Digital Game Design for Elderly Users:
A Multi-Disciplinary Review

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Subject: Research Topics in HCI
Abstract

This paper reviews and further discusses the digital game design for the elderly from multiple disciplines including health, psychology and design. The purpose of the study is to look beyond the classic viewpoint of usability requirements established by age-related physical impairments, towards the design opportunities to produce digital games that are beneficial to both of physical and mental health of seniors with new interactions.

Keyword: Elderly, Game, Health, Psychology, Design, Interaction
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1. Introduction

According to International Population Report from US Census Bureau, by the year 2040, more than 25% Europeans is likely to be aged 65+, and there will be 14% of them aged 75+. Besides, the world’s population of 80+ years old is predicted to raise 233% from 2008 and 2040 in contrast of 160% for proportion aged 65+ [1]. Besides, digital games bring various benefits to elderly users, such as the mental and physical improvement. From a marketing perspective, senior adults are a very large potential customer base. However, so far the growing 65+ demographic is not served well by the majority of existing commercial digital games on the market, providing a remarkable potential market for game designers.

This paper discusses the features of elderly users, which includes the lifestyle, age-related impairment, psychological characteristics and involvement in digital games. The understanding of these features is the key to designing digital games for seniors, then further analyzes a collection of digital games for seniors and put forward to the design opportunities based on the understanding of elderly users.

2. Understanding Elderly Users.  

The first key of digital game design for elderly users is to conduct a user-centered design with the comprehensive understanding of senior gamers. This section summarizes the lifestyle and psychology characteristics of elderly users, presenting the implications of game design for the elderly. Besides, it also analyzes the age-related impairments effecting old people to play digital games and reviews the elderly’s motivations on games and their involvement with digital games.

2.1 Lifestyle Characteristics

Compared with youths, elderly users have different lifestyle features in which factors range from the apparently unrelated ones (e.g. house location) to those essential elements like education and computer knowledge. There are various educational levels among elderly individuals, and a notable percentage of them only have low literacy. According to the survey reported by the UK 2011 Census [2], which testing all usual residents aged 65 or over, it shows that about 60% of them have no formal educational qualification. The lack of educational degrees indicates that older adults can not be assumed to be familiar with digital games or computer techniques. Therefore, it is significant to confirm that the game information is in acceptable forms, and game guidance is straight-forward.

Moreover, some retired seniors have extremely busy lives concerning not only with their hobbies and business, but also involving in caring for their grandchildren. However, there are also lots of older people feeling alone and isolated, and having large amounts of free time.

Therefore, the digital game design should take account of senior gamers’ education level, literacy and living style, to make sure the interfaces are easy for them to learn and to enjoy the
game, helping senior players reduce the sense of loneliness and isolation.

2.2 Age-related Impairments

Aging is associated with various impairments, such as sensory decrement in vision and hearing, the decline of motor abilities and cognitive impairments [5], all of which affect elderly adults to play games.

Vision loss is a common physiological change among elderly adults: approximately 30% the old has various types of vision-reducing problems by the age of 65 [6], and among the 38 million individuals who are blind, there are 22 million people with age of 60 or older [8]. Impairments, in contrast, sensitivity, dark adaptation and color sensitivity will make it difficult for senior gamers to catch sight of small components on a small screen, to look for the small print instructions, or to search out details on a complex display [7]. To improve the game usability for the elderly, the game should have original screen mode suitable for senior gamers. And also, provide them with easy access to adjust the font, color contrast, and window size. These customizations should not exceed appropriate boundaries for the playability of a game on a system. For example, a 200 point-size font on a portable game device will not increase readability. Besides, elderly users should be able to set or undo the customization with single clicks [7].

The loss of ability to hear high frequencies with ageing, known as presbycusis, is also another common impairment. Most human suffer a small amount of hearing loss from around 40 years of age [12]. Senior gamers with presbycusis may have trouble in understanding synthetic speech which is sort of distorted. Lower frequency tones between 500 to 1000Hz are easier for senior players to hear compared with higher pitched sounds [8]. In general, it is recommended to provide abundant information through different ways. For example, providing subtitles if audio or video content is essential to the game’s user experience and testing the frequencies of synthetic speech.

The decline of motor control is another impairment with age, making it more difficult for senior gamers to play the digital game. Elderly users have deficits in the coordination of bimanual and multi-joint movements [13] and also show slower response time because of the loss of motor units. Therefore, it may be challenging for senior gamers to use the mouse steadily as it is quite accurate, and responsive interfaces might be more suitable for elderly users.

Cognitive impairment with age ranges from mild to severe. A report shows that the number of Americans aged 65+ years having Alzheimer's disease (the most well-known type of cognitive impairment) is 5.1 million, which might rise to 13.2 million by 2050 [14]. Senior gamers who suffer cognitive impairment have difficulty in working memory, learning and decision making. Obviously easy digital games often include the tasks demanding those cognitive process. For instance, remembering information will be hard for senior gamers due to the decline in working memory [10]. Thus, the focus of game interface design for older adults should be on intuitiveness and simplicity, reducing the burden of memory as well as cognitive processes.
2.3 Psychology Characteristics

Senior’s psychology characteristics differ from youths, and they suffer from psychological problems with age. According to the reports from American Psychological Association, 7% of older people have anxiety disorders where an individual may undergo apprehension, dread and stress lasting more than six months. Also, 5%-7% of seniors aged 65 are afflicted by Dementia, which is accompanied by emotional disturbance. The elderly with Dementia are often in depression and anxiety which also have the negative effect on their physical health [3].

Depression is a negative emotion distinguished by a sense of helplessness, sadness and the feeling of loss. Those with depression is more likely to suicide, and for those seniors, who have disabilities and loss of lovers, or live far away from family members, may suffer from depressive [4].

Overall, digital games for elderly users should help reduce their depression and anxiety, stress with providing more social connections with others and more entertainment.

2.4 Involvement in Digital Games

A recent study conducted by the BBC [16], indicates that seniors aged 65+ are more likely to involve in TV watching compared with other age groups, and they use the internet less often than youths. The principal purpose of using the internet for them include travel, education, and finance, shopping. Nevertheless, over 30% of pensioners shows that they are keen on updating with new technology.

A review of pioneering research in game design area [15] shows that a majority of older adults are attracted to play digital games when being provided the opportunities with systemic instructions or stimulations if the games can bring various benefits ranging from improvements in motor skills to mental enrichment. Besides, a report shows that around 18% of sample UK individuals aged 51-65 plays digital games, and 66% of them play at least once per week. Although these statistics may not be typical results of the Europe, a recent Finnish consumer research conducted by VTT. As a piece of the Exergames project which has 1489 respondents aged 13-76, finds that there are 52% of pensioners age 65+ playing digital games, and 22% of retirees playing games on a daily basis [17]. Besides, the Entertainment Software Association (ESA) in the US finds that 19% of Americans aged 50+ played video games in 2004, increasing from 9% in 1999, and this number raise to 25% in 2005 [18-19].

In general, although elderly users play digital games less often than other age categories, this can not be ascribed to the lack of interest or openness. Despite it is challenging for seniors to interact with digital technology, research indicates that elderly adults are quite receptive to computer technology. A study of technology adoption behavior by senior gamers states that elderly adults would like to invest time in new computer technology providing them with benefits [20]. Besides, Steyaert [21] presents that seniors support new technology providing valuable opportunities for them but not at any price. For instance, they do not hope technology
to replace face-to-face communication, but want such technologies supplying additional social activities, connecting adults with similar hobbies, or assistant them to keep in contact if immobile.

2.5 Benefits of Playing Digital Game

There is a growing number of research showing that digital game is beneficial for elderly users’ physical and psychological health.

As for physical health, a series of studies detected that game assistant to treat diseases associated with cognitive difficulties [22-27], such as loss of working memory and the lack of attention, as well as those treatment requiring more physical activities. Besides, digital games are positive alternatives to physical therapy and to motivating seniors to build a habit of daily physical exercise with game interfaces of movement or gesture control [28-33].

As for psychological health, playing digital games can increase the sense of achievement and self-esteem [34-35]. In addition, modern technologies provide seniors with opportunities to meet and connect with others, reducing the negative effects caused by isolation and loneliness.

3. Digital Game Design for the Elderly

Based on the understanding on senior gamers, this section reviews and discusses a collection of the existing digital games aiming senior users, then find out the design opportunities for digital game design for seniors.

3.1 Review of Previous Digital Game Design

This part search out existing digital games for seniors through Google and YouTube with some related keywords such as ‘digital game for senior’, and then selected some topical games and summarize their features (shown in Table 1 and Figure 1).

<table>
<thead>
<tr>
<th>ID</th>
<th>Name of Game</th>
<th>Benefits of the Game</th>
<th>Evaluation of the Game Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Brain Age</td>
<td>Improve memory skills and concentration</td>
<td>1) Good: clear training, funny instruction and easy to learn,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2) Bad: pen-touched interaction.</td>
</tr>
<tr>
<td>2</td>
<td>Animal Bingo</td>
<td>Memory skills</td>
<td>1) Good: big icon and easy to learn.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2) Bad: simple mode</td>
</tr>
<tr>
<td>3</td>
<td>Smart Aging Platform</td>
<td>Brain function (cognitive impairment) and well-being</td>
<td>1) Good: simple daily tasks, voice guidance, 3D virtual environment</td>
</tr>
<tr>
<td>4</td>
<td>EVO</td>
<td>Detect Alzheimer’s disease</td>
<td>1) Good: interesting interaction</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2) Bad: complex background</td>
</tr>
<tr>
<td>5</td>
<td>V-time</td>
<td>Reduce fall risk</td>
<td>1) Good: simple daily tasks, voice guidance, 3D virtual environment</td>
</tr>
<tr>
<td></td>
<td>Digital Game</td>
<td>Description</td>
<td>Strengths/Weaknesses</td>
</tr>
<tr>
<td>---</td>
<td>--------------</td>
<td>-------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>6</td>
<td>Lumosity</td>
<td>Train cognitive skills</td>
<td>1) Good: simple task and touch-based interface, interesting icon and multiplatform support. 2) Bad: small text size</td>
</tr>
<tr>
<td>7</td>
<td>Treasure of Bell Island</td>
<td>Attention, memory, visual perception and executive function</td>
<td>1) Good: color design, guidance, and multiplatform support.</td>
</tr>
<tr>
<td>8</td>
<td>DJ Fiero</td>
<td>Acquired Brain Injury and movement</td>
<td>1) Good: gesture control</td>
</tr>
<tr>
<td>9</td>
<td>SeeME</td>
<td>Rehabilitation and physiotherapy (motor skill)</td>
<td>1) Good: simple gestures, big display, data collection for patient</td>
</tr>
<tr>
<td>10</td>
<td>Zoezi Park</td>
<td>Reduce fall risk</td>
<td>1) Good: gesture control, data collection, and good feedback, natural background</td>
</tr>
</tbody>
</table>

Table 1: Digital games for senior gamers.

Figure 1: Digital games for senior users
3.2 Design Opportunities

Elderly users have different lifestyle, interests, physical and psychological characteristics which differ them from other age groups. However, there is no enough experimental statistics showing what categorization of elderly users may look like and the mapping between game content and senior gamers. Despite the features discussed earlier may motivate the focus on usability improvement for the elderly group, it has argued that senior gamers are attracted by the perceived benefits instead of the costs.

Keeping the above information in mind, it seems that there are four major fields having remarkable design opportunities. Firstly, to design digital games entertaining and relaxing seniors, as they may be boring and feel lonely when living alone. Despite a number of strategies for problems, such as housekeeping and personal care, often involve in the technology support and social connections. The use of technology or social support, these types of solution may be not suitable when seniors are frustrated by boring leisure activities [36]. Alternatively, there are 60% of sample seniors giving up on their favorite entertainment. Thus, the most acute barriers for using technology support to meet their requirements are their availability and acceptability to use these [37]. Digital games can present interesting tasks and information through various forms, such as text, video and 3D virtual environment, which contribute positive effects to the elderly’s leisure time.

Secondly, a number of senior gamers regard games as a way to socialize with others inside or outside network, as games supply a series of topics to communicate and decrease the social distance (e.g. Animal Bingo). A lot of digital games can be played alone, but digital gaming can be a great social activity by providing multi-player mode. Research has showed that 75% of sample gamers from Spain, Italy, the UK, Germany and France play digital games with others at least an hour per week. Besides, the motivation of playing games is to be social. Therefore, social interaction module is a significant motivator to play in digital game, and it can provide seniors with different kind of ways to play with others, such as two-player competition.

Finally, digital games can be designed to improve people’s cognitive abilities (e.g. Brian Age). By providing seniors some quizzed, games will be beneficial for challenge senior’s memory skills. Besides, with the advent of new interaction technologies, such as Microsoft Kinect, games can be played with additional tools, which can provide them gesture control or acceleration sensing (e.g. SeeME). Such interactions can help improve both seniors’ physical and psychological health. Besides, seniors are not familiar to these new interactions, so games should provide the voice guidance and video instructions.

4. Conclusion

Digital games have remarkable potential to elderly adults, providing them entertainment and social activities which is beneficial to their psychological health, and allowing them to engage
a series of physical activities with new interactions for the treatment of age-related impairments.

This study reviews related research of various disciplines, summarizing the features of elderly user, and those characteristics can be the guildlines of game design. It also analyzed the existing games for elderly and put forward to the design opportunities. However, due to the lack of time and resource, the finding of this study is limited. To explore and understand deeply senior gamers, further study is to conduct more detailed research, such as focus group interviews, user profile and market analysi

References


