Asking Water with Stones: Designing Playful Dialogues with Water System to Build Connection between Human and Water Ecosystems

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Figure 1: Water's Echo User Demonstration, a: A player throw a stone into the water; b: A player begins a conversation with the system.

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Abstract

The more-than-human field has contributed numerous opportunities for interacting with nature, animals, plants, and microorganisms. However, few studies have examined water ecosystems. Current water-related work primarily treats water as a medium for human-centered activities, rarely positioning water as an interactive subject. Building upon prior research, we explore how to better integrate water more playfully into digital-physical interactions as

an interactive subject. We designed and developed *Water's Echo*, an AI-powered public installation that enables human-water communication through a playful stone-throwing dialogue. We conducted a field study at a local pond, recruiting 15 residents to participate in *Water's Echo*—a playful conversational interaction. Our findings indicate that this playful dialogue approach raises participants' awareness and understanding of surrounding aquatic environments. This research provides insights for design researchers to establish engaging water ecology interactions across cultural communities, promoting a More-than-human perspective in re-examining human-nature relationships.

CCS Concepts

• **Human-centered computing → Natural language interfaces**; **Contextual design**; *Interface design prototyping*; Empirical studies in HCI; Sound-based input / output.

Keywords

More-than-human design, WaterHCI, Human-nature interaction, Embodied interaction, Large Language Model (LLM), Conversational agent, Sustainability, Playful interaction, Ecological awareness

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1 Introduction

More-than-human [43, 55] is a perspective that allows humans to think and rethink our own identities and human-nature relationships [18]. For example, prior research has explored incorporating non-human (e.g., microorganisms, mycelium, and plants) as integral parts of interactive systems, investigating how humans coexist with these non-human species [12, 19] and how such interactions may influence human awareness of nonhuman life and ecological co-construction [8]. The water system, as a crucial non-human object, its interaction is still underexplored. As the foundation of all human material activities and a key collaborator in the operation of human society, a better understanding of the water ecosystems would benefit environmental sustainability [38]. Hence, we aim to explore how to better integrate water—this natural element—into everyday social interactions, fostering human-nature interactions, thereby enhancing our understanding of the water environments that surround our daily lives.

Research on water-related interactions primarily concentrates on the WaterHCI field [21, 42, 44]. These interaction approaches mainly focus on providing convenience and services for humans, predominantly divided into human-centered applications that provide public services [1, 53], or installation-based research utilizing water as an interactive medium for artistic performances [10]. Which includes human-centered aquatic recreational interaction facilities [27], aquatic artistic performances [16, 30, 36], underwater operations [27], and interactive underwater games [42]. However, these works have not focused on aquatic ecosystems or positioned water as the primary subject of interaction. Apart from this, a small number of studies [32, 35, 40, 47] have begun to address water environment monitoring and visualization interactions[47, 49], as well as water pollution detection [14]. These studies try to observe the dynamic changes of hydrological ecosystems, but fail to establish the connection between people and water. Building upon this research foundation, we aim to further strengthen the deep resonance and lasting connections that local residents have with their surrounding aquatic ecosystems. Through continuous and engaging interactions, we hope to enable people to not only enjoy the playful pleasure of interacting with water, but also gain a deeper understanding of the more-than-human aquatic environment—including ecology, pollution, history, and other data that deserve to be seen.

To design engaging interaction system with water and investigate their impact on residents living near aquatic environments, we selected a local park pond in Finland as our research site. This study aims to enhance local residents' awareness and understanding of the surrounding aquatic ecosystem through playful interactive approaches, thereby fostering a harmonious relationship between humans and nature. Our research include:

- System Design: We designed and developed an interactive prototype system named *Water's Echo*, firstly, it has conversational AI with data fusion capabilities. *Water's Echo* integrates multi-source data, including real-time water quality monitoring data from websites, on-site collected pollution parameters, and historical environmental data of the pond. This creates an AI chatbot embodying water as the conversational agent. Through dialogue with the chatbot, residents can comprehensively learn about the pond's "life story" and related ecological information. Secondly, it has embodied interaction design, to enhance engagement and participation, the system moves beyond traditional text-based dialogue by implementing a physical interaction method—"throwing stones into water." The conversation is triggered when a stone enters the water, allowing users to engage in dialogue while facing the pond, creating a more natural and immersive interactive experience.
- User Study: To explore the impact and potential challenges of this water-centric conversational interaction system, on nearby residents and the ecological environment, we conducted a 3-day field user study. Using random recruitment, we invited 15 local residents living near the pond (valid participants) to experience the system by throwing stones into the water to initiate dialogue with "the water". Throughout the study, we recorded complete conversation logs between users and *Water's Echo*, and conducted semi-structured interviews after each experience session to gather in-depth user feedback and experiential insights.

Our experimental results demonstrate that 1) Interaction System Preferences: Compared to traditional text-based conversational interfaces, the embodied interaction approach mediated by stone-throwing garnered strong user preference and willingness to participate. This play interaction model, which combines physical action with digital dialogue, significantly enhanced user engagement and

experience. 2) Cognitive Transformation: The majority of participants experienced notable cognitive shifts regarding the pond's aquatic environment after dialoguing with *Water's Echo*. Users no longer perceived the pond as a static landscape element, but instead developed a more multidimensional, dynamic, and vivid understanding of its ecosystem. This study proposes a novel human-nature interaction paradigm that transcends traditional environmental education media (such as textual descriptions, infographics, and static museum displays). 3) Educational and Sustainability Implications: Through the design strategy of playful dialogue, the system achieves engagement through enjoyable interaction while simultaneously deepening users' understanding of the pond's aquatic environmental conditions during conversation, demonstrating long-term educational and sustainability significance. Our research provides a reference for future design researchers to establish engaging water ecology interaction modalities across different cultural communities, promoting a re-examination of human-nature relationships through a non-anthropocentric lens.

2 Related Work

2.1 WaterHCI

Water has long been explored as a material and medium for HCI, owing to its unique physical and sensory properties such as fluidity, reflectivity, and tactility [45]. Some research focuses on the interaction of water sports or underwater games, for example, interactive activities and entertainment devices in water include smart paddleboards and other auxiliary tools [29], underwater AR exploration toy interactive games [42], etc. Some research has investigated how water can act as an expressive interface for artistic and experiential interaction [54]. Early examples such as the Hydraulophone [31] allowed users to create musical sounds through direct contact with flowing water, while installations like aquaTop display [23, 44] and liquid display [6, 21] leveraged water surfaces for visual or gestural interaction. These studies demonstrate water's potential as both a performative and communicative medium, capable of supporting embodied and sensory-rich experiences.

Beyond these studies, water has also been used as an interface for environmental communication and education. Environment visualization projects have employed water to represent dynamic data about ecological change, such as river levels, rainfall, and pollution [9, 14, 39]. Other studies have explored underwater operations and data collection tools for scientific or recreational purposes [49], including smart paddleboards for training and fitness [29], These approaches demonstrate the versatility of water in HCI, as both a natural sensor system and a data-driven interface for monitoring environmental conditions.

However, despite these advances, most existing WaterHCI projects remain grounded in a human-centered design paradigm. Water is often treated as a manipulable material or a visual metaphor, serving human experience rather than expressing its own agency. Such designs tend to mirror human behaviors and social activities, using water as a tool for play, visualization, or education rather than acknowledging it as a living system or ecological collaborator. This anthropocentric framing limits opportunities to explore more-than-human perspectives, where water itself can be seen as a participant in the interaction. To move beyond these limitations, our research aims to ensure the fun of human interaction and play, while using the aquatic environment as the main object of interaction. In the process of interaction and communication, we strive to achieve a deeper engagement and understanding with the aquatic environment.

2.2 AI and the Construction of Non-Human Emotions

Recent research has explored how AI can enable affective communication for non-human entities. In affective computing, AI-driven emotion models have been applied to robots, virtual agents, and artificial life systems to simulate emotional states [3, 7]. Interactive art installations have also used AI to interpret environmental data—such as temperature or soil moisture—and translate it into affective expressions, allowing audiences to "feel" the emotions of plants or landscapes [11]. Advances in generative AI and multimodal learning have further expanded this field, with neural networks trained to map oceanic waveforms or bioacoustic data to musical or visual forms [47], and weather-driven generative art projects [46] interpreting natural fluctuations as emotional states. In these works, AI serves as a mediator bridging human perception and non-human systems, transforming data into narrative and matter into feeling.

In our research, we collect extensive water environment data to establish the persona of the water AI chatbot, drawing on previous work in affective computing [56]. When users chat with *Water's Echo*, they can sense its distinct character shaped by this data, allowing them to immerse themselves in understanding the local ecology and the impact of human behavior on water systems.

3 Water's Echo: System Design

Water's Echo is an AI-powered public installation enabling dialogue with aquatic environments. Players throw stones into water to trigger conversations. Once initiated, players can continue throwing stones for multiple dialogue exchanges, with each water-impact sound triggering a new conversational turn. During dialogue, *Water's Echo* utilizes collected environmental data to express information about the water's history, background, current weather conditions, and nutrient pollution levels. The Lake persona in "Water's Echo" was developed using a data-driven methodology, instead of participatory co-design or fictional character authoring. We leveraged Ali Bailian large language models (LLMs) to map locally situated environmental data, such as nutrient load, pollution indicators, air and water temperature, algae presence, groundwater status, and historical pond information, into constrained prompt structures. These constraints were instrumental in shaping the lake's first-person responses, regulating its tone, emotional tendencies, and narrative perspective. To further regulate the linguistic style and affective orientation, we used MBTI-inspired personality dimensions [17, 50] as design shorthand (rather than as literal psychological models). This approach allowed the lake to express complex ecological conditions through emotionally grounded, metaphorical language while remaining strictly anchored in real environmental data, detailed in the Appendix B.3. The resulting persona offers users an intimate understanding of the aquatic world from a first-person

perspective and highlights the challenges it faces. The collected environmental data and the player interact with water demonstration detailed in the Appendix B.2, B.3.

Before interacting with Water's Echo, participants were exposed to a publicly displayed poster introducing the installation. The poster explained that the system represented the local lake speaking in the first person and that throwing a stone into the water would initiate or continue a conversation. It also presented example phrases as illustrative prompts (e.g., asking the lake about its name or mood), framing the interaction as an open-ended dialogue rather than a task-oriented activity. No additional verbal instructions, scripts, or step-by-step guidance were provided by the researchers. Participants were informed through the poster that there were no correct or incorrect ways to interact and that they were free to speak naturally and ask any questions they wished. By using a shared, static poster as the sole form of priming, we aimed to standardize the introduction across participants while minimizing direct researcher intervention. This approach was intended to reduce experimenter influence and allow interaction patterns and interpretations to emerge organically during the dialogue.

User Interaction Flow: 1) Players pick up stones placed around the installation and throw them into water, where underwater contact microphone sensors detect the impact; 2) Upon receiving the signals, *Water's Echo* responds with greetings and ice-breaking prompts to engage participants. 3) Participants can throw additional stones to initiate new conversational threads or continue the ongoing dialogue with *Water's Echo*.

System Compliment: 1) Arduino underwater microphone sensor - detects and identifies stone-impact sounds; 2) Arduino underwater chemical sensors - monitors sulfide and heavy metal pollution in real-time; 3) The AI workflow B.1 software primarily operates by obtaining data on exceeded nutrient levels in local water quality for the current day from a Finnish water quality monitoring website, along with historical information on the local water environment, its origins, major transformation events, and weather data.

Previous research suggests that constructing an MBTI personality can increase communication interaction and establish a sense of agency [17, 50]. Therefore, we used prompt keywords applied to the water data to generate a corresponding personality description. The mapping logic draws extensively on prior research (see Appendix B.2), and ultimately generates the corresponding MBTI personality type from these personality descriptions. The mapping logic includes aspects like: the lower the temperature, the calmer the conversational tone [15, 41], and the system responds and asks questions with emotional inflection based on the designated persona during the dialogue (detailed prompt keywords and the specific mapping logic can be found in Appendix B.2, B.1). 4) Questions and dialogue content revolve around aquatic ecological background data (detailed workflow in Appendix B.1).

Our water persona-data mapping process references prior research [52]. While not representing complete local water ecosystem data, but this does not affect our research objectives. Our research aims to enhance water environment awareness through playful conversational interaction which use embodied interaction rather than rely on extensive text, websites, museums, or posters for environmental education. This persona-based playful dialogue approach provides an engaging format for human-nature interaction.

4 User Study

4.1 Research Method

Our user experiment was conducted at a residential park pond (*Sorsalampi's*) near a university. This pond is characterized by its beautiful scenery; however, the actual detected data and the environmental pollution records published on official websites revealed severe contamination. This stark contrast became the primary focus and content of conversations between Water's Echo and participants. We deployed the *Water's Echo* system in the pond and randomly recruited local residents who were walking nearby to participate in the test. We recruited a total of 20 random participants, with ages evenly distributed between 20 and 60 years old. Participants were briefed on the purpose of the study and given a brief demonstration of how to initiate and conduct a conversation with *Water's Echo*. They were encouraged to speak naturally and ask any questions they wished. We recorded the duration of each participant's experience. Following the experience, we conducted brief 5-minute interviews. We recorded participants' conversations with *Water's Echo* and interview responses using audio recording software. Five participants were excluded due to early withdrawal during the interview phase. Ultimately, we obtained 15 valid data samples (8 female, 7 male; mean age = 39.1 years, SD = 11.4). Participants interacted with Water's Echo for an average of 6.4 minutes (range: 4.0–9.3 min, details are included in the Appendix A.1). We analyzed these data using thematic analysis [51]. Two coders independently reviewed the data and applied open coding to identify relevant themes and concepts. After multiple rounds of coding, these codes were refined into three major themes. Our interview questions are included in the Appendix A.1.

4.2 Result

4.2.1 Players established a relationship with the local water environment. All players learned about *Sorsalampi's* current environmental conditions, pollution levels, history, and most information related to the pond during their conversations. In interviews, they expressed surprise and curiosity about the discrepancy between *Sorsalampi's* beautiful appearance and its actual pollution status. P1 remarked: *"I walk here every day, but I never knew the pollution was so severe. If he hadn't told me himself, I would never have known—I can only say that because everything looks so beautiful."* During conversations, most players proactively inquired about how to help *Sorsalampi* address its pollution issues. Some players even felt sad at the end because this anthropomorphic dialogue made them realize they needed to care about surrounding aquatic environments but didn't know how to help *Sorsalampi. P10 shared: "I don't know how I should help him, because he keeps telling me he has an 'affluence disease'—he says he has too many nutrients. He only looks good on the surface, but deep down he's very sad."* Some players expressed anticipation about *Sorsalampi's* emotional state the next day. P14 asked: *"He seems very sad. Can I come see him again tomorrow?"* Several residents described *Sorsalampi* as someone who appears cheerful on the outside but is actually melancholic inside. Most players characterized this as a "normal person," while others described it as "a familiar stranger." P3 reflected: *"I walk my dog here every day. I thought I knew him well enough, but his mood, his voice, what he wanted to say—all of this felt so unfamiliar to me. This was a very special experience."* Our

water chatbot, constructed using local aquatic environmental data, not only raised residents' awareness of non-human entities but also fostered their attention to and connection with the surrounding water environments during conversations with local residents.

4.2.2 More interesting and diverse play interaction with water. The majority of players expressed interest in the playful interaction of throwing stones to initiate dialogue, noting that this play-based approach created a sense of ritual before starting conversations, making them more willing to participate in dialoguing with water. This demonstrates that engaging playful interaction is a crucial step in establishing connections between people and water. However, some users provided constructive suggestions for enhancing water-based playful interactions. P15 stated: *"I think the stones should also convey my emotional feedback to the water, not just serve as a trigger switch. For example, if I throw a very large or heavy stone, he should know that I'm in a bad mood."* Other players expressed desires for more diverse interaction modalities. P1 suggested: *"We could use a slingshot to shoot stones into the water—that would feel more interesting."* P14 shared: *"I actually wish my stone-throwing could be like drawing fortune sticks. When I throw it into the water, the AI could tell me what I should do in the future, help with my inner confusion, and so on."* Taken together, players desire rich and diverse interaction modalities during water dialogues, rather than being limited to stone-throwing or simple conversation. Further enhancing the enjoyment of human-water environment interaction would establish deeper connections.

4.2.3 More sustainable interactions with non-human entities. During interviews, numerous users provided insights regarding sustainability. All users considered this playful conversational interaction approach sustainable. Many participants noted that compared to museum educational explanations, this interactive dialogue format deepened their understanding of the surrounding water environments' background information and current conditions. P6 reflected: *"This is definitely much more vivid than reading about town pollution on social media through my phone. I feel like this is a friend, a living one. I'll come to check on him during my next walk to see how he's doing recently."* Beyond the sustainability of repeated conversations at the same pond, P9 even suggested that this playful dialogue should be deployed across different regions for comparison: *"I think if you place this in other countries with severe pollution, the AI's personality would probably be quite different. I really want to try dialoguing with those heavily polluted countries and see what happens."* This sustainability lies in how *Water's Echo* sparks people's curiosity about other aquatic ecosystems' conditions and stories. Finally, some players expressed sustainable behavioral intentions for the future. P1, who shared many personal feelings and private topics with *Water's Echo*, stated: *"I think he's very romantic—he's my new friend now. You know, sometimes coming here to relieve my stress would be a great choice. I hope every park has an AI like this. Now Sorsalampi is as lonely as I am."*

Taken together, our AI public installation, through its playful conversational interaction format, demonstrates sustainability across multiple dimensions for different players—including environmental education, cross-regional pollution comparison, more embodied interaction, and long-term conversational companionship. This showcases the sustainable potential of playful dialogue-based water interaction.

5 Discussion

5.1 From Interactive Medium to Interactive Subject

Water's Echo innovatively transforms water from a traditional interaction medium into an interactive subject capable of communicating with humans. The project personifies local water bodies using environmental data (water quality, historical information) and an anthropomorphic MBTI profile to construct an embodied personality. The act of throwing a stone and the resulting acoustic ripples serve as a conversational trigger, linked to an AI agent that speaks in the first person with local residents. This approach complements previous WaterHCI work [9, 14, 39], which typically treated water as a visualization tool, sensing interface, or data carrier.

5.2 Gamified Expression of Interaction

The stone-throwing mechanism establishes a clear, lightweight ritual for initiating dialogue. Compared with text-based interfaces, this gamified trigger lowers entry barriers and enhances immersion. Most participants intuitively understood throwing as a communication signal and engaged with the water as an interactive being rather than passive landscape[28, 33]. Responses ranged from newfound awareness (P1: "I walk here every day but didn't know how polluted it is") to emotional connection (P14: wanting to "see how he feels tomorrow"). Participants also proposed expressive extensions—linking throwing strength to emotional tone (P15), using slingshots (P1), or "fortune-drawing" responses (P14)—demonstrating that the gesture becomes a carrier of personal meaning. Overall, personified dialogue combined with playful interaction fosters intimate, sustained human–water connections.

5.3 Generality of Embodied Interaction

The stone-throwing ritual shows strong cross-site transferability. Participants found it natural for initiating communication and refocusing attention (P1, P14), while first-person narration transformed abstract data into situated experiences—forming a reusable core structure for diverse contexts. Adaptation strategies emerged: mapping throwing energy to response tone (P15), site-specific triggers (P1), and culturally meaningful uncertainty (P14). Two long-term engagement patterns appeared: (1) Revisiting and comparison—participants expressed willingness to return and compare experiences across time and sites; (2) From empathy to action—questions like "What can I do?" suggest low-barrier prompts can channel emotional resonance into environmental practice. This supports a cross-scenario design logic: maintain stone-throwing and first-person narration as the interaction core while customizing gestures and feedback per site to sustain engagement across aquatic contexts.

5.4 Design Insights and Implications

This study shows that embodied, first-person interaction significantly increases public engagement with natural environments. The stone-throwing mechanism anchors attention and establishes interactive rhythm, while grounding dialogue in local data transforms

water from passive landscape into relational partner. Participants' suggestions—linking throw intensity to emotional tone—reveal potential for expressive, personalized gestures. Three design recommendations emerge: (1) Expressive responsiveness—reflect gesture variations through adaptive tone and highlight environmental changes to encourage revisits; (2) Sustainable boundaries—use locally sourced materials, avoid excessive anthropomorphism, and ensure accessibility; (3) Actionable empathy—transform playful encounters into ecological care through ongoing engagement prompts. Overall, Water's Echo offers a replicable framework for converting momentary encounters into sustained ecological empathy and action.

5.5 Limitation and Future Work

There are some limitations in using our current data (water quality, climate, history, etc., from the adopted ponds) to construct a complete MBTI personality profile. Data Scope: First, this data does not fully represent all data points from the local ponds. In the future, we will incorporate more comprehensive data and diversify our data collection methods. Mapping Logic: Secondly, although our contribution focuses on creating a playful interaction between people and water, rather than on the MBTI[17, 50] mapping itself, the logic used to map MBTI personalities to the data in our current interactive system still has potential incompleteness and flaws, including biases inherent in AI, misunderstandings of prior work[15, 41], Additionally, Different style prompts may introduce potential AI biases, which could lead to variations in the final experimental results. In the future, we will reference more research work and incorporate insights from psychology and sociology to conduct user experiments, continuously refining and adjusting the prompts. see Appendix B.2. Moving forward, our work will build upon the existing use of MBTI-related personality mapping by adding more scientifically rigorous frameworks, such as the Big Five personality traits [4], We then conducted a new user study based on the personality derived from the updated mapping results, and analyzed the differences between the finalized outcomes.

6 Conclusion

To establish connections between people and aquatic environments, we designed *Water's Echo*—an AI-powered public installation enabling playful dialogue through stone-throwing. The AI builds contextually appropriate personas based on water environment data, local history, and background information, revealing insights throughout the conversation. This embodied interaction helps people better understand their surrounding water environments. We conducted a user study at a park pond with 15 participants who engaged in stone-throwing conversations with water. Qualitative analysis of interviews revealed that all participants experienced cognitive shifts regarding local water environments and preferred this intimate interaction modality. Our research provides a reference for designing engaging water ecology interactions across cultural communities, promoting non-anthropocentric re-examination of human-nature relationships.

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A User Study

A.1 Study Methods

Our interview questions primarily included: 1) In one sentence, what kind of "person" do you think Sorsalampi (pond's name) is, and what is your relationship with them? Why? 2) What was the most touching or impactful moment during your entire conversation? 3) What forms of water resource education or science communication content have you previously encountered? How would you compare them to your interaction with Sorsalampi? 4) How has your interaction with Sorsalampi influenced your care for nature? Will you take any actions or make any changes?

Participants interacted with Water's Echo for an average of 6.4 minutes (range: 4.0–9.3 min).

Table 1: Participant Demographics for Water's Echo User Study

Participant	Gender	Age	Duration (min)
P1	F	34	5.5
P2	M	27	7.2
P3	F	45	4.8
P4	M	52	6.5
P5	F	23	8.1
P6	M	38	5.2
P7	F	56	6.8
P8	M	31	7.5
P9	F	42	4.2
P10	M	29	9.3
P11	F	48	5.8
P12	M	25	6.1
P13	F	59	7.8
P14	M	36	4.0
P15	F	41	6.7

B Design System

B.1 AI WorkFlow

We provide a AI workflow prompt for the persona dialogue of Water (*Sorsalampi*). When people initiate the dialogue mechanism, the AI workflow will start running.

(1) Based on the day's Water Quality Parameters combined with the corresponding Reference and Description, generate a brief Mapped Personality Trait/Description;

(2) According to the current Mapped Personality Trait/Description, combined with the latest version of the MBTI personality database, generate the corresponding MBTI personality type;

(3) Combine with your MBTI personality to form Sorsalampi's complete persona, and through dialogue, narrate your life experiences, allowing people to learn about environmental issues during the interaction process. Talk Methods (MOST IMPORTANT!): Speak like a normal person, not poetry; Keep sentences short, like everyday conversation, Finns are very direct—don't be too literary, Use feelings instead of data; Never say directly "phosphorus load 210"; Instead say: "I feel heavy inside, very uncomfortable"; See yourself as human: Your "body" is the pond; Your "blood" is the water; Your "high fever" is algae blooms; Invite, don't blame: Don't scold humans for polluting you; Instead ask: "Did you notice my color looks a bit strange today?" or "Can you feel that my temperature isn't quite right?" to guide them to care about you.

B.2 Mapping Logic

Table 2: Water Quality Parameter to Personality Mapping Logic

Water Quality Parameter	Mapped Personality Trait/Description	Reference and Description
Water Temperature 5.4°C	Introverted, withdrawn, cautious, fragile	Temperature impacts both physical and emotional states of environments. Lower temperatures are often linked to feelings of fragility and caution in ecological contexts. Studies suggest that environmental temperature can alter the emotional tone of interactions [15, 41].
Water Temperature 7.2°C (Ambient temperature)	Bright yet cold, polite distance, reserved	The ambient temperature influences the emotional quality of an interaction. Cooler temperatures can lead to more reserved or distant emotional states, a pattern seen in environmental design research [22].
Soil Moisture (Wet - high)	Heavy, easily affected	High moisture levels in ecosystems often correlate with a more vulnerable or heavy atmosphere. This mapping draws from ecological studies where high moisture in environments contributes to a sense of being overwhelmed or fragile [25, 26].
Phosphorus Load (210 load)	Phosphorus and nitrogen are my "diseases of affluence," stemming from the civilization I rely on	Phosphorus and nitrogen loads are indicators of pollution and overabundance. Environmental studies commonly link these excess nutrients to a sense of overgrowth and ecological imbalance, as well as their "disease-like" impact on ecosystems [5, 13].
Nitrogen Load (9 load)	Alertness, sensitive to changes, responsive to environmental shifts	Nitrogen loads influence the ecological balance and often increase the sensitivity of an environment to change, fostering a heightened sense of alertness, as discussed in pollution and ecosystem monitoring literature [37, 48].
Algae Presence (Surface algae)	Blood thick, internal chaos, low fever	The presence of algae, especially surface algae, is linked to eutrophication and pollution, often leading to chaotic or unstable environmental states. This mapping draws on studies that equate high algae presence to physiological "illnesses" in ecosystems [24].
Surrounding Plants (Water lilies, perennials)	Love of fleeting beauty, transient yet graceful, delicate existence	Plants such as water lilies symbolize ephemeral beauty and are often associated with delicate, transient life cycles. Their presence can convey a gentle, yet fleeting nature, a metaphor seen in ecological studies focusing on the symbolism of plant life in environmental narratives [20, 34].
Birds (Ducks, geese, swans)	Guardianship, a protective yet distant presence	Birds, particularly geese and swans, are often seen as protectors or guardians of aquatic environments. Their presence in ecology is linked to themes of watchfulness and guardianship, as noted in ethology and environmental behavioral studies.
Shoreline Length (450 m)	Spacious yet bounded, sense of loneliness, keen observation	A longer shoreline provides a sense of openness but also a feeling of isolation. This spatial dynamic is often discussed in terms of ecological isolation and introspection, linking physical space with emotional solitude [2].

B.3 The Player Interact with Water Demonstration and Interaction System Image

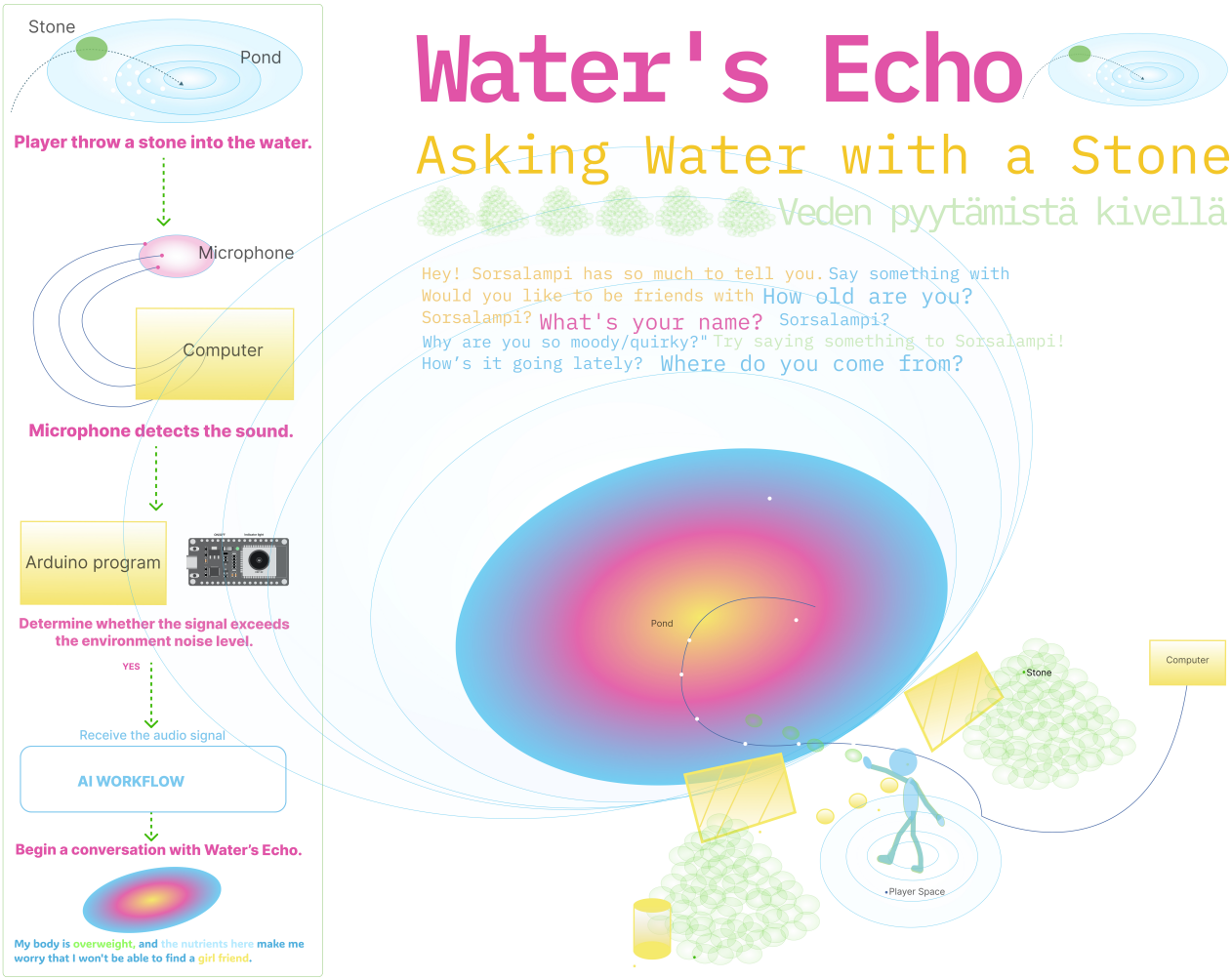

Figure 2: The player interact with water demonstration and the interaction system