"When You Are the Plant": Encouraging Hydration Through Playful Virtual Reality Embodiment

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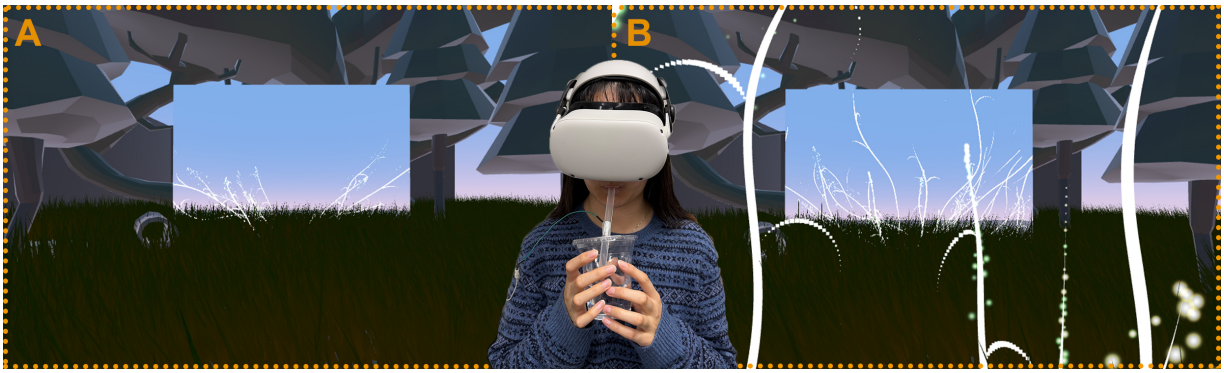

Figure 1: *PlantSelf* interaction. (A) The initial state where the user sees their plant avatar in a mirror within a calm VR environment. (B) After drinking water using the sensor-enabled straw, the virtual plant grows.

Abstract

Staying hydrated is essential, but maintaining water intake in daily life often lacks engaging feedback or personal motivation. We present *PlantSelf*, an interactive Virtual Reality (VR) system that encourages healthy hydration through playful embodiment. The system combines a capacitive-sensing straw, an ESP32-based wireless signal pipeline, and a mirror-based VR environment. Users see themselves in a virtual mirror as a "plant" that grows when they drink water. Real-time feedback links physical drinking action to virtual transformation, fostering intrinsic motivation. By merging sensing, self-representation, and metaphorical growth, *PlantSelf* aims to open new opportunities for turning hydration into an engaging, self-driven experience.

Index Terms: Virtual Reality, embodiment, hydration behavior, health HCI, virtual avatar.

1 Introduction

Drinking fluids, especially water, is a fundamental part of daily life, often repeated multiple times a day. Maintaining adequate hydration—approximately 3.7 liters per day for men and 2.7 liters for women—is essential for health and well-being [2]. In response, researchers have explored how human-computer interaction (HCI) can support healthy drinking habits [1, 11, 7]. One example is Wwall [11], a smart public water dispenser system built with Arduino, NFC sensors, and a projector, which tracks individual water intake and motivates office workers to stay hydrated by displaying a shared visual that only completes when everyone reaches their hydration goal. Another example is the Smart Interactive Water Bottle [7], which uses ultrasonic, pulse and DHT11 sensors to monitor water intake, heart rate, and environmental conditions, sending data to a mobile app for real-time feedback and hydration reminders, thereby encouraging healthy drinking habits through personalized prompts. While these systems creatively use sensing and feedback to encourage hydration, they rely primarily on external prompts. Intrinsically motivating approaches, such as those that are playful, embodied, or self-driven, remain underexplored. To address this, we propose *PlantSelf*, an interactive Virtual Reality (VR) system that reshapes drinking as play [6]. In our system, users enter a mirror-based immersive environment where they see themselves embodied as a "plant" rooted in soil. When they drink water through a custom-designed sensor straw, their "plant-self" visibly grows (from Figure 1A to Figure 1B).

We chose VR for its capacity to allow users to inhabit another body and experience scenarios from a first-person perspective. The illusion of ownership over a virtual body can be induced [8], potentially leading to changes in behavior. In particular, mirrors serve as powerful interfaces in VR by allowing users to see their own avatar, which can play a central role in avatar embodiment [3]. This includes facilitating the illusion of body ownership and strengthening identification with altered self-representations [9, 10]. In our project, the mirror also plays a crucial role by enabling users to visually align with their virtual plant-body, reinforcing a sense of "this is me". In addition, the metaphor of a plant may serve as an effective form of user embodiment, given its widely recognizable symbolic associations and its potential to evoke emotional projection across cultural contexts [5]. The biological dependency of plants on water is a universally understood principle, allowing hydration behaviors to be mapped intuitively onto the visual metaphor of growth or decay. Its abstraction could invite emotional projection [4], wherein users may experience empathy toward their deteriorat-

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ing plant-self, thus reinforcing the behavioral feedback loop.

By combining mirror-based VR embodiment, and playful metaphor, we aim to transform hydration into a playful activity and therefore promote self-motivated healthy drinking behavior.

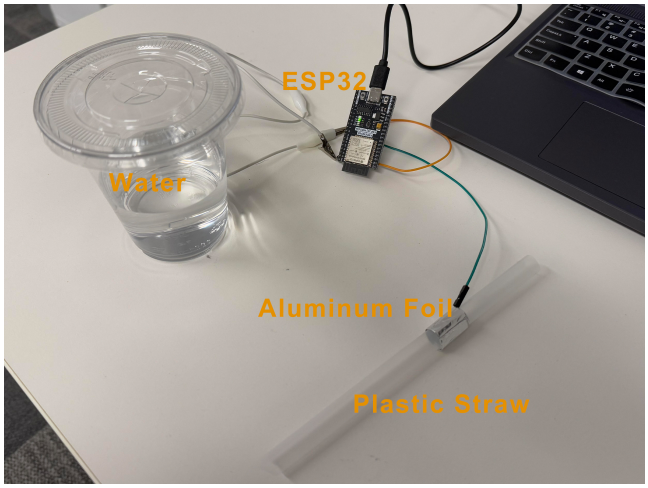

Figure 2: Hardware Design

2 Designing PlantSelf

The design of *PlantSelf* integrates two main components: a hardware-based sensing system (Figure 2) to detect drinking behavior, and an immersive VR environment to deliver real-time, embodied feedback. Together, these components form a closed loop that connects physical hydration with virtual growth. Below, we describe the hardware implementation and interactive system in detail.

2.1 Hardware Design

To detect drinking behavior, we designed a custom straw by wrapping aluminum foil around a conventional plastic straw. The aluminum foil functions as a capacitive touch sensor, capable of detecting changes in capacitance when water flows through the straw.

This sensor is connected to an ESP32 microcontroller via one of its capacitive touch pins. Upon detecting touch input (i.e., when the user drinks), the ESP32 transmits a signal via Wi-Fi using the WebSocket protocol to our Unity application running on a Meta Quest 2 VR headset.

The microcontroller is programmed using the Arduino IDE, enabling real-time sensing and communication. On the software side, the Unity application leverages the NativeWebSocket library to receive input signals and trigger appropriate visual feedback in the virtual environment.

2.2 Interactive VR System

The VR system, developed in Unity, presents the user with a mirror that reflects their virtual embodiment as a "plant" which is created by Visual Effects (VFX) rooted in soil. This mirror-based embodiment is designed to allow users to see themselves as plants, reinforcing identification through visual alignment.

Upon receiving a drinking signal from the hardware system, the plant avatar visibly grows— the "stem" extends upward and new "leaves" begin to sprout—providing immediate feedback. Conversely, prolonged periods without drinking cause the plant to gradually wither, visually conveying the consequences of "dehydration".

By integrating physical sensing with embodied interaction in VR, our system aims to build an empathetic connection between the user and their virtual self, encouraging proactive, self-motivated hydration behavior through play and identification.

3 Conclusion

Despite its strengths, this system also has limitations. First, it detects only the presence of drinking via capacitive touch, without measuring actual intake volume or frequency. Second, the system does not yet adapt to users' drinking patterns or hydration schedules, limiting its effectiveness in supporting long-term behavior change. In future work, we plan to integrate more fine-grained sensing to align plant growth with users' hydration rhythms. We also hope to expand the visual expressiveness of the plant embodiment—such as adding dynamic lighting, blooming states, or environmental cues—to create a richer feedback loop. Additionally, we envision incorporating physiological signals (e.g., dryness, fatigue) to strengthen the user–plant connection.

In conclusion, we hope PlantSelf offers a new perspective on how VR embodiment could support intrinsically motivated behavior change in everyday health contexts.

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