

The Audible Giant: Transforming Tiny Sounds into Human-Scale Experiences

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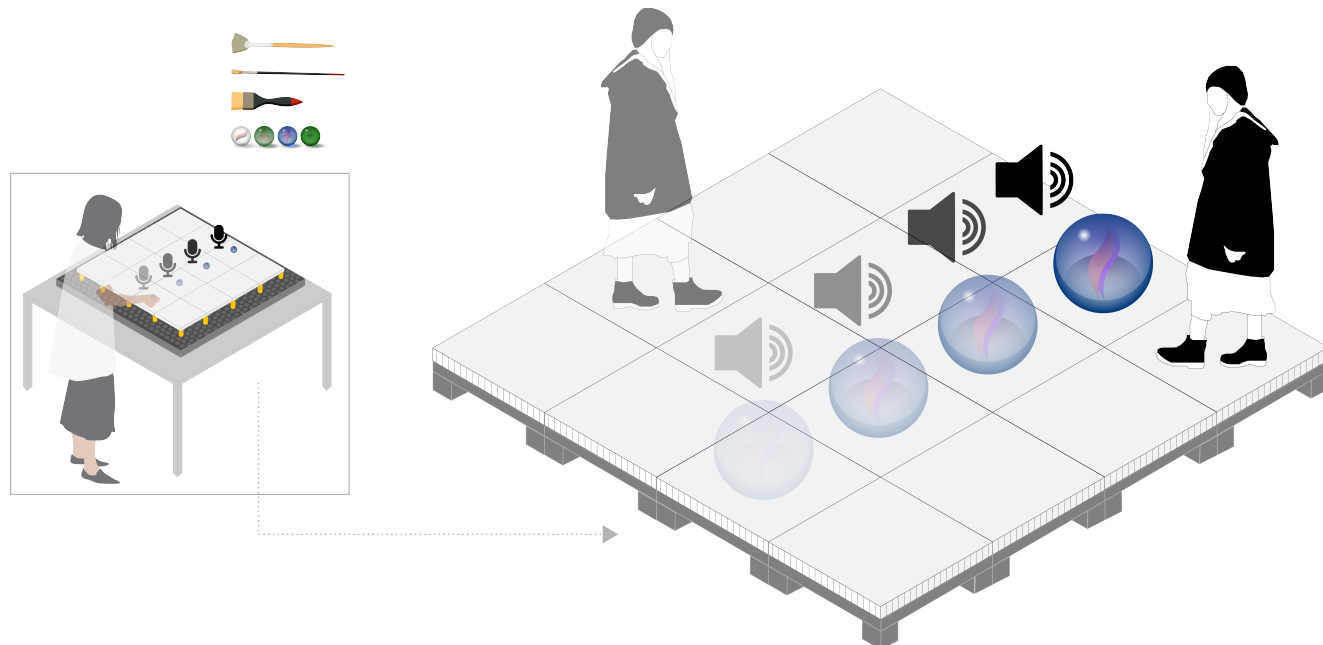


Figure 1: Conceptual diagram of the system in action: the sounds produced by the marble in the miniature are amplified, transforming from object-scale to human-scale across the floor.

Abstract

Humans are giants compared to the objects in their environments, and this difference influences how we interact with and perceive those objects. *The Audible Giant* explores a shift in perspective

by scaling objects from their original 1:1 scale to human scale, thus enabling humans to experience the world of objects through auditory immersion.

We designed a miniature floor where objects inhabit their true scale, capturing the sounds of their movements, impacts, and vibrations. These sounds are then transmitted and amplified through a human-scale floor, creating an auditory experience that transforms human perception. This system bridges the gap between human and object scales, allowing humans to inhabit the world of objects and perceive them as equals.

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By distorting barriers of size and scale, our project aims to redefine the relationship between humans and their surroundings, encouraging a deeper appreciation of everyday objects through sound.

CCS Concepts

• **Applied computing** → **Sound and music computing; Media arts.**

Keywords

Sound Interaction, Multi-Scale, Human-Floor Interaction

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1 Introduction

In the much-beloved children's classic *Alice's Adventures in Wonderland* [3], a school-aged Victorian child drinks a potion that allows her to fit through a tiny door, only to realize that she forgot the key on the human-scale table. Unsure of what to do, she eats a small cake labeled "EAT ME," which causes her to grow so large that her head hits the ceiling. In this illustrative dream-like sequence, Alice experiences a singular room on at least three different scales, each providing a different experience of a space that remains the same in size.

Such experiences, which can be understood as multi-scale, have been explored across art, research, and design for a variety of aims and reasons. What can be observed, especially with regard to research in extended reality, is that visual cues are the primary vehicle for communicating increases and decreases in size. Perhaps there is a lack of research exploring how other kinds of sensory data can augment our perception of size due to a preference for visual technologies, particularly in the West [19].

That said, there appears to be room for exploring sound in augmenting size perception. According to Larsson, sound can be considered a medium that can "induce both object presence [and] spatial presence [10]." Moreover, as pointed out by Pope and Chalmers, our field of vision can be limiting as an input as we can only see what is directly in front of us [17].

Floors can offer a useful intermediary for the transferring of sensory information. As Ingold points out, humans leave imprints on the world through walking [7]. Likewise, Ingold also argues that walking is a form of "thinking in movement" where "motional thought" is something that "runs along the ground [8]". In this Interactivity, we present a system that uses auditory cues to augment size perception. The system relies on using two prototypes: a 2m x 2m human-scale floor and a 1:5 miniature version of this floor measuring 40cm x 40cm. The surface of the miniature is embedded with a total of 16 hidden microphones, one underneath each panel, while the human-scale floor is fitted with 16 hidden speakers. Essentially, the entire surface of the miniature functions as an input surface while the floor functions as a corresponding output surface (see

figure 1). In this way, the sounds that are captured by the miniature are effectively scaled up when played through the larger floor (see figure 3).

2 Literature Review

Augmentation of size perception has long been of interest to artists, designers, and researchers. Sculptors like Ron Mueck [4] and Robert Therrien [5] made names for themselves in the art world with their oversized sculptures, with the latter focusing on scaling-up everyday objects. Scale augmentation has been explored extensively in extended reality, where it is usually referred to as "multi-scale," namely in virtual [9][1][12][24][11] and mixed reality [14][15][16], and to a lesser extent augmented reality [6][23].



Figure 2: Fully assembled miniature mounted in foam, which serves as a surface for capturing sound (left), and an individual module displaying the contact microphone embedded in the center (right).

Although explicit size augmentation through sound has less of a rich history, there are some works that operate from similar premises. The installation art piece "Bug's Beat" by Dorita Takido and Yumi Sasaki plays back real-time audio of insects walking through directional speakers [2]. Valsecchi et al. detailed a more-than-human approach to sound design that involves using stromatolites as the basis for sound generation [21]. In the closely related field of haptics, Zook et al. [25] developed textile-based prototypes for multi-scale haptic interaction, while Wang et al. [22] designed multi-scale haptic interface devices for the metaverse.

Given that the floor is the primary interactive medium in this work, it is also worth mentioning the work of Tsujita et al. [20], who devised a vibrotactile floor for room-scale interactions.

3 System and Prototype Design

This section details the construction of both the miniature and human-scale floors that are described in this Interactivity, in addition to the experiential flow of the interaction.

3.1 Miniature

The miniature is comprised of 16 2.5mm thick 100mm x 100mm 3D printed miniature panels, each attached with foam tape to four 3D printed screws which are inserted into a polyurethane soft foam board. The panels are equipped with commercially available Adeline AD-35 Transducer contact microphones (see figure 2).

Sound from each panel is recorded through a Behringer UMC1820 audio interface, expanded with a Behringer ULTRAGAIN DIGITAL

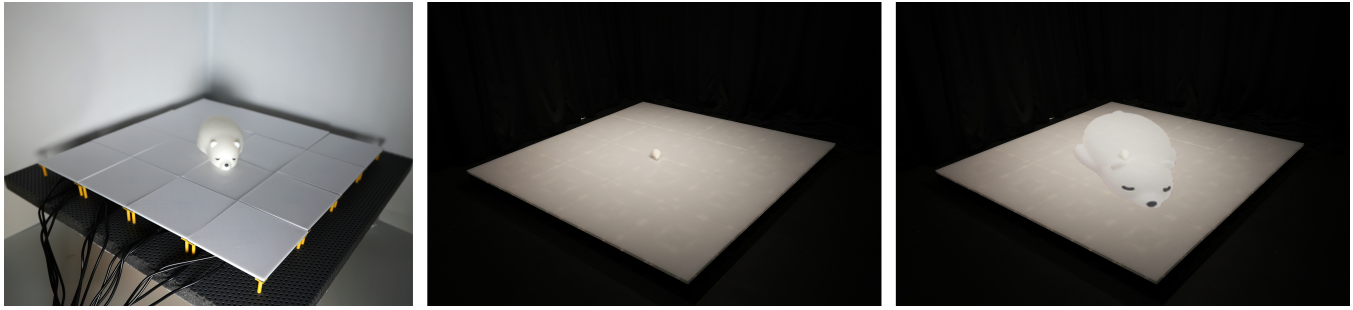


Figure 3: Reference object in three contexts to illustrate the scale-up effect: on top of the miniature (left), on the human-scale floor (actual size, center), and on the human-scale floor (scaled-up, right).

ADA8200 via ADAT for additional channels. The 16-channel audio and synchronized video were recorded using Max, with the video captured on an iPhone 14 Pro.

3.2 Human-Scale Floor

The human-scale floor is comprised of 16 180mm thick 500mm x 500mm polypropylene honeycomb panels, each equipped with a 20-watt distributed mode loudspeaker (DML) manufactured by Dayton Audio attached directly on the bottom. 4mm acrylic foam tape separates the panels from commercially available OA flooring units with the center piece removed to make room for the speaker (see figure 4). The panels are arranged in a four-by-four grid. Pairs

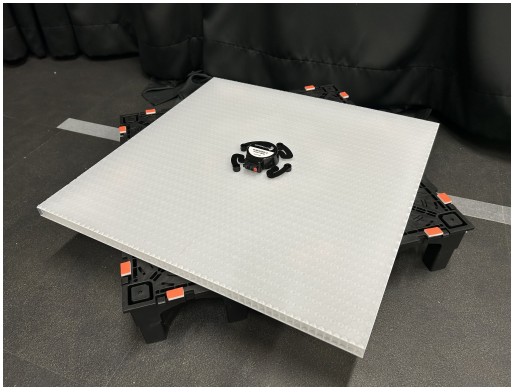


Figure 4: Individual floor module for the human-scale floor before assembly, with a DML attached to the center of the panel to evenly distribute sound across the surface.

of adjacent speakers are each wired to one of eight Nobusound NS-01G amplifiers, which are connected to the soundcard described in the previous subsection. Sixteen channels of live or recorded audio from the miniature are played back through Max, along with video when applicable.

Due to the poor low-end response of flat-panel speakers [13][18], the audio is processed with compression, EQ, and overdrive, either in real-time in Max or offline in Logic Pro.

3.3 User Experience

After removing their shoes, users step onto the floor, where they are welcome to sit, stand, or walk around. Watching the video and being on the floor is the essence of the scaled-up audio experience. Users will likely observe that if standing or sitting directly above one of the speakers, the sound on that particular panel will sound muffled, but the vibrations produced by the speaker will be felt on the body.

For the real-time (and possibly secondary) application of this system, it is not recommended to interact directly with the miniature while standing on the floor, as this could create an auditory feedback loop. In this specific use case, it is encouraged that users explore the system with multiple people—one on the human-scale floor and the other manipulating the miniature.

4 Conclusion

In this Interactivity, we describe a system for scaling up audio through the transmission of sounds from a miniature floor to one that is at human-scale. Our system relies on using contact microphones in the former and DML in the latter to achieve the illusion of size augmentation. The system can be experienced with both recorded and live audio.

This is the first phase of this project, with much room for improvement. Issues pertaining to fidelity (both in terms of input and output) and sound localization will likely need to be addressed if this project is to expand in scope. At this stage, the human-scale floor is stand-alone, but we aim to integrate the panels into a built environment to create a stronger auditory presence. That said, there are limited opportunities to exhibit this work due to the challenges of assembling and reassembling the prototypes, as well as the high costs of transporting them, especially to overseas venues. We hope this demo will generate valuable feedback to help us improve and refine our design.

Acknowledgments

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