Heightened Empathy: A Multi-user Interactive Experience in a Bioresponsive Virtual Reality

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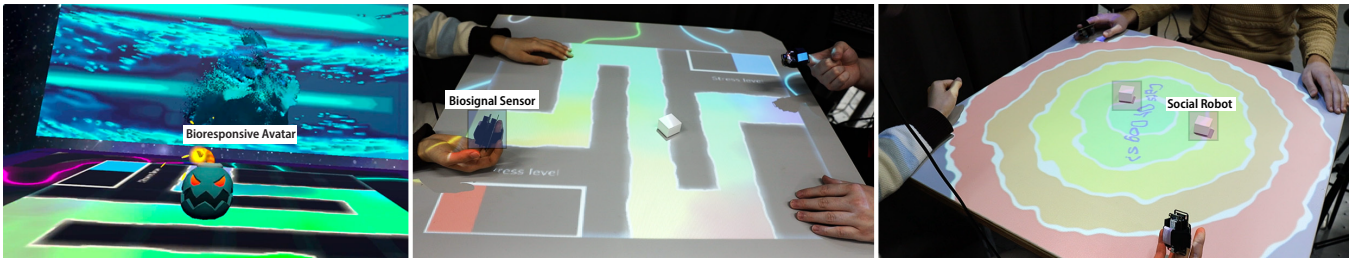

Figure 1: The Heightened Empathy interactive experience comprises of two distinct modes, each designed to stimulate different types of empathy. The first mode, Competitive mode, is intended to stimulate cognitive empathy (left and center). Communication mode is intended to stimulate emotional empathy (right).

ABSTRACT

We present Heightened Empathy, a multi-user interactive experience in bioresponsive virtual reality (VR) designed to visualize emotional states and stimulate different types of empathy between two players in various interactive modes. The experience immerses users in a VR representation of each other's emotional state, while also reflecting this to the audience using a table-top social robot and projection as they interact with each other. In competitive mode, the goal is to promote cognitive empathy where each user needs to understand the new emotional representation in VR to win. In communication mode, we have users act on one another verbally to promote emotional empathy. The experience aims to enhance empathy perception by placing the players in virtual environments that require them to understand, share, and act on each other's perspectives and emotions.

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CCS CONCEPTS

• **Human-centered computing**; • **Virtual Reality**; • **Empathic computing**;

KEYWORDS

bioresponsive, biofeedback, virtual reality, avatar, empathy

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Figure 2: Heightened Empathy System setup

1 INTRODUCTION

Empathy plays a pivotal role in communication, collaboration, and cooperation [Goleman et al. 2017]. VR technology provides a unique opportunity to explore and enhance empathy, enabling researchers to design experiences that stimulate different types of empathy between users. Prior literature has investigated expressive biosignals to facilitate empathetic communication [Liu 2020]. Yet, this work focuses on utilizing biosignals to enhance empathy in the context of smartwatch-based communication.

We present Heightened Empathy, a social VR experience stimulate different types of empathy between two players. The goal of this experience is to enhance empathy by adapting the user's emotional and cognitive states to the visual representation of their bioresponsive avatar [Skiers et al. 2022]. As both players acquire a new visual representation of a mental model of empathy, we share this state with the audience with the inclusion of a projected desk with a social robot driven by their emotional and cognitive states.

2 HEIGHTENED EMPATHY SYSTEM

Meta Quest Pro[1] was used to experience the virtual avatars. We use the Unity[2] game engine for rendering. For the physical space, the field is projected onto a tabletop, where the content changes depending on the modes. A social robot, Toio[3], acts as a physical avatar representation of the participants. Both the virtual avatar representation and social robot behaviour are driven by the players' emotions which were computed based on electrodermal activity (EDA) and heart rate variability (HRV). This was captured using Emotibit[4] and piped to TouchDesigner[5] software for preprocessing and emotion prediction as shown in Figure 2.

Physiological Signal Processing: We used XGboost regression algorithms to predict levels of emotions(valence and arousal) and cognitive load to train our model on the extracted features and classify emotions based on new data with mean squared error of 1.712(0.3) [Gupta et al. 2020]. We trained the XGboost regression model where we asked participants to watch 360° videos in VR while their physiological responses and Self-Assessment Manikin score were collected at the end.

[1]https://www.meta.com/jp/en/quest/quest-pro/
[2]https://unity.com/
[3]https://toio.io/
[4]https://www.emotibit.com/
[5]https://derivative.ca/

Bioresponsive Avatar Design: The bioresponsive avatar is a self-virtual representation that responds to changes in the user's physiological state. It is designed with particles and color gradients from the design considerations proposed by Skiers et al. [Skiers et al. 2022], and provides real-time feedback to enhance self-awareness, cognitive function, and empathy as shown in Figure 1 (left).

3 USER EXPERIENCE

Competition Mode for cognitive empathy: Participants are placed in a virtual environment where they encounter a bomb-like robot. This robot moves towards the player with the highest cognitive load and participants must predict their opponent's cognitive load by observing their avatar. The game concludes when the player closest to the robot at the end loses. This fosters a deeper understanding of each other's perspectives by encouraging participants to understand and adapt to each other's limitations.

Communication Mode for emotional empathy: Participants engage in a discussion centered around a general topic while their emotional states are monitored. In the virtual environment, if the emotions of both players synchronize, their avatars move closer to each other, while they move further apart if not. This mode incorporates two social robots, each representing a player's avatar and mirroring their emotional state. Participants are expected to develop a deeper emotional connection and understanding of each other's feelings, ultimately promoting emotional empathy.

Collaboration Mode for compassionate empathy: Participants collaborate in a virtual rescue mission utilizing a social robot. One player controls the robot, while the other provides navigational instructions. The instructions are revealed once the player solves a puzzle. The social robot is programmed to move once the puzzle is solved and both players remain calm. Participants develop a sense of compassion for each other and a greater understanding of the significance of taking action to help those in need.

4 CONCLUSION

Heightened Empathy is an empathic VR experience to understand, share and act on each other's perspectives and emotions. We envision a bioresponsive future of emotion sharing to be able to promote prosocial behaviour change and build better relationships.

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