Design Interactive VR Experience for Human-Nature Connection

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Abstract

This thesis explores how immersive virtual reality can be designed to support emotional engagement, relaxation, and a sense of connection to nature. Based on experience design and gesture interaction theory, this project developed a VR experience titled "Night Journey". In this experience, users can explore a virtual nature and interact with a responsive ecosystem through natural body gestures, without the need for traditional controllers. This research is rooted in the background of increasing alienation between humans and nature in modern society. Unlike simple ecological simulation, this project focuses on the design and implementation of gentle interaction. It employs meaningful gesture interaction and feedback mechanisms, along with a slower interaction pace and a high degree of freedom. In order to construct a healing digital space, the design uses low brightness settings, particle visual effects, and blue with purple tones. To evaluate the design, a small-scale user evaluation was conducted with ten participants. The results indicated that the design and interaction fostered a sense of calmness and reflective awareness among users, successfully enhancing their emotional resonance with the virtual environment. Yet, the navigation and movement through microgestures presented some initial learning challenges. Overall, this research shows that VR experiences can serve as a bridge between humans and the natural world. It provides a practical reference for designing restorative digital environments and offers new insights into how immersive technology can support psychological well-being and sustainability awareness.

Keywords: Virtual Reality, Gesture Interaction, Experience Design, Psychological Well-being, Human-Nature Connection

Sammanfattning

Denna uppsats utforskar hur immersiv virtuell verklighet kan designas för att stödja emotionellt engagemang, avkoppling och en känsla av samhörighet med naturen. Baserat på teorier inom upplevelsedesign och gestinteraktion har detta projekt utvecklat en VR-upplevelse med titeln "Night Journey". I denna upplevelse kan användare utforska en virtuell natur och interagera med ett responsivt ekosystem genom naturliga kroppsrörelser, helt utan behov av traditionella handkontroller. Denna studie tar avstamp i den ökande alienationen mellan människa och natur i det moderna samhället. Till skillnad från rena ekologiska simuleringar fokuserar detta projekt på design och implementering av "varsam interaktion" (gentle interaction). Den använder meningsfull gestinteraktion och feedbackmekanismer, kombinerat med ett långsammare interaktionstempo och en hög grad av frihet. För att skapa en återhämtande digital miljö använder designen låg ljusstyrka, visuella partikeleffekter samt färgtoner i blått och lila. För att utvärdera designen genomfördes en småskalig användarstudie med tio deltagare. Resultaten visade att designen och interaktionen främjade en känsla av lugn och reflekterande medvetenhet hos användarna, vilket framgångsrikt förstärkte deras emotionella resonans med den virtuella miljön. Dock innebar navigeringen och förflyttningen via mikrogester vissa initiala inlärningsutmaningar. Sammantaget visar denna forskning att VR-upplevelser kan fungera som en bro mellan människan och den naturliga världen. Arbetet utgör en praktisk referens för design av återhämtande digitala miljöer och erbjuder nya insikter om hur immersiv teknik kan stödja psykiskt välbefinnande och hållbarhetsmedvetenhet.

Nyckelord: Virtuell verklighet, Gestinteraktion, Upplevelsedesign, Psykiskt välbefinnande, Relationen mellan människa och natur

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Our studies in Lund were an unforgettable and invaluable journey.

Best wishes to everyone!

Lund, February 2026
Tiantian Li and Yineng Wang

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1 Introduction

This chapter introduces the topic of this study, about gesture-interactive VR experiences for the connection between humans and nature. It has five sections: background, research goals and questions, sustainability goals, ethical considerations, and existing related studies.

1.1 Background

The human-nature connection is a global issue of concern in contemporary society. It is closely related to both environmental protection and human well-being. Indeed, natural environments are commonly seen as restorative spaces [1]. Research in environmental psychology shows that exposure to nature, such as viewing natural landscapes and visiting natural locations, is associated with many health benefits [2].

However, modern lifestyles have significantly changed the way people interact with the natural world [3]. Factors such as urbanization, digital work, increased indoor time, and decreased outdoor recreation activities often reduce people's daily contact with forests, parks, and other green spaces [4]. It is not always easy for people to regularly access such natural environments due to physical distance, time limitation or other personal constraints. Studies suggest that this growing separation from nature may cause negative effects on physical and mental health, and a general weakening of people's sense of nature connectedness [5].

With advances in digital technology, virtual reality (VR) offers an alternative way to interact with nature [6]. Immersive virtual nature (IVN) can provide the users with a greater sense of presence [7]. Moreover, it generates psychological responses that are highly similar to those in real nature [6].

Interaction plays a crucial role in how users perceive and experience virtual environments [8]. In virtual nature, gesture interaction offers unique design possibilities [9]. Simple hand movements, such as waving the palm and thumbs up, can be used to influence environmental elements like plant growth. This method feels more natural and intuitive to users than traditional controllers.

1.2 Research Questions

The overall goal of this project is to design a gesture-interactive VR experience that enhances emotional well-being and fosters a sustainable connection between humans and nature. The thesis is guided by three research questions that present different aspects of the project, including interaction design strategies, user experience, and sustainability awareness.

1. How can visual and environmental design support a calming and immersive atmosphere in VR experiences?
2. How does gesture interaction influence users' sense of immersion, presence, and interaction fluency in VR?
3. To what extent can a virtual nature experience improve users' emotional connection to nature and reflective awareness of human–nature sustainability?

1.3 Sustainability Goals

The sustainability goal of this project is to support a stronger connection between humans and nature through immersive and interactive experience design. Although traditional efforts often focus on policy, technology, or behavioral regulations, this project explores how experiential interaction can encourage personal awareness, reflection, and emotional engagement with nature. It is based on the idea that pro-environmental actions are motivated by emotional connection and empathy to nature rather than ecological knowledge alone [10].

The virtual nature is designed as a responsive environment. People can influence plant growth and interact with the ecosystem through intuitive hand gestures. The interactions are intentionally slow and gentle, encouraging people to observe the effects of their actions and fostering a sense of care and responsibility.

The project is related to several United Nations Sustainable Development Goals (SDGs). One of the most relevant goals is SDG 15 (Life on Land), which focuses on protecting terrestrial ecosystems, managing natural resources responsibly, and preventing biodiversity loss [11]. In this project, the virtual environment represents a simplified ecosystem where users can interact with plants and observe how their actions influence the environment. It is also connected to SDG 3 (Good Health and Well-being), as immersive virtual nature has been proven to provide users with emotional relaxation and improve mental well-being [7].

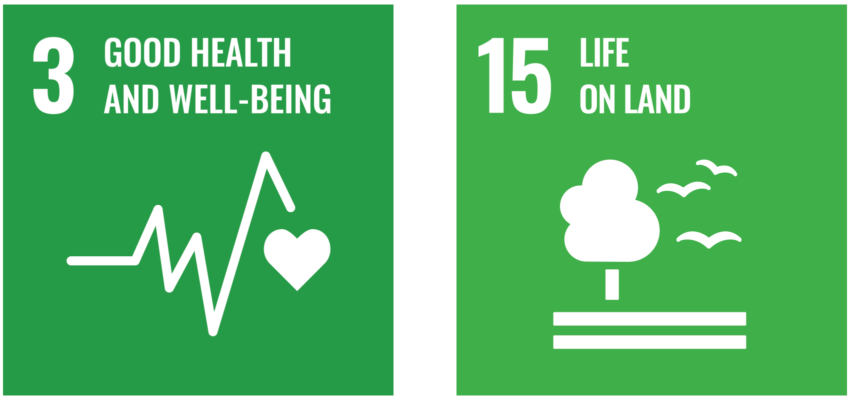


Figure 1.1 Sustainable Development Goals 3 and 15

1.4 Ethical Considerations

The immersive VR experience has some specific ethical challenges. First, participants may not fully understand the research process and possible risks before joining, which could affect their choice to participate voluntarily. Second, the ethical review needs to consider any type of user data that could potentially be generated, observed, or collected during the experience and user evaluation, such as hand movements, gesture path, interaction frequency, and feedback on participants' feelings. It is necessary to think about privacy and responsible data management. Finally, the VR experience might cause some physical or psychological discomfort. Therefore, designing an immersive VR experience requires careful ethical consideration to ensure the safety, privacy, and well-being of all participants.

1.4.1 Informed Consent

Every participant will receive a detailed information sheet including the research purpose, procedures, expected duration, data collection, and potential risks. They will be clearly informed that their participation is voluntary and they can stop at any time. Written consent will be collected before starting the VR session.

1.4.2 Privacy and Data Protection

All data for this project will be collected anonymously, and be kept private and safe. Participants' personal information will be replaced with a participant code. Also, the data will only be used for this project and will not be shared with others.

1.4.3 Physical and Psychological Safety

The VR experience is designed to be peaceful, relaxing, and non-invasive. The experience time will be controlled within a reasonable range to reduce the risk of discomfort, eye strain, or cybersickness. We will be present throughout the entire session to monitor the participants, offer assistance, and stop the research when participants feel unwell. In addition, a short debriefing will be conducted after the experience to confirm the feelings and conditions of the participants.

1.5 Related Work

The related work of this project focuses on three areas. The first part is about immersive virtual nature and its psychological effects. The second part explores gesture interaction in virtual reality. Finally, we discuss how digital experience design might influence people's connection to nature and sustainability attitudes.

1.5.1 Immersive Virtual Nature

A growing body of research has explored the application of immersive virtual nature in supporting human psychological well-being.

Recent studies found that virtual natural environments enable users to experience a stronger sense of involvement, and effectively enhance relaxation [12, 13]. For example, Anderson et al. [13] demonstrated that IVN could support stress recovery in controlled settings. Similarly, Brambilla et al. [7] suggested that IVN might strengthen the connection by helping people relive positive past experiences in nature or increasing their interest in visiting real natural places. However, there is still a gap for systematic reviews that synthesize the scientific evidence from experimental studies on IVN.

1.5.2 VR Gesture Interaction

Gesture interaction is a widely used method in VR and human–computer interaction design. It uses hand movements to interact with digital environments.

Many studies focus on improving the recognition accuracy, latency, and real-time responsiveness of hand gestures in VR environments [14, 15, 16]. Some researchers design specific gestures for different VR tasks, and test how easy they are for users to learn and remember [17].

Although gesture interaction offers a more natural way, several potential challenges remain. One issue is the lack of standardized gesture design, which means that users usually need to learn new gestures for different VR applications. Additionally, gesture input is generally less precise than traditional methods. Its accuracy and fluency are often affected by interaction device, the recognition method, and user proficiency [9].

1.5.3 Digital Experience Design

Digital experience design shows how interactive systems influence people's feelings, participation, and personal sense of meaning, instead of focusing only on functional outcomes. In sustainability research, studies have shown that emotional and experiential design methods can help people reflect more and increase their awareness of sustainability [18]. Interactive experiences let users explore the impact of their own actions on nature and form a more personal understanding of the sustainability connection.

2 Theory

This chapter presents the key theoretical and technical concepts that support this thesis. It is split into six sections: virtual reality, immersive virtual nature, presence, embodiment, gesture interaction and recognition, and experience design.

2.1 Virtual Reality

Virtual reality (VR) is a technology that creates a computer-generated three-dimensional world [9]. It allows users to enter and interact with this digital environment in an immersive way. The device used for VR is head-mounted display (HMD), commonly called VR masks or VR headsets. A typical VR system also uses motion tracking and real-time rendering to support interaction [7]. However, some users may have cybersickness when using VR headsets. This is a kind of motion sickness that can cause nausea or discomfort.

2.2 Immersive Virtual Nature

Immersive virtual nature (IVN) is a type of VR application that simulates natural environments such as forests, parks and landscapes [7]. It integrates visual, spatial, and auditory elements to create a sense of being surrounded by nature. IVN has two common types: 360° videos and computer-generated scenarios. 360° videos are recorded by special cameras to capture real nature from all angles. These videos look highly realistic, but users can only experience them passively. Differently, computer-generated scenarios are created through video game visualization techniques. These scenes may look less natural, but they provide different levels of user interaction.

2.3 Presence

Presence is defined as the subjective psychological experience of “being there” in a virtual environment, although the user physically remains in the real world [19]. It shows the extent to which users perceive a virtual environment as real and immediate, allowing them to focus on the virtual space instead of the physical surroundings.

In VR research, presence is considered as a key indicator that determines the effectiveness of immersive experiences. Several factors can influence the level of presence, such as visual realism, spatial sound, interaction, and the responsiveness of the system to user movements [19].

2.4 Embodiment

Embodiment means the feeling of having a body in a virtual environment [20]. Users can perceive that the movements of the virtual body correspond to their own physical actions. The sense of embodiment (SoE) consists of three components: the sense of self-location, the sense of agency, and the sense of body ownership. In VR systems with hand tracking, the sense of embodiment will be stronger when users see their virtual hands react naturally to their real hand gestures [20].

2.5 Gesture Interaction and Recognition

Gesture interaction is a method to interact with digital systems using hand or body movements [9]. In VR environments, people can use simple hand gestures to manipulate virtual objects, trigger specific events, or navigate space.

Gesture recognition is the core technology that supports gesture interaction. It refers to the whole process of tracking people's gestures, turning these gestures into clear signals, and then converting the signals into meaningful commands for digital systems [21].

2.6 Experience Design

Experience Design is a design approach that focuses on users' subjective experiences when interacting with a system or product [22]. It not only aims to make products functional, but also thinks more about how users feel, perceive, and interpret the interaction process. User experiences in this approach include three aspects: aesthetic experience, emotional experience, and experience of meaning.

3 Design Process

This chapter introduces the design process of the VR experience. It explains how immersive virtual nature is built to support a stronger connection between humans and nature. This chapter is divided into four sections: conceptual design, scene design, flora design, and user interface.

3.1 Conceptual Design

This section presents the conceptual design of the project. Based on the themes of healing, nature connection, and immersive interaction, it explains the design decisions that shape both the atmosphere and the user experience. This section first introduces the core concept and visual theme, and then describes how users gradually explore, interact with, and reflect upon the virtual ecosystem.

3.1.1 Core Concept and Theme

The core concept of this VR experience is healing and symbiosis. In modern society, people are often separated from natural environments. This project aims to rebuild that connection by creating a peaceful digital ecosystem. Unlike common games with tasks, scores, or time limits, the environment is presented as an open space where users can freely observe, relax, and explore without pressure.

An important idea in this concept is to avoid using traditional VR controllers. The goal is to reduce the physical barrier between the user and the system by directly using hands to explore the virtual world. This approach reflects a more instinctive way of interaction. It also suggests that the user is not a controller of nature, but a participant within it.

For the visual design, the project follows a dreamy night theme, as shown in Figure 3.1. It is inspired by the style of a midsummer night's dream and dark design theory proposed by Nick Dunn. In dark design, nocturnal ambiance is seen as a dynamic and emotional experience rather than just a visual background [23]. It influences how users feel, explore, and engage with the environment. A dark environment can help users calm down more quickly, and make interactive elements more noticeable. Additionally, the low brightness and the contrast between light and shadow at night can motivate a sense of calmness and introspection [23]. Based on this idea, the project uses dark tones as the main background, while interactive objects represent soft glowing colors like blue and purple. Light, sound, movement, and gentle visual changes are also designed to respond to user actions. This approach can support a more focused and comfortable experience.

Figure 3.1 Visual Style Example

3.1.2 User Experience Flow

The user experience flow is designed as a gradual and continuous process. It includes four main stages: entering, exploration, interaction, and reflection. Each stage supports and connects with others, guiding users to slowly become familiar with the environment.

At the beginning of the experience, users wear the VR headset and are first presented with a title page showing the name “Night Journey”. According to the title, users may imagine the overall tone of the experience, and associate it with some characteristics such as a gentle rhythm, a dark night, and a sense of peacefulness. After that, users can see their virtual hands in the scene. On the left side, there is an instructional animation that teaches users how to use gestures for navigation. This step helps users understand that the experience is controlled by their own hands, which may encourage more active exploration.

In the virtual environment, users are placed in a quiet and nocturnal setting. At the same time, soft ambient sound and music will support a calm and relaxing mood. This atmosphere may help users slow down and adapt to the environment more easily. After adapting, users begin exploring the environment using hand gestures for movement. At first, they may need some time to get used to the navigation method.

As users look around the space, their attention is naturally drawn to sparkling objects and subtle moving elements. Research on visual perception suggests that movement and brightness contrast can effectively guide human attention in spatial environments [24]. Against the dark environment, glowing particles and animations become more visually noticeable, encouraging users to approach and explore them further.

When users approach the interactive objects and perform the “Open Palm” gesture, the flowers such as tulips will slowly grow and bloom, as if they are gently awakened. As the experience progresses, users find that the flora sways slightly, emits particles, and responds in a subtle way to their presence. Sometimes, they will act as a soft “wind”, helping plants complete the spread of pollen. This interaction fosters a sense of participation within the ecosystem. During this process, if users wish to capture a moment, they can use the “Thumbs Up” gesture to take screenshots.

In the final phase, users can observe positive environmental changes that created through their interaction. It helps users to generate a sense of contribution and involvement, and also reflect on their role within the virtual nature. The experience does not set any time limit. Users can choose when to leave, and a soft transition will perform at the end of the experience.

3.2 Scene Design

Based on the conceptual goals discussed previously, the scene design focuses on how environmental elements can support emotional immersion and reinforce the feeling of entering a living virtual ecosystem. The scene is designed to shape the user’s mood, spatial perception, and exploration experience throughout the interaction process. Figure 3.2 shows the global perspective of the scene in Unity.

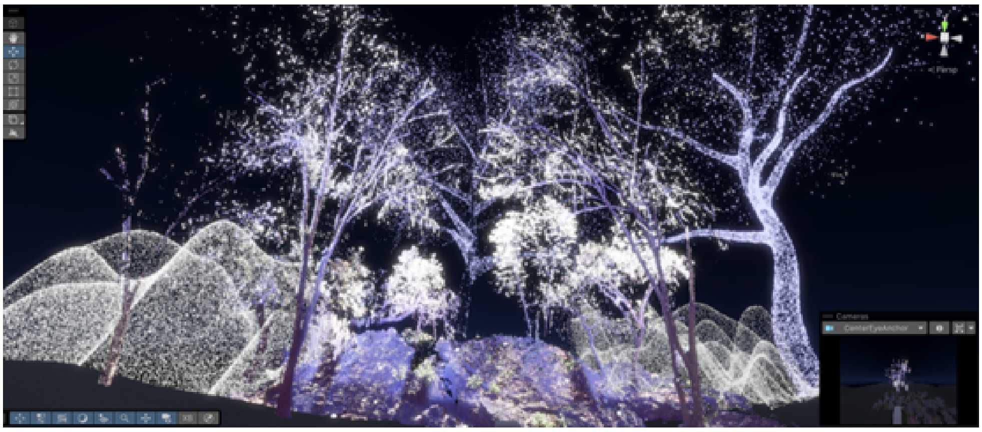
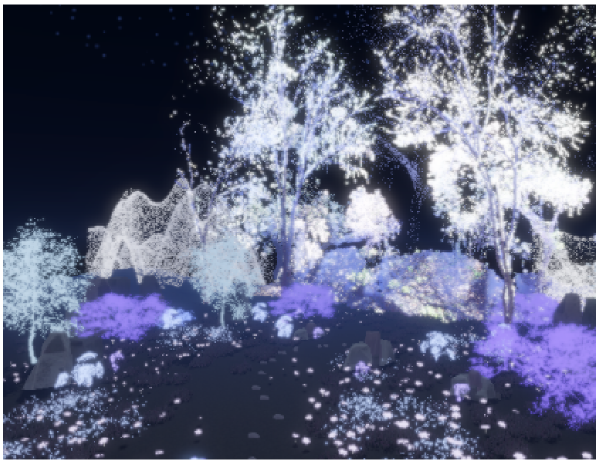
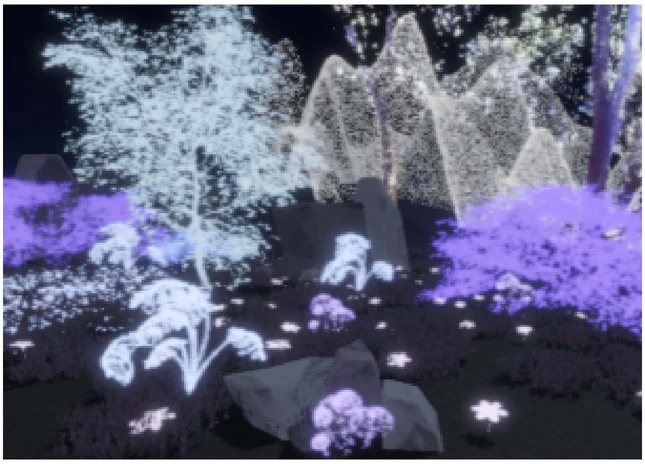


Figure 3.2 Global Perspective of Scene in Unity

To create a restorative atmosphere, the environment combines darkness, soft lighting, particles, and simplified visual forms. Different elements in the scene, including the sky, mountains, butterflies, vegetation, and interactive flora, are visually connected and follow the consistency of the design. As for the basic color palette, it relies on deep, soothing dark tones. In the environment, the surroundings such as the bush and trees, are designed in blue and purple. According to research in color psychology and emotional regulation [25], cool tones such as blue and purple are highly effective in relieving psychological stress, and evoking feelings of peace and safety. The overview of the scene design is shown in Figure 3.3.



(a) Distant View



(b) Close-up View

Figure 3.3 Scene Design Overview

The following subsections explain how these environmental elements were designed and implemented, including the dynamic starry sky, digital mountains, and point cloud models.

3.2.1 Dynamic Starry Sky

Unlike many standard VR environments that rely on static skyboxes, this project takes a different approach to designing the night sky. A traditional skybox is usually a static image wrapped around the scene. While this method is technically efficient, the environment remains visually motionless. This lack of vibrancy can sometimes make the virtual world feel flat and break the user's sense of immersion. Therefore, we replaced the standard skybox with a dynamic starry sky using the built-in particle system in Unity, to create a more authentic and engaging atmosphere, as shown in Figure 3.4.

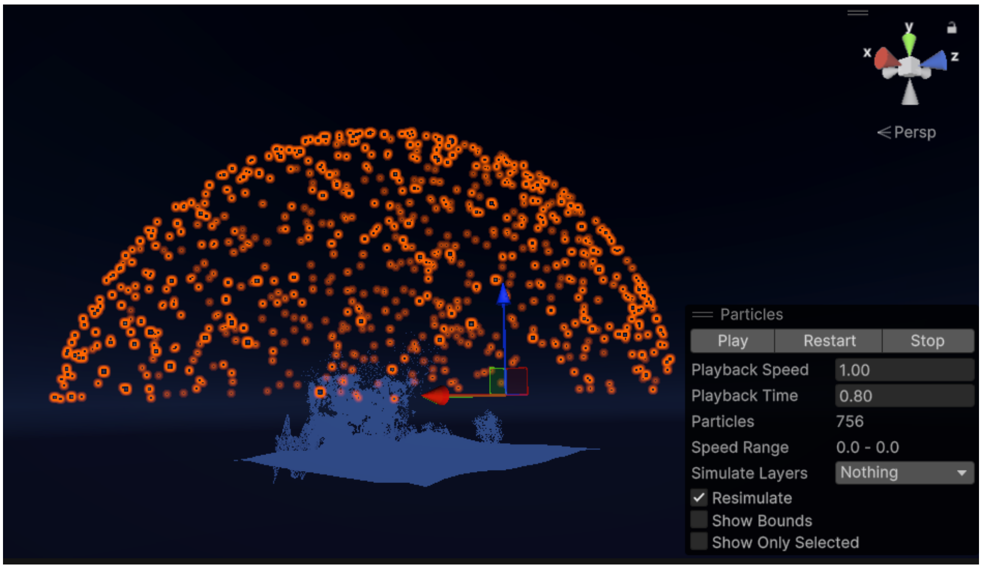


Figure 3.4 Particle System

By randomly changing the size, lifetime, transparency, and movement of the particles, the stars produce a twinkling effect that continuously changes over time. This motion helps the environment feel less artificial and gives the scene a sense of vitality, even when the user is standing still.

Collectively, these dynamic particles establish a living visual environment rather than a static digital background. The use of particles also introduces the core visual principle that continues throughout the entire project, where natural elements are represented through soft glowing points instead of solid geometry. Based on this aesthetic direction, the following section further expands the environment by introducing large-scale landscape elements into the distance.

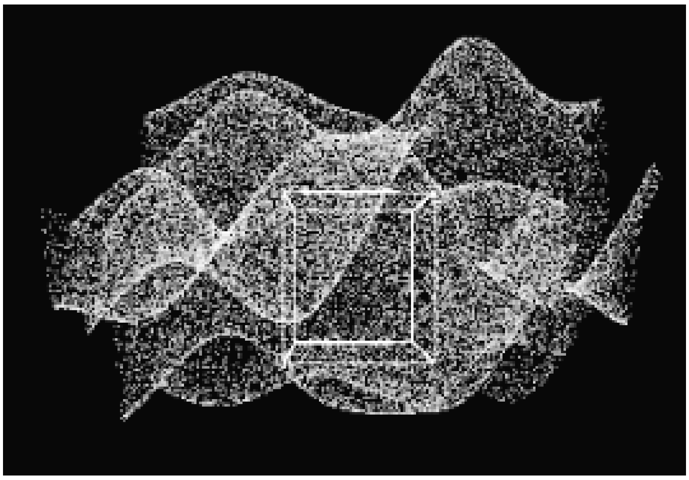
Figure 3.5 Starry Sky in the Scene

3.2.2 Digital Mountains

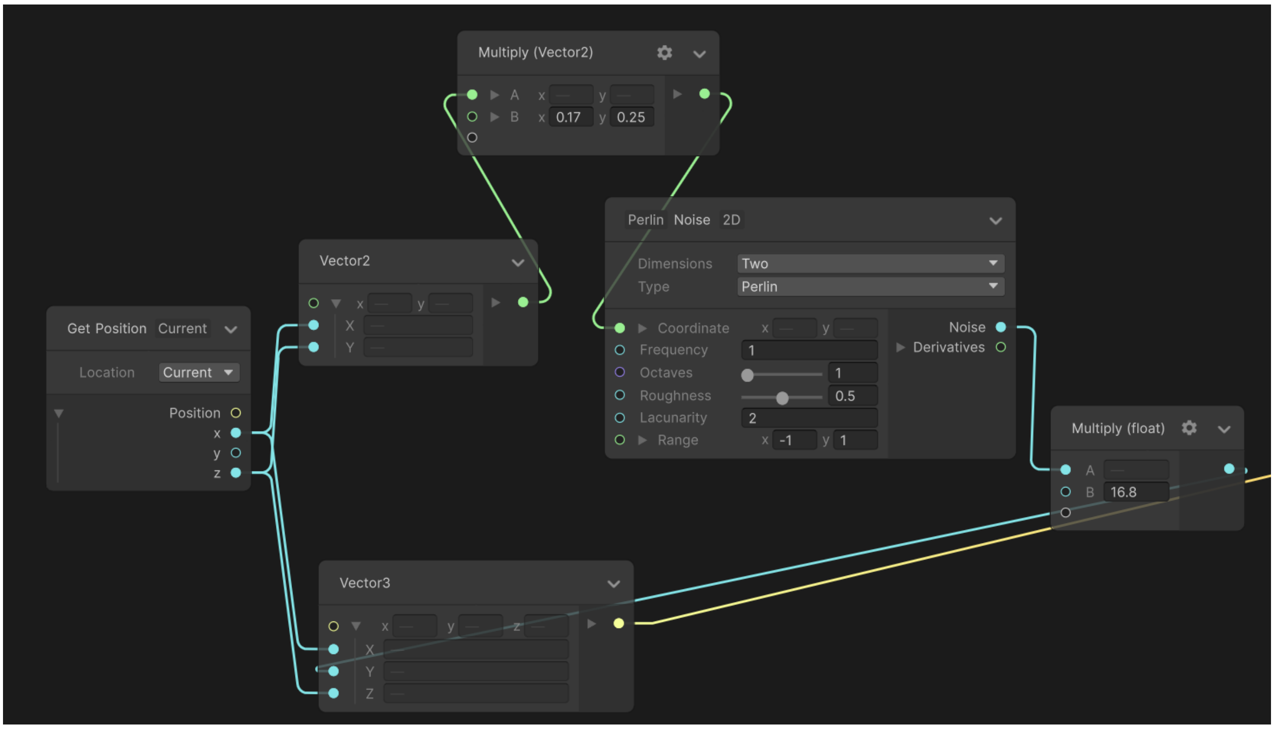
In order to enrich the scene and soften the boundaries of the terrain, digital mountains were designed into the background. These mountains were constructed using Unity's Visual Effect Graph. They are formed by glowing particles, reducing the feeling of confinement in the environment. Meanwhile, these digital mountains, serving as a distant background, surround the entire scene, defining the overall field of view.

The technical approach was straightforward but highly effective. First we defined a basic plane to define the mountain range. For each particle, we extracted its X and Z coordinates. To generate the organic, undulating elevation of the mountains, these coordinates were processed through a 2D Perlin noise function. By applying specific multipliers to the X and Z inputs, we could adjust the width and layout of the terrain based on the scene. The output of the Perlin noise was then multiplied again to define the vertical height (the Y coordinate), and finally recombined with the original X and Z values. This mathematical approach efficiently transforms a flat plane into a natural, rolling landscape. The result and VFX graph setting are shown in Figure 3.6.

While the mountains help shape the spatial depth of the environment, the scene still requires more detailed organic elements to strengthen the feeling of life and ecolog-



(a) Result of Digital Mountains



(b) VFX Graph Setting of Digital Mountains

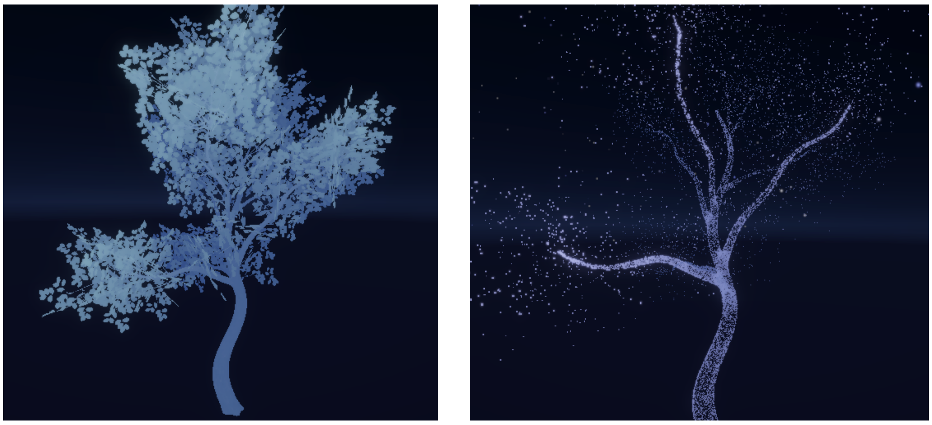
Figure 3.6 Digital Mountains Implementation

ical presence. Therefore, the next step is to design more vegetation in the form of point cloud models.

3.2.3 Point Cloud Model

To make the scene feel more lifelike, we added different natural elements like trees and bushes. Besides, in order to keep everything visually consistent, we also changed the original solid plants into point cloud particles, as illustrated in Figure 3.7. This way, they match the same soft, glowing, and simple style used in the starry sky and digital mountains we designed earlier.

We used Unity's Visual Effect Graph to transform 3D models into point cloud representations. As shown in Figure 3.8, a custom TargetModel node is used to input the specific 3D mesh. By utilizing the Set Position Mesh node, these particles are spawned across the surface area of the target model. This effectively strips away the solid volume of the plant, leaving behind a delicate silhouette composed by particles.



(a) Original 3D Model **(b) Transformed Model**

Figure 3.7 Tree Transformation

After establishing the overall environmental style and scene design, the project further developed interactive flora, allowing the environment to actively respond to the user's presence and gestures.

3.3 Flora Design

After the environment is established, the core interactive elements are designed, with flora serving as the medium connecting users with the world. To clearly explain these design, we categorized the flower interactions based on their specific visual

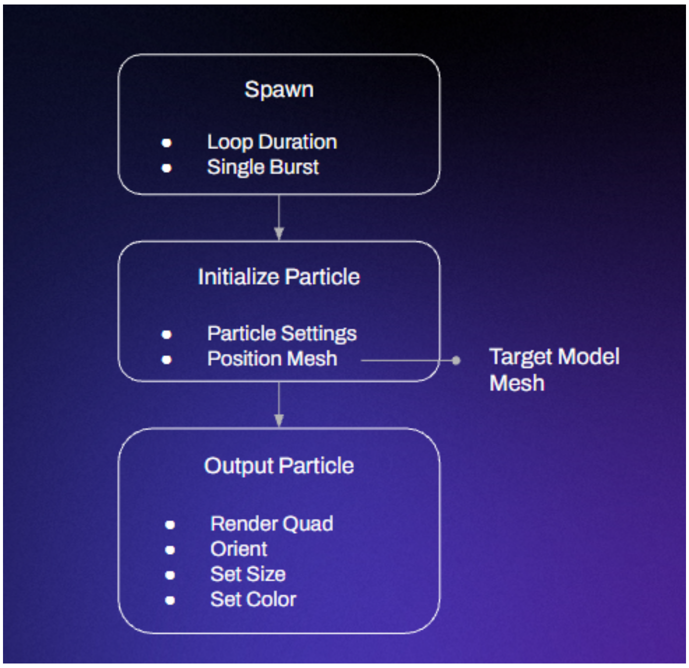


Figure 3.8 VFX Graph Configuration

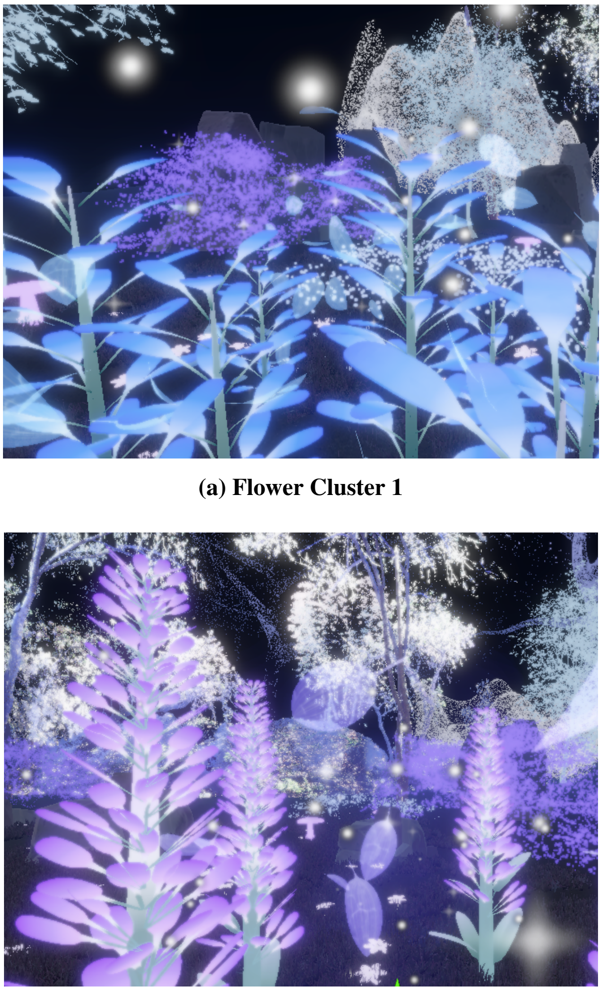
and emotional effects. The following subsections will explore these three different themes: Sense of Breathing, Tangible Expressions of Life, and Awaken Vitality.

3.3.1 Sense of Breathing

In this scene, interaction is not a simple on-off switch. Instead, it is a two-way, rhythmic exchange of life energy. When the player approaches the flowers, the flora responds naturally, with a gentle breath, surrounded by sparkles, leaves, particles and mist. The results are shown in Figure 3.9.

Typically, leaf materials are created using standard 2D image textures. However, we built the material from scratch using Material Nodes in Blender. This approach allowed us to create a more artistic and abstract texture for the leaf veins.

We used gradient node to create a transition from light to dark across the leaf, which makes it feel light and soft. Then we used Voronoi texture to simulate the natural patterns of the veins. For the final touch, a stretched noise texture adds fine vertical lines to the surface. The final material result is illustrated in Figure 3.10.



(a) Flower Cluster 1

(b) Flower Cluster 2

Figure 3.9 Visual Feedback of the "Sense of Breathing" Interaction

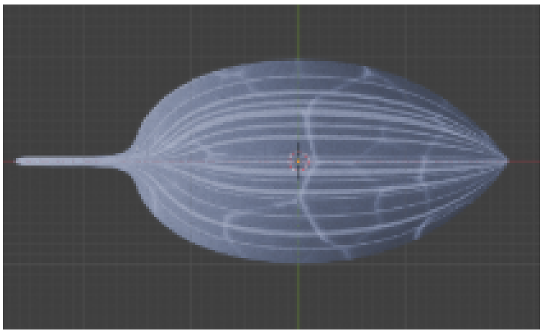


Figure 3.10 Leaf Material Result

3.3.2 Tangible Expressions of Life

This group of flora interactions focuses more directly on visualizing life processes in nature. Through blooming, pollen spreading, and gradual transformation, abstract ecological activities are translated into visible and interactive experiences. These interactions are intended to make users feel that their actions can gently influence and participate in the ecosystem.

Pollen Spread

Pollen is the spark of life and the key to nature's reproduction. In reality, pollen travels through wind or insects. In our virtual world, we designed the player's open hand to act as a "gentle breeze" that triggers this life cycle.

We used the particle system to mimic the spread of pollen in real life, which transforms the microscopic processes into a romantic visual effect. When the user opens palm towards this flower, particles begin to rise slowly from the bottom. The flora and effect is as shown in Figure 3.11. Instead of just watching, this visual feedback makes the user an active participant in the ecosystem.

Figure 3.11 Flora with Pollen Spread Effect

Flower Blooming

Flower blooming is the most realistic and common interaction among all the flora in the experience. When users open their hand near the flower, the petals will slowly unfold and expand outward, which creates a strong sense of connection between humans and nature. The result is shown in Figure 3.12.

Figure 3.12 Flower Blooming

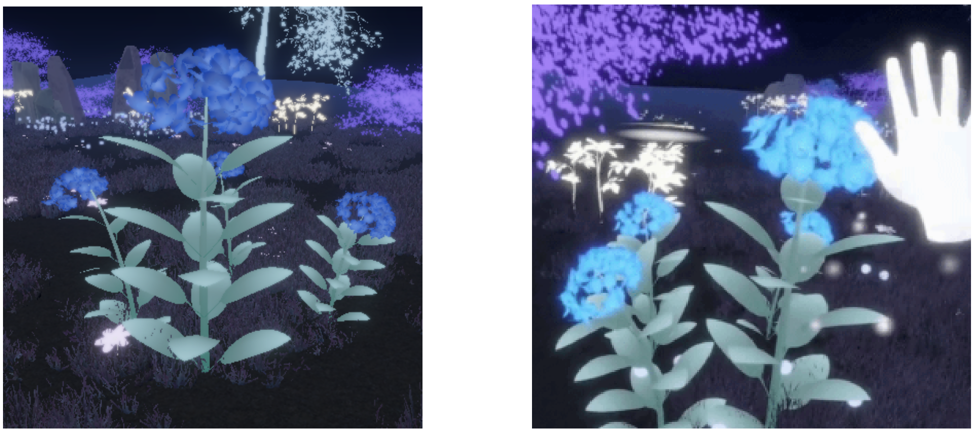
3.3.3 Awaken Vitality

While the previous flora interactions focus on natural growth and life processes, this group of flora explores how visual feedback can convey the feeling of vitality awakening within the environment. Through light, color transition, and sequential animation, the flora appear to gradually come alive in response to the users' presence. These interactions aim to create moments of surprise and emotional resonance during exploration.

Gradual Brightening

The interaction for the Hydrangea focuses on a gradual transition of color and brightness. When the user approaches the hydrangea, its petals slowly shift from a deep blue to a brighter blue over approximately three to five seconds. This visual transformation before and after user activation is illustrated in Figure 3.13.

The gradual transition is designed to create the feeling that the flora is being gently awakened by the users. The slow increase in brightness allows the interaction to



(a) Default State (Deep Blue) (b) Activated State (Bright Blue)

Figure 3.13 Visual Feedback of the Hydrangea Color Transition

feel calm and organic, while also reinforcing the overall theme of vitality emerging quietly within the environment.

The effect is implemented by dynamically controlling the material properties of the flower through Unity scripts. The project uses MaterialPropertyBlock to adjust emission intensity and color values during runtime. This approach allows only the targeted flower cluster to change visually, without affecting other objects that share the same material.

Sequential Lighting

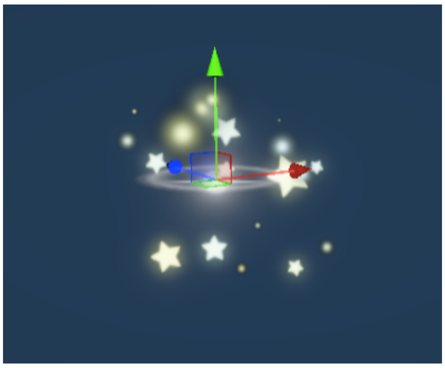
The design idea for Lily of the Valley comes from a creative vision. Since the flowers look like tiny bells, we treated them as a string of light bulbs. When activated, the flowers light up one by one in a sequence, as shown in Figure 3.14a.

To make this moment feel magical, each flower releases a visual effect when it lights up: stars, particles, a soft halo, and a glowing ring. The breakdown of this layered effect is illustrated in Figure 3.14b. This layered effect perfectly visualizes the awakening of vitality, making the plant feel truly alive.

3.4 User Interface

For a restorative VR experience, maintaining users' sense of immersion and presence is the design priority. Therefore, the project adopted a minimalist UI strategy and intentionally avoided traditional menus, complex interface buttons and screen text. In many VR applications, these interface elements can constantly remind users of the

(a) In-scene Lighting Effect

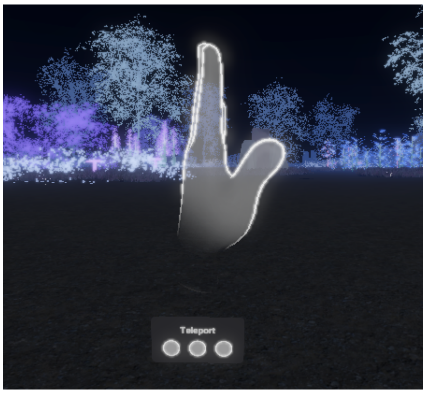


(b) Particle Effect Close-up

Figure 3.14 Visual Feedback Design for the Lily of the Valley Interaction

digital system itself, which may interrupt the feeling of being inside the virtual environment. Conversely, natural interaction methods and reduced interface complexity can help strengthen users' sense of presence and improve emotional engagement within virtual environments [26].

The only user interface included in this project is Meta's Microgesture Tutorial UI. It appears floating near the user's hands to provide clear visual instructions on how to perform the gestures (Teleport and Turn). Figure 3.15a displays the UI for Teleportation, guiding the user on how to use a pinch gesture to move through the environment. Figure 3.15b shows the UI for Turning, which allows the user to adjust their orientation. Once the user learns the interaction, the UI disappears, leaving an unobstructed view of the virtual nature.



(a) Teleport Gesture Prompt

(b) Turn Gesture Prompt

Figure 3.15 Implementation of the Meta Microgesture Tutorial UI

4 Interaction

This chapter presents the interaction method of the project. It explains how users interact with the virtual environment through hand gestures. It also introduces the main interaction ideas, the use of virtual hands, gesture mappings and feedback, and technical implementation.

4.1 Interaction Principles

As introduced in the conceptual design, the experience relies on hand tracking and simple gestures. The interaction system follows the user-centered approach, and aims to create meaningful digital feedback through the user's physical movements. In alignment with the core theme of healing and symbiosis, the gesture interaction is guided by three main principles: natural interaction, intuitive mapping, and interaction simplicity.

First, the interaction design follows the idea of Natural User Interfaces (NUI). Wigdor and Wixon argue that the interactive system should adapt to human behavior and existing habits rather than forcing users to learn abstract rules and commands [27]. NUI helps users to interact without thinking too much about how to operate the system. Based on this idea, the project removes external tools and complex controls, allowing users to interact directly through their hands. This approach aims to make the interaction feel more immediate and embodied, while also supporting a stronger sense of presence within the environment.

However, the concept of natural interaction also has limitations. Norman points out that many natural interfaces are not truly natural, because users still need to learn how gestures correspond to system functions [28]. Even seemingly intuitive interactions are often influenced by cultural habits, previous technical experience, and system constraints. Furthermore, gestures are not widely standardized. Therefore, this project does not assume that gesture interaction is completely natural or effortless. Instead, the design aims to make interactions easier to understand by using familiar and simple gestures, consistent feedback, and concise interaction logic.

Second, the interactive system prioritizes intuitive mapping. According to Norman, mapping serves as a bridge that connects users' mental models and the design elements they interact with [29]. When users can easily understand and predict what will happen, it leads to a sense of control and confidence. Therefore, interactions should match users' expectations and experiences, and maintain consistency with the corresponding functions. For example, opening palm usually shows giving or openness, which can be a trigger for bloom.

Finally, consider the limitations of gesture recognition. Hand tracking may sometimes be unstable, especially when the hands overlap or move too quickly [30]. To reduce this issue, the interaction design avoids small or complex finger movements that are difficult for the system to detect. Instead, it uses some clear hand poses, such as an open-palm and a thumbs-up gesture. These gestures are visually different from each other. This method ensures that the system recognizes gestures more accurately and effectively reduces unintended interactions. On the other hand, simplifying gestures also helps users reduce cognitive load.

4.2 Virtual Hand Representation

In this project, the users' hands act as the main interface for interaction. The visual representation of hands plays an important role in enhancing embodiment and immersion. It directly affects how users perceive themselves within the environment. Compared to realistic human hands, the project intentionally adopts a more abstract and stylized design. This choice helps avoid the uncanny valley effect and allows the hands to better integrate into the surreal visual environment. The visual hand is displayed in Figure 4.1.

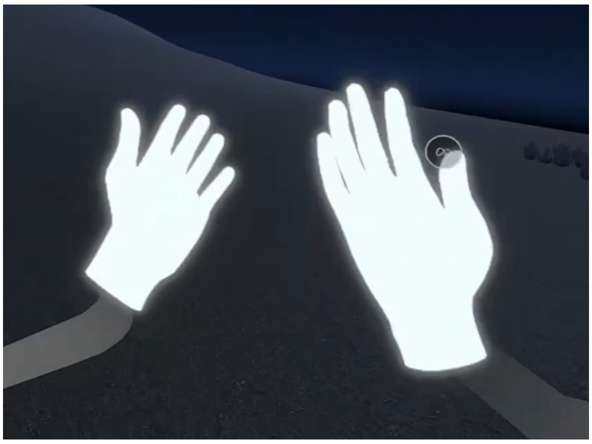


Figure 4.1 Virtual Hand

For the appearance, the virtual hands are designed with glowing white color and motion trails. This visual style matches the dreamlike atmosphere, and maintains visual consistency with other environmental elements, including glowing particles, interactive flora, and point-cloud scenery. The glowing appearance also makes hand movements more visible and helps users improve spatial awareness. In addition, motion trails provide continuous visual feedback during movement, allowing users to perceive the direction of their gestures more clearly.

4.3 Gesture Mapping and Implementation

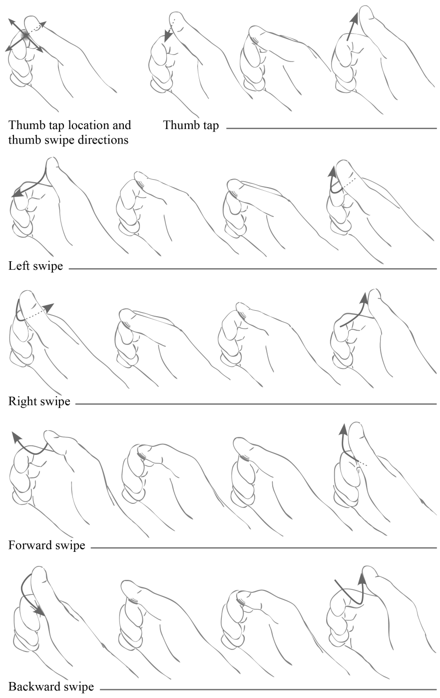
Based on the interaction principles discussed previously, the project further develops a gesture system. The interaction design attempts to integrate navigation, environmental interaction, and system functions into a unified experience. The following subsections explain how different gestures are mapped to specific functions, including navigation through microgestures, interaction through the "Open Palm" gesture, and screenshot capture using the "Thumbs Up" gesture.

4.3.1 Navigation: Microgestures

Movement in the virtual environment is controlled through Meta hand-tracking microgestures. Users navigate using thumb tap and thumb swipe motions, which trigger discrete directional commands, similar to arrow keys. Compared to large arm or body movements, microgestures require very little physical effort and can be performed naturally without distracting the user's attention from the surrounding environment. The low physical intensity and lightweight interaction conform to the interaction principles in this project.

The gesture is based on thumb movement along the side surface of the index finger. Different swipe directions correspond to different navigation commands. As shown in Figure 4.2a, swiping the thumb towards or away from the fingertip can trigger directional movement, and thumb taps can be used for the teleportation function. All movements are performed with the left hand, and the appearance is consistent with the virtual hand mentioned in the previous subsection.

In terms of technical implementation, the navigation system utilizes the Meta XR Core SDK and the OpenXR hand-tracking microgesture extension. The system continuously monitors hand-tracking data and detects specific thumb motions in real time. Once a valid gesture event is recognized, the corresponding movement action is triggered through Unity interaction scripts. This allows navigation and environmental interaction to rely on the same hand-tracking system, helping the overall experience feel more continuous and cohesive. Figure 4.2b presents the navigation system in VR.



(a) Thumb Swipe Directions

(b) Microgestures with Left Hand

Figure 4.2 Microgestures

4.3.2 Interaction: Open Palm

The "Open Palm" gesture is the core interaction of the experience, representing the primary connection between the user and the virtual nature. This interaction design is closely related to the conceptual theme previously proposed. In many digital environments, grabbing gestures often imply control, possession, or manipulation. This project aims to move away from this interaction method and encourage a more harmonious relationship between humans and nature.

Previous studies on embodied interaction suggest that bodily movements and gestures are not only functional inputs, but also carry emotional and symbolic meaning [31]. In everyday communication, an open-palm is commonly associated with openness, acceptance, trust, and giving. Based on this symbolic association, the project uses the open-palm gesture to activate flora interactions. Through this mapping, the interaction attempts to shift the user's role from a controller to a participant within the ecosystem.

When users perform this gesture, glowing particles slowly emerge from their palm and diffuse into the surrounding environment. As can be seen from Figure 4.3, this effect visually extends the action and reinforces the feeling of releasing energy into nature.

Figure 4.3 Particles from Palm

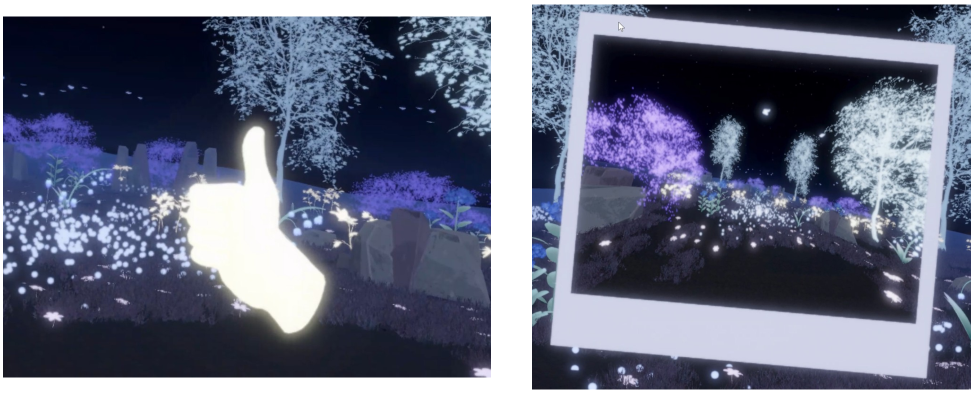
To ensure the stability and reliability of the interaction, the gesture recognition system incorporates multiple detection conditions through the Meta OVR interaction SDK. The open-palm interaction is activated only when both the hand shape and palm orientation meet the requirements. Finger extension is identified using the ShapeRecognizer component, while palm orientation is detected using conditions in the TransformRecognizer component. These states are connected through an "AND" relationship using ActiveStateGroup logic. The interaction also has distance restrictions, which means that users need to get close to the interactive flora and walk up to them. This helps prevent accidental activation of interactions during normal movement.

4.3.3 Screenshot: Thumbs Up

The project also includes a "Thumbs Up" gesture used for screenshot capture, as illustrated in Figure 4.4a. This function is a common feature in various games, experiences and applications, allowing users to record their favorite moments.

Typical methods, such as opening menus or pressing interface buttons, are not suitable for this project. To avoid disrupting the user experience, we directly incorporated screenshot function into the gesture system. The thumbs-up gesture was chosen because it is visually distinctive and easy to recognize. It is also familiar to most users, aligns with user habits, and represents a positive meaning in daily communication.

After the thumbs-up gesture is recognized, a short countdown audio is triggered to prepare the user for the screenshot. Three subtle audio cues are played in sequence, indicating that the capture is about to occur. Once the screenshot is taken, the captured image will be presented directly in the scene in the form of a physical photo, following the style of a Polaroid film, as shown in Figure 4.4b. A camera shutter sound is played at the moment of capture to reinforce the action.



(a) Thumbs Up Gesture **(b) Screenshot**

Figure 4.4 Screenshot through Thumbs Up

5 User Evaluation

This chapter introduces the user evaluation of the VR experience. It explains how to set up and conduct the evaluation, including the participants, procedure, and data collection methods. It also summarizes and discusses the feedback collected from users.

5.1 Setup and Procedure

The purpose of this evaluation is to assess the overall user experience and interaction design of the VR project. It mainly focuses on visual effects, interaction, immersion, emotional response, and user perception of the virtual nature.

The evaluation involved a small-scale user study with ten participants, six females (60%) and four males (40%). They were all students at Lund University, aged from 21 to 30. The participants represented a diverse range of prior experience with VR, ensuring that the usability could be evaluated from both expert and novice perspectives. Specifically, four participants identified as frequent VR users, four had used VR a few times, and two participants were complete novices. The summary of participant profiles is presented in Table 5.1.

Table 5.1 Summary of Participant Profiles

Category	Result
Total Participants	10
Age Range	21–30
Gender	6 Female, 4 Male
Dominant Hand	8 Right-handed, 1 Left-handed, 1 Ambidextrous
Prior VR Experience	4 Frequent user, 4 A few times, 2 None

The evaluation was conducted in a controlled indoor setting using the Meta Quest 3S VR headset, as shown in Figure 5.1. The overall procedure of the user evaluation is outlined in the flowchart in Figure 5.2. Before the session, the participants received a brief introduction of the project, the purpose of the study, and the procedure. They were also informed that participation was voluntary and they could stop at any time. Then participants were asked to wear the VR headset and follow a short instruction interface, which explained how to use gestures for movement and interaction.

Figure 5.1 VR Headset

When entering the virtual environment, participants were free to explore the space at their own pace without any specific tasks or goals. During the session, participants were not required to speak or describe their actions to avoid interrupting their immersion. All verbal expressions or emotional reactions were entirely spontaneous. Additionally, the researchers only observed the behavior of the participants and did not provide additional guidance or instructions, unless the participants asked for help. This approach helps maintain a more natural and uninterrupted experience.

After the session, participants completed a questionnaire about their overall impressions. The questionnaire included basic personal information and background, questions about this VR experience, and open-ended feedback. Most of the questions focused on subjective feelings, such as immersion, interaction, and emotional response. Besides, some multiple-choice questions and five-point Likert scale ranging were used to support a more structured evaluation. This was followed by a short informal interview, where participants could share more thoughts and feelings.

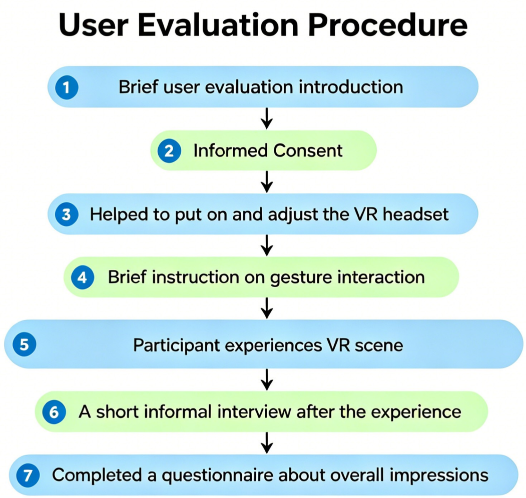


Figure 5.2 User Evaluation Procedure Flowchart

5.2 User Feedback and Results

The evaluation results are divided into three main aspects: overall experience and atmosphere, gesture interaction, and emotional response. Through questionnaires, observations, and post-experience interviews, the analysis examines how users perceived the immersive space and interaction system of the VR experience. It also explores how the environmental atmosphere and gesture design influenced users' engagement with the virtual nature.

5.2.1 Overall Experience

In general, the feedback indicated that most of the participants found the experience immersive and calming. Furthermore, the color palette and atmosphere created a visually relaxing and comfortable feeling. In the questionnaire, the statements "The environment made me feel immersed and relaxed" and "The experience felt healing, peaceful, and helped me relieve stress" both received the highest score among all metrics, reaching 4.8 out of 5. The detailed distribution of user ratings is illustrated in Figure 5.3 and Figure 5.4.

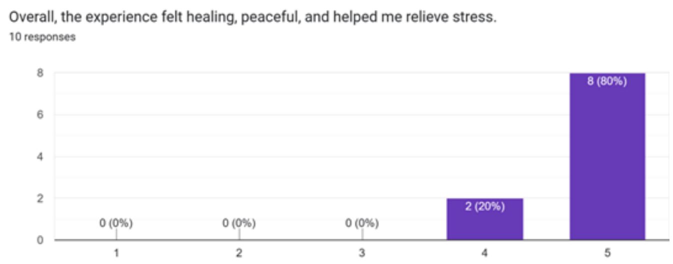


Figure 5.3 Distribution of User Responses on Overall Feeling

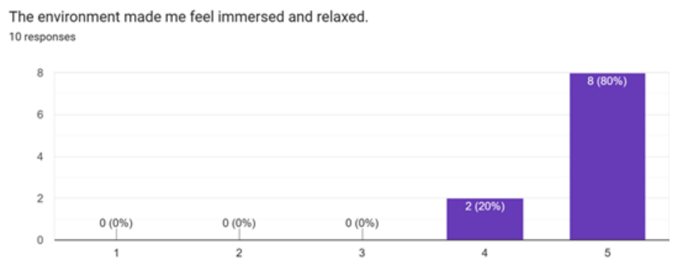


Figure 5.4 Distribution of User Responses on Immersion and Relaxation

Eight participants described the environment as "dreamlike", "magical", "peaceful", and "relaxing". They specifically mentioned that the stars, glowing particles, point-cloud mountains, and different interactive flora were the most memorable parts of the experience. It is noteworthy that when asked about their favorite elements, six participants highlighted the glowing particles. This finding supports the design choice of using particles as visual indicators.

Moreover, the atmosphere and sound effects also appeared to play a significant role in emotional relaxation. One participant reported feeling anxious before the test but much calmer afterward. Another participant stated that quietly gazing at the stars and listening to music helped her slow down.

An informal thematic categorization was conducted based on the interview and open-ended answers, as shown in the Table 5.2.

Table 5.2 Thematic Categorization of User Feedback

Theme	Keywords & User Descriptions
Visual Effect	dreamlike, magical, peaceful, stars, particles, color, phenomenon
Feeling	calm, relaxed, peaceful, stress relief, slow down
Interaction	blooming flowers, particles, diverse feedback, alive, surprise, vitality, smooth, creative
Reflection	reminds of nature, past experience, impressed by the flora, get close to natural life

As five participants explicitly noted, the environment encouraged their desire and curiosity to explore. One participant said that the experience had a high degree of freedom and randomness, so she could not predict what she would encounter next. Similarly, another participant explained that he especially enjoyed the moments walking away from the main path and freely observing the surroundings. This reflects the original design intent to create a non-task-oriented experience that allows users to interact with the environment at their own pace.

5.2.2 Gesture Interaction

The results suggest that the gesture interaction system was generally easy to learn and use. The statements “Interacting with my own hands felt smooth and intuitive” and “Gestures are easy to remember and use” both received a mean score of 4.7 out of 5. This indicates that the simplified gesture design helped users quickly understand how to interact with the environment. The results of the five-point Likert scale are summarized in Table 5.3.

Table 5.3 Quantitative Results for Gesture Interaction and Navigation

Theme	Statement	Mean Score
Interaction	Interacting with my own hands felt smooth and intuitive.	4.7
Learning	Gestures are easy to remember and use.	4.7
Gesture	Using the “Open Palm” gesture made me feel like I was gently giving to or communicating with nature.	4.7
Movement	Using the microgesture with my left hand to move around was comfortable.	3.9

In terms of the open-palm interaction, all participants adapted rapidly to it. Four participants thought the glowing particles emerging from the hand created a sense of vitality and made the interaction feel more lifelike. However, during the experience, two participants mentioned that they wanted to touch the petals and also tried to interact with some particles using their virtual hands. This shows the importance of haptic feedback in enriching the experience. It can serve as a direction for future improvement.

Despite the positive results, navigation was the weakest part in the questionnaire. Four participants were not used to navigating with their non-dominant hand. Five participants noted that controlling movement was initially difficult for them, and they did not often use their left thumb to complete commands. This issue increased both cognitive effort and physical difficulty. Three participants also reported confusion about orientation after turning and loss of spatial awareness. In some cases, they occasionally could not find the direction after a rotation or turning, particularly when accidental inputs triggered unintentional actions. For example, one participant stated that after completing the initial left-hand movement instruction, he was disoriented, and unsure of his location or how to return to the original spot. Although there were some difficulties at the beginning, four participants noted that interaction became much smoother after a short period of practice. This indicates that the main difficulty lies in the initial learning phase.

Two participants also mentioned slight physical discomfort during navigation. Repeated thumb movements felt unfamiliar or tiring over time because this type of motion is not commonly used in everyday interactions. Three participants explained that they preferred rotating their own body rather than relying entirely on gesture turning.

5.2.3 Emotional Response and Nature Connection

The evaluation results show a clear emotional resonance between users and the virtual ecosystem. Seven participants strongly agree that using the open-palm gesture made them feel like they were gently giving or communicating with nature.

When asked about the process of awakening the virtual flora, five participants noted that they could feel a distinct sense of accomplishment and agency. Four participants also connected the experience with their personal memories and feelings related to nature. One participant mentioned that quietly observing the stars and listening to the ambient sound reminded her of previous experiences in natural environments. Another participant pointed out that the environment helped the participant empty his mind and enjoy the atmosphere. These responses suggest that the experience supports immediate emotional relaxation and also triggers reflection and memory association connected to nature.

The participants also showed curiosity about the different interactions of the flora. Two participants mentioned that discovering different feedback from the flora created surprise and anticipation during exploration. The interaction effects, including blooming, glowing, floating particles, and moving petals, helped maintain participants' interest.

At the same time, the participants suggested several potential improvements. Specifically, they expressed a desire for haptic feedback when touching plants, rather than having their hands pass through the geometry. Additionally, adding more animals or guiding creatures into the environment to make the world feel more vibrant.

6 Discussion

This chapter discusses the findings of the project, and relates them to the research questions. It also reflects on the design decisions and processes, and introduces the limitations and possible directions for future work.

6.1 Discussion of Findings

Through self-review and user evaluation, we obtained a comprehensive and in-depth understanding of the experience. The following analysis will combine the results to answer the three research questions initially proposed.

The first research question explores how design strategies can be used to create a specific atmosphere in immersive VR experiences. The findings validate the importance of environmental design in shaping users' emotional responses. Elements such as ambient lighting, color, visual effects, and sound can be effectively combined to form a coherent sensory environment. This supports a sense of calmness and relaxation, and helps users quickly adapt to the environment. Moreover, the slower environmental pacing and gentle visual responses also appear to contribute to this experience.

The research results also reflect the idea of dark design. Previous studies on environmental design show that relatively low visual complexity and darker settings can help minimize distraction and enhance focus on subtle sensory elements [23]. In this project, the dark background allows luminous particles, flora interactions, and hand representations to stand out more clearly.

Regarding the second research question, the findings show that gesture interaction has a significant influence on users' sense of immersion, presence, and interaction fluency. Meanwhile, immersive interaction does not always benefit from increasing the number of functions or gesture complexity. The use of hand tracking allows users to interact with the environment in a direct and embodied way, which helps maintain a continuous sense of presence. Many users were able to understand the gestures and enjoyed using the virtual hands.

However, the results reveal that interaction fluency is not consistent across all gestures. While simple and expressive gestures, such as the open-palm, are intuitive and easy to adopt, navigation based on microgestures requires more effort. Users need time to learn how to control the movement, and it can occasionally cause confusion and difficulties. This issue may interrupt immersion, as users need to stop their current actions and consciously think about how to perform the gesture. This suggests that even within a minimal interaction system, different types of gestures can create different degrees of cognitive load, which directly affects the overall experience. In addition, the level of difficulty may also vary depending on the individual habits. Therefore, a fixed gesture system cannot meet the habits of all users, and more choices and solutions need to be provided to deal with the problem. This also reflects that seemingly natural interactions are not entirely natural and effortless, as they remain heavily influenced by multiple factors such as the user's cultural background and familiarity with digital systems.

Finally, the last research question is related to emotional connection and reflection. The findings suggest that the virtual nature experience can enhance users' emotional connection with nature and encourage a certain level of reflective awareness. Yet, the effect remains limited in scope. As described in the User Evaluation chapter, participants stated feeling relaxed and emotionally engaged, and some noted that they had moments of reflection, such as recalling past experiences in nature or having the desire to visit a park. The interaction with flora also contributed to this connection. When users' actions led to visible changes in the environment, such as flower blooming or light responses, it created a sense of involvement and personal engagement. During the experience, this process can strengthen the relationship between the user and the environment, making the experience feel more meaningful. However, the findings also indicate that this emotional connection exists primarily at the level of experience and reflection, rather than producing significant behavioral changes. This issue will be explained in more detail in the Limitations section.

6.2 Limitations

Despite the positive outcomes of the project, there are several limitations that need to be considered, both from the technical aspect and the evaluation process.

One limitation of the project relates to gesture interaction. The current interaction system depends on several conditions at the same time, such as the distance between hand and object, raycasting direction, and whether the user is actually looking at the target object. Although these constraints help reduce accidental activation, they also mean that interactions may not always be triggered correctly in a very immediate way. In some cases, users may need to adjust their position or repeat the gesture before the interaction is successfully triggered. In addition, the detection of Meta microgesture is highly sensitive, sometimes leading to unintended actions when the users relax their fingers or drop slightly downward. The project also revealed that gesture interaction is closely related to users' physical habits, adaptability, learning speed, and previous experience. While assigning navigation to the left hand aligns with conventional control schemes in most games, users still require a learning curve to adapt to the system.

The second limitation is connected to the feedback design. In this project, feedback is mainly visual, supported by different kinds of sound effects when users trigger the interaction. This works well for atmosphere, but it also means the interaction lacks physical sensation or haptic feedback. When users touch or influence the flora, they can see and hear the result, but they cannot physically feel it. This creates a small gap between action and perception and limits tactile immersion. It is not a critical problem, but it affects how well the interaction feels, as some participants mention in the interview after experience.

There are also some difficulties about system performance. Because VR requires a stable frame rate, the scene cannot be too heavy. Some ideas, such as more detailed plant structures or a richer ecosystem with more variation, had to be simplified or removed during development. As a result, the current space is relatively limited both in scale and diversity. It cannot yet present a highly complex natural environment.

The last limitation lies in the evaluation phase. The number of participants is relatively small, and most of the findings come from subjective feedback and self-reported impressions, including questionnaires and short interviews. It lacks objective and reliable evidence. Some participants described a stronger sense of connection to nature, which is also consistent with findings in the existing literature. However, in this project, there is no supporting psychological framework or measurement to validate these effects. Moreover, each participant only experienced the project once. This makes it unclear whether the responses would last over time and create a longer-term impact, or if they are simply short-term reactions to a new experience.

6.3 Future Work

Based on the limitations, there are several directions that can be considered for future development.

Depending on the results from user testing, ineffective interactions may make users feel confused and frustrated, and even reduce their willingness to explore the environment. Therefore, the detection conditions need to be more flexible regarding hand position and distance, so that users do not need to perform gestures too precisely. It ensures that users can interact easily, making the gesture execution less restrictive. Also, since everyone has different habits and some users are left-handed, the project should offer a customizable mode. In this way, users can choose and switch the roles of each hand according to their personal preference, which may significantly enhance accessibility and overall user comfort.

Another direction is to further explore the balance between gesture interaction and controller-based interaction. The findings suggest that hand gestures can strengthen embodiment and create a more direct connection between users and the virtual environment. This is particularly valuable in experiences that aim to encourage reflection and emotional engagement. However, compared with traditional controllers, microgestures may provide lower precision, reduced reliability, and greater physical effort during prolonged use. For different scenarios and user groups, hybrid interaction models that combine the strengths of both controllers and gesture interaction could be considered. For example, hand gestures could be reserved for expressive and meaningful interactions with the environment, while controllers could support navigation or other functions that require greater precision and stability. Such hybrid approaches may help maintain immersion while improving usability and accessibility for a wider range of users.

To further enhance the immersive experience, more feedback could be incorporated into the space. One possible direction is to introduce spatial audio that responds more directly to user movement, such as wind sounds when the hand moves through the space, or fluttering sounds of butterflies when they fly past users. It may also be valuable to explore haptic feedback, although this would require additional wearable devices. Multisensory feedback significantly helps users to experience the natural space in a more complete way, and improves the overall sense of presence.

In addition, based on better optimization in system performance, the system could support a richer environment. Designers can expand the ecosystem with more plant types, diverse behaviors, and more other animals. Additional AI techniques can also be used to create some random natural events, making the environment more vivid and interesting.

Finally, the evaluation method could be improved through collaboration with other disciplines, in order to address the current lack of objective data. In previous studies on immersive virtual nature, evaluation often includes controlled comparisons or pre-post measurements to better find changes in user state [7]. If working with researchers in psychology, they would provide systematic ways to evaluate user responses, such as quantitative data or validated scales. These results support more reliable evidence to study and understand how the experience affects users. Meanwhile, it is also necessary to increase the sample size and involve participants from diverse backgrounds and levels of experience.

7 Conclusion

This chapter concludes the main contributions and outcomes of the project. It reflects on how the design and evaluation address the research goals, and discusses the broader relevance of the work in relation to digital experiences, virtual nature, and sustainability. The chapter also considers the potential of immersive VR as a reflective and experiential medium.

This thesis explores how immersive virtual reality can be designed to support emotional engagement, relaxation, and a sense of connection to nature. Based on experience design, gesture interaction, and theories of immersive virtual nature, the project developed a gesture-interactive VR experience titled Night Journey. During the experience, users can freely explore the space and interact with a responsive ecosystem through natural body movements. The design aims to create a calm and reflective virtual space, encouraging users to slow down and engage with their surroundings.

This work is placed within the broader context of increasing alienation between humans and nature, an issue closely related to global sustainable development challenges. In response, the project aligns with the United Nations' Sustainable Development Goals, particularly SDG 3 (Good Health and Well-being) and SDG 15 (Life on Land). Rather than focusing on ecological simulation alone, the project investigates how immersive experiential design can serve as a medium for psychological restoration and reflective awareness, offering an alternative approach to fostering a more sensitive and meaningful relationship between humans and nature. The primary contribution of this thesis lies in designing and implementing a form of gentle interaction in VR. Users can engage with the virtual nature through simple gestures rather than direct manipulation. In this context, the user's physical presence is not treated as a controlling force, but as a part of the responsive system. The idea is informed by existing work in experience design and immersive virtual nature, and is further advanced through the design of gesture interaction in this project.

In addition, this study offers a design-oriented perspective on digital experiences, which was widely accepted by participants in the user evaluation. Drawing on the research by Jonauskaite and Mohr [25] regarding how colors and visual effects influence emotions, this project uses a low-brightness setting combined with particle visual elements and soft blue and purple tones. This design offers a practical reference for building restorative digital spaces, particularly for those focusing on psychological well-being.

Regarding sustainability goals, this project achieves a small-scale exploration of how immersive media might support awareness of human–nature relationships. Instead of directly presenting sustainability information or natural simulation, the experience attempts to emotionally engage users through their personal feelings and the changes they can bring to nature. While this may not lead to direct changes in user behavior, it can enhance the user's sense of symbiosis with nature to some extent. Furthermore, it highlights the potential of VR to provide a new approach to environmental communication.

In conclusion, technology is not necessarily a barrier isolating us from the natural environment. Instead, when designed with care and intention, technology can become a bridge reconnecting us to nature. The "Night Journey" VR experience is not intended to replace personal experiences in the real world, but rather serves as a digital way to remind people of nature's healing power and its need for our protection. This research also emphasizes that the digital experience has a broad potential that extends beyond entertainment and relaxation. By incorporating diverse design strategies, it can support educational roles and fulfill multiple functions. As immersive tools continue to develop, it is hoped that design will move toward a more symbiotic future. In such a future, virtual experiences could help us slow down and reconnect with nature, eventually encouraging this enhanced awareness to positively impact the real world and contribute to sustainable development.

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A Appendix

A.1 User Evaluation Questionnaire

This appendix presents the post-study questionnaire used in the user evaluation. The questionnaire is administered via Google Forms and consists of three sections: Demographics, Scale Questions, and Open-Ended Feedback.

Section 1: Demographics

1. **Participant No.** [Short answer text]
2. **Age** [Short answer text]
3. **Gender**
    - Male
    - Female
4. **Occupation**
    - Student
    - Other: ____________________
5. **Dominant Hand**
    - Right Hand
    - Left Hand
    - Both
6. **Prior VR Experience**
    - None
    - A few times
    - Frequent user
    - Other: ____________________

Section 2: Scale Questions

Please rate from 1 to 5, where 1 = Strongly Disagree, 5 = Strongly Agree.

1. Interacting with my own hands made me feel smooth and intuitive.
2. Using the microgesture with my left hand to move around was comfortable.
3. Gestures are easy to remember and use.
4. The environment made me feel immersed and relaxed.
5. The representation of my virtual hands helped me easily track my movements in the dark environment.
6. Using the "Open Palm" gesture made me feel like I was gently giving to or communicating with nature.
7. Overall, the experience felt healing, peaceful, and helped me relieve stress.
8. The process of awakening the virtual flora enhanced my emotional connection to nature.

Section 3: Open-Ended Feedback

Please share your detailed thoughts.

1. How do you feel about this experience? Which moment or element left the deepest impression on you?
2. Did you face any difficulties during the experience?
3. Do you have any other comments or suggestions?