Experiencing Sensorium Arc: An AI-Agentic Eco-Artwork for Interactive Ocean Data Exploration

Noah Bissell
Immersive Media Design
University of Maryland College Park
College Park, MD 20742
nbissell@terpmail.umd.edu

Ethan Paley
Immersive Media Design
University of Maryland College Park
College Park, MD 20742
edpaley@terpmail.umd.edu

Joshua Harrison
Center for the Study of the Force Majeure
University of California, Santa Cruz
Santa Cruz, CA 95064
harrisonstudio@gmail.com

Juliano Calil
Virtual Planet Technologies
Santa Cruz, CA 95060
julianocalil@gmail.com

Myungin Lee
Immersive Media Design
University of Maryland College Park
College Park, MD 20742
myungin@umd.edu

1 Description of the work and the roles of AI and ML

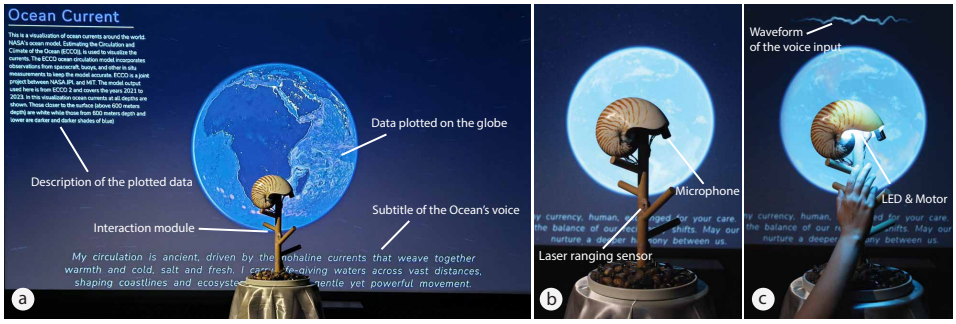

Figure 1: a) Exemplary setup for the Sensorium Arc exhibition b) User interface before activation showing the sensors c) Activated user interface showing the response from the system. Users are able to engage in natural interaction, as if whispering into a seashell.

Sensorium Arc is an immersive eco-art installation that blends art, science, and engineering to transform oceanic data into a participatory, dialogic experience. Through an embodied interface inspired by the Nautilus shell, visitors lean close and speak as if addressing the Ocean (Fig. 1). This gesture activates an AI-mediated exchange in which the Ocean replies with language grounded in scientific data, ecological philosophy, and poetic nuance. Surrounding visual layers respond in real time, rendering patterns in chlorophyll blooms, hyperspectral water clarity, CO_2, and ocean currents as dynamic, interactive data visualizations.

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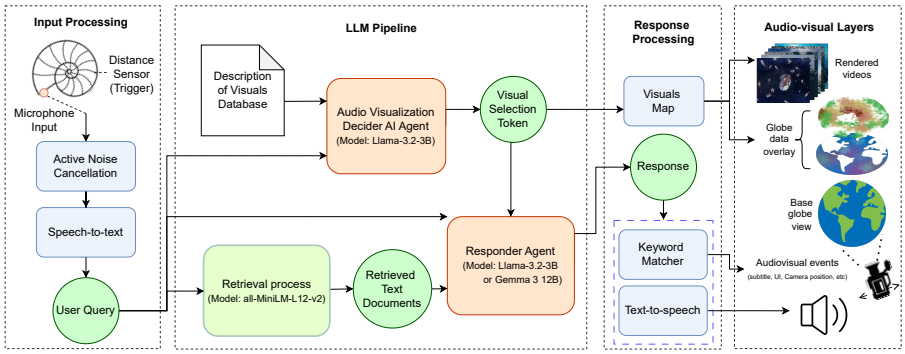

Figure 2: Overall diagram of the Sensorium Arc system

At the core of this system (Fig. 2) is a multi-agent AI architecture that orchestrates the translation of human inquiry into synchronized narrative and visual form. Early trials with monolithic LLM showed that combining retrieval, control, and persona generation in one model led to prompt interference, unstable outputs, and reduced interpretability. Separating functions into specialized agents creates clear role boundaries and ensures that each stage—dataset selection, document retrieval, and narrative generation—can be optimized independently. This structure allows the system to match model size and complexity to the demands of each task, improving efficiency and reducing contention with Unity's real-time rendering. The modular design also makes the installation inherently extensible; new datasets and visualization layers can be added without modifying the overall pipeline, and these resources can be immediately incorporated into the RAG corpus for narrative grounding. In an exhibition setting, this separation further enhances robustness and safety, as control over visual activation remains isolated from the narrative generation process.

• **Visualization Decider Agent:** This agent interprets the participant's spoken input after it has been transcribed and semantically parsed. It uses few-shot reasoning and grammar-constrained outputs to determine which datasets are most relevant to the query. Drawing from preprocessed NASA Earthdata resources, it selects and activates datasets such as hyperspectral diffuse attenuation coefficient (Kd) layers, sea surface temperature fields, CO2, wind flow models, or chlorophyll concentration maps. The system is modularized, allowing new datasets—whether environmental indicators, simulation outputs, or artistic visual layers—to be added without altering the core architecture. Once integrated, these datasets can also be linked to the retrieval-augmented generation (RAG) pipeline, ensuring that the Ocean's narrative can reference and interpret them alongside existing scientific and cultural sources. Upon selection, the agent issues control tokens to Unity, triggering globe overlays, camera transitions, and environmental effects in real time.

• **Retrieval Agent (RAG):** This agent reformulates the participant's question using the Qwen 8B model with chain-of-thought prompting, ensuring that colloquial or metaphorical phrasing aligns with the domain-specific corpus. The revised query is then embedded using the all-MiniLM-L12-v2 model and matched against a curated database of marine science publications, ecological manifestos, and transcripts of environmental art projects. Through this process, the system retrieves text passages that balance scientific accuracy with eco-aesthetic perspectives, grounding the Ocean's voice in both data and cultural context.

• **Responder Agent:** This agent integrates the selected datasets and retrieved text segments with affective cues extracted from the participant's voice, such as tone and pacing, to maintain a coherent and emotionally resonant Ocean persona. Using large language models such as LLaMA 3.2 3B or Gemma 3 12B, it generates responses that merge factual content with poetic narrative. These outputs are then synchronized with other system components, enabling text-to-speech audio, subtitles, and coordinated visual transitions to create a unified multimodal experience.

Supporting these agents are machine learning components for speech recognition, semantic parsing, vector similarity search, and AI-controlled audiovisual orchestration. Together, they enable Sensorium Arc to operate as both a scientific interface for oceanic data exploration and a performative artwork, inviting audiences into an embodied, sensory dialogue with the Ocean in which machine intelligence serves not just as mediator, but as creative collaborator.

2 Theme: Humanity

Sensorium Arc explores a mode of human–machine collaboration in which each party operates from its unique strengths: human participants bring curiosity, empathy, and culturally embedded modes of storytelling, while the AI contributes rapid access to vast scientific archives, multimodal synthesis, and the capacity to sustain a responsive ecological persona. By personifying the ocean through a conversational AI grounded in marine science and eco-aesthetics, the system transforms environmental data from an abstract resource into a co-authored narrative. This co-authorship challenges traditional notions of authorship and agency, inviting reflection on how meaning is negotiated when non-human systems participate as narrators and interpreters.

In this framework, human craft is not replaced but reframed. The artist's role becomes one of designing interaction rituals, such as leaning in to whisper into a nautilus shell, that choreograph the exchange between human voice, machine processing, and oceanic data. These rituals offer new forms of environmental engagement, blending scientific accuracy with symbolic resonance, and foreground the ethical question of what values we encode into AI systems that speak on behalf of the more-than-human world. Through this interplay, Sensorium Arc invites audiences to reconsider sustainability not solely as an energy metric but as a cultural practice, where technological mediation strengthens, rather than erodes, our collective ecological imagination.

3 Biography

Noah Bissell is a programmer and aspiring technical artist, currently pursuing a B.S. in Immersive Media Design (IMD) and Computer Science at the University of Maryland. His work as a student of the IMD program, exploring areas from data visualization to gestural interfaces, have been showcased at campus events and the Kennedy Center.

Ethan Paley is an undergraduate student pursuing dual Bachelor of Science degrees in Computer Science and Immersive Media Design at the University of Maryland. Their academic interests include interactive entertainment development, sustainability, and the intersection between art and technology.

Joshua Harrison is a researcher, artist, and director creating large-scale immersive installations that bridge art, science, and climate action. He directs the Center for the Study of the Force Majeure at UC Santa Cruz and leads Sensorium for the World Ocean, a multi-sensory installation addressing ocean collapse. His interdisciplinary work spans interactive media, environmental systems, and regenerative policy, with projects featured at Getty's PST: Art & Science Collide, the AlloSphere, Bioneers, and international festivals. Harrison co-founded the green infrastructure company Leaf Island and the forest restoration initiative Living Forests, and has collaborated widely with tribal nations, federal agencies, and research teams to turn complex environmental data into experiences that inspire community engagement and systemic change. - Prior works: https://www.centerforforcemajeure.org

Juliano Calil is a climate scientist and entrepreneur specializing in immersive VR for climate adaptation and coastal management. He holds a Ph.D. in Ocean Sciences from UC Santa Cruz and is Founder and Chief Scientist of Virtual Planet Technologies, developing VR tools for climate outreach and community engagement. Calil serves as Adjunct Professor at the Middlebury Institute of International Studies and Senior Research Fellow at the Center for the Blue Economy, and is a Science Advisory Team member for Sensorium for the World Ocean. His work spans sea level rise visualization, climate vulnerability assessment, and nature-based coastal defense, with projects featured in leading journals and implemented in communities from California to Florida and beyond. - Prior works: https://www.virtualplanet.tech

Myungin Lee is a researcher, artist, and educator with a Ph.D. in Media Arts and Technology from the University of California, Santa Barbara, and is currently a faculty member in Immersive Media Design at the University of Maryland, College Park. He creates multimodal XR experiences at the intersection of HCI, signal processing, and machine learning. His recent projects include Wave: From Space to Ocean, developed with NASA and presented at the Kennedy Center, which transforms satellite data into interactive visualizations of ocean health, and Sensorium: The Voice of the World Ocean, an art–science project addressing ocean survival through immersive engagement. These works exemplify his interdisciplinary approach, using AI-driven data visualization and embodied interaction to translate complex oceanographic data into experiential narratives that connect scientific insight with artistic expression. - Prior works: https://www.myunginlee.com/projects