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Virtual Reality Cognitive-Behavioral Therapy Biofeedback System for Glossophobia

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Abstract

The fear of public speaking is one of the most common social phobias causing anxiety problems in many people.

In this context, this project focuses on developing a tool capable of helping mental health professionals using virtual reality as a controlled environment in expository therapies, in this case applied to Glossophobia.

To enhance the creation of self-control mechanisms in these patients, the use of virtual reality is explored with the aid of Neuro and Biofeedback, allowing the visualization in real time of the physiological response to the stimuli of the virtual environment.

1 Introduction

In an era faced with the limitations caused by a global pandemic that not only affected physical contact but also changed the norms of social interaction, it is not surprising that the number of diagnoses of social phobias increases. The restrictions imposed on social contacts led to public speaking, one of the most prevalent of all social phobias, has become something rare and easy to avoid, leading to an increase in avoidance behavior and reinforcing the phobia's power in the lives of thousands of people. But with the end of the pandemic and restrictions, the problem emerges again.

This project proposes the creation of a cognitive-behavioral therapy tool aimed at public speaking phobia. It is intended that this tool allows users to confront their fear of public speaking, recreating an immersive virtual scenario in which they are invited to give a lecture (Maples-Keller, Bunnell, Kim, & Rothbaum, 2017). The use of biofeedback seeks to create a mechanism to reinforce the user's self-control during the lecture, using the collection of biological signals, in this case electroencephalogram and variance of the heartbeat, which will be analyzed in real time and used to adapt the behavior of the virtual audience as well as providing direct visual indicators to the user through a graphical interface (Botella, Fernández-Álvarez, Guillén, García-Palacios, & Baños, 2017). The collection of biological signals synchronized with the virtual environment becomes especially relevant for further analysis by professionals in the field, both for diagnosis and for technical validation of the application (Sá, Veloso Gomes, Marques, & Correia, 2020).

Thus, this project intends to be a new approach to the use of virtual reality (VR) in the area of mental health, reinforcing the already proven use of virtual scenarios with the introduction of biofeedback and direct and synchronized data recording that will allow to evaluate its usefulness for users and therapists and open doors to more extensive research that validates the tool as a therapeutic resource, eventually allowing its use in the field in the near future.

2 Development

This VR experience uses state-of-the-art equipment in the form of the HTC Vive Pro virtual reality system, one of the best virtual reality devices today that allows for high-quality visual and sound immersion levels. Regarding biological sensors, two different sensors were chosen, one for electroencephalogram (EEG) and another for heart rate. In terms of EEG, the author opted for the Looxid Link device because it is an extension of the HTC Vive Pro, fully integrating its operation, this device records EEG of the frontal lobes and allows to detect fluctuations in the user's attention and relaxation levels (Veloso Gomes, et al., 2021). In the case of heart rate, the Bitalino device was chosen because it allows the collection of various biological signals, it can also connect remotely with other devices through Bluetooth technology. Both sensors include software that allows direct integration with the Unity game engine used in developing the VR experience.

The development of this experience focused on five core elements:

- Immersive virtual scenario that simulates a stressful situation for patients with Glossophobia.
- Graphical representation of biofeedback indicators on user interface.
- Algorithm that aggregates and analyses data from electroencephalogram and heart rate variance sensors outputting variables for the graphical user interface and game cycle manager.
- Game cycle manager to adapt the virtual scenario in response to the biological signal’s algorithm.
- Biological signals recorder and exporter.

During several stages of development, functionality tests were performed with elements of the target audience to validate each iteration of the project, collect feedback, and proceed with optimizations based on these findings.

3 Application

The experience itself unfolded in two phases. In an initial phase, the user equipped with the VR headset was subjected to a collection of baseline data, to record physiological data relevant to the course of the experience on a neutral state. This baseline data record allowed to obtain average values for the biological signals that would be used in the game mechanisms of the experiment acting as comparison values. Values outside the average trigger changes to the game cycle.

The second phase of the experience follows shortly after the collection of baseline data and involved the virtual representation of an auditorium full of virtual characters. The user was given the task of simulating a presentation as faithful as possible, even being able to use a PDF file of a real presentation of his favorite theme. The user was placed on the stage next to a pulpit with a laptop and a microphone, he should pick up the microphone and touch the laptop as soon as he wants to start the presentation.

The notebook functions as a graphical user interface displaying information, including data about the presentation itself such as the current slide, the number of slides remaining, and the time left to finish the presentation. A biofeedback panel with data on heart rate, attention, and relaxation indices was place on the left side of the notebook. This data was updated in real time and changed color to reinforce its meaning.

When starting the presentation, the user activated the sampling system, which would cyclically collect biological data to obtain new averages that would be compared with the basal averages. Significant variations in averages triggered changes in the game cycle focused mainly on modifying the behavior of the virtual audience. This changes in the game cycle were intended to recreate the behavior of a real audience that loses interest and becomes louder when the speaker is not focused on the presentation. If the sampling averages approach the values of the basal averages again, the game cycle would gradually return to normal.

More than 8 different animations were used to represent the disinterest on the part of the audience, from yawning, talking to the side, looking at the cell phone, among others. The changes in the audience's behavior were accompanied by changes in sound with the sounds of whispers, people talking, cell phones ringing.

It is thus intended that the user can focus during more tense moments to reduce distracting elements by training a form of self-control that is valid not only in the virtual context, but also capable of being used in real situations.

4 Conclusion

The developed VR environment allows a two-dimensional approach, users can practice public speaking, and in real time check the result of their performance. The therapist can track and monitor the biofeedback values obtained in real time and change the environment conditions to send different stimuli to users so that they can adapt their attitudes to new situations.

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