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Systems Neuroscience
& Neurotechnology Unit

Closed Loop Virtual Reality for the Treatment of Phobias

Bachelor Thesis

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Saarland University of Applied Sciences
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Declaration

I hereby declare that I have authored this work independently, that I have not used other than the declared sources and resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources. This work has neither been submitted to any audit institution nor been published in its current form.

Saarbrücken, February 16, 2018

Dominik Limbach

Abstract

we want to find out if it is possible to design a fully automatic therapy system using vr and psycho physiological measurement. therefor we will test our virtual environment with a random group of subjects and measure ecg and gsr the goal of the conducted experiment is to show that our virtual reality is capable ob causing fear this will be done by evaluating the measured bio data

furthermore our virtual can be controlled by a therapist the therapist will be able to exercise control through a matlab program provided with real time visual data the therapist will be a substitute for the AI which will later be controlling the vr respectively to the measured data

the vr and the related pc will feed visual input to the subject this input is processed by the subject and he gives output information in the form of gsr and heart rate serving as input for our third system, the therapist (visual presentation of processed data) therapist can control vr —loop closed

Zusammenfassung

translation of abstract

Acknowledgments

Contents

1 Introduction

Virtual reality combines real-time computer graphics, body-tracking devices and high-resolution visual displays to create a computer-generated virtual environment. With their ability to immerse the user into a virtual mirror of the real world virtual environments are a powerful tool in clinical application, especially in the treatment of phobias (source). Studies have shown anxiety disorders to be the most prevalent mental disorders (Kessler et al., 2005). Many consider exposure therapy the most effective form of treatment for specific phobias (DeRubeis and Crits-Cristoph,1998)(source). However that may be, considering the nature of certain phobias such as fear of heights, exposure therapy involves a genuine risk of injury. Performing therapy in a virtual environment can therefore be a promising alternative to in vivo exposure.
The efficacy of virtual reality exposure therapy (VRET) has already been demonstrated in the past. A study conducted on acrophobia, comparing two groups of student subjects, showed that VRET is more effective than no treatment (Rothbaum et al.,1995). Furthermore VRET was also found to be as effective as exposure in vivo (Emmelkamp et al., 2002). With this in mind and the possibility to conduct therapy inside a controlled and secure environment like a therapist's office virtual reality is certainly becoming an attractive choice. A recent study explored the acceptability of virtual reality exposure and in vivo exposure in subjects suffering from specific phobias supports this hypothesis. Seventy-six percent chose virtual reality over in vivo exposure. In addition to this the refusal rate of 3% for virtual reality exposure was substantially lower than 27% for in vivo exposure (Garcia-Palacios et al., 2007). These results suggest that virtual reality exposure could help increase the number of people who seek therapy for phobias. Although epidemiological studies show a lifetime prevalence of 28.5% for vHI and 6.4% for acrophobia alone, only 11% of susceptible people consult a doctor (Huppert et al., 2013; Kapfhammer et al.,2015).
With so many people going untreated and all things considered there is a distinct need to establish virtual reality in everyday clinical work.
In recent years there has been a lot of research on virtual reality treatment for different phobias trying just that.
-list studies for agora, aero phobia etc.

There also have been studies on ways to control the virtual reality. In a pilot study Levy et al. (2015) explored the possibility of a remote controlled virtual reality. After a trial session in a neutral virtual environment the patients received a total of six therapy

sessions. The first three sessions were remote virtual reality exposure therapy (e-VRET) followed by three sessions in the presence of a therapist (p-VRET). The study showed that e-VRET not only is possible but produces results equal to p-VRET. This inevitably leads to the idea of an independent VRET. To our knowledge there has not yet been a form of VRET that does not depend on external control. A system that can adapt to the mental state of the patient throughout the entirety of therapy and therefore qualify for private use could help expanding the reach of exposure therapy even further. Assessing the mental state of a patient is essential for the success of therapy. A task which usually falls to the hands of the therapist and in most cases relies on a verbal communication between both parties. To ensure the quality of our therapy system we clearly have to provide some sort of substitute for this.
-stimulation triggers fear and this is shown through psychophysiological biosignals
-list studies that state gsr and hrv as valid indicators for emotions stress and fear
-hypothesis: independent system is possible if vr can trigger fear -goal of this thesis is to design a virtual environment for this purpose and proving it is capable of

we want to create a closed loop virtual reality, which is adaptive an can function without external control based on input from realtime measurement of psychophysiological data.

- establish that an adaptive VE would greatly benefit therapy - past studies VR paradigms where none adaptive - state goal as an automated

Research Question - is the designed VE able to elicit fear (subjective) - can the fear be related to changes in measured biosignals

2 Materials and Methods

2.1 Materials

mention the SNNU and the lab where the study takes place

2.1.1 Setup

- description of the therapy setup
- graphic 1, shows a patient inside the defined treatment area, wearing VR-Headset, the lighthouse system, eeg and gsr sensors, connection to the pc controlled by the physician

2.1.2 Procedure(Paradigm)

- how many subjects did participate?
- which tasks did the patients fullfill? (cross the bridge etc.)
- duration of the experiment

- description of the virtual environment, the procedure (baseline measurement,VRET in detail)
- pictures that show the VE in it's starting state as well as it's therapy state (descended floor)
- description of how the VR is controlled by the user(which parameters can be influenced)

2.2 Methods

- main objective is the measurement of gsr during the therapy and the evaluation of the gsr data concerning the stress of the patient during the therapy
- how is the gsr information processed and evaluated?

how is it presented to the user?
- description of how the VR is controlled by the user(which parameters can be influenced)
- graphic of control chain

3 Results

4 Discussion

5 Conclusions and Future Work

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