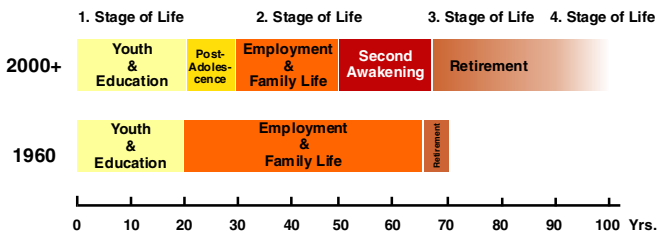


Fig. 1. From three-fold to five-fold life stages [6]

2.2 Characteristics of Aging

Nevertheless, even if people are living longer and thereby start into new phases of their life, age is still associated with biological changes, which begin very early. Those biological changes are associated to the vision, the hearing, the strength as well as flexibility and influence especially the usability of new media [11]. Therefore, and in order to design a new media system for the generation+, special attention has to be given to those boundary conditions as a violation can sometimes lead to frustrated user experiences and in consequence, in a termination of use.

Vision. With increasing age, a deterioration of all individual functions of vision can be observed. With each decade of life the visual acuity deteriorates. Thus, it reduces the visual perception of an 80-year-olds by up to 80 percent. Here, the visual acuity is influenced by a deterioration due to turbidity or discoloration of the lenses, reduction of the visual field, by limitations in the eye movement as well as depth perception. Additionally, the color perception decreases to a result that blue, blue, green and purple rendered objects are difficult to be distinguished. However, most easily distinguishable colors that could be used are red and yellow [11].

Hearing. First limitations of the capabilities of hearing typically appear at age of 45. In particular, complex language tasks (background noises, overlays) might lead to problems [12]. Language, music and sounds often need to be louder for the elderly to be perceived appropriately. Nevertheless, the perception of the full range of frequencies is often difficult, so lower frequencies are better “absorbed” than higher. Furthermore, the processing speed of the perceived tones often slows down, which means that certain syllables are only perceived reduced and fuzzified. Thus, the perception of multiple simultaneous sounds is problematic for many seniors, so that a distinction is often difficult. This implies a sensory overload (“Party syndrome”) and older people try to remain focused on certain sounds [13].

Cognitive changes. A basic requirement for mental fitness is physical health. Thus, suffering by a low vision system and without the use of visual aids, no success in reading and learning can be achieved [14]. Many elderly people don’t have problems to recall general or personal knowledge of past events from their long-term memory. However, the ability to store, organize and retrieve new information deteriorates. This is due to a performance decrease in short-term memory¹ [15]. The probability for disease-related degradation increases in higher ages. For example, 10% of Americans over 65 years, but already about 50 percent of the 85-year-old are afflicted with the, e.g. Alzheimer, disorder [15]. However, in contradiction to the persistent stereotypes of spiritually impoverished old people, it should be noted, that the mental abilities not exclusively decline at higher ages but rather are shifting. Older people have a richer knowledge of goal oriented procedures, a greater knowledge of temporal relations and developments over life, as well as better knowledge on how to deal with uncertainties and unforeseen events [15].

¹ This should not be confused with Alzheimer’s disease, afflicting only a small proportion of senior citizens.

2.3 Motivation for Activity

Intervention studies did show, that asking physically active 50- to 70-year-olds for their motives performing sports, most frequent aspects are fun of the sport, relaxation, balancing individual work life, fitness and sociability (fig. 2, [16]). With increasing age, however, the motivation to exercise more shift mostly to health related aspects, such as improving the general well-being, physical performance and exercise capacity or resilience and resistance to diseases.

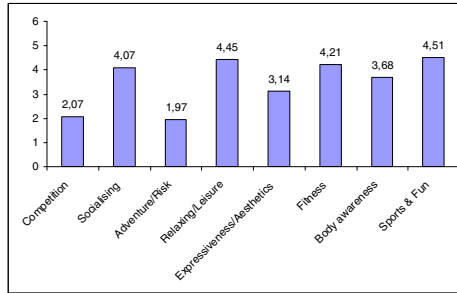


Fig. 2. From three-fold to five-fold life stages [16]

2.4 Segmentation of the Target Group

A diversity of segmentation models come from recent research activities [17], e.g. for example [18], [19] and combine socio-demographic, psychographic and behavioral characteristics. The segmentation of our target group reflects additionally on activity level and physical activity in everyday life, which are the more interesting aspects being addressed within the framework of this work. For this reason, the elderly were classified according to the features: health, accommodation, sports motivation, activity level. Thus, the system focuses on healthy, independent living people, neither being multimorbid nor suffering from dementia. They are living in their own homes and occasionally in multigenerational homes or senior housing communities. They organize their daily lives still independently and without major support from relatives or social services. Although they are aware of an increasing decline in physical fitness and the importance of physical activity, it is hard for them to maintain a motivation to exercise. They actually do not feel attracted by traditional sports activities such as seniors sports, Thai-Chi groups or senior citizens fitness studios, such as the health-oriented “Kieser Training”. Also, they lack the incentive to be in regular sport or to exercise more. In general, less than 10 percent of the above 60-year-old persons perform the recommended weekly amount of exercise.

3 Methodology

Recent intervention studies show, that an increase of physical activity within the generation plus, nevertheless, is possible [20]. New instruments to motivate seniors and raising their activity level are needed.



Fig. 3. Observation of older people using video games (“Wii Fit”, “Eye Toy”, etc.) analysing motivational aspects for enhanced physical activity

Aside senior and motivation specific training programs, new ICT technologies have been deployed recently, most of the time concealed within games. Aside motivational aspects also technology barriers influence the adoption of new media systems within the generation plus [5]. As the most competitive manufacturers have to cover a wide range of groups of players, no system is developed specifically targeting seniors. As a consequence, a completely independent use by older people without support is almost impossible. Even worse, badly realised access to game content and its storyline makes games appear to seniors as irrelevant or too complex.

In order to resolve these challenges we designed a new system using a holistic approach based on user observations, interviews and evaluation studies with senior citizens in order to gain a better understanding of the target group (fig. 3). Due to the observations we modelled a “persona” which is a typical representative of the generation plus and defines conditions for a new media system aimed at a motivational support for more daily physical activity. Our methodology included existing systems that have, themselves, been tested and analyzed in close discussion with experts from sports medicine, daily carer and seniors.

3.1 The Basis

To structure the interviews, an interview guide has been developed covering several aspects of the seniors “being” and interlinking technological aspects to their living context. Thus, questions related to the person and their everyday habits such as “watching TV”, “reading or watching news”, “music interest”, “theatre or cultural activities” as well as “personal interests” such as “travelling” or “preferences on holiday locations” have been equally important as asking for their technological affinity. Further on, it was important for us to find out personal biases of sports, activities and their engagement in games (real or virtual). Within a different questionnaire we also asked people within the near vicinity of the elderly persons responsible for the physical recreation and daily care in order to learn more about the target group. Those questions addressed general issues related to the use of media systems as well as dedicated questions to the recreational programmes they are conducting with the elder target group within senior housing communities. Another questionnaire has been used for informal talks with sports and exercise scientists in order to exclude dangerous movements within an envisioned game play for the older people. The following table summarizes the data basis we used during a two months period.

Table 1. Conducted interviews and observations

Method	Data	Material
Interviews	5 Persons f=5, 73-90 yrs	Questionnaire Training Therapy)
	4 Persons m=3, f=1 65-80 yrs	
	3 Persons f=3 73-85	
	2 Persons Physiotherapist (Medical	
	2 Persons Sports Medicine	
Observations	1 Person f=1 90 yrs	Nintendo Wii Sports
	3 Persons f=3 73-85	Wii Fit
	4 Persons m=3, f=1 65-80	Sony's Eye Toy

3.2 The Analysis

The analysis of the interviews in relation with the observations revealed short comings in the usability and sustainable activity motivation due to immature game concepts and bad interface design. Factors like “mental fitness” and “maintaining independent living” have also not been considered in recent commercial game concepts. Those are either targeting only physical activity within repetitive loops leading to fast signs of fatigue or being just too complicated to use.

4 “Muntermacher”

When designing a system for older people aiming for a longer use and higher acceptance it has to account for several requirements such as simple metaphors and guides (auditory, visual) avoiding seniors to be quenched of complicated technology, built on biological and training stimuli that induce an adaptation of the organism (body adapts to new/higher loads) and finally to involve seniors to actively participate in controlling the game. As part of our envisaged system we focused on the training stimuli in the area of power, coordination, balance. Major objectives:

- *Experience Goals* (experience requirements during use): want to be entertained and cognitively challenged
- *End-Goals* (goals that are pursued by the system): experience and learn something new
- *Life-Goals* (long-term goals in relation to the system): maintain independence as long as possible

4.1 System Design

The system concept foresees a video game for home TV. As television sets can be found in 99 percent of the over-50s, this medium seems particularly suitable. The system consists essentially of a console, the so-called “mbox” (“MotivotionBox”), which includes an integrated camera and captures the movements of the user. The device also supplies a power connector and a cable to connect to the TV. The camera is located above the TV in order to enable a control of the game by the user. As indicated above long-term sportive activities can only be achieved being intrinsically motivated, i.e. by a “personal drive”. The analysis, however, shows clearly that this particular drive needed for physical activity is only marginally present within the target group.

In contrast to the physical motivation the target group has a strong incentive to keep its level of mental fitness. Thus our concept focuses primarily on cognitive training fulfilling the wishes of the target group for mental fitness and independence. The training however, is strongly associated to physical exercises and accounts for sports prophylactic effects, and secondly, to increase the effectiveness of the “brain jogging”. This relationship between physical activity and mental impact has been particularly stressed in order to promote the intrinsic motivation of the users.

4.2 Game Design

Our gameplay consists of several mini-games of various sports categories combined with thought and some knowledge questions at general education level. Since there is in science no uniform classification for puzzle games, our design did focus on popular puzzle categories such as logic, memory, mathematics and perception. According to the requirements analysis, the game play should be performed within a humorous and sympathetic environment. Thus, the user finds itself embedded within a colourful game world, in which he interacts with small lively figures (“brain cells” that need to be alerted throughout the game). The central task of the player is to connect different brain cells together and accomplish puzzle tasks such, that the brain cells are “activated”. Visual guides using shadowing metaphors and integrated auditory assistance assist the seniors in navigating.

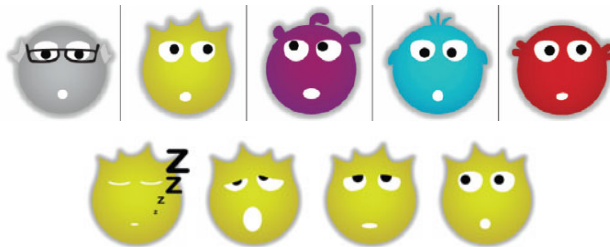


Fig. 4. Brain cells used in the mini games (above); a brain cell “wake up” if touched (below)

The most important figure represents the “gray cell” that takes the role of a moderator and as a virtual companion for the players, guiding them through all the menus and games. The results during our observations showed that a virtual companion, providing advice and support improved the operation of a game significantly. The “grey cell”, is the faithful companion of the player, and provides support at any position within the game.

4.3 Interaction Design

In order to interact with the system we designed a new interaction device using a modified gymnastics band (fig.5). The modification is based on pressure balls attached to both ends of the band and deployed as end effectors. The band is actively integrated into the game and not only used in addition to a passive gesture control. This is due to the observation when using commercial games such as “Eye Toy”,

seniors tend to physically grab the virtual objects. Hence, the new interaction device accounts for this physical feedback as soon as virtual objects are crossing the interaction path of the end effectors of the band. The different colours of the end effectors allow our deployed image processing to segment the colours and to calculate the position of the balls within the video stream and retrieving the right 2D position within the rendering plane in order to activate the brain cells (fig.6).



Fig. 5. Modified gymnastics band, two interaction balls as end effectors (right), in use (left)

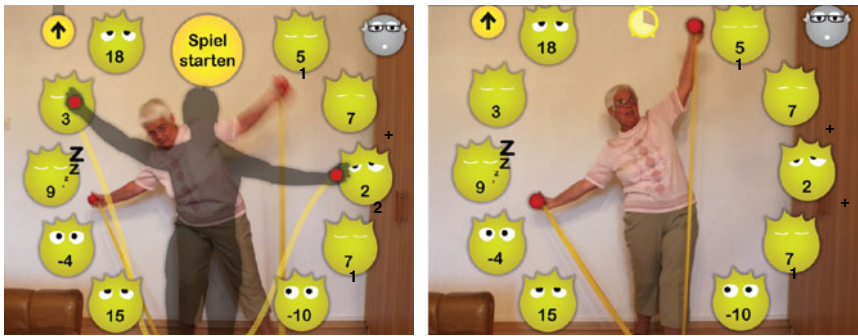


Fig. 6. Gameplay and puzzle of cells within the game; ghost rendering showing on how to pick up the position and to interact with the system (left)

5 Qualitative Evaluation

The target group being actively involved within the observations (section 3.1) has also been included in first qualitative user tests. Here, main focus has been given to the handling and understanding of the interactions using the new input device in combination with the game world.

The handling of the exercise band and finding the correct position was perceived very well by the users. In general a simple demonstration of a ghost rendering (fig.6) showing on how to use the device and what posture should be taken was sufficient for the seniors in order to start and use the game. Also, the basic procedure for operating a selection element by simply pressing a ball has been quickly learned in a short time.

One problem, however, presented the correct positioning of a ball outside the selection elements. Furthermore, the transmitted video image which should serve as a guide in positioning was barely perceived by the seniors. This caused the balls not being adequately positioned while triggering the cells. The relationship between the positioning of the balls and the mode of operation to select an element should be explained in more detail by the “grey cell”. A visual highlight of the balls on the TV screen, could also be helpful. Purely auditory instructions within games, as it was realized within the first prototype, proved to be insufficient. Despite the detailed auditory explanations of the moderator, he was not able to teach the subjects sufficiently several interaction processes within the game. This is especially true for the “hold on and press” interaction as soon a brain cell has to be activated. This implies that a further development of the prototype has to include animated demonstrations of the gameplay as well as a practical introduction with detailed instructions.

6 Conclusion

In order to resolve the challenge to intrinsically motivate elderly people for more physical activity we designed a new system for a game that can be used in daily environments. Our design is based on a holistic approach using user observations, interviews and evaluation studies in collaboration with senior citizens to gain a better understanding of the target group. Due to the observations we modelled a “persona” which is a typical representative of the generation plus and defines conditions for a new media system aimed at a motivational support for more daily physical activity. Our methodology included existing systems that have, themselves, been tested and analyzed in close discussion with experts from sports medicine, daily carer and seniors. The resulting games provides a new form of interaction which accounts for an ease of interaction within the gameplay as well as a new game concept specifically designed for the generation plus. It challenges seniors for cognitive tasks linked to physical activity. One positive aspect of the designed game is the playful nature that has been exposed to be within the focus rather than the sportive activity, which happens “aside”. Thus, the user mainly focuses on experiencing the game rather on the workload happening due to physical activity.

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