

**SERIOUS GAMES – INNOVATIVE APPROACH FOR SCREENING AND
REHABILITATION OF COGNITIVE IMPAIRMENT**

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Abstract: Information and communication technologies (ICT) provide innovative ways of prevention, treatment and assessment of patients with dementia. Interventions based on ICT can provide non-invasive, patient-centred and cost-effective solutions to detect early cognitive and functional decline in patients with cognitive impairment. The article discusses some key features of serious games and describes the potential benefits of using computer games platform and opportunities to assess its effectiveness as a diagnostic and therapeutic method in patients with cognitive impairment and Alzheimer's disease. The aim of this report is also to represent the pilot projects experiencing the use of game technology for cognitive screening and rehabilitation.

Keywords: serious games, cognitive assessment, cognitive rehabilitation, dementia, mild cognitive impairment

INTRODUCTION

A key challenge for Europe and developed countries on other continents is aging of the population and the social, health and economic consequences. The European Commission has funded a number of projects related to this issue in the 7th Framework Programme for Research and its successor Horizon 2020. In 2011 the Commission launched the first European Innovation Partnership on Active Ageing and Healthy (EIP-AHA). [1] This is a pilot initiative to promote innovation that brings together all stakeholders at European, national and regional levels from different policy areas to tackle social challenges and to involve all levels of the innovation chain. In the center of the Strategic Plan for the implementation of this partnership are: prevention, screening and early diagnosis; Care and treatment; Active aging and independent living.

Some of the activities taken to achieve these objectives are related to develop solutions based on ICT that can help older people to remain active, independent and mobile longer. In connection with the implementation of these actions several working groups were formed and the study of "serious games" was in focus of the group "Prevention of functional decline and frailty." Special attention is paid to cognitive impairment and translation of ICT "serious games" in screening these disorders.[2] As a result of this initiative in 2015 it was realized platform based on serious games - SMART Aging Serious Games Platform. The main goal of the platform is to support an early diagnosis of Mild Cognitive Impairment in persons between 50 and 80 years old. SMART Aging is based on traditional tests to assess cognitive functions and realized through a strong collaboration between neurologists, neuropsychologists and game developers. The platform is in validation phase to provide evidence of the efficacy and usefulness of the Smart Aging system in clinical practice.[3]

In recent years, computer games become very popular and replace traditional games not only as a means of entertainment but also as a means of education, training and improvement of various skills. Many of the early studies on the effects of computer games have focused mainly on their negative impact, and in particular to games with violence. On the one hand, these games are associated with increasing aggression, aggressive behavior and way of thinking and with antisocial lifestyle. On the other hand, computer games are associated with problems such as addiction, inability to regulate the time spent playng games, social exclusion etc.

Despite these negative aspects, the games have many positive effects. Initially the subject of an interest became games designed for entertainment that have the potential to be useful in training. This interest soon grew into development of training programs based on games (games - based learning) and design of games for learning purposes. Modern theories of effective training prove that this process is most effective in an active environment through experience based on solving problems in certain situations and with immediate feedback. This is so called Edutainment Games or education & entertainment games. "Serious games" and games of persuasion used in health, politics, communications, marketing, politics and education also have become very popular.

DEFINITION

The definition of the term "serious games" isn't unequivocal. It depends on who uses it and in what context. Firstly this concept sounds contradictory because the games are associated with entertainment that precluded the possibility to be perceived as something serious. Secondly, the gaming itself and the games have developed as tools for training and in most cases, players perceive the game pretty seriously.

The idea of using games or game technologies for purposes other than mere entertainment, originated from the book *Serious Games* by Clark C. Abt (1975). When he introduces the subject of his book, he states: "We are concerned with serious games in the sense that these games have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement." (Abt 1975, p.9) According to him, the educational goal is not necessarily to be a part of the design of the game, and may be incorporated in the context of the game, or be embedded inside it. Later, Ben Sawyer gave another definition of serious games to "any meaningful use of computerized game/game industry resources whose chief mission is not entertainment".[4] Serious games use not only game elements in a serious context, but something more - the experience gained during the game can help to achieve real-world goals. According to the general opinion of researchers in the field of Serious Games, the primary objective is to increase the motivation of the player to pursue a real-world goal via gaming experience. Other effects that can be achieved are increasing knowledge on a particular problem, attitudes and relations, cognitive ability, physical ability, health or mental status of the user (McCallum, 2012).

GAMES FOR HEALTH

Serious games are widely used in healthcare, occupying a special place in the world of computer games - Games for health. These games are developed for patients as well as for health professionals. When it comes to the patients, these games have preventive, diagnostic, therapeutic or information purposes. For health professionals, serious games can help to enhance their competence in a safe environment.[5]. In recent years Serious Games have been developed for patients with diabetes, for overweight people and for those suffering from asthma. They are applied in the field of rehabilitation, such as neuropsychologic and chronic disease, and in patients after stroke[6]. These games are applied in adults with physical and mental disorders as well as in children with autism spectrum disorder. [7]. One of the advantages of computer games is that they allow personalized approach taking into account the individual characteristics of the players. [8]

Today, there are a growing number of games for cognitive training, exercise and social skills that aimed to reduce symptoms of different types of cognitive disorders, such as mild cognitive impairment (MCI), Alzheimer's disease and Related Disorders (ADRD). However, the games associated with dementia have not been well studied. Faced with new challenges in aging population researchers undertake experiments with serious games as a training platform to help delay or alleviate the condition of people with cognitive impairment.[9]Dementia is characterized by problems with memory, impairment in thinking, communication, orientation and difficulties to perform everyday tasks.[10]

CLASSIFICATION

The classification of Games for dementia is made based on functional disorders and on the objective.[11][12] There are three categories of games:

- Games, for cognitive training, which can lead to an improvement of memory and attention
- Physical games or exergames that promote physical activity. Physical activities have positive effect on patients with Alzheimer's disease such as improvements in gait or balance of the body or in the conscious motor control.
- Games that have a positive effect on social and emotional functions such as improvement in mood and depression reduction.

Each of these game categories serves different purposes. Depending on the purpose games separate into games for informational, therapeutic and preventive purposes. Games from the first group provide information needed to assess the condition and to diagnose. These games apply standard neuropsychological tests to assess such as MoCa (Montreal Cognitive Assessment) and MMSE (Mini - Mental State Examination) in the digital environment. The second group includes games incorporated mechanisms for improvement of cognitive function. The third group of serious games has the potential to predict the beginning of dementia before the patient be officially diagnosed.[13]

SERIOUS GAMES FOR COGNITIVE ASSESSMENT AND COGNITIVE REHABILITATION

Cognitive rehabilitation is designed to solve those problems that are most common in patients with dementia or Alzheimer's disease. This type of rehabilitation allows patients with cognitive impairments to reach their optimum level of health. The subject is to identify the goals and skills of the patient and to direct interventions for development of specific skills.

Serious games are mainly apply for cognitive training and cognitive screening. Games for cognitive training aimed to stimulate cognitive abilities of a player through cognitive tasks. Games for screening assess the behavior of the player during the execution of the tasks. Although, it is difficult to determine the causal relationship between cognitive functions and activities that stimulate these function, many studies have shown that video games for cognitive training give an indication of a positive effect on the functions of memory, attention, emotional state and as well as delay the cognitive decline.[13][14][8] [15][16][17]

The development of ICT and especially the "serious games" leads to increased opportunities for neuropsychological assessment in clinical practice because they have characteristics that give them an advantage over the traditional methods. Traditionally, western medical treatment has been focused on an expert matching the symptoms of an individual with a diagnosis. Interventions were performed based on population statistics, generalized information, and treating symptoms in isolation, not because of a desire to ignore the individual, but because of lack of evidence on how individuals respond to interventions.[18] Serious games allow a personalized approach taking into account the strengths and weaknesses of the player.

Another feature of these games is that they show increased motivation to the diagnostic and therapeutic process due to the attractive game components. It is known also that the motivation plays a key role in the rehabilitation process thus serious gaming may lead to better results from the recovery process.

Flexibility and timely feedback are another essential characteristic of Serious Games. Flexibility refers to the ability of the game to increase the difficulty of the tasks automatically depending on the progress of the user. So do not perform tasks that are too easy or too difficult and the user automatically receives feedback or progress report in motivating ways.[19]

Having emphasized all these advantages it should be noted that these games have the potential that has not been fully studied and have to be checked and validated. When the computerized test for cognitive assessment or rehabilitation is applied a new problem need to be solved - the lack of motivation. Thus, finding a suitable tool for assessing game acceptance is a key challenge.[15]

CONCLUSION

The design and implementation of information and communication technologies in healthcare is a complex process that requires close collaboration between the computer specialists and health professionals. It is important to note that the developing of serious game to this group of patients requires an interdisciplinary approach to the possibilities of modeling cognitive impairment in a virtual environment and methods for its response. ICT can play a key role in assessing the mental status of patients with Alzheimer's disease and related disorders, both in terms of earlier and more accurate diagnosis and in monitoring the development of the disease. This systematic review shows that serious games can be a very useful tool for professionals who are involved in care of patients with cognitive impairment.

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