THE SHAPE OF SOUND: USING MIXED REALITIES TO BRIDGE MUSIC AND ARCHITECTURE

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Abstract. There are structural and aesthetic components in architectural design that mirror the foundational components of musical compositions. In recent years, both architects and musicians have taken advantage of the advances in technology, allowing for new designs and compositions that would not be possible without computers. Mixed Realities, the merging of different reality worlds to create new environments where objects from these reality worlds can interact with each other in a real-time manner, is envisaged to become such technological platform bridging between space and sound. This paper discusses the interfaces of such bridging that can occur via Mixed Realities, the associated issues and possible outcomes of a Mixed Realities system that would allow for collaboration between architects and musicians.

Keywords. Mixed Realities, Collaboration, Architecture, Music, 3D Visualizations.

1. Introduction

There is a certain fluidity and beauty to post-contemporary architecture that is not found in the stoic classical buildings of the past. While the buildings of the past are beautiful in their own light, it is with the recent advances in technology that more experimental designs and structures have been made possible. The same is true for music. With the aid of computer technologies, musicians are able to experiment with the shape of sound and the way in which it is produced.

Architecture and music are linked by their similar characteristics. The structures, repetitions, patterns, harmonies and variations (among other elements) are based on the same mathematical and aesthetic principles that can be found in nature (http://www.mcs.surrey.ac.uk: Sep 2007). With the digitization of design (including musical composition as a design form), the latest trends in architecture and music have included producing impressive new techniques. Using technology to create a feasible collaborative connection between architects and musicians can potentially produce an enriching design environment where the relationship between space and sound will be able to evolve, just as each of the separate fields have advanced with the aid of technology. Mixed Realities, the merging of different reality worlds to create new environments where objects from these reality worlds can interact with each other in a real-time manner, is envisaged to become such technological platform bridging between space and sound. The exact definition of Mixed Reality is indeed debatable. Milgram et al. (1999) defined Mixed Reality as an environment where physical and digital information is presented together on a single display. However, Benford et al. (1998) defined Mixed Realities in a
broader sense, as new forms of shared space that span different dimensions and that integrate
the local and remote and the physical and synthetic. Closer to the Benford’s definition, the
Mixed Realities concept in this paper refers to any merging of different reality worlds, more
specifically between music (played or written) and architecture (physical or digital). This
paper discusses the issues and possible outcomes of a Mixed Realities system that would
allow for collaboration between architects and musicians.

There has been some noted research work on concepts and interfaces for linking music and
space together. For instance, in Navigation via Continuously Adapted Music (Warren et al.,
2005), the authors described a system of musical navigation where information about location
and space are given to the user through musical cues. They believed using music as a
navigational guide to location is a promising approach to tracking mobility. Three dimensional
music interfaces are the key components to Sutoolz 1.0 Alpha: 3D Software Music Interface
(Wynnychuk et al., 2002). The user controls music by navigating through virtual architectural
spaces. Sound becomes a visual experience as the user creates an auditory performance with
visual elements. In The Magic Music Desk, the emphasis is on visual 3D sound, where sound
is linked to virtual 3D objects. Rethinking the design of traditional acoustic instruments, and
questioning why digital instruments (such as the keyboard compared to the piano) mimic their
acoustic counterparts, is the basis of the design described in Augmented Reality Interface for.

2. Precedent

2.1. COLLABORATIVE DESIGN

Using technology for collaborative design purposes is typically thought of from two approaches,
the designer-designer collaborative relationship, and the designer-client instructive relationship.
Two designers can use technology to collaborate with each other at different stages of a
design. In a designer-client relationship, the designer can use the technology to explain
confusing or difficult concepts to the client. But for the purpose of collaborative design between
architect and musician, the technology needs to be appropriate for each of the separate skill
sets and design techniques brought to the collaborative environment (similar to the designer-
designer collaborative environment, except with the addition of a different type of design.) It
also needs to be able to translate what each person is into a language that the other person can
understand (similar to the designer-client instructive environment.) To do this, there must be
similar attributes between the two separate fields that are translatable, at the very least, on an
abstract level. Those similar attributes are elaborated and discussed in the next section.

2.2. SIMILARITIES OF ARCHITECTURE AND MUSIC

Music is usually thought of as an auditory experience, but just as architecture has rules,
musical composition also is guided by structure. A basic rhythm tree shows the very
mathematical and precise nature of musical composition. The musician is bound to rules
without which music cannot exist. Architecture, likewise, can not physically exist as real
spaces without set rules that are dictated by gravity and other forces outside of the architect’s
control. Architectural structure is composed of beams, columns, trusses, foundations, and
other physical objects which already exist in previous buildings and designs, but which the
architect can change, according to the rules of architecture, to meet the needs of each space.
Musical structure is composed of notes and rests within measures. These elements of music
are given, but it is in the way the musician places them, according to the rules of music, that
individual pieces of music are produced.

An interesting element is the element of surprise. In music this is the climax of a piece and
in architecture is often referred to as the attractor or a focal point of a space. This element of
surprise is not necessarily a loud, shocking moment in time or space. It can be tranquil - an
open atrium flooding a space with unexpected ambient light, or a several measure long trill building up to a pleasant, flowing resolution in a particular piece of music.

Where music is guided by time, architecture is seen by the movement through space. At different points in time, a musical piece will fluctuate, but the overall atmosphere of a good piece will stay consistent with its main theme. The different spaces in a building will also change depending on context, but the overall atmosphere of a good space will also stay consistent with itself.

Further, music is appealing to the emotions of the listener or player through expression, while architecture provokes a certain experience from the user. These might be considered the most influential part of the piece or space, for it is the expressive experience that lasts with the listener or user and that is used to describe the work. Both music and architecture use repetition of elements as a structural or aesthetic design component. Repetition can create movement through space or time, and produces pleasing patterns and shapes (see Figure 1). Musical repetition is created both with repetitive individual notes and rests, but also with repetitive patterns of notes and rests. Architectural repetition can be created with structural elements such as columns or trusses, but can also be created with repetitive patterns designed by the architect.

Harmony in music is equivalent to proportion in architecture (Khoueiry, 2006). A good harmony is proportional, just as a well proportioned space has a certain and pleasing visual harmony. Additionally, a musician can use dissonances to change the effect of the harmony. A dissonance might sound like a mistake, but if it follows the structural rules of music and it is as the musician intended, it is not a mistake. Similarly, architectural dissonances, such as many deconstructivist buildings, might appear wrong but are not. Designed well, dissonances have their value, and too many are aesthetically pleasing.

![Figure 1. Examples of repetition in the structural elements of Bartok’s String Quartet No. 4 and Norman Foster’s Dresden Station.](image)

The intimacy of a physical space is similar to the amplitude, or volume, of music. A small space might appropriately match a soft pianissimo volume, while a large space could express the feelings of a loud fortissimo. However, each space and musical piece is different and the amplitude matching the intimacy is certainly dependent on each unique example.
Music is meant to be performed, to be enjoyed by an audience, by a single listener or by the musician performing the piece. Likewise, architecture is meant to be used and lived in; it is meant for interaction. “Music is part of architecture — the acoustics of the building, the sound of a city, inspire you and give you kind of a connection. And certainly, even the way that architecture is produced is very similar to music. You have to write an abstract score. The plans, the sections, elevations, but in the end it has to be performed by others and it has to… be harmonious” (http://www.cnn.com: Nov 2006). Like the expression and experience, music and architecture are similar in their dependency on human interactivity.

Finally, all music has a concept or story. The music itself is a story, it tells a story, it goes along with a story, or it is a story to be determined by each individual listener. The story might be a specific one, a fairy tale, an opera, a pop culture reference; there are no limits on the stories that music tells. Similarly, architecture starts off with a concept. There are specific meanings behind the design decisions that an architect makes. The design begins in the conceptual stage with ideas that might or might not be made public, but those ideas often carry through the entire design process.

2.3. SPACE MEETS SOUND

There are many examples of architects using their musical backgrounds as inspiration for their designs. Two notable musician architects are Daniel Libeskind and Iannis Xenakis. Daniel Libeskind, formerly a professional pianist, has spoken often about the connection between music and architecture. “Music is certainly part of my life and it is part of architecture. When I was designing the Jewish Museum in Berlin, the acoustics of the building, the sound of the building was one of the primary dimensions of creating that space of the void.” (http://www.cnn.com: Nov 2006) Libeskind has made abstract and aesthetic connections between sound and space and designed buildings based on his own interpretations of those connections. Iannis Xenakis was a 20th century Greek composer and an architect who took a more literal approach to designing spaces based on the shape of sound. He drew theoretical musical elements (Figure 2) and then translated those into physical shapes. Using elements from music, Xenakis worked with Le Corbusier on projects such as the chapel at Ronchamp. He was intrigued by the nature of the problems and solutions within architecture and music (www.arts-electric.org: Sep 2007), and his architectural design strongly reflected his musical abilities.

Figure 2. Drawings by Iannis Xenakis (www.arts-electric.org: Sep 2007)
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There are also examples of architects collaborating with musicians, such as Santiago Calatrava’s Milwaukee Art Museum opening to a musical piece written by Philip Glass specifically for the opening. While this is a unique collaborative example showing the compatibility of architecture and music, there are still issues involved with this type of collaboration. Most notably, as Philip Glass has spoken about, the design of the building was nearly finished by the time Glass was asked to write music for the opening. “The designer or the architect or the artist has to actually be willing to get into the complex business and the complex encounter of collaboration. And usually, you have to remember, by the time the inauguration of a building happens, the building is done, it’s up... By the time they think of the composer, the work is done... The trouble is that real collaboration has to begin very early and by the time they think of the composer, it’s very late.” (Lerner, 2007) True collaboration between architect and musician would enable them to work together at the beginning of the design process, placing equal importance on both the music and the building.

2.4. SOUND MEETS SPACE

There are several artistic projects and computer programs that use the similarities between architectural space and music to create new sounds or spaces. Symbolic Composer (www.symbolicomposer.com; Sep 2007) is a computer program for musicians that aids in musical composition. It has the capability of generating 3D models in VRML format based on the music. Instant City (www.instantcity.ch; Sep 2007) is an interactive table that allows users to create sounds by manipulating space in the form of blocks. Audiopad (www.jamespatten.com; Sep 2007) is a system that facilitates the composition and performance of electronic music via the movement of objects on a tabletop. AudioCubes (www.percussa.com; Sep 2007) allows the user to create musical patterns which are then exchanged by the cubes. As the user moves the cubes around, the patterns evolve and music is created. Each of these systems is unique and innovative, but they give greater importance to the music than the space. If space and sound are given equal importance, new ideas and possibilities can be generated from the collaborative work between architects and musicians.

3. MR Collaborative Platform for Architects and Musicians

3.1. A MARRIAGE BETWEEN SPACE AND SOUND

A technology that allows for a digital marriage between architecture and music, one in which both will have equal importance, will have certain issues with which to be dealt. Primarily would be the question of music being taken as either an abstract or literal definition of space or if a median between the two (depending on the context of each individual situation) should be used. Music is already known for having two dimensional visualizations, as seen on any media player visualization window. The dynamics of a real space translated from a virtual music will be considerably different depending on the degree of abstraction in the translation. Additionally, if a unique, real architectural space can be produced from a virtual music, then reversing the process should produce real music out of virtual three dimensional spaces. The more experimental the dialogue between real and virtual, the more interesting the resulting spaces and sounds will be.

3.2. PLATFORM FOR COLLABORATION

To bring musicians and architects together to a collaborative environment that places equal importance on both music and architecture will require the collaboration to take place at the beginning, conceptual and experimental stage of design for both. Each will require a unique
system and interface that is appropriate for the details of their work. Figure 3 depicts the conceptual designs of designer interfaces for the Mixed Realities system. The musician will need digital instruments, inputs, audio equipment and music editing software, while the architect will require CAD and modeling programs. But the systems must also be able to read, translate and display the work of both. The architect must hear the music and see the two dimensional graphical representation, and the musician should be able to see the spaces generated not only by the computer (from the music) but the spaces edited by the architect.

With this system, a musician would be able to compose real music, send it through the computer to the architect, who receives the digital audio and video files as well as a Virtual Reality Modeling Language (VRML) model. The architect would then be able to manipulate the model into a space which can then be developed further towards the realization of a physical building, or it can be sent back to the musician, the process reversing and the manipulations made by the architect becoming new sounds with which the musician can work.

![Figure 3. Left: Musician’s interface. Right: Architect’s interface](image)

The intended purpose of the MR system is not to produce great works of music or architecture. The technology is a long way from being perfected for this type of collaboration. Instead, it is to facilitate and encourage architects and musicians to share their skills with each other and produce experimental new spaces, sounds and ideas that can then be used as inspiration in their work.

4. Summary

With the aid of technology, architects and musicians have generated impressive new works. Because the two fields are closely related, a collaborative Mixed Realities design system linking the two can facilitate an environment for shared exploration of the shape of sound and the sound of space and has the potential to allow architects and musicians to produce innovative new techniques and designs that would not be possible without this technology. This paper revealed the similar attributes between music and architecture where Mixed Realities concept can potentially bridge by putting them into appropriate real and digital formats. This paper also discussed the issues and possible outcomes of a proposed Mixed Realities system that would allow for collaboration between architects and musicians. Future work will be implementing and experimenting the Mixed Realities system as a collaborative platform to improve the joint work between architects and musicians.
REFERENCES


