Rainforest sound installation

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Abstract. The Rainforest sound installation creates an interacting sonic element in space. It's made of a set of original porcelain shapes, which are in fact an 8-channel audio system. The porcelain shapes are individually resonated by the attached solid drivers. The interactive live interface is build in Max/MSP. The main input into the system comes from the live camera feed and is based on the actual position of the listener. The detected movement is than translated into a specific soundscape, which is triggered on the fly. The sound installation mimics a living organic element, which is suspended off the ceiling and interacts with its surroundings.

Keywords: porcelain design, multichannel sound, Max/MSP, solid drivers, movement detection

Introduction

The Rainforest sound installation is based on an initial prototype called Sound Extrusions. This prototype was designed, manufactured and tested in the span of five months in 2013-14 in Brisbane, Australia, as part of the artist in residence position at The Edge[1]. The name of the second version of the installation, the Rainforest, also references the David Tudor's original approach to the object sonification strategies. The project itself primarily investigates novel use of the porcelain material and explores its sound resonant qualities. This installation piece also represents a specific live interface which generates soundscapes. It can be though of as a sonic open system producing unlimited number of soundscape variations based on listener's changing position. This *movement – interaction – soundscape* concept had been already used previously in installations such as Myron's Krueger *Videoplace* (1975), David Rokeby's *Very Nervous System* (1986-90) or Rolf Gehlhaars's installation *sound=space* (1894) just to name few original realizations. Nevertheless the novelty of the Rainforest installation is based mostly on the exploration of the experimental nature of the porcelain design and it's unusual use in the sound and interaction domain.

Sound installation design

The organic-looking porcelain shapes are in fact an 8-channel audio system, which interacts with the position of the listener. The actual use of porcelain crafting proved to be quite an exciting and innovative experiment in acoustics and porcelain design.

All of the porcelain shapes are amplified resonators using solid drive (vibration) speakers and are applied to all of the porcelain shapes to deliver a spatial hearing experience. The installation itself is suspended off the ceiling, while the integral part, the supporting base section, is made of individual interconnected triangular pieces. The base section is suspended in an angle and the design evokes a humming bird in flight or manta ray shape.

[1] The Edge (Centre for Arts, Technology & Enterprise); more information can be accessed online at http://edgeqld.org.au

Figure 1. Rainforest sound installation

The installation behaves as a living element. When it notices the listener's movement in the space, it plays a start-up sequence, it 'stretches out' and plays a so-called 'wake up song'. From this point on, as the listener moves around the space underneath the installation, it follows him with the live generated soundscapes across the full 8-channel audio system.

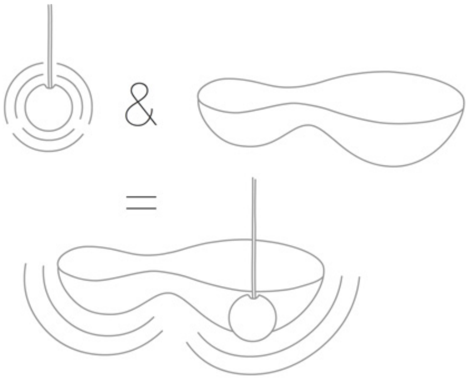

Figure 2. Rainforest – the porcelain shapes with solid drivers schematics

Porcelain Design, Manufacturing & Sonification

The porcelain shapes were designed as simple shapes and slip-cast from the highest quality porcelain available in Australia, the Southern Ice porcelain. The original shapes were hand modelled as prototypes in clay and were used for the original plaster mould manufacturing. The shapes had to be casted in 1 mm porcelain wall thickness to ensure the highest possible resonance response. This presented a lot of manufacturing difficulties and in the end, only one out of three slip-cast shapes in general, were successfully produced without any defects. A kiln at the Queensland College of Arts (QCA) was used, thanks to my research student status at Griffith University at the time. This allowed me to take care of the whole manufacturing process and aim for the thinnest shape's wall thickness possible. This manufacturing phase wouldn't be possible without the excellent mentoring of Corey Biever, a Brisbane based experienced porcelain maker and ceramics technology expert.

Figure 3: Rainforest – the porcelain shapes with solid drivers in detail

The highest porcelain grade available made it possible to transfer the full upper audio spectrum and create rather brittle sounding shapes. Nevertheless the bottom end of the audio spectrum doesn't transfer well in the porcelain material especially in such a small surface dimensions. The actual solid audio drivers are partially attached with a silicon paste, which was applied to the edges of the driver's surface. This attachment creates the needed adhesion, but still leaves enough room for the direct vibration transfer onto the shape's surface. The central part of the driver's surface is touching directly the porcelain shape (this represents a problematic attachment of the small flat surface of the driver onto the round porcelain surface). Small portable X-Vibe solid drivers[2] designed for mobile applications were used, with the output audio power of 1W. There were used two types of the porcelain shapes: small ones measuring 25 cm and the bigger ones measuring 35 cm across the full shape's length. Because of the missing low and mid-low audio spectrum, a special solid driver, with the output audio power of 5W, had to be used as a sub-woofer and attached to the base section of the installation. The central suspending base component acts as a solid drive sub-woofer, which in turn complies with the *solid driver sonification* concept used throughout the whole installation.

This experiment, using the porcelain in conjunction with audio, represents a rare example when porcelain objects are coupled with the solid drivers. In order to be able to smooth out the irregularities present in the varying porcelain shape thickness, an extensive filter section has to be added in to the Max/MSP patch. The EQ section than allows the sound installation to 'be tuned' properly and to reflect each shape's resonant properties and overall sound EQ characteristics. The tuning section consists of a set of individual parametric EQ filters attached to each of the audio output channels. The purpose of the tuning phase is also to ensure, that the sound travels seamlessly across the whole 8-channel audio field without additional shifts and inconsistencies in the sound color properties and perceived loudness. The shapes also had to be suspended on sets of invisible strings in order to bring the most from the mid and low-mid spectrum. The strings are attached to the shapes by using a small hidden glued wooden objects with a miniature slots.

[2] X-Vibe solid driver; more information about the solid driver can be accessed online at www.goxdream.com/x-vibe.php

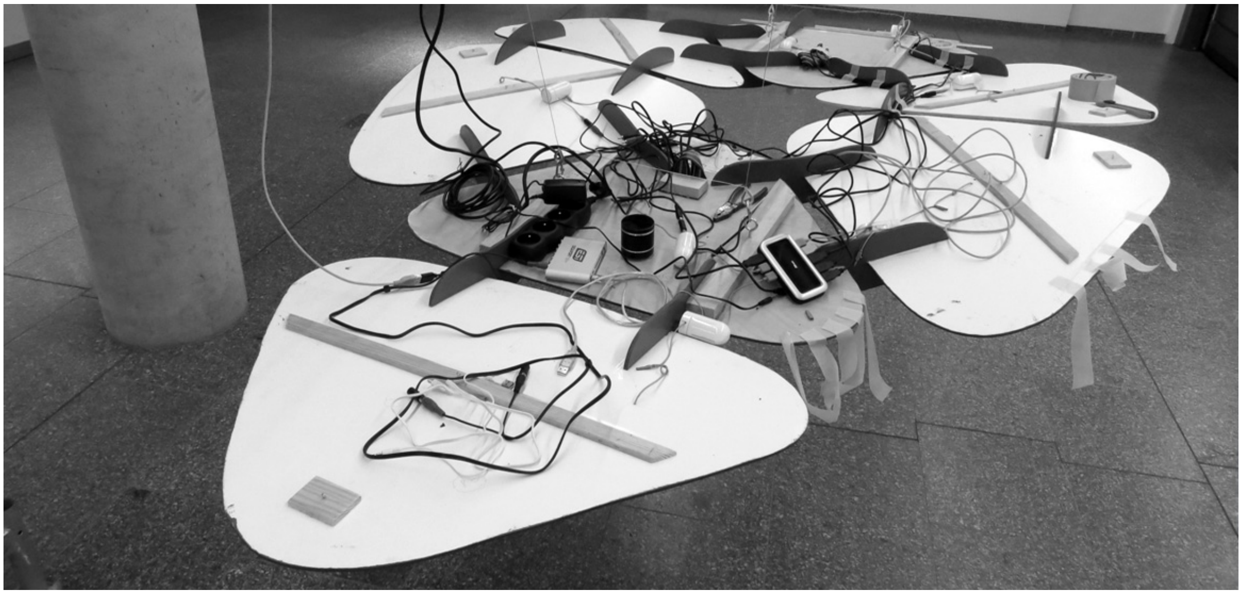

Figure 4: Rainforest – the suspending base detail & overall audio setup

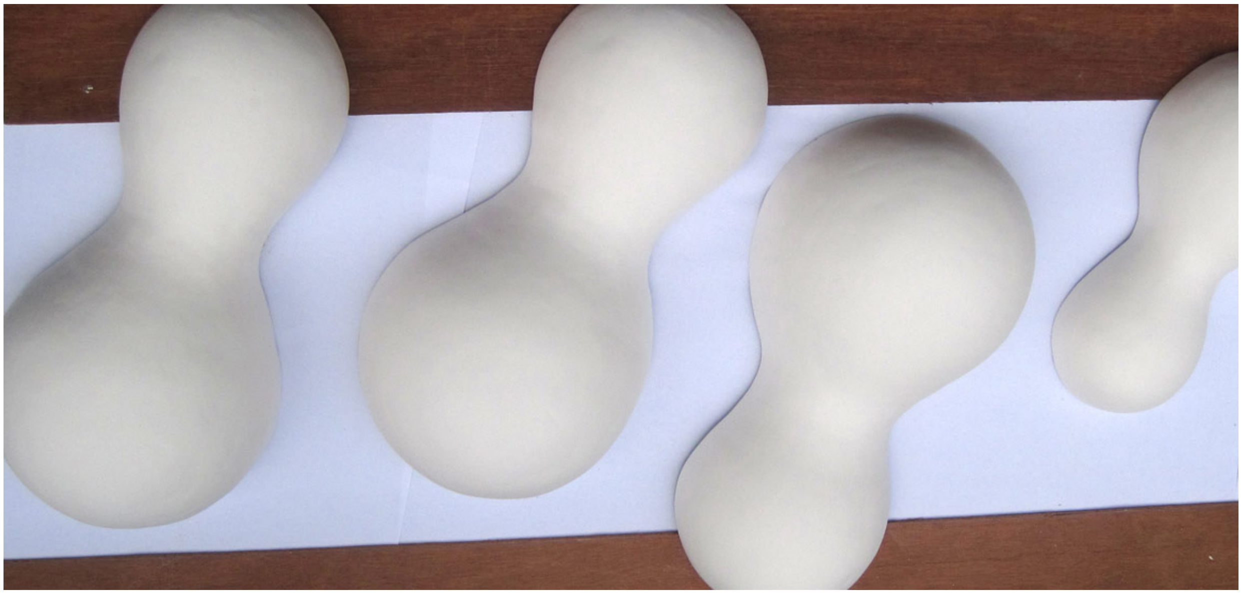

Figure 5: Porcelain shapes manufacturing – the bisque firing

In commercial solid drive applications a special hardware EQ modules are used to bring the hi-fi audio quality into such setups[3]. They are introduced to the signal path in order to compensate the specific frequency attenuation and the acoustic property irregularities of the vibrating materials – specific presets for glass, wood or other materials can be than designed and applied to create flat response curve of the audio system.

The Ambisonics engine[4] is used to control the position of individual sound sources in the installation. It has to be noted, that the use of the Ambisonics was not intended as regular setup of the Ambisonics environment from the very beginning, but rather represents a repurposed and creative use of an existing technology, which allows for an interactive placement of sound sources across the sound installation. Also the porcelain shape 'speakers' are not distributed evenly, and as such, they are not intended to create consistent sound field in the way the Ambisonics work. The Ambisonics engine was selected, because it also offers a convenient graphic interface for the realtime sound source position visualization.

Interactive live interface – the Max/MSP patch

The heart of the interactive element of the sound installation is the Max/MSP patch. The patch runs on a laptop in the Max/MSP runtime environment.

In order to capture the listener's interaction and movement, the Max/MSP Jitter library was used. Live webcam video stream is fed into the patch, while individual video frames are analysed for specific colour boundaries changes. The colour of the floor is subtracted in the process, so a clear image of the moving silhouettes of listeners can be obtained. The actual position of the listener is acquired from the video stream using the Jitter Max/MSP *jit.findbounds* object. The $x - y$ axis position of the listener is based on the Cartesian coordinates and is derived from the installation area projection onto the floor. The projected plane is than translated into an Ambisonics sound 2D position. The camera itself is suspended from one of the central base components and is setup to cover evenly a one meter radius around the installation.

The change of the listener's position is also continuously evaluated and sounds are triggered, when the acceleration of the listener's movement exceeds a specific set threshold. The soundscapes are generated on the fly from the pre-recorded sounds, which are stored in two separate audio banks: the *drone sampler section* and the *solo sampler section*. Every time the movement acceleration of the listener exceeds a preset value a solo sound theme is added to the soundscapes as a spatialized element following the listener's actual position. The *drone sampler section* builds up the underlying vibe and mood of the soundscape, while the *solo sampler section* sound theme bank follows the moves of the listener across the installation audio field. The selection of the sound samples itself is triggered randomly and ensures, that a new original sound combination always creates an original soundscape.

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[3] Solid Drive®; more information can be accessed online at http://soliddrive.mseaudio.com

[4] Ambisonics Tools from the Institute for Computer Music and Sound Technology ICST, Zurich University of the Arts can be accessed online at: https://www.zhdk.ch/index.php?id=icst_ambisonicsexternals

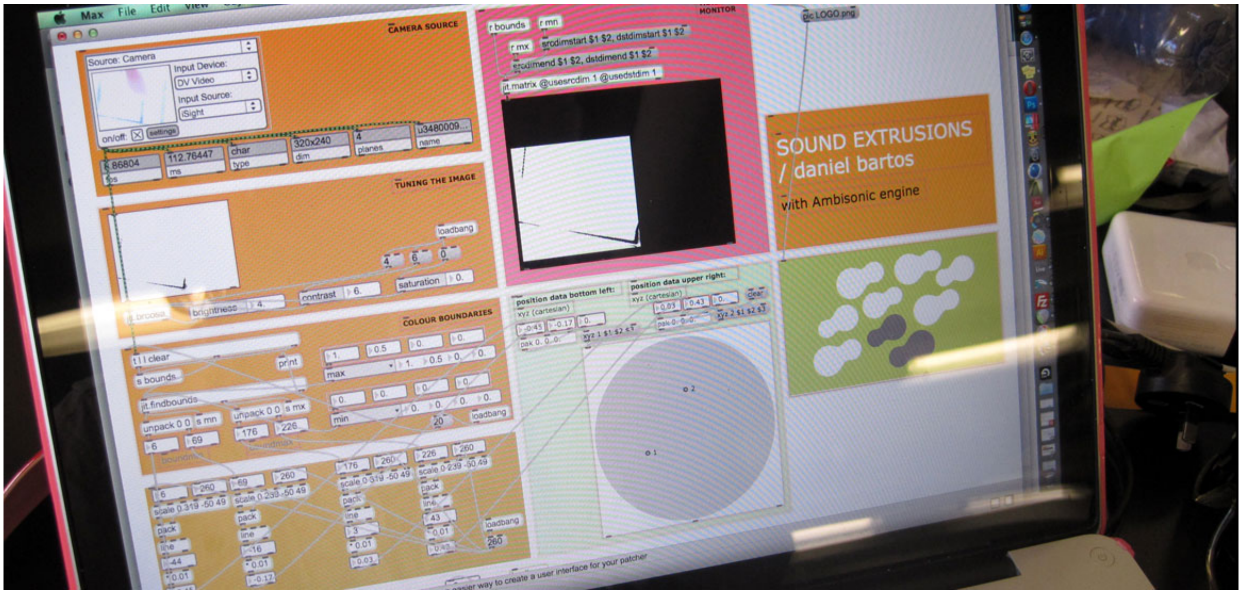

Figure 6: The original Max/MSP patch

Lookout & Conclusions

The porcelain production proved to be the bottle neck of the whole production, as this was expected from the very start of the project. The manufacturing itself took more than three months to complete due to the details of manufacturing process involved. Two original shapes were modelled in clay. The clay models were than transferred into two negative plaster moulds. The process of mould drying, of such a rather larger size, takes weeks to dry out completely. The success of the following porcelain slip casting depends on the quality of the materials used and it's respective handling. Casting of such a thin porcelain walls presented a problem on its own and many shapes were broken during the process – a regular 'safe' wall thickness would be around 3 mm in this type of object casting. The bisque firing takes also minimum of 24 hours to complete, as it involves the cooling phases as well. The final firing with applied glazes is also crucial and a porcelain shape design has to be taken into the account as the porcelain properties change in the range of higher temperatures above 1200C°. The shapes become elastic during the process of porcelain vitrification and if not correctly suspended, they can come out of the kiln distorted. The whole production process takes weeks rather than days or hours. The shapes have also great degree of variation of the wall thickness and the acoustic properties are not consistent than. Having said that, a series of measurements in an anechoic room would be a perfect addition to the project, but was not realized yet. The best sounding sounds projected through the shapes were the ones capturing physical impact of small objects on a hard surface. For example rainstick sounds or impacting pebbles sounded very realistic, especially in the overhead position. The position sensing ability has it's own specific limitations: because the patch is using the *jit.findbounds* Jitter Max/MSP object, the interaction is limited to one listener at the time. Another solution would be using more advanced techniques from the CV package[5], which would give the whole project more interaction possibilities – as for example creating polyphonic soundscapes interacting with multiple listeners at once.

Overall, the Rainforest installation represents rare use of the porcelain material in a sound installation experiment and creates novel state-of-the-art element with an unique design rather than a special hi-end submersive audio field.

[5] Computer Vision for Jitter by Jean-Marc Pelletier; more information can be access online at http://jmpelletier.com/cvjit

Additional Information

Daniel Bartoš is sound and multimedia artist from the Czech Republic. The most important attribute in his work is represented in the blend of digital realm within the tangible analog world. The preferably invisible digital interaction opens up new creative world of experience. Daniel is focused on sound, multichannel setups and interaction programming, while using other media platforms in the process as photography and animation. The mixture of digital realm with the physical aspects of sound and interaction is especially true for the following projects: *Motion Origami* – gesture based experimental music instrument using Leap Motion; *Rainforest – a* porcelain sound installation as an interacting living element; *e-didjeridoo instrument* (electro – extended – enhanced) – where the traditional Australian music instrument becomes an expressive breath controlled synthesiser. Daniel works with Music Academy in Prague on various sound and multimedia projects collaborations and is current doctoral student at the Centre for Audiovisual Studies at FAMU, Prague. In 2013-14 Daniel has won a 6 months long art residency position as a Sound resident at The Edge institute in Brisbane, Australia.

Web: www.danielbartos.com/rainforest; www.danielbartos.com/sound-extrusions

Video: https://youtu.be/Pz2Erx-JTWc

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