

l'boundary: Entangled Aesthetics of Plant Transpiration with Human Attention

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Abstract

l'boundary is an installation that intertwines public participation with the subtle transpiration processes of hydroponic plants. Comprising of a schlieren photography setup and a heat lamp responsive to human presence, the installation offers two interactive modes where either human proximity or online attention influences plant transpiration. Participants engage in a nuanced dialogue between humans, nature, and machines, interacting with the device to actively modulate the brightness of the heat lamp. Serving as a sensory bridge between the visible and invisible, l'boundary encourages visitors to immerse themselves in an experience where they can actively shape the environment while also observing how the device responds to online attention.

Keywords

Schlieren Imaging, Domesticated Plants, Hydroponics, Transpiration, Interactive Installation

Introduction

Understanding the living processes within other organisms is often elusive for humans, reflecting a broader lack of awareness of the interconnectedness of nature. This paper explores how new visual aesthetics can reveal the livingness of organisms, potentially fostering improved relations. Our focus is on the transpiration of plants, a crucial process (Fig 1.) regulating water movement within plant structures in response to temperature changes. While typically invisible, we employ a custom schlieren system to visualize water evaporation through plant leaves, connecting this transpiration process to the presence of physical visitors and general attention of people on the internet towards plants. This paper addresses the need for a deeper conceptual understanding of human-nature relationships, introducing an interactive art installation that prompts reflection on the interplay between visual aesthetics, interaction, and the role of human presence in ecological processes.



Figure 1. *Spathiphyllum* plant leaves undergoing transpiration as seen in the circular schlieren image (grayscale) in the background of the plant.

The installation has two modes:

1. In the first mode, the proximity of participants dynamically influences the intensity of a heat lamp positioned above the plant. As visitors approach (Fig 2b) the plant, the intensity of the lamp gradually increases, affecting the transpiration process of the plant, and vice versa.
2. In the second mode, the installation operates autonomously (Fig 2a), adjusting the lamp's intensity based on Google Trends data related to the keyword "Domestic Plants." (Fig 3.) In this scenario, visitors become passive observers, witnessing the impact of online attention on the leaves as a fusion of digital data and ecological sensitivity.

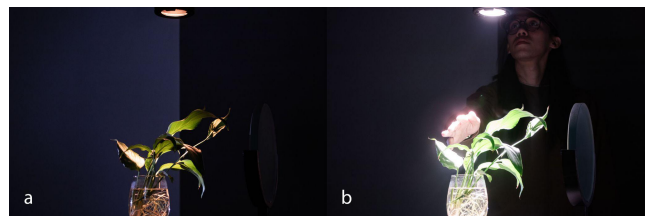


Figure 2. a) When no visitor is in front of the plant, the preset intensity of the lamp is seen as very weak. b) As a visitor approaches a plant, the intensity of the heat lamp increases gradually

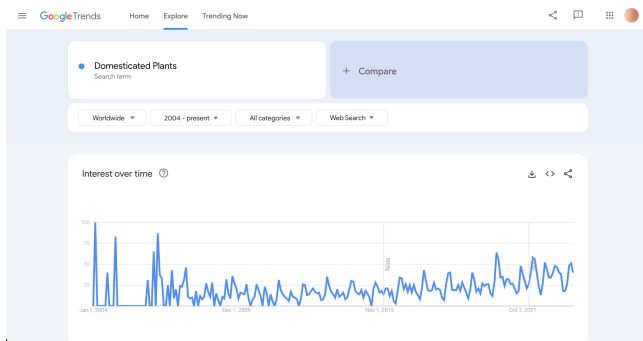


Figure 3. Screenshot showing interest over time to “Domestic Plants” keywords in Google web searches.

These interaction modes prompt individuals to reflect on the relationship between the visual aesthetics and the livingness of the organisms involved, offering a deeper understanding of the connection between visual allure and the subtle interaction between the observer and the living entities within the installation.

Concept

Building on the work of Haraway [3] and Escobar [4], our concept challenges the traditional division between humans and nature. Latour described nature as a modern parenthesis [5], a way of organizing the division. We advocate for the design of intra-actions [6], emphasizing the interconnectedness of all entities within an ecosystem. Drawing inspiration from Jane Bennett’s vibrant matter [7], we portray plants as narrative objects, revealing hidden material and digital boundaries.

Central to our concept is the dynamic interaction between humans, machines, and nature. The installation unfolds the complex blending where human engagement dynamically influences the transpiration process in plants, while also operating autonomously in response to online activities. Participants are invited to contemplate the interconnection between visual aesthetics, interaction, and the impact of human presence in the survival of living entities, offering a fresh perspective on the weaving of art, technology, and ecological processes.

System Implementation

The installation consists of an optical schlieren system that images the transpiration process of hydroponic plants and a heat lamp triggered by human presence and online activities. The Schlieren setup (Fig. 4.) comprises a concave parabolic mirror, a Canon T6s camera with an EF-S lens, a razor blade, and a coaxial LED light source.

The heat lamp is made sensitive to physical proximity of visitors. This setup comprises of Lowel Pro-Light controlled in intensity through a Chauvet D6 Dimmer Pack via Arduino Uno and a Time-of-Flight (ToF) sensor. In the visitor-free mode, where heat lamp intensity is controlled through online data, the Arduino board employs a WiFi connection to obtain data via Google Trends API and tune

the initial intensity of the lamp. Visitors can see real-time schlieren output on a projector in the same room (Fig 5.).



Figure 4. Camera lens, razor, and LED light position settings, for a schlieren setup to visualize refractive index changes of transpiration vapor coming out from plant leaf-tips



Figure 5. Hydroponic plant, parabolic mirror, and camera setup in physical space. Projections in the room help in seeing the visitor's interaction with a plant, mediated through a light.

At a room temperature of 23°C, the surface temperature of the leaves is often around between 22-24°C (due to the leaf cooling effect). When a visitor is close to the installation and the lamp’s intensity is the highest, the surface temperature of the leaf increases to 28-30°C. (Fig 6.) This temperature difference triggers high transpiration activity that is captured through our schlieren setup.

Spathiphyllum (Peace Lily) is chosen as the observation subject due to its common usage as a house plant. The ample leaf area allows for a clearer observation of water vapor. The installation offers two experiential modes: engaging with physical visitors and entanglement with the digital world through Google Trends data.

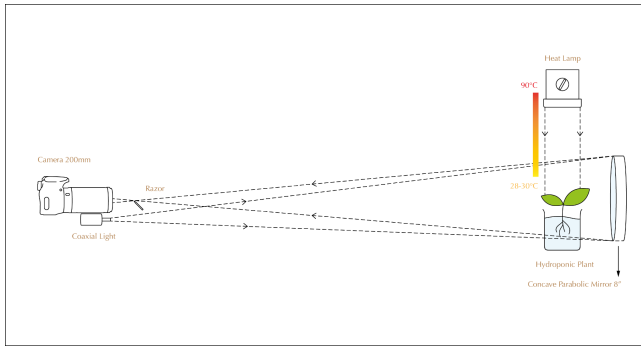


Figure 6. Illustrating showing the schlieren setup and temperature variation in the leaf to the distance of light.

Experience Walkthrough

The installation offers two experiential modes:

i. Engaging with Physical Visitors: Visitors are initially captivated by the visual aesthetics, drawing them toward the plant. As they approach, they realize that the brightness of the light (within predefined limits) responds to their physical presence (Fig 7.). Observing the transpiration process, they are intrigued by the revelation of something formerly unseen. Departing from the space becomes a dilemma for them, metaphorically likening the installation to a “candy house.”

ii. Digital Influence and Virtual Dialog: In today’s society, the impact of the virtual world extends beyond direct physical engagement. Google Trends, in our context, materializes our collective focus on houseplants by influencing the initial brightness of the heat lamp. During moments of inactivity and when no one is physically interacting with the installation, we seize the opportunity to document the plant’s transformations influenced by online attention.

Our commitment to nature transcends the boundaries of both the physical and digital realms, playing a crucial role in sustaining plant life. In our test showcase of the installation (n=3), people who encountered our design shared their surprise at the visually striking aesthetic from a distance, which, however, transforms into a nuanced and sometimes conflicting interaction when engaged with up close. This inherent contradiction is precisely the concept we strive to emphasize — a delicate interplay where beauty and melancholy coexist within our artwork. In the future, we intend to make this work immersive in a larger space, where multiple people and audiences may be able to experience it together (Fig 8.)

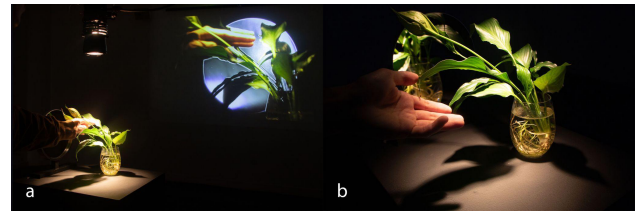


Figure 7. a) Schlieren system capturing evaporation on the leaf surface and heat radiating from human hands. b) Close-up view of a hand approaching plant leaves

Conclusion

The boundary is an exploration merging schlieren techniques with domesticated plants, creating a space where human awareness intertwines with the often unseen transpiration processes. The interaction modes in this installation offer a multifaceted exploration of the dynamics between humans, nature, and machines. Our implementation bridges physical and digital experiences, creating an immersive encounter that uncovers moments of beauty and conflict. This work serves as a bridge between the tangible and intangible, inviting participants to navigate the delicate visual allure, human interaction, and ecological interconnectedness.

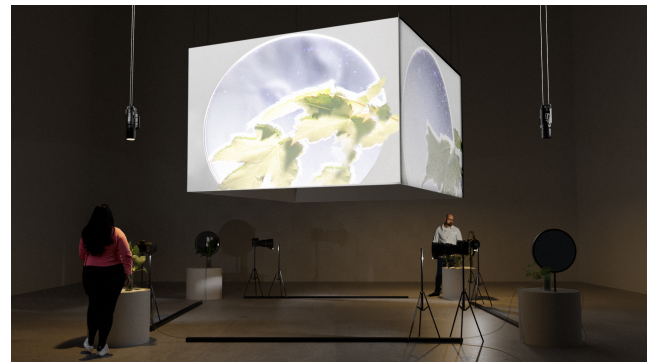


Figure 8. Rendering for a larger scale, where we imagine an immersive scenario with multiple people to engage.

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