

Main Documentation

Handcrafted Oceanic States:

A Real-Time Interactive Audiovisual System for Embodied Oceanic Listening

1. Project Overview and Aims

Handcrafted Oceanic States is a real-time interactive audiovisual system designed for users interested in exploring sound, image, and oceanic environments through embodied interaction.

Drawing on the idea of “the Open Work”, which invites audiences to engage through “active interpretation” and “co-creation”,¹ the project allows users to enter and affect a sonic and visual oceanic environment alongside a fixed-media electroacoustic work, which functions both as an atmospheric background and as an active partner in shaping the interaction.

The fixed-media work moves through four oceanic states – mystery, beauty, destruction, and recovery. Using a hand tracking system, the project turns ocean environmental listening into an embodied participatory experience, encouraging reflection on the consequences of human intervention in ocean environments.

2. Background and Framework

The emphasis on openness and participation places this work within a broader history of participatory sound practices. Early works such as Max Neuhaus’s *Public Supply I*²

¹ Umberto Eco, “The Poetics of the Open Work” (1959), 173, as quoted in Guy Harries, “‘The Open Work’: Ecologies of Participation’, *Organised Sound*, 18 (2013), 1: 3–13; here, 3.

² Max Neuhaus, *Public Supply I* (radio and telephone network sound work, 1966), Max Neuhaus Estate, <https://www.max-neuhaus.estate/en/sound-works/vectors/networks/public-supply-i-wbai-new-york-1966> (accessed 27 April 2026).

in 1966 and José Maceda's *Ugnayan*³ in 1974 used broadcast media to involve ordinary listeners in shared public sound environments. More recent participatory works such as Thomas Studley's *SwimTunes*⁴, developed more direct forms of audience and technological participation. These examples emphasise a relatively open interaction, giving participants greater agency to explore and shape the work.

By contrast, *Handcrafted Oceanic States* adopts a more guided form of participation. Users interact through hand gestures to shape sounds and visuals, but their interaction takes place within a designed oceanic framework. This allows users' agency to remain active while their interaction still follows the composer's narrative trajectory.⁵ This also resonates with George E. Lewis's view that power and influence are dynamically allocated and shared with the audience.⁶

3. System Design and Rationale

3.1 Overall System Architecture

Based on the background discussed above, this project uses Leap Motion as the gestural interface because it allows participants to interact through open bodily movement.⁷ Max/MSP (version 9.1.4) functions as the central audio and control environment, using its modular data-flow structure to process sensor data and map it to sonic parameters in real time.⁸ TouchDesigner (version 2025.32820) generates the visual system and communicates with Max through OSC.⁹ The fixed-media electroacoustic work constructs a composed space and a directed listening

³ José Maceda, *Ugnayan: Music for Twenty Radio Stations* (radio-broadcast electroacoustic work, 1974), Western Front, <https://westernfront.ca/events/ugnayan> (accessed 27 April 2026).

⁴ Thomas Studley, "SwimTunes: A Gamified Music Performance System for Co-Creating with a Novice Audience", in *Proceedings of the International Conference on New Interfaces for Musical Expression* (Canberra: NIME, 2025), 415–421.

⁵ Harries, "The Open Work": Ecologies of Participation"; here, 3–7.

⁶ George E. Lewis, "Interactivity and Improvisation", in Roger T. Dean (ed.), *The Oxford Handbook of Computer Music* (Oxford: Oxford University Press, 2012), 457–466; here, 462.

⁷ Abhishek Nandy, *Leap Motion for Developers* (New York: Apress, 2016), 1–7.

⁸ Patrik Lechner, *Multimedia Programming Using Max/MSP and TouchDesigner* (Birmingham: Packt Publishing, 2014), 7–12.

⁹ *Ibid.*, 233–34, 302–03.

environment,¹⁰ while also controlling additional changes in interactive sound and visuals beyond those shaped by users' gestures in real time.

As Figure 1 shows, Leap Motion data is first received and scaled in Max, where it controls the real-time audio layer and is also transmitted to TouchDesigner to shape the visual environment. Meanwhile, the fixed-media work allows these interactive processes to unfold within a pre-composed oceanic trajectory.

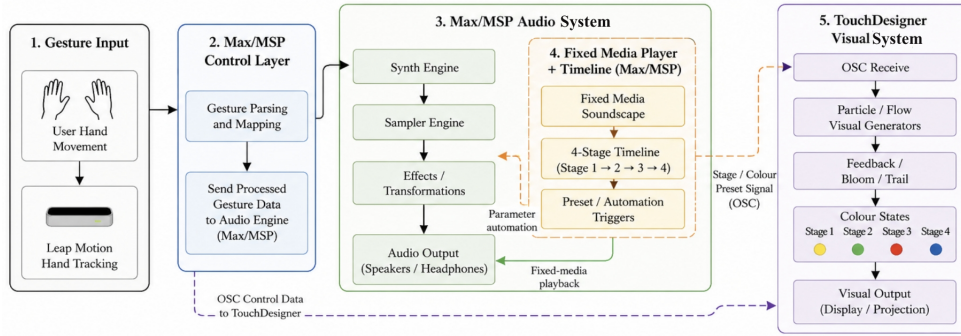


Figure 1. Schematic of *Handcrafted Oceanic States*.

3.2 Gestural Interface and Data Parsing

As Figure 2 demonstrates, the interface is based on a Leap Motion controller placed on the table in front of the user. The physical coordinate system is defined from the user's embodied perspective: x increases to the right, y increases upward, and z increases forward. In Max/MSP, the object *ultraleap @unit m* receives the tracking stream and separates left- and right-hand data.¹¹

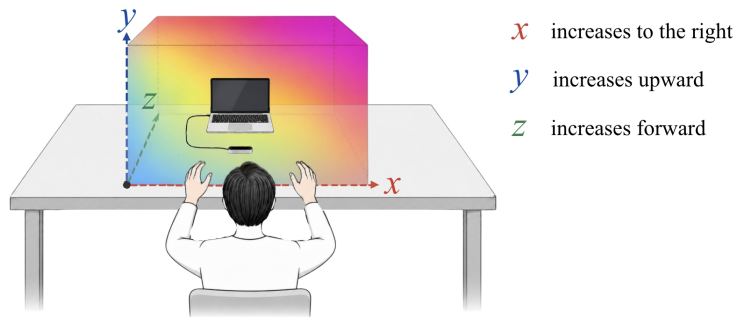


Figure 2. Embodied Leap Motion coordinate space used for the interaction design.

¹⁰ Denis Smalley, "Space-form and the Acousmatic Image", *Organised Sound*, 12 (2007), 1: 35–58.

¹¹ Cycling '74, "Ultraleap Max Package", *Cycling '74 Packages*, <https://cycling74.com/packages/ultraleap> (accessed 1 May 2026).

Figure 3 shows how the patch extracts hand position, pinch, grab, velocity, hand appearance, and device frame rate. The hand-position lists are divided into $x/y/z$ values, rounded and scaled into musically useful ranges. The normalised streams are then distributed as L_X , L_Y , L_Z , R_X , R_Y , and R_Z . At the same time, OSC messages are sent to TouchDesigner through separate ports for left-hand position, right-hand position, pinch, grab, preset changes, and playback states.¹² This keeps the audio and visual systems independent while maintaining a shared gestural control layer.

Figure 3. Max/MSP data parsing and OSC routing modules.

The fixed-media electroacoustic work was created by the composer. It presents the ocean's changing states, moving from mystery and beauty to destruction and recovery and functions as both the project's background music and formal timeline. It establishes the oceanic atmosphere while shaping the real-time interactive audio and visuals. As Figure 4 illustrates, a Max playback module based on *sfplay~* opens the

The Sampler system uses a *polybuffer~* to store forty-two audio files recorded by the composer at the seaside. A randomised selection mechanism selects and plays these sounds. Right-hand pinch triggers sample selection and playback, and hand position controls frequency, low-pass filtering, and random panning. In addition, Max *mc.* objects allow the system to create dense, distributed textures,¹⁴ while automatic effects processing creates distinct timbral characters across the fixed-media stages.

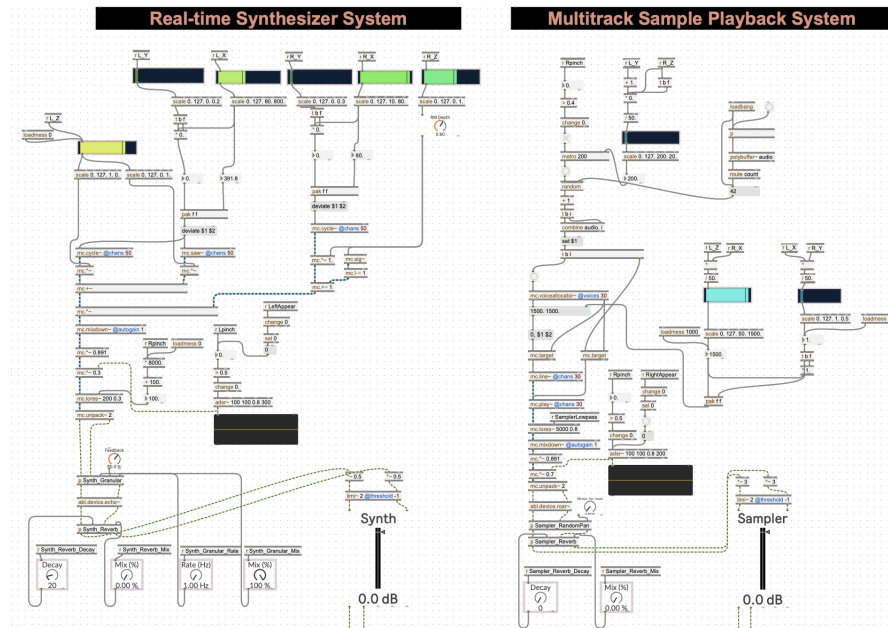


Figure 5. Synth and Sampler modules in Max.

This audio system ensures that the sound is shaped over time through both the fixed-media timeline and the user’s gestures. It reflects Ge Wang’s argument that “there is an aesthetic to interaction”, where the physical act of control is not merely functional but becomes part of the musical experience itself.¹⁵

3.5 TouchDesigner Visual System

TouchDesigner receives the preprocessed OSC streams from Max and converts them into visual control channels via the OSC In *CHOP*. Left and right *x/y/z* positions are

¹⁴ Cycling ’74, “MC”, *Max 8 Documentation*, https://docs.cycling74.com/legacy/max8/vignettes/mc_topic (accessed 1 May 2026).

¹⁵ Ge Wang, *Artful Design: Technology in Search of the Sublime* (Stanford: Stanford University Press, 2018), 208.

separated, passed through *Math CHOPs*, and exported as stable values such as L_X , L_Y , L_Z , R_X , R_Y , and R_Z .¹⁶ These values control particle position, displacement, density, colour behaviour, and visual turbulence. Figure 6 demonstrates this process.

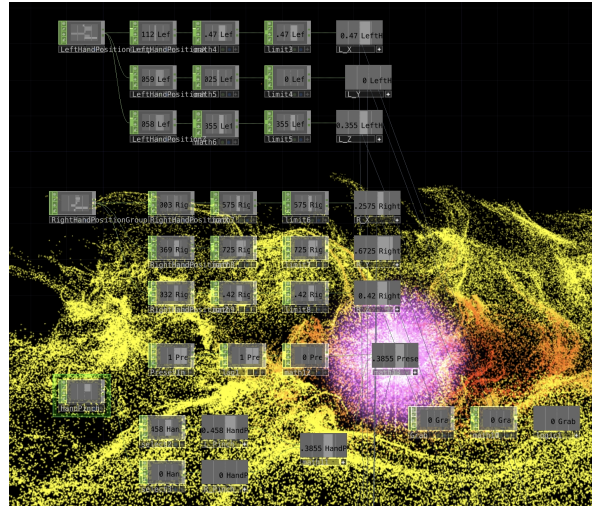


Figure 6. TouchDesigner OSC input channels and position normalisation modules.

Figure 7 shows the main visual processing field, where a particle-based ocean forms the background environment. Like the audio system, the visuals respond to pinch gestures and hand positions, while also changing colour and particle state across the four fixed-media stages. When both hands pinch, rolling spheres appear according to the hands' two-dimensional positions, enhancing the connection between the user and the oceanic environment.

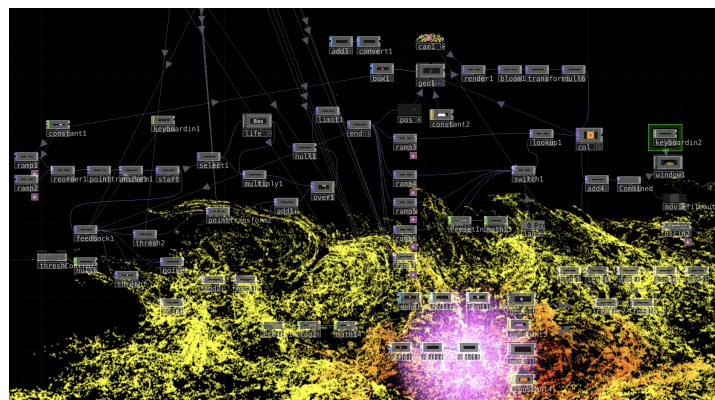


Figure 7. TouchDesigner visual processing field.

¹⁶ Derivative, “Math CHOP”, *TouchDesigner Documentation*, https://docs.derivative.ca/Math_CHOP (accessed 1 May 2026).

Technically, hand-position data from Max is received through OSC and mapped to particle displacement, density, turbulence, and the position of the rolling spheres. *Feedback TOP* creates trailing textures and a sense of fluid memory by reintroducing previous frames into the visual chain,¹⁷ while particle system logic produces the wave-like ocean surface. *Lookup TOP*-based ramps remap colour gradients so that the same particle system can shift between ecological states.¹⁸ In addition, Max sends */Preset*, */play_start*, */continue*, */stop*, and */reset* messages to keep the TouchDesigner visual system synchronised with the fixed-media structure, making the work repeatable while still allowing users' gestures to create different visual outcomes.

4. Conclusion and Future Work

Rather than treating interaction as unlimited freedom, the main distinctive feature of *Handcrafted Oceanic States* lies in its use of gesture to connect users physically with an oceanic environment, while positioning the fixed-media electroacoustic composition not merely as background music, but more importantly as an active partner that shapes the interaction alongside the users' gestures. In this way, the work creates an embodied participatory experience through which users can reflect on the fragility of ocean environments and the consequences of human intervention.

Future development of this project could refine the gesture mapping through user testing with more non-specialist participants, helping to clarify whether the relationship between hand movement, sound, and image is understandable. The work could also be expanded into a multichannel performance system, making the oceanic space more immersive and spatially dynamic. In the visual system, the four ecological states could be further differentiated through more distinct particle behaviours, colour palettes, and feedback intensities.

¹⁷ Derivative, "Feedback TOP", TouchDesigner Documentation, https://docs.derivative.ca/Feedback_TOP (accessed 1 May 2026).

¹⁸ Derivative, "Lookup TOP", TouchDesigner Documentation, https://docs.derivative.ca/Lookup_TOP (accessed 1 May 2026).

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