Project Proposal for *Visible Sound*,
an Interactive, Virtual-Reality Exhibit about Sound

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Project Title

Visible Sound

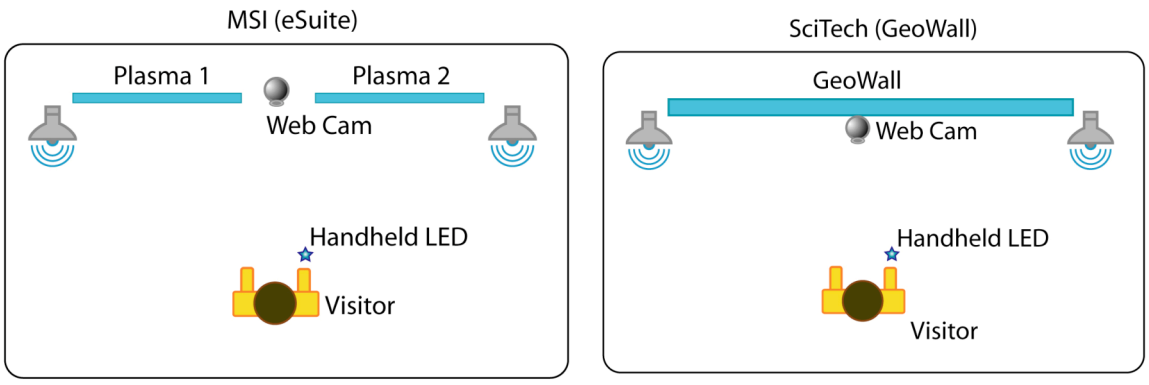
Type of Project

Visible Sound is an interactive, virtual-reality exhibit. It aims at conveying what sound is as well as some of its properties using a tangible interface. “Tangible interfaces give physical form to digital information, employing physical artifacts both as representations and controls for computational media. Tangible User Interface’s couple physical representations (e.g., spatially manipulable physical objects) with digital representations (e.g., graphics and audio), producing interactive systems that are computationally mediated, but generally not identifiable as “computers” per se” [1].

This exhibit employs a number of technologies. A large display or GeoWall is the main focal point of the exhibit where users place most of their attention. The GeoWall is a low-cost PC-based 3D stereoscopic projection system [2]. A user interacts with *Visible Sound* using a cylindrical wand with an infra-red (IR) LED at one end, and held by the user at the other end. An inexpensive web camera mounted above the display captures the movement of the handheld IR device. Speakers provide audio feedback to the user based on the user’s interaction. The exact placement and type of equipment *Visible Sound* uses depends on the museum and venue.

Target Museum and Venue

Visible Sound can be installed at the Museum of Science and Industry (MSI) [3] in one of its media enabled rooms, such as the eSuite or the World Live Theater. At the SciTech Hands-On Museum (SciTech) [4] *Visible Sound* can be exhibited using the current GeoWall. See figures below.



Target Audience

Visible Sound targets elementary school children, and loosely meets goals 12.C.2a and 12.D.2a of the Illinois Learning Standards [5], specifically the descriptions of sound energy and periodic motion. The interactive nature of *Visible Sound* will likely appeal to a general audience as well.

Big Idea

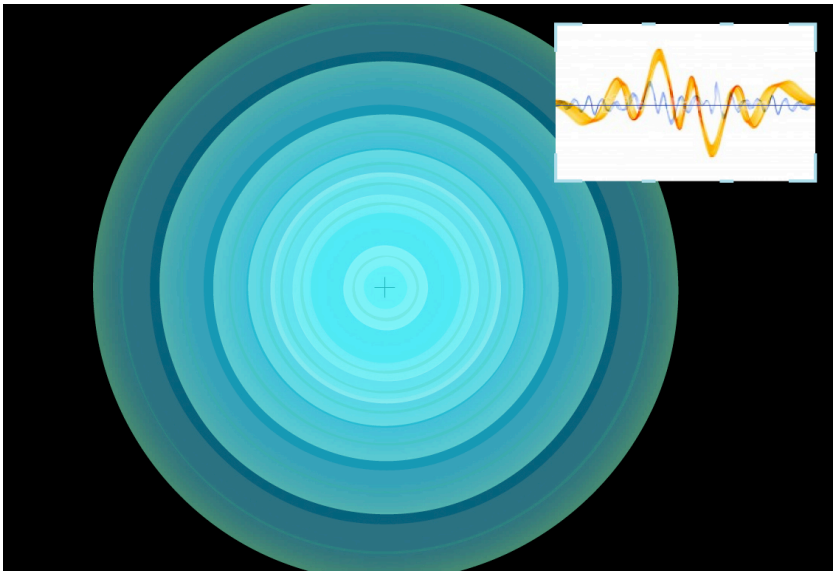
Visible Sound demonstrates that sound is the effect of vibrations in materials. Sound has properties, two of which are its frequency (pitch) and amplitude (loudness). The density of the material affects the properties of sound traveling through it.

Project Description

The *Visible Sound* experience has two parts. The first is a one minute animation with voice over that introduces the scientific concepts of sound, and gives the museum visitor directions for interacting with the exhibit.

For the second part, the visitor controls the amplitude and frequency of the sound wave using a handheld LED, which generates graphics on the display or GeoWall, and produces sound at the same time. The LED generates IR that serves as input data for the web camera and triggers both the visual and audio feedback in real-time.

Two representations of sound are drawn on the display. The main representation is a 3D waveform that expands contracts and pulsates as visitors interact with the exhibit. An auxiliary view of a traditional waveform appears in the upper right corner of the display. See figure below.



The amplitude of the sound wave is related to the distance the visitor moves the IR device. If the visitor moves the IR device a large distance the sound wave has high amplitude. The wave drawn expands to fill more space on the display, and the intensity of sound heard from the audio system increases. If the visitor moves the IR device a small distance the sound wave has low amplitude. The wave drawn shrinks on the display, and the intensity of sound heard from the audio system decreases.

The frequency of the sound wave is related to the time the user takes to move the IR device. If the visitor moves the IR device quickly the frequency of the wave is high. The wave drawn pulsates more, and sound heard from the speakers has a high pitch. If the visitor moves the IR device slowly the frequency of the wave is low. The wave drawn pulsates less, and sound heard from the speakers has a low pitch.

Explanation of science behind the concept

Sound is made when things vibrate and particles bump into each other. Particles displace particles next to it and those particles displace particles next to it, and so on, until the displacement reaches your ear. Your ear sends this information to your brain which perceives it as sound. [6]

Sound can be described as a wave. Sound waves have many properties, two of which are its frequency and amplitude. The frequency of a sound wave is then number of waves that pass a point each second. Our brains perceive high-frequency sounds as high-pitch sounds and low-frequency sounds as low-pitch sounds. The amplitude of a sound wave is the amount of energy it has. Our brains perceive high-amplitude sounds as loud sounds and low-amplitude sounds as soft sounds. [7]

Evaluation Plan

As part of the development of *Visible Sound*, a front-end evaluation is necessary in order to find out how museum visitors understand and think about sound. The study should focus on the following areas:

- How do visitors think about and understand sound?
    - What is sound?
    - What is frequency and amplitude?
    - How does sound change in different materials?
- What are visitors' reactions to the exhibit?
- What questions do visitors have about sound?

We propose to conduct the evaluation using face-to-face interviews with casual visitors to the museums. This type of interview methodology is more intimate than a survey and may provide richer and more interesting results.

A preliminary timeline for conducting front-end evaluations at one of the two target institutions follows:

- 01/30 – Begin collecting data from museum visitors.
- 02/10 – Finish collecting data from museum visitors.
- 02/13 – Begin evaluating results.
- 02/17 – Evaluation completed.

Connections to SciTech or MSI Exhibits or Educational programs

SciTech currently has a number of sound exhibits and a GeoWall. This exhibit will complement SciTech's sound exhibits and add sound to the current GeoWall experience. At MSI *Visible Sound* complements existing sound exhibits and aligns with their goal of creating a new sound demonstration.

References

[1] http://www.hiit.fi/uerg/seminaari/T-121900-2004-essay-slaakso.pdf
[2] http://geowall.geo.lsa.umich.edu/
[3] http://www.msichicago.org/
[4] http://scitech.mus.il.us/
[5] http://www.isbe.state.il.us/ils/science/pdf/goal12.pdf
[6] http://science.howstuffworks.com/hearing1.htm
[7] http://www.fi.edu/fellows/fellow2/apr99/soundvib.html