

VIRTUAL REALITY EXPOSURE THERAPY (VR-ET) APPLICATION FOR MENTAL HEALTH

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Abstract— In recent decades, Virtual Reality (VR) therapy has emerged as a promising avenue for addressing mental health issues, providing an immersive and interactive environment to enhance traditional therapeutic approaches. By embracing VR treatment options, mental health professionals can expand their toolkit, improve patient engagement, and offer innovative solutions for addressing mental health challenges. In the paper, we aimed to design and develop a standalone, smartphone-based Virtual Reality Exposure Therapy application tailored for the VR exposure therapy of specific phobias, Aerophobia(Fig.1), Claustrophobia(Fig.2), and Glossophobia(Fig.3). Additionally, a biofeedback system completes the VR application. The app will leverage immersive virtual environments to provide a controlled and therapeutic platform for individuals dealing with various mental health challenges. It will help to counter the low utilization rates of available treatments for mental instability.

Keywords--Virtual Reality Exposure Therapy, Phobias, biofeedback, mental health, Aerophobia, Claustrophobia, Glossophobia.

I. INTRODUCTION

In recent years, virtual reality technology has developed rapidly at an alarming rate. Virtual reality technology (VR) mainly uses computer systems to synthesize 3-D graphic environments from digital data, to produce a virtual environment visually,

listening, sniffing, and touching multi-sensory, and to collect the user's reaction and motion information through input equipment, and to change the virtual environment accordingly. Then let the user interact with the environment, producing the illusion of immersion in the environment and experience. Using virtual reality technology, users can feel the same experience as the real world and can integrate into the virtual system with complete-life individuals, so that their perceptual activities and emotional reactions can be expressed incisively and vividly. At the same time, the virtual reality situation has certain controllability, the user can carry on the environment modification according to their own will, thus making the virtual reality more in accord with their acceptance ability in the real reality. Mental health disorders, including anxiety disorders, phobias, and post-traumatic stress disorder (PTSD), impose a significant burden on individuals and society as a whole. Despite the availability of effective treatments such as cognitive-behavioral therapy (CBT) and medication, a considerable proportion of individuals continue to experience debilitating symptoms and challenges in accessing timely and appropriate care.

II. MOTIVATION

According to the World Health Organization, one in 8 people worldwide require mental health care at any one point in their lifetime, yet only nine mental health workers are available for every 10,000 people globally. In a survey of 22 countries, 7.4% of respondents

reported that they experienced specific phobias within their lifetime. Anxiety disorders are among the most common mental disorders affecting nearly 18.1% of adults. Anxiety symptoms can cause significant distress, impair quality of life, and increase stress. Anxiety increases the risk for a range of co-occurring physical conditions, including chronic pain. In addition to pharmacotherapy, treatment for phobias also includes cognitive-behavioral therapy techniques, with elements of exposure therapy and relaxation. VR exposure therapy is used to treat Phobias, post-traumatic stress Disorder, Stress, Anxiety, etc.,. Usually, mental health professionals use VR to create controlled and immersive environments for exposure therapy, anxiety management, or skill-building exercises. In VRET, the person is immersed in a virtual environment whose characteristics confront him/her with a feared situation or stimuli. VR exposure therapy seems to be a good alternative to standard exposure (facing a feared object or situation in real life). Often, it is easier, economical, and safer to access these stimuli in a virtual environment than in real life, as the exposure is performed under the supervision of a therapist in the safety of a consultancy room or other facility.

III. RELATED WORKS

Virtual reality exposure therapy is frequently utilized in the treatment and prevention of mental health disorders. This method is commonly used to treat anxiety, phobias, PTSD, and other conditions. The premise is to immerse clients in simulated environments that trigger their fears or traumatic memories. This enables therapists to gradually desensitize them to these stressors in a controlled, safe setting.

Initially, the therapist conducts an assessment to understand the client's diagnosis, symptoms, triggers, and therapeutic goals. Specific anxieties or phobias are identified and evaluated for suitability for VR therapy. The client is introduced to the virtual reality equipment and the therapy process is explained. Based on the evaluation, the therapist designs customized virtual environments tailored to the client's unique fears and anxieties. Scenarios are structured to progressively expose the client to triggering stimuli, beginning with less distressing situations and advancing to more challenging ones. In sessions, the client wears a VR headset and enters

the virtual environment created by the therapist. The therapist guides the client through graduated exposure exercises, increasing intensity and duration as the client habituates. The therapist encourages, coping strategies, and support to manage distress during exposure. Biofeedback devices may monitor physiological arousal like heart rate, sweating, and breathing to gauge stress reactions objectively. Based on reactions, the therapist calibrates the exposure intensity, speed, or content of scenarios.

After sessions, the therapist and client debrief to discuss experiences, insights, and progress. The client reflects on reactions, emotions, and successful coping skills, identifying achievements and areas needing improvement. Homework may be assigned to practice real-world application of coping abilities. Throughout treatment, the therapist tracks progress, tailoring the plan based on the client's responses and objectives. Additional VR sessions may be scheduled to address new challenges or reinforce gains.

As the client's confidence and mastery over anxiety increases, they gradually transition out of VR therapy. The therapist supplies strategies for maintaining progress and managing future challenges. Follow-up appointments may assess continued progress and provide support. The therapist remains available for ongoing assistance as the client proceeds on their mental health journey.

IV. PROPOSED SOLUTION

The paper outlines our ongoing research that aims to design, build, and clinically evaluate a smartphone-based virtual reality (VR) application for VR exposure therapy of phobias. This mobile app increases the accessibility of VR exposure therapy to more people who may not have access to traditional in-person therapy or specialized VR equipment. Patients can do therapy sessions from home. They can schedule and do virtual reality exposure therapy sessions when convenient, fitting therapy into busy schedules without disrupting other commitments, and eliminating the need to travel or have appointments at a therapist's office. Therapists can provide therapy remotely through the app, allowing more flexibility for both patients and clinicians.

The app asks users questions to evaluate various mental health aspects. These questions may cover areas like situational triggers, physical anxiety symptoms, past

experiences, and impact on daily life. By validating the patient's reported symptoms, the app identifies the patient's phobia types and offers existing virtual environments related to that phobia. Patients put on a VR headset to immerse themselves in the virtual environment. These environments may include elements like landscapes, objects, people, and interactive features designed to evoke specific emotions or triggers.

Therapy sessions start with exposure to less anxiety-provoking elements in the virtual environment, gradually increasing in intensity or complexity over time. The intensity of stimuli will be increased automatically in the individual stages of therapy by the application. However, the therapist continues to have full control over increasing the complexity of the presented situation. An example is the fear of public speaking, where a sudden qualitative change is represented by a different reaction of the audience (starting with a smile, through boredom to whistling and expressing dissatisfaction), while a gradual quantitative change is a gradual increase in the number of people in the audience with a given type of reaction.

Interactive features in the virtual scenario allow patients to practice coping skills, confront fears, and challenge negative beliefs in a controlled setting. The mobile app includes feedback mechanisms like self-reports, physiological sensors, or VR analytics tools to assess patient responses and progress. Patients can provide feedback on emotions, anxiety levels, or subjective experiences using in-app surveys or rating scales. Therapists can analyze this data to track patient outcomes, identify trends or patterns, and make informed decisions about treatment adjustments or interventions.

Design of the application

The virtual reality exposure therapy (VRET) application is developed using the Unity game engine and Microsoft Visual Studio software. For building and testing the VRET app, the development hardware used was: an Intel i7 CPU, 16GB of RAM, an NVIDIA GTX 1080Ti graphics card, and an HTC Vive Pro virtual reality headset. The final release will be compatible with any VR-ready PC that has at least an NVIDIA GTX 1050 graphics card. Eye tracking is enabled by the HTC Vive Pro Eye headset. The VRET app utilizes Steam VR, allowing compatibility with

most tethered VR headsets. User behavior data within the VR app is recorded through a web tool built with Visual Studio Code, the Laravel web framework, and standard web technologies like PHP, HTML, CSS, and JavaScript.

Physiological data is captured using a wearable sensor system paired with the VR system. The wearable system contains two analog front-end (AFE) devices to monitor electrocardiogram (ECG) data like heart rate. ECG electrodes are used to measure cardiac activity. Specifically, a 1 CH ECG sensor with R-R interval detection and 500Hz sampling rate is utilized. These devices comply with 89/391/CE and 96/82/EC standards. The AFE chip is an ADS1292R, a multichannel, simultaneous sampling, 24-bit, delta-sigma analog-to-digital converter (ADC) operating up to 8kSPS, with a built-in programmable gain amplifier (PGA).

Methods

The Support Vector Machine (SVM) algorithm is used to identify anxiety triggers and specific phobias based on the patient's responses. The wearable devices that are integrated with the application monitor the physiological conditions (heartbeat) of the patients, based on which the app increases or maintains, or decreases the intensity of the stimuli exposed to the patients.

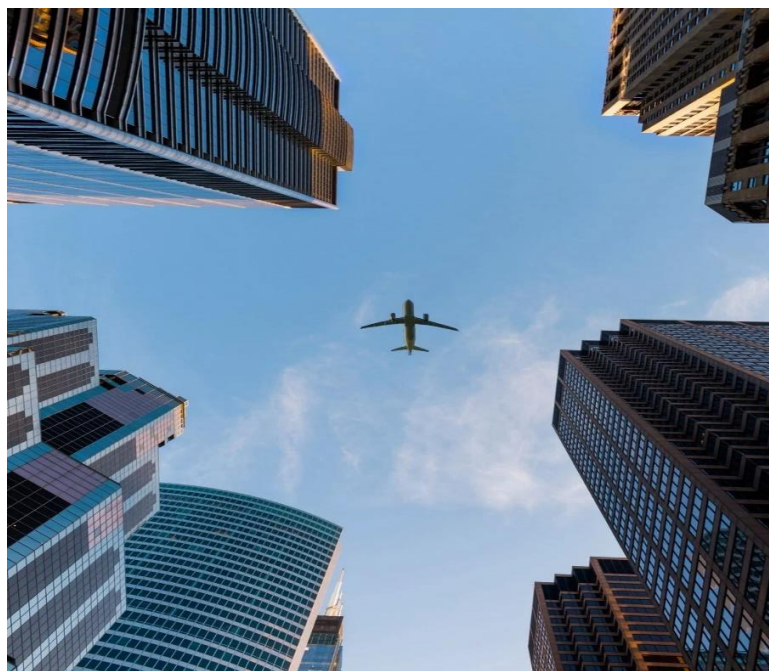


Fig.1.Aerophobia



Fig.2. Claustrophobia



Fig.3. Glossophobia

V. Conclusion

In conclusion, the utilization of virtual reality (VR) exposure therapy in mental health treatment presents a prospective avenue for enhancing therapeutic outcomes. Through immersive and controlled environments, VR offers a safe space for individuals to confront and manage their fears, anxieties, and traumas in a manner that is both effective and accessible. However, while the potential of VR exposure therapy is promising, further research is required to completely understand its long-term effects, optimal implementation strategies, and potential limitations. Additionally, considerations regarding ethical guidelines, patient safety, and accessibility must be addressed to ensure its responsible and equitable use in mental health care. In summation, VR exposure therapy represents a groundbreaking innovation in mental health treatment, offering a transformative approach that holds immense promise for improving the lives of individuals contending with various psychological challenges. As technology continues to evolve and research advances, the integration of VR into conventional mental health care practices has the potential to revolutionize treatment paradigms and provide promise for a brighter future in mental health care.

VI. References

- [1] X. B. Lin, et al., "Exposure Therapy With Personalized Real-Time Arousal Detection and Feedback to Alleviate Social Anxiety Symptoms in an Analogue Adult Sample: Pilot Proof-of-Concept Randomized Controlled Trial", *JMIR Mental Health*, 6(6), e13869, 2019.
- [2] B. K. Wiederhold, D. P. Jang, R. G. Gevirtz, S. I. Kim, I. Y. Kim, and M. D. Wiederhold, "The treatment of fear of flying: a controlled study of imaginal and virtual reality graded exposure therapy", *IEEE Transactions on Information Technology in Biomedicine*, 6(3), pp. 218-223, 2002.
- [3] T. Donker, J. R. Fehribach "Automated mobile virtual reality cognitive behavior therapy for aviophobia in a natural setting: a randomized controlled trial", *National Library of Medicine*, Epub 2022 Nov 25.
- [4] Dorothee Bentz, Nan -Wang , "Effectiveness of a stand-alone, smartphone-based virtual reality exposure app to reduce fear of heights in real-life: a randomized trial", *npj Digital Medicine*, 16 (2021)

- [5] Iskren Ivanov, Agata Manolova, Bozhilov, Radostina Petkova, Nicole Christoff, "Virtual Reality Application for Height Fear Treatment", IEEE, 25 July 2023.
- [6] Kahan M. Integration of Psychodynamic and Cognitive-Behavioral Therapy in a Virtual Environment. *Cyberpsychology & Behavior*, 2000, 3(2).
- [7] Castro, et al. Cognitive-behavioral treatment and antidepressants combined with virtual reality exposure for patients with chronic agoraphobia[J]. *International Journal of Clinical & Health Psychology*, 2014, 14(1): 9-17.
- [8] Rothbaum B, Hodges L, Alarcon R, Ready D, Shahar F, Graap K, Pair J, Hebert P, Gotz D, Wills B & Baltzell D. Virtual reality exposure therapy for PTSD Vietnam veterans: A case study. *Journal of Traumatic Stress*, 1999, 12:263-271.
- [9] Riva G, Bacchetta M, Baruffi M, et al. Virtual Reality Environments for Body Image Modification: A Multidimensional Therapy for the Treatment of Body Image in Obesity and Related Pathologies. *Cyberpsychology & Behavior*, 2000, 3(3): 421- 431.
- [10] L. R. Valmaggia, L. Latif, M. J. Kempton, and M. Rus-Calafell, "Virtual reality in the psychological treatment for mental health problems: An systematic review of recent evidence," *Psychiatry Res.*, vol. 236, pp. 189-195, Feb. 2016.
- [11] G.M. Reger et al., "Effectiveness of virtual reality exposure therapy for active duty soldiers in a military mental health clinic," *J. Trauma Stress*, vol. 24, no. 1, pp. 93-96, Feb. 2011.
- [12] G. L. Cesa et al., "Virtual reality for enhancing the cognitive behavioral treatment of obesity with binge eating disorder: Randomized controlled study with one-year follow-up," *J. Med. Internet Res.*, vol. 15, no. 6, 2013, Art. no. e113.
- [13] C. Breuninger, D. M. Sl'ama, M. Kr'amer, J. Schmitz, and B. Tuschen Caffier, "Psychophysiological reactivity, interoception and emotion regulation in patients with agoraphobia during virtual reality anxiety induction," *Cogn. Therapy Res.*, vol. 41, no. 2, pp. 193-205, Apr. 2017.
- [14] A. Aldao, S. Nolen-Hoeksema, and S. Schweizer, "Emotion-regulation strategies across psychopathology: A meta-analytic review," *Clin. Psychol. Rev.*, vol. 30, no. 2, pp. 217-237, Mar. 2010.
- [15] D. Villani, P. Cipresso, A. Gaggioli, and G. Riva, "Positive technology for helping people cope with stress," 2016. Online. Available: <http://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/978-1-4666-9986-1.ch014>.
- [16] Hui Guo & Yang Liu. (2021). The exploration and strategy of mental health education for adolescents in the new era. *Psychology Monthly* (16), 212-213+222.
- [17] Li Jiang & Dan Han. (2021). Research on the Application of Virtual Reality Technology in College Students' Mental Health Education--Comment on "Mental Health and Talent Education of College Students in the 21st Century". *Forest Products Industry* (01), 105.
- [18] C. M. Johnson and E. M. Sullivan, "Art Therapy: Using the Creative Process for Healing and Hope Among African American Older Adults "Geriatric Nursing, Volume 27, Number 5, Aug, 2006, PP309 - 316.
- [19] N. R. Carlton, Digital culture and art therapy, *The Arts in Psychotherapy* Vol 41, 2014, pp 41-45.
- [20] A. "Skip" Rizzo and G. J. Kim, A SWOT Analysis of the Field of Virtual Reality Rehabilitation and Therapy, *Presence: Teleoperators and Virtual Environments* Vol. 14 Issue 2, April 2005, pp. 119-146.