Exploring the Application of Multimodal Interaction and Virtual Reality in Enhancing Awareness of Digital and Space Debris

Objectives

In future research, I plan to focus on the issues of information overload and fragmented content in digital environments. As technology advances, a mutually reinforcing relationship has formed between space debris and digital debris. (Chen, S., 2011) This study aims to design an immersive VR game using multimodal interaction technologies (visual, auditory, tactile) to transform the abstract crisis of "uncontrolled growth of digital waste" into an interactive, perceptible experience.

Research Purpose

Space 'debris', originating from discarded satellites and spacecraft, indirectly drives the explosion of digital 'debris', leading to cognitive fatigue and greater demands for data processing. (Peeters, W., 2021) (Hall, A. and Walton, G., 2004) As a "data hoarder," I have long tried to establish a dialogue between personal experiences and societal phenomena. In my project 'CHAOTIC ECHOES', I explored potential future crises using audio-visual installation. However, I realized that while it stimulates thought, it lacked deeper emotional resonance. So, I plan to further explore how VR can enhance user immersion and participation, allowing audience part of the story and makes experience unique each person.

Research Focus of Future Design

1. Development of Multimodal Interaction Technologies

The goal is to convert the issue of 'debris' accumulation into a tangible user experience through visual, auditory, and tactile feedback. Visual simulations will help players understand the uncontrollable growth of 'debris,' while auditory design will incorporate noise from 'debris' collisions and cleaning processes to enhance the chaotic perception. Tactile feedback using Electrical Muscle Stimulation (EMS) technology will further enhance immersion. (Knibbe, J., Alsmith, A. and Hornbæk, K., 2018)

2. Creation of Immersive Game Prototypes

A zero-gravity virtual environment will be developed using VR and Unity3D, with real-time motion capture via Leap Motion. Through real-time visual and auditory feedback, the interaction between soundscapes and dynamic visual effects will be explored to improve the interactive experience.
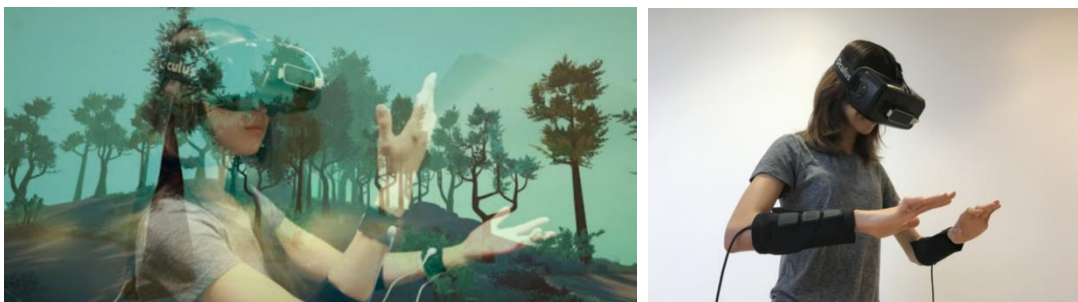

Figure 1&2: Using VR, EMS and leap motion technology to give users a more immersive experience (MIT Media Lab. 2024)
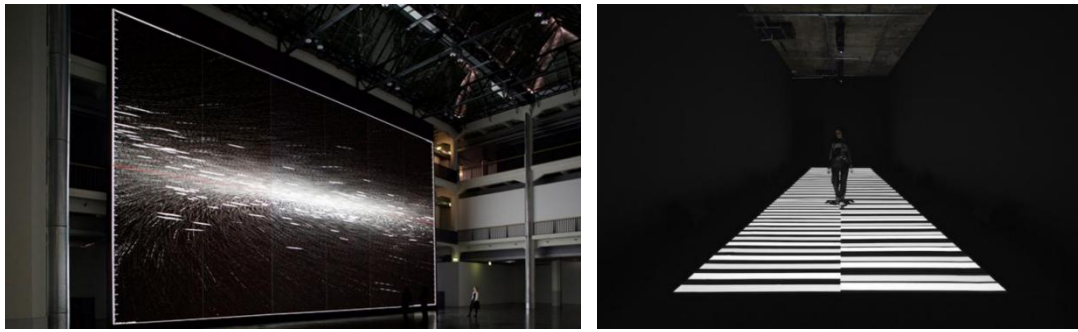
Figure 3&4: Combining soundscape with visual dynamics (Ikeda, n.d.)

3. User Behavior Data Analysis

AI will be used to record and analyze player behavior, examining how game mechanics influence emotional responses, behavioral patterns, and engagement with sustainability topics. By comparing stress factors like timed modes, I aim to observe how players react to 'debris' accumulation and optimize the game design for greater emotional investment.

Methodologies

Throughout the research, I will analyze the creation of digital and space 'debris' and the effects of information overload and resource waste through literature, interviews, and secondary research. I will also study immersive interactive experiences to understand how interaction design can stimulate user thinking. User testing will evaluate the game prototype's usability and interactivity for further optimization. The aim is to develop intuitive, emotionally resonant, and sustainable interaction designs. By using VR, I will create an environment that simulates psychological pressures, enhancing players' sense of involvement and reflection.

Design Output and Impact

The design output aims to combine interdisciplinary research with VR, sensors, interaction design, and programming to create an immersive interactive experience that offer users a deep understanding of the conflict between technological advancement and data accumulation. By analyzing user experience data, I plan to establish sustainable interaction design principles that can offer theoretical support and practical guiding future digital experiences and environmental education efforts. The game will also be promoted as an educational tool, raising awareness of digital and space 'debris' issues, particularly among younger audiences, and encouraging global dialogue on the sustainable use of digital resources.

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