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

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Fig. 1. Water's Echo User Demonstration: A player begins a conversation with the system after throwing a stone into the water.

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.

Additional Key Words and Phrases: 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 [30, 40] is a perspective that allows humans to think and rethink our own identities and human-nature relationships [13]. 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 [9, 14] and how such interactions may influence human awareness of nonhuman life and ecological co-construction [5]. 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 [26]. 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 [15, 29, 31]. These interaction approaches mainly focus on providing convenience and services for humans, predominantly divided into human-centered applications that provide public services [1, 38], or installation-based research utilizing water as an interactive medium for artistic performances [7]. Which includes human-centered aquatic recreational interaction facilities [17], aquatic artistic performances [11, 20, 25], underwater operations [17], and interactive underwater games [29]. 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 [22, 24, 28, 34] have begun to address water environment monitoring and visualization interactions[34, 35], as well as water pollution detection [10]. 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 [32].Some research focuses on the interaction of water sports or underwater games, for exampleinteractive activities and entertainment devices in water include smart paddleboards and other auxiliary tools [19], underwater AR exploration toy interactive games [29], etc. Some research has investigated how water can act as an expressive interface for artistic and experiential interaction [39]. Early examples such as the Hydraulophone [21] allowed users to create musical sounds through direct contact with flowing water, while installations like aquaTop display [16, 31] and liquid display [3, 15] 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 [6, 10, 27]. Other studies have explored underwater operations and data collection tools for scientific or recreational purposes [35], including smart paddleboards for training and fitness [19], 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

In parallel, recent research has explored how artificial intelligence (AI) can enable new forms of expression and affective communication for non-human entities. In the field of affective computing, AI-driven emotion models have been applied to robots, virtual agents, and artificial life systems to simulate emotional states and behaviors [2, 4]. A lot of interactive art installations have also used AI to interpret natural data, such as temperature, humidity, or soil moisture, and translate it into affective expressions, allowing audiences to "feel" the emotions of plants or landscapes [8]. These works leverage AI as a mediator that bridges human perception and non-human systems, giving rise to emotionally resonant interactions that challenge anthropocentric assumptions about affect. Recent advances in generative AI and multimodal learning have further expanded this field, enabling the translation of environmental or sensory signals into expressive outputs. For instance, neural networks have been trained to map oceanic waveforms or bioacoustic data to musical or visual forms [34], creating new ways to perceive and empathize with marine life. Similarly, weather-driven generative art projects [33] use AI to interpret natural fluctuations as emotional states, prompting reflection on the sentience and sensitivity of non-human systems. In these examples, emotion becomes a medium through which AI reconfigures human relationships with non-human entities, transforming data into narrative, and matter into feeling.

In our research, we collect as much data about the water environment as possible to better establish the persona of the water AI chatbot. We will refer to previous work on affective computing[41] as much as possible. When users chat with *Water's Echo*, they can feel the differences in its character and way of speaking due to the data it has. This allows participants to immerse themselves in understanding the ecological environment and the impact of human behavior on local water during the conversation.

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. We employed Ali Bailian large language models(LLM) to construct a persona based on multidimensional data (e.g.temperature, soil moisture, phosphorus load, nitrogen load, algae presence) to shape water personality (Fig 2), allowing users to intimately understand the world from water's first-person perspective and the challenges it faces.The collected data can be found in the supplementary materials.

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) AI workflow software - retrieves daily water quality and nutrient data from Finnish monitoring websites, incorporates local water history, origins, significant events, and weather data, then generates MBTI-based personas[12, 36] through specified prompts to deliver emotionally responsive dialogues; 4) Questions and dialogue content revolve around aquatic ecological background data (detailed workflow in supplementary materials).

Our water persona-data mapping process references prior research[37]. 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.

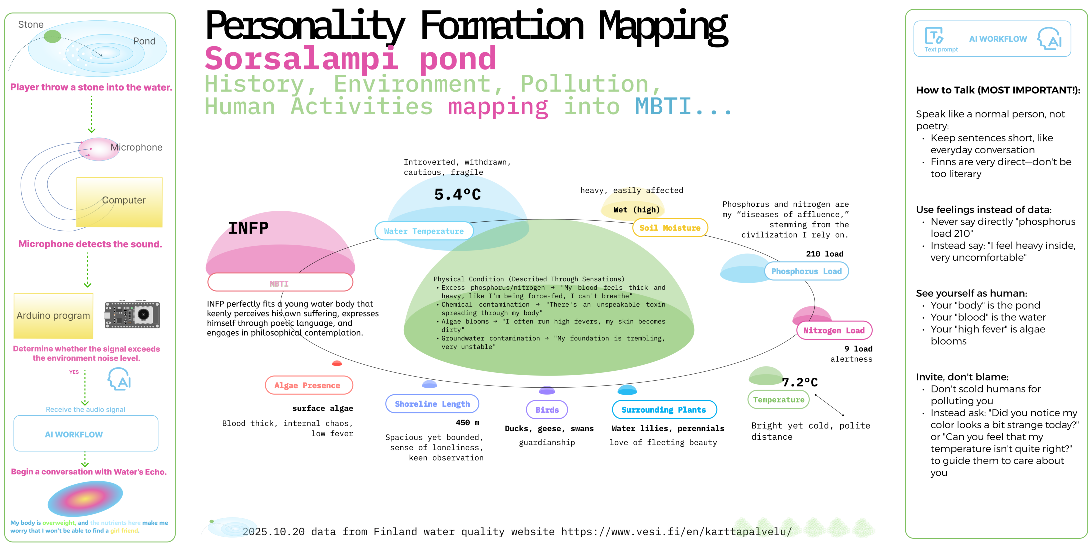

Fig. 2. The composition of *Water's Echo* interaction system

4 User Study

4.1 Research Method

We conducted our user study at a residential park pond near the university. Although the pond is celebrated for its picturesque scenery, monitoring data and officially published pollution levels indicate severe contamination—a striking contrast that formed the central theme of players' dialogues in *Water's Echo*. We deployed the *Water's Echo* system in the pond and randomly recruited local residents who were walking nearby to participate in testing. We recruited a total of 20 random participants, with ages evenly distributed between 20-60 years old. All players experienced *Water's Echo* and participated in brief 5-minute interviews. We recorded both the dialogue content between players and *Water's Echo*, as well as the interview responses using audio recording software. After data analysis and organization, we obtained 15 valid datasets. Our interview questions are included in the supplementary materials.

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 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 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 [6, 10, 27], which typically treated water as a visualization tool, sensing interface, or data carrier.

5.2 Gamified Expression of Interaction

The game-like mechanism of initiating dialogue through stone-throwing establishes a clear, lightweight, and repeatable ritual for entering interaction. These playful rules help participants focus on the real-time feedback of the water surface and the immediate context. Compared with text-based interfaces, this gamified trigger lowers the entry barrier, enhances engagement, and strengthens immersion.

Most participants intuitively understood "throwing a stone" as a signal to start communication and showed greater willingness to engage with the water as an interactive being rather than a passive landscape[18, 23]. For example, P1 said, "I walk here every day but didn't know how polluted it is," P10 described the water's eutrophication as a "disease of affluence," P3 felt "a strange mood in a familiar place," and P14 said they wanted to "see how he feels tomorrow."This play-driven emotional closeness fostered both curiosity and empathy, raising residents' awareness and concern for their local aquatic ecology. Participants also proposed more expressive modes of engagement: P1 suggested using a slingshot for more fun, P15 proposed linking stone size or throwing strength to emotional tone, and P14 imagined a "fortune-drawing" response mechanism. These ideas show that the act of throwing is not merely a trigger but a carrier of personal meaning and self-expression. When gestures become expressive inputs, human–environment interaction becomes more immersive and sticky.Overall, the combination of personified dialogue and playful interaction encourages more intimate and sustained connections between people and their surrounding water environments.

5.3 Generality of Embodied Interaction

The "stone-throwing" ritual demonstrates strong cross-site transferability as both an entry gesture and turn-taking mechanism. Participants found throwing natural for initiating communication and refocusing on the water surface (P1, P14). First-person narration of local environmental data transformed abstract information into situated experiences, suggesting this combination forms a reusable core structure for diverse water contexts. Adaptation strategies emerged from participant feedback: P15 proposed mapping throwing energy to response tone and topic for expressive input; P1 suggested site-specific triggers like slingshots; P14's "fortune-drawing" idea introduced culturally meaningful uncertainty.

These insights indicate designers should maintain the ritualistic, turn-based structure while customizing gesture forms and feedback styles to ensure accessibility and site-specific character. Two long-term engagement patterns emerged: 1) **Revisiting and comparison.** Participants expressed willingness to revisit and compare experiences (P14: "see how it feels tomorrow"; P9: compare regional waters), indicating that local water quality and history variations naturally shape narrative diversity. 2) **From empathy to action.** Participants asking "What can I do?" suggests that low-barrier action prompts (e.g., monitoring, reducing disturbance) can channel emotional resonance into environmental practice. This supports a cross-scenario design logic: use stone-throwing and first-person local narration as the interaction core, adjust gesture expressiveness and feedback per site, and leverage data-driven nuances to encourage revisiting and comparison, sustaining engagement and community attachment across aquatic contexts.

5.4 Design Insights and Implications

This study demonstrates that embodied, first-person interaction significantly increases public engagement with natural environments. The stone-throwing mechanism anchors attention to the water surface and establishes an interactive rhythm that encourages conversation and extended on-site engagement. By grounding dialogue in local data and history, abstract information becomes personified, transforming water from passive landscape into relational partner. Participants' suggestions—linking throw intensity or stone size to emotional tone—reveal the potential for expressive, personalized gestures. Three design recommendations emerge: 1) Expressive responsiveness: Recognize and reflect variations in gesture through adaptive tone and content to enhance immersion. Update the embodied agent's expression based on local environmental changes or highlight cross-site contrasts to encourage revisits. 2) Sustainable boundaries: Use only locally sourced natural materials to avoid ecological disturbance; avoid excessive anthropomorphism; provide accessible alternatives for inclusivity. 3) Actionable empathy: Transform playful encounters into ecological care by motivating ongoing engagement. Overall, *Water's Echo* offers a replicable, scalable framework for public environmental interaction—converting momentary encounters into sustained ecological empathy and action.

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.

7 Acknowledgments of the Use of AI

We use LLM ChatGPT-4o in manuscript preparation with the prompt "Give me some connecting words to tie this quote to the previous theory." to achieve smooth integration of quotes and references. We also use ChatGPT-4o in language refinement with the prompt "Help me correct the grammatical errors in this text." to achieve grammar correction. Finally, ChatGPT-4o was applied in translation with the prompt "Translate into English" to achieve accurate bilingual alignment. Authors take responsibility for the output and use of AI in this paper.

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