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Real-time Anxiety Detection in Virtual Reality Exposure Therapy

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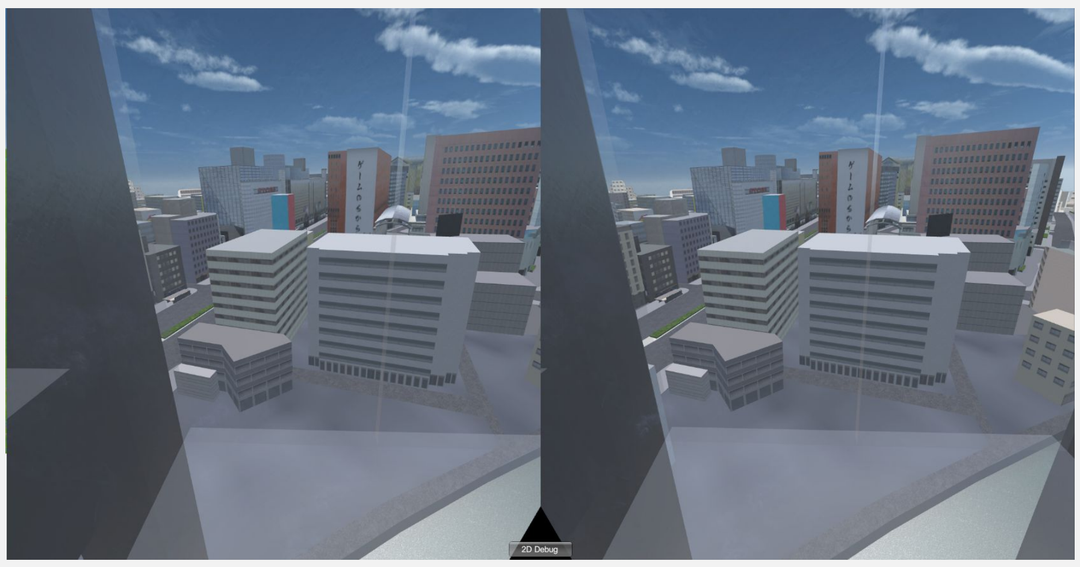
Introduction

The study sets out to integrate real-time anxiety prediction into Virtual Reality Exposure Therapy (VRET) for better decision-making. VRET is a therapy method that involves gradual exposure to a certain stimulus that the user is uncomfortable with, and couples this exposure with relaxation techniques. There have been many controlled experiments that provide evidence that VRET produces effective and long-lasting results [1]. This study focuses on using wearable physiological sensors to collect information from the user and using a neural network to predict the anxiety level. This prediction can be used to enhance therapy by better tailoring it to the user's needs.

Design

To better accommodate the needs of different types of users, a framework that includes the following will be developed:

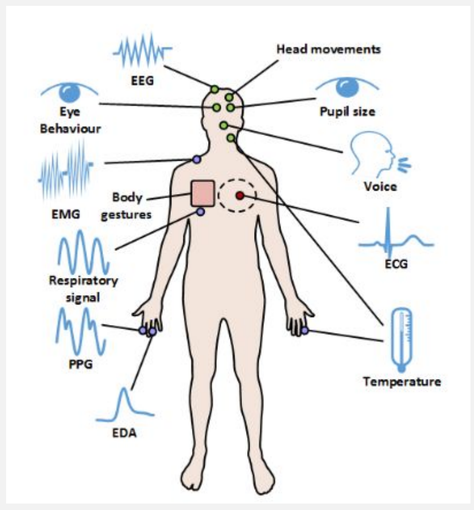
- A control interface that displays the anxiety level prediction, current environment and exposure.
- Multiple environments to accommodate users with different types of phobias or anxiety disorders, for example, acrophobia (fear of heights) or claustrophobia (fear of confined spaces).
- Different environments will be developed in a way that defines certain parameters to be adjusted based on the current anxiety level.
- When the anxiety level seems too low at the current exposure level, the exposure could be increased via the control panel and vice versa.



Acrophobia VRET simulation scene

Physiological Sensors

There are a number of studies that investigate the accuracy of using physiological signals to detect anxiety with varying results. Most reliable and accurate systems are not fit to be used within Virtual Reality (VR) due to mobility limitations. Mobility within VRET is important for immersion and the effectiveness of the therapy. This study investigates a method to combine different signals to minimise the effects of noise from movement.



Common physiological and physical measures related to stress [2]

The most commonly used wearable sensors within VR [2] are the following:

- **Electrocardiogram** (ECG) for detection of heart rate, heart rate variability and breathing rate and patterns
- **Photoplethysmogram** (PPG) for detection of pulse rate, pulse rate variability and blood volume pressure
- **Electroencephalogram** (EEG) for detection of electrical activity in the frontal lobe of the brain
- **Galvanic Skin Response** (GSR) for the detection of electrical activity in the skin

Research Questions

- The central question that this study aims to answer is whether it is possible to make an accurate prediction of anxiety within VRET without compromising immersion and mobility.
- Another important question that the study hopes to answer is coming up with an effective way to decide the ground stress level of the users, meaning the anxiety level of the user in their calm state.

References

[1] Krijn, Merel, et al. "Virtual reality exposure therapy of anxiety disorders: A review." *Clinical psychology review* 24.3 (2004): 259-281.
[2] Giannakakis, Giorgos, et al. "Review on psychological stress detection using biosignals." *IEEE Transactions on Affective Computing* (2019).

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