

Repositório ISCTE-IUL

Deposited in *Repositório ISCTE-IUL*:

2023-02-15

Deposited version:

Accepted Version

Peer-review status of attached file:

Peer-reviewed

Citation for published item:

Cláudio, A. P., Carmo, M. B., Pinheiro, T., Lima, J. & Esteves, F. (2012). Virtual environments to cope with anxiety situations: Two case-studies. In 7th Iberian Conference on Information Systems and Technologies (CISTI 2012). Madrid: IEEE.

Further information on publisher's website:

<https://ieeexplore.ieee.org/xpl/conhome/6255876/proceeding>

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Virtual environments to cope with anxiety situations

Two case-studies

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Abstract—Anxiety is a growing problem in modern societies. Virtual reality has been widely adopted to treat anxiety and more severe psychological problems. We have been working on an approach that involves compelling virtual environments (VE) to treat anxiety. These VE recreate a particular situation and support in real-time the intervention of the therapist. Public domain software tools and a simple projection screen have been used. This paper describes two interactive applications that simulate VE to help people coping with particular anxiety situations. One of the applications is developed in Blender and is dedicated to the fear of talking in front of an audience; the other application is developed in OpenSim and is devoted to the fear of driving inside a tunnel.

Interactive virtual environments; anxiety treatment

I. INTRODUCTION

As we all know, the ability to deal with anxiety is relevant to our overall quality of life. Although to experience some level of anxiety is natural, and might have a positive motivational value, in general anxiety is difficult to deal with, and in some cases may be highly debilitating. In those cases, and if not properly treated, it can evolve to more serious problems, for instance, anxiety disorders, phobic behaviors or panic attacks.

In Psychotherapy, cognitive-behavioral therapies expose patients to situations they fear. This exposure technique is essential to improve, and is traditionally carried out either *in vivo* or by imagining the situations.

During the 90's, some psychotherapists started using Virtual Reality (VR) systems to apply exposure therapy. At present, the use of VR on the treatment of anxiety disorders is considered a valuable tool and has been tested by different research groups with different types of disorders.

Several authors, citing their own research or someone else's work, seem to agree that VR is a valuable tool in treating phobic disorders [1] [2] [3]. Klinger et al [4] tested the efficacy of VR Exposure Therapy (VRET) in a controlled clinical study with social phobic patients and concluded that the efficacy of the VRET was similar to cognitive behavior therapies. Scientists from the Delft University of Technology and from the University of Amsterdam are working since 1999 on a project called "Virtual Reality and Phobias" [5].

Virtual Reality has been used to reproduce exposure situations even in more severe situations such as post-traumatic stress disorders. For instance, at the Georgia Tech Graphics, Visualization, and Usability Centre, a virtual reality simulation of Vietnam War combat was developed to treat Vietnam veterans suffering from post traumatic stress disorder [6].

The use of digital platforms to support the therapeutic process has many advantages when compared to traditional techniques: it offers greater variety of possible scenarios and reduces the cost of creating situations that might be difficult or even impossible to recreate. It supports automatic recording of data, it is geographically independent, and recreates situations that may be infinitely replicable. A single package of content may be used by many therapists, or even allow therapists around the world to access it via internet.

The aim of our work is to use open source software tools to produce compelling virtual environments (VE) that support the therapist's control over the simulation before and during a therapy session. This type of control allows the therapist to adjust the intensity of the stimulus to which the patient is subjected. The level of control over the simulation is higher than the one available in a recreated exposure therapy that involves real scenarios and/or real people, where unexpected events or behaviors may occur. The use of open source software will facilitate the utilization of these scenarios in different geographic settings, without requiring the purchase of expensive software for each possible user, and sophisticated technical expertise from the therapists.

We have been using Blender [7] and OpenSim [8], open source software tools. Our simulations are displayed on a projection screen, using a perspective projection, and in a manner such that the patient sees the projected elements of the environment with a size analogous to their real counterparts. Sound is also introduced in the simulations, so both sight and hearing senses are stimulated. The patient does not control the simulation which is solely controlled by the therapist.

Based on pre-evaluations and feedback from clinical psychologists, we believe that the whole set is capable of generating in the patient the sense of presence in the situation. This immersive characteristic will be tested in the near future with patient volunteers.

This paper describes two interactive applications that simulate VE to help people cope with particular anxiety situations. Section II describes the application that is being developed in Blender, devoted to the fear of speaking in front of an audience. Section III concerns another application that is being developed using OpenSim and is intended to help with the fear of driving inside a tunnel. In section IV we draw some conclusions and discuss future work.

II. THE VIRTUAL AUDIENCE

Most people experience a more or less intense feeling of anxiety when it is necessary to speak in front of an audience. Exposing the patient to a real audience in a controlled setting may be quite complicated: it is not always easy to gather a significant number of people and the therapist is not absolutely capable of controlling the course of events.

Our approach was to use Blender and its ability to develop videogames (e.g., the game engine and the physics engine) to create a VE simulation of an auditorium populated with virtual humans. During a therapy session, the patient will face the challenge of delivering a speech or a presentation before the virtual audience. While the patient is focused on his task and on the simulation, the therapist is observing his or her reactions and is controlling the stimulus.

This simulation control is performed using a window on the therapist's computer screen, which is independent of the window displaying the simulation on the projection screen.

The sense of presence is induced in the patient by the auditorium environment (figure 1), the background noises and by the virtual humans' reactions as expressed by their look and physical posture.

A. Environment

To provide a compelling environment, the virtual auditorium reproduces the model of a real one.

It is important to fully customize the session to each patient, so one of the implemented functionalities is to define in number and gender the virtual humans that will populate the scenario. Other variables like apparent age or profession can also be simulated in the case they might be relevant for the specific patient. This is performed before the therapy session.

Another implemented functionality is the control, during the session, of the level of attention of the virtual humans, by making them more distracted or attentive to the patient's speech. Other specific events are available, e.g., all the attentive virtual humans nod in agreement, a cell phone rings, an airplane flies over, and the lights of the auditorium become weaker or lighter.

B. Technologies

This project is based on the 3D modeling software Blender. Thanks to the integrated game engine, the Blender Game Engine, it enables us to model 3D objects and their direct use without any type of conversions.

Virtual humans are imported from the MakeHuman tool [9], free software that allows the creation of naked realistic virtual humans. It is necessary to export these models to

Blender, make minor modifications to the virtual human, model their clothes and apply textures.

The animations were made through motion capture, using a Kinect camera [10] and the IpiRecorder software [11] to record data. The IpiStudio software [12] was used to process the obtained data, mapping the actor's body onto a working skeleton. After this process, we used the software BVHacker [13] to cut and stitch the animations in order to make seamless looping animations.

All the game logic is made in Python extending the functionality of Blender in a wide array of ways, e.g., the interaction window uses the GUI module wxPython [14] and sounds are controlled by the audio module Audaspace [15].



Figure 1- The auditorium populated by virtual humans.

III. THE VIRTUAL TUNNEL

Crossing a long tunnel during a car journey is a situation that can cause higher or lower levels of anxiety, especially if we start to think about hypothetical situations of emergency.

We have used OpenSim to produce a simulation to treat the anxiety caused by these situations. During a therapy session, the patient will start a journey inside the virtual tunnel. While the patient is focused on controlling his own level of anxiety, the therapist is observing his/her reactions and controlling the stimulus.

The sense of presence is induced in the patient through the model of a long curved tunnel (figure 2), the vehicles in the scenario, and the signs that alert to accidents causing delays ahead.

A. Environment

As requested initially by the psychologist in the working team, crossing the tunnel should take approximately 10 minutes. This requirement raised a problem, since OpenSim islands have a fixed area of 256 by 256 meters.

Thus, it was necessary to consider some design options for managing this limitation.

The initial model of the tunnel was a large multi-storey car-park which operated throughout the entire three-dimensional space of the island to make better use of available space.

However, the object modeling system in OpenSim made the idea extremely impractical. In a system where small geometric pieces are put together gradually to form larger objects, complex and irregular shapes are particularly onerous to represent.

Thus, an alternative plan was adopted: to model a sort of “squared spiral”. The straight sections of the tunnel allowed us to benefit from the modularity inherent to a system based on geometric primitives. It was only necessary to model one section of tunnel to construct the entire length of it.

The model also includes some graphic details for therapeutic purposes - the initial section of the tunnel goes down, and the final one goes up, so that the patient, at the end of a session, arrives in a natural green environment under an open sky, a soothing escape from a stressful situation.

Before the session begins, the therapist customizes the simulation to the patient’s needs, defining the number and type of vehicles that will be present in the scenario, as well as their speed. During the session, he can adjust the speed and insert disturbing delaying events. This is performed through a control panel in the scenario.

B. Technologies

OpenSim works natively in client-server architecture, and could easily face use cases involving dozens of people scattered throughout the entire world. In this particular case, the patient can be present in the same real-life room as the therapist, connected from another computer.

The cars produced for the simulation, exhibited in figure 2, try to achieve some level of photorealism and are entirely autonomous. They have been programmed with two sensors. One detects the various sections of the road, calculates the best path to go through them, and interpolates the cars’ positions between the guiding objects, over the course of the tunnel. Another sensor is used to determine if they are too close to the car ahead as part of broad-phase collision detection.

This type of simplified computer vision is guided by metadata - the parts that compose the road all have the same name to be easy to tell apart from other objects. However, the sensor system of OpenSim is more flexible than this and would allow us to approximate real vision, based on the objects color or size.

We pervasively use the built-in message-passing architecture that underlies the entirety of OpenSim development.

There is no centralized control, no object hierarchy equivalent to the “Document Object Model” that defines web pages. All visual objects can contain scripts, and these scripts are specific to the object.

Messages are passed connectionlessly, through broadcast, and the burden of filtering lies on the receivers. It is possible to make the receiver’s job easy by specifying a numeric channel – analogous to UDP ports.

The server maintains in memory a list of messages sent. Each script is a single, separate thread that runs through the list trying to apply its listening filters, that can rely on a specific

channel, on the sender’s name, on the contents of its message, or its UUID (Universally Unique Identifier).

If a message is found, the listen event handler is triggered, which is analogous to traditional RPC (Remote Procedure Call).

This is the only way to implement modularity in OpenSim. It has the advantage of being able to simultaneously control all sorts of objects in the simulation without keeping a list of them and iterating through it. However, it makes it difficult to implement projects that need to maintain a global state upon which complex algorithms and data structures need to be implemented.



Figure 2- Tunnel with both lanes occupied with intense traffic.

IV. FUTURE WORK

As part of our ongoing work we are improving the realism of the elements contained in the scenarios and also the therapist’s interface that allows controlling the parameters of the virtual environments and the course of the events.

In the near future, we will perform a preliminary evaluation of both applications with therapists. Their feedback and suggestions will be valuable to improve the tools and to prepare them to be tested with volunteers who recognize their anxiety to deal with the recreated situations.

ACKNOWLEDGMENT

We acknowledge the financial support of FCT, the Portuguese National Foundation for Science and Technology (FCT). We are also grateful to the investigation centre LabMAG (Laboratory of Agents Modelling).

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