Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 104 (2017) 445 – 451

Procedia Computer Science

ICTE 2016, December 2016, Riga, Latvia

Low – Cost Devices Used in Virtual Reality Exposure Therapy

Pawel Bun[a,*], Filip Gorski[a], Damian Grajewski[a], Radoslaw Wichniarek[a], Przemyslaw Zawadzki[a]

[a]*Poznań University of Technology, Piotrowo 3 STR, 60-965 Poznan, Poland*

Abstract

The Virtual Reality technology is nowadays dynamically developed, thanks to appearance of low-cost devices and interest by large companies related to entertainment, communication and visualization. It is especially important in medicine, as it allows a much wider access to tools such as Virtual Reality Exposure Therapy. The paper presents possibilities of using low-cost VR devices in curing phobias by exposure to a stress-generating factor in an immersive virtual environment. Several use scenarios are presented for a simple application aimed at exposing a patient to fear of heights. A test group consisted of healthy individuals. To evaluate level of immersion and fear caused by the application, a heart rate monitor was used, to record heartbeat in real time.

Peer-review under responsibility of organizing committee of the scientific committee of the international conference; ICTE 2016

Keywords: Virtual reality; Low – cost devices; Virtual reality exposure therapy

1. Introduction

During the recent years, the Virtual Reality (VR) technology developed significantly. The VR applications, starting from a level of simple graphic applications made for entertainment and studies, now are used extensively in many professional branches. Virtual Reality can be used as specialized engineering tool[1,2], for medical education[3,4], engineering education[5,6] or advanced training and simulation systems[7]. One of the frequently mentioned uses of VR is treatment of psychological conditions, such as phobias and anxieties, by means of exposure, which is known as the VRET – Virtual Reality Exposure Therapy[8]. There are many cases of successful use of such therapeutic tools, for example in treatment of acrophobia[9] and post-traumatic stress disorder[10].

* Corresponding author. Tel.: +48 61 665 2708; fax: +48 61 665 2774.
E-mail address: pawel.bun@put.poznan.pl

Peer-review under responsibility of organizing committee of the scientific committee of the international conference; ICTE 2016
doi:10.1016/j.procs.2017.01.158

To increase efficiency of a therapy, it is necessary to increase immersion level, in order to induce the feeling of presence and – as a result – anxiety needed for therapeutic results[11]. Immersion, understood as a feeling of being physically present in a non-physical world, can be expanded using appropriate tracking and vision systems[12,13], as well as haptic devices[14], allowing to touch and feel virtual objects. Up to this point, a relevant limitation for development of VR applications for wider audience was price of certain peripheral device for interaction with the virtual environment, well beyond capabilities of even medium companies, let alone individual users. Development of the new batch of so-called low-cost devices (started by the Oculus Rift DK1 device), as well as growing interest by large electronic entertainment companies (such as Samsung, Microsoft etc.) leads to increase availability and popularity of VR technology. This translates into using it in disciplines, where potential is large, but potential use was scarce – such as the VRET. An example of this application of the low-cost devices is the "Be Fearless" program introduced by the Samsung company[15], aimed for use by individual users to help them overcome certain anxieties.

2. Materials and methods

2.1. Phobic reactions in Virtual Reality

Despite numerous studies, aimed at determination of various factors on immersion level, a problem of influence of display parameters on efficiency of therapeutic applications is not sufficiently explored. In many cases, the immersion level is determined indirectly by survey studies[16]. In case of applications used for phobia treatment, the higher immersion, the higher is subconscious conviction of patient that he is subjected to factors causing him phobic / repulsive reactions. The whole concept of exposure therapy is based on it[11], so higher immersion obviously allows obtaining better treatment results. It translates into several stress-induced body reactions, such as increase of blood pressure, muscle vibration, accelerated heart beating, sweating etc[17]. In the initial phase of therapy, exposition level should be carefully selected, in order to not induce any violent reaction by the patient, then he can get gradually accustomed with the fear.

Therefore, to study capabilities of a Virtual Reality display, patient reactions can be measured using a hardware such as a pulsometer. There is a need for an application, where both level of exposition (application content) and level of display-induced immersion (software and hardware parameters – image resolution, field of view – FOV, etc.) can be controlled, to study patient reactions. The more the patient is immersed into a virtual world, the stronger he will react to a stress-inducing situation, which will translate directly into measurement results[18].

2.2. Case and problem definition – therapeutic application

To study influence of display parameters on level of immersion, a therapeutic Virtual Reality application was prepared, intended for curing of acrophobia (also known as fear of heights). The application is an environment consisting of multi-floor buildings with moving platforms and lifts. It was created in the 3D Studio Max software. Prepared 3D data was imported to two different 3D engines – EON Studio and Unreal Engine. It these two engines, identical interaction functions were added – positional and rotational tracking of user and collision detection between character and environment, to ensure effects such as free fall or bouncing off walls and platforms. Similar visualization techniques have been used to make the application look almost the same. The EON Studio application was prepared for use with the professional HMD, while the Unreal Engine was adjusted to work with the low-cost VR devices, such as Oculus Rift or HTC Vive. The two separate engines were used for comparison of application building methodology, as well as for easiness of use (EON Studio has in-built tools for used professional VR hardware, but use of low-cost devices is limited, it is the opposite with the Unreal Engine). In both applications, long distance user movement was ensured by use of joystick, and the user is assumed to take a standing position, with slight walking allowed over short distance. Seated pose can be also taken by the user, limiting tracking to the head orientation, decreasing immersion. It is especially important in case of strong phobias, to allow patient taking more comfortable position.