The Black Box

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ABSTRACT

The Black Box[1] is a site based installation that allows users to create unique sounds through physical interaction. The installation consists of a geodesic dome, surround sound speakers, and a custom instrument suspended from the apex of the dome. Audience members entering the space are able to create sound by striking or rubbing the cube, and are able to control a delay system by moving the cube within the space.

Keywords

Satellite CCRMA, Beagleboard, PureData, Faust, Embedded-Linux, Open Sound Control

1. THE INSTALLATION

1.1 The Dome

Measuring 16 feet across and 8 feet in height, the geodesic dome is the central form of the installation[2]. The dome's structure is comprised of 65 struts, each of which were pressed, drilled, and bent by hand. Geodesic Domes are known for their robustness and efficiency of materials.

1.2 The Cube

Black and white acrylic were the primary materials used in the cube's construction. Each face comprised of a sheet of frosted white acrylic fused with a laser cut sheet of black acrylic. The black acrylic portion of each face was laser cut with a unique pattern to allow the audience to create various types of impulses. Internally the box is re-enforced with a cross bar and fittings for each edge. A single face was left unfused from the main body, it is secured by magnets making it easy to remove in order to access the internal electronics.

1.3 Interaction

Individuals are able to interact with the installation by striking any of the faces of the cube. The impulse created by the strike is used to drive the synthesis model. Participants are able to control the resonance of the signal by pushing the cube away from its resting position at the center of the dome. If the user pushes the cube past a certain displacement angle for longer than a second the preset of the synthesis model is changed.

[1] `http://ccrma.stanford.edu/~rmichon/dome`.
[2] `http://www.desertdomes.com/domecalc.html`

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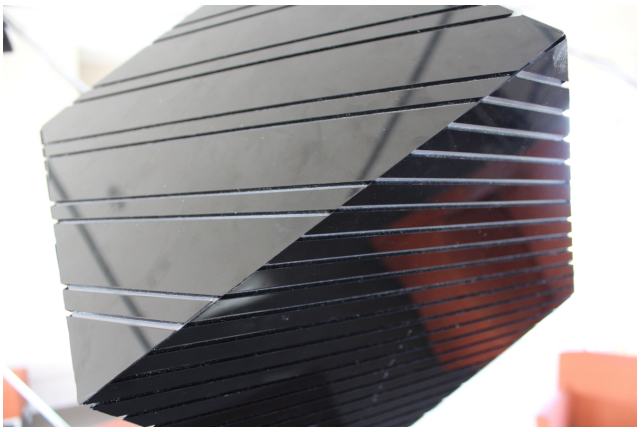

Figure 2: The box from the outside.

2. INSIDE THE BOX

2.1 Hardware

At the center of the *Black Box* is the *BeagleBoard*[3], an ARM based embedded-linux prototype board. Piezos are used to excite the physical model running on the *BeagleBoard*. The impulses created by the piezos are able to capture the shape of the cube and apply some of its properties to the physical model. This technique was inspired by previous works by M. Puckette, D. Schlessinger and J.O. Smith [1][2].

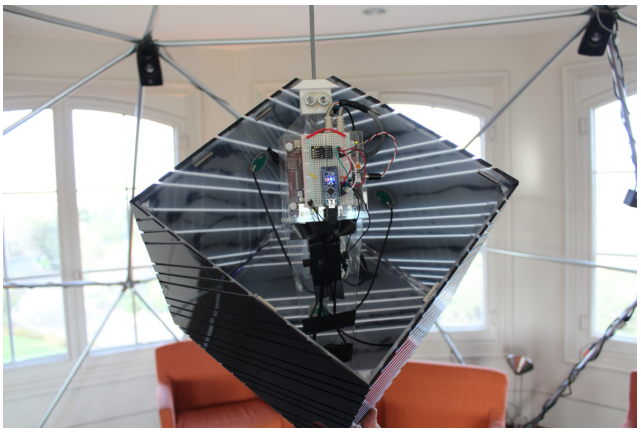

Figure 3: Box interior view.

[3] `http://beagleboard.org/`.

Figure 1: Overview of the installation.

The *BeagleBoard* communicates via serial with an *Arduino*[4] which is used to poll an accelerometer and update a *Blink-M*[5] via i2c. The accelerometer data is used to calculate the displacement angle of the box, and the *Blink-M* is used to light up the enclosure.

2.2 Software

The *BeagleBoard* runs *Satelite CCRMA* [6]. The signal processing and control tasks are carried out in a *PureData*[7] patch. The physical model of a metal bar is based on a previous work by Smith and Michon [3]. It is a 4x4 nonlinear feedback delay network written in *Faust*[8] and compiled as a *PureData* external. The Model has ten different presets that users are able to switch between by holding the box at a certain angle for more than a second.

Due to the cubes size it can act as a microphone, amplifying the space it is in. In order to deal with this, the impulses created by the piezos are sent through a noise gate to limit the impact of the sounds present in the room. Additionally, the impulse is highpass filtered in order to eliminate low frequency sounds that might occur within the box when it is agitated.

The spectrum of the sound generated by the physical model is analyzed and filtered with a lowpass, highpass, and bandpass. These three resulting signals are used to control the RGB lights of the*Blink-M*.

Finally, a simple stereo feedback delay effect is used to allow the instrument to be more expressive. The feedback gain is controlled by changing the displacement angle of the box.

[4]`http://www.arduino.cc/`.
[5]`http://thingm.com/products/blinkm-maxm.html`.
[6]`https://ccrma.stanford.edu/~eberdahl/satellite/`.
[7]`http://puredata.info/`.
[8]`http://faust.grame.fr`.

3. LOOKING FORWARD

As *The Black Box* has been built using embedded linux, there are a number of features that can be leveraged for novel interactions. Most interesting is that of a user-space, the ability for audience members to log in and modify the state of the installation. Work has begun on developing an intuitive platform that will allow audience members to create custom installations and sound art with the *Black Box*. This process will allow for more social engagement with the installation.

4. ACKNOWLEDGMENTS

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5. REFERENCES

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