

Chapter 20

A Serious Games Framework for Health Rehabilitation

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ABSTRACT

Serious Games is a field of research that has evolved substantially with valuable contributions to many application domains and areas. Patients often consider traditional rehabilitation approaches to be repetitive and boring, making it difficult for them to maintain their ongoing interest and to assure the completion of the treatment program. This paper reviews Serious Games and the natural and multimodal user interfaces for the health rehabilitation domain. Specifically, it details a framework for the development of Serious Games that integrates a rich set of features that can be used to improve the designed games with direct benefits to the rehabilitation process. Highlighted features include natural and multimodal interaction, social skills (collaboration and competitiveness) and progress monitoring. Due to the rich set of features supported by the framework, the games' rehabilitation efficacy can be enhanced primarily from an increase in the patient's motivation when exercising the rehabilitation tasks.

1. INTRODUCTION

Nowadays, increasing attention is called upon and given to the development of tools for the rehabilitation of patients suffering from various disabilities. Additionally, the use of Serious Games as part of these rehabilitation tools is also

proliferating. Serious Games is a field of research that has evolved substantially with valuable and potentially beneficial contributions in many areas.

As a multidisciplinary field of research, Serious Games can be applied to solve different problems in wide-ranging areas such as: education, military, health care and rehabilitation. In such areas,

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computer games design and technology can be used to provide the user with an entertainment or enjoyment component, while fulfilling other desired purposes, namely, educate, train (military strategies), cure and rehabilitate. The key purpose while playing the game is not the entertainment, or enjoyment, or fun, but another (more serious) purpose. In this research we focus on its potential impact on the health rehabilitation domain.

Rehabilitation of patients from a wide variety of disabilities resulting from diseases or traumatic incidents has associated high costs due to the potential loss of work productivity and rising of patient rehabilitation expenses, contributing also to rapid social costs growth. Studies have shown that most patients can sometimes regress into depression as soon as the rehabilitation program starts, contributing to increasing the associated healthcare costs even more. In previous studies (Mendes et al., 2012; P. Rego, Moreira, & Reis, 2010; P. A. Rego, Moreira, & Reis, 2011, 2012), we have discussed issues and identified features that could benefit the rehabilitation process using Serious Games. Building on those discussions, our key objective here is to highlight our work regarding the design and implementation of a hardware-software architecture for the development of Serious Games in Health Rehabilitation; more specifically, an architectural framework to augment patients' motivation during their recuperation plan and one that integrates the set of features we find as relevant to this process.

This article extends our work presented in the WorldCIST 2014 - World Conference on Information Systems and Technologies, in Madeira, Portugal (Paula Alexandra Rego, Moreira, & Reis, 2014). The rest of the paper is structured as follows. The next section presents the motivation for using Serious Games in health rehabilitation and reviews Serious Games in this domain, organized by single and multiplayer prototypes. Following this, Section 3 presents examples of natural and multimodal user interfaces in rehabilitation. Section 4 discusses design considerations and system

requirements for the developed architecture while Section 5 describes the framework architecture. Section 6 presents results of user testing using the described architecture, current work and some directions for future work. Finally, Section 7 summarizes the major conclusions.

2. SERIOUS GAMES IN HEALTH REHABILITATION DOMAIN

Games can be used in the rehabilitation area to increase patient motivation in the rehabilitation sessions. Due to the repetitive nature of exercises, patient motivation is a key problem that has challenged traditional therapy sessions (Burke et al., 2009).

Most studies on rehabilitation show that an effective rehabilitation must be done early and must be intensive and repetitive (Burke, et al., 2009; Burke et al., 2010). As such, traditional rehabilitation approaches are often considered as repetitive and boring by the patients, resulting in difficulties to maintain their continuing interest and in assuring that they will complete the treatment program (Burke, et al., 2009). On the contrary, games can motivate and engage the patients' attention and even distract them from their disability conditions due to a set of features that characterize them: games have a story, they require the ongoing engagement in some motor and cognitive activity, and they can offer feedback and levels of challenge and difficulty that can be adapted to the patient needs and skills.

Computer games design can offer invaluable contributions in the development of more effective games for rehabilitation programs. However, designing a game with all the features that could benefit the rehabilitation process is a complex task. The identification, classification and assessment of game features that are relevant for the health rehabilitation domain are very important for designing rehabilitation games.

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