NatureBlendVR: Hybrid Space Interactive Experience For Emotional Regulation And Cognition Improvement

Kinga Skiers
Keio University, Graduate School of Media Design
Yokohama, Kanagawa, Japan
XXX@kmd.keio.ac.jp

Danyang Peng
Keio University, Graduate School of Media Design
Yokohama, Kanagawa, Japan
pengdanyang@kmd.keio.ac.jp

Giulia Barbareschi
Keio University, Graduate School of Media Design
Yokohama, Kanagawa, Japan
barbareschi@kmd.keio.ac.jp

Yun Suen Pai
University of Auckland, School of Computer Science
Auckland, New Zeland
yun.suen.pai@auckland.ac.nz

Kouta Minamizawa
Keio University, Graduate School of Media Design
Yokohama, Kanagawa, Japan
kouta@kmd.keio.ac.jp

Figure 1: (a) Bio-responsive haptic flower sphere in the hybrid NatureBlendVR environment (b) User interacting with haptic flower sphere (c) Additional elements (deer) reacting to user heart beat

Abstract

NatureBlendVR is a hybrid interactive experience designed to promote wellbeing by leveraging the benefits of forest bathing. The system combines XR technology with interactive bio-responsive physical elements. Throughout the experience, users are immersed in a hybrid space where elements of a physical garden are placed in the immediate surroundings of the user, including a flower sphere that provides haptic and visual biofeedback reacting to the person's heartbeat. A gradual transition from the view of the real space to a meticulously crafted virtual forest where digital elements match the position of physical ones promotes a sense of continuity, allowing the person to feel present in the natural space as embodied sensations match the expectation created by virtual interactions.

SA XR '24, December 03–06, 2024, Tokyo, Japan

ACM ISBN 979-8-4007-1141-1/24/12
https://doi.org/10.1145/3681759.3688929

CCS Concepts

• **Human-centered computing** → **Virtual Reality**; **Haptic devices**.

Keywords

haptic device, virtual reality, hybrid space, relaxation

ACM Reference Format:
Kinga Skiers, Danyang Peng, Giulia Barbareschi, Yun Suen Pai, and Kouta Minamizawa. 2024. NatureBlendVR: Hybrid Space Interactive Experience For Emotional Regulation And Cognition Improvement. In *SIGGRAPH Asia 2024 XR (SA XR '24), December 03–06, 2024, Tokyo, Japan.* ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3681759.3688929

1 Introduction

Nature has long been acknowledged for its positive impact on well-being. The Japanese practice of Shinrin -yoku or forest bathing, has been shown to promote psychological and physical health [Wen et al. 2019]. Prior literature has explored the use of VR technologies to facilitate access to nature. Comparative studies have shown that VR nature experiences can produce similar benefits to traditional forest bathing, but have highlighted limitations due to reliance on solely digital means [Reese et al. 2022]. Recently, researchers have

begun to explore the integration of haptic and somatosensory stimuli in VR nature experiences, but these are generally generated by the system and do not occur as a result of active engagement, despite physiological signals being collected from participants [Lopes et al. 2022]. Furthermore, studies on VR biofeedback experiences have shown how dynamic visualizations have the potential of decreasing stress and improving empathy [Armstrong et al. 2023; Skiers et al. 2022]. We present NatureBlendVR an immersive hybrid forest bathing experience that blends physical and virtual elements for active multi-sensory engagement. By incorporating responsive biofeedback elements including a touchable flower sphere and embedded features that pulsates and glows in synchrony with the heart beat of the person we further promote reflection with embodied sensations and deepen the sense of connection with the surrounding hybrid nature, transcending previous limitations.

2 NatureBlendVR System Design

For the physical setting, we constructed a tangible, interactive environment incorporating simulated elements of nature, including artificial grass, trees, flowers, and illumination. The Virtual Reality system has been crafted with Meta Quest 3 and Unity3D framework. Within this immersive digital environment, users are transported to a forest clearing with a starry sky. The position of the closest trees and plants surrounding the user in the virtual environment matches the distance of the ones placed in the physical space. The experience is heightened by the incorporation of nature sounds, for which we used noise-cancelling headphones Bose 700. A haptic flower sphere is present in both the physical and virtual forest has pulsating lights and haptic modules which are reacting to the users heart beat. To collect user's biosignal we use the wearable sensor Emotibit and pipe the data via TouchDesigner to a wireless Arduino module connected to LED strips and 20 haptic actuators in the physical flower sphere which glows and pulsated in synchrony with its digital counter part. After conducting a user study with eight participants, we further integrated additional biofeedback responsive objects in the virtual space, including animated animals and carefully selected trees. This decision was made due to several factors: users reporting a sense of loneliness in the forest at night (leading to the introduction of fauna, such as deer and cat), and an increased need to feel 'connected' to nature (by incorporating elements beyond the sphere that respond to biofeedback).

Figure 2: (a) User touching haptic sphere in VR (b)Emotibit and haptic-flower ball

3 User Experience

The user will be invited to sit comfortably in a space designed with artificial grass, trees, and flowers, and will be equipped with an EmotiBit sensor. Experience will take around 2 minutes. In front of the participant, a haptic sphere adorned with flowers will be placed, which responds to heartbeats with pulsating vibrations and light intensity. The user will then be transported to a virtual environment where the positions of the flowers, sphere, and trees mirror those in the physical setting. Participants will be able to immerse themselves in the multi-sensory aspects of the forest, feeling the leaves of the trees shake in both the physical and digital worlds, with sounds reinforced by headphones. As they touch the flower sphere, they will observe and feel it connecting with their physiological state, with visual and haptic biofeedback elements causing the sphere and some elements to glow and pulsate in synchrony with their heartbeat. As the experience progresses participants will witness certain elements in the virtual space gradually transform into interactive objects integrated with biofeedback, fostering a sense that they are becoming 'part of the forest.'

4 Conclusion

NatureBlendVR is an innovative hybrid multi-sensory forest bathing experience integrating physical and virtual elements with biofeedback technology. This system facilitates re-connection with nature, promoting psycho-social well-being. By offering an immersive environment where users can interact with both physical and virtual representations of nature, we provide a platform for enhancing the sense of presence and connectivity with the natural world. The integration of biofeedback elements allows for a deeply personal interaction, fostering mindfulness and relaxation.

Acknowledgments

This work is supported by JST Moonshot R&D Program "Cybernetic being" Project (Grant number JPMJMS2013) and JST COI-NEXT "Minds1020Lab" Project Grant Number JPMJPF2203

References

Mark Armstrong, Kinga Skiers, Danyang Peng, Tamil Selvan Gunasekaran, Anish Kundu, Tanner Person, Yixin Wang, Kouta Minamizawa, and Yun Suen Pai. 2023. Heightened empathy: A multi-user interactive experience in a bioresponsive virtual reality. In *ACM SIGGRAPH 2023 Immersive Pavilion*. 1–2.

Marilia KS Lopes, Belmir J de Jesus, Marc-Antoine Moinnereau, Reza A Gougeh, Olivier M Rosanne, Walter Schubert, Alcyr A de Oliveira, and Tiago H Falk. 2022. Nat (UR) e: Quantifying the Relaxation Potential of Ultra-Reality Multisensory Nature Walk Experiences. In *2022 IEEE International Conference on Metrology for Extended Reality, Artificial Intelligence and Neural Engineering (MetroXRAINE)*. IEEE, 459–464.

Gerhard Reese, Jasmin Stahlberg, and Claudia Menzel. 2022. Digital shinrin-yoku: Do nature experiences in virtual reality reduce stress and increase well-being as strongly as similar experiences in a physical forest? *Virtual Reality* 26, 3 (2022), 1245–1255.

Kinga Skiers, Yun Suen Pai, and Kouta Minamizawa. 2022. Transcendental avatar: Experiencing bioresponsive avatar of the self for improved cognition. In *SIGGRAPH Asia 2022 XR*. 1–2.

Ye Wen, Qi Yan, Yangliu Pan, Xinren Gu, and Yuanqiu Liu. 2019. Medical empirical research on forest bathing (Shinrin-yoku): A systematic review. *Environmental health and preventive medicine* 24, 1 (2019), 1–21.