THE ART OF AUDIO ENGINEERING IN THEATRE

An Interactive Qualifying Project Report
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by

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Abstract

This project focuses on the exploration of technology, specifically a MIDI music workstation, to aid in developing techniques for the live performance of audio for theatre. The techniques and technologies examined in the course of this project were practiced during the WPI performance of an adaptation of *Frankenstein*.

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Chapter 1

Overture

What is art? This question has been the topic of long debates by people from all walks of life. I feel that art is a form of expression. It shows creativity, and imagination. An artist has something to say, or feelings to express, and he expresses them through his art. I take a more liberal definition of the word "art" in that I believe that things such as the way one arranges and decorates his bedroom is art, if he is expressing himself though the arrangement. Other people are more conservative with using the word "art." These people look at paint splattered on a piece of canvass as just that, not as art. There are also many, many people who fall somewhere in between. The definition of "art" is very subjective.

I am a very technical person, but I feel that much of what I do is an art. Computer programming, audio engineering, and lighting for both concerts and the theatre all fall in this category. All of these involve highly technical procedures, but each is an art as well. For example, every computer programmer has a distinct style of writing code, and every audio engineer has a different perception of what the band or the theatre show should sound like. Any one of these activities is "an art," but not all of them are considered "art."

As Shakespeare once said, "All the world's indeed a stage, and we are merely player, performers, and portrayers, each another's audience outside the guilded cage." Shakespeare, of course, was referring to the actors. Back in his time he did not have the lighting or audio technology that we have to work with today. If any audio effects were used the actors themselves generated them. In this day and age, however, we have a

multitude of resources on our hands for generating and playing back theatre sound effects at the appropriate time. The people in charge of audio for a theatre show have been labeled "tech people," and are treated differently than the actors. This doesn't have to be.

Traditionally, sound engineering for theatre shows has been more of a craft than an art. The sound engineer would simply press a button when told to do so and make a pre-defined sound or combination of sounds play. In the course of this project, I explored several methods of bringing audio engineering for theatre from a craft to an art. I moved forward with the idea that I could become part of a show, rather than simply sit on the outskirts and press a button when someone told me to. I examined many different technologies and techniques that would allow me to carry out my vision. I brought some of these techniques to life during WPI's world premiere performance of an adaptation of *Frankenstein*.

This is the tale of my adventure.

Chapter 2
Scrutiny

I investigated several pieces of equipment that I believed could aid in my quest to bring out the performance aspects of audio engineering in theatre. My primary focus was on the Korg N364 musical workstation. This is a MIDI keyboard with a full compliment built-in MIDI samples, sequencer, and ability to interface with other MIDI devices.

One of the original thoughts was to use the keyboard's built in MIDI samples to build sound effects instead of using the traditional method of creating digital sound samples, recording cues to CD Audio tracks or minidisk tracks, and playing them when called. This idea was quickly abandoned. The Korg N364 is a great tool for composing electronic music and MIDI sequencing. However, it would take a large amount of effort to create a usable MIDI sound effect of the same quality as a digital sound effect.

Despite this fact, the N364 was integral to the success of this project. A Sufficiency project done in D-term of 2001 showed how this keyboard could be connected to a PC and used to play digital sound cues stored on the PC. I took this one step further, and instead of storing whole cues, I stored a collection of sound samples that I would need to generate the cues. Each cue was designated, on paper, as one or more keyboard keys that needed to be played simultaneously or in rapid succession.

Another question that arose was whether we could use the keyboard's built-in MIDI sounds as well as using it to play digital samples stored on the computer. I found that it is possible, albeit tricky. If the computer software that listens to the keyboard and plays the digital samples is running, these samples will play when the appropriate keys on

the keyboard are touched. If the software is not running, you cannot use the keyboard to play the digital samples. Also, if you change the keyboard's MIDI instrument while the computer software is running, it will no longer play the digital samples.

One solution to this problem is to use another piece of computer software to play the digital samples while you are playing MIDI samples on the keyboard. Since the digital samples are simply Windows wave files, most audio playback software will work. With this method, though, you lose the ability to easily play multiple samples at the same time.

I used the Creative Keyboard, packaged with the software shipped with most Creative Labs sound cards, as one tool for interfacing the MIDI keyboard and the digital sound samples. The Creative Keyboard has a nifty feature which allows the user to right-click on a key and it will hold. So if you have one or more looping sound effects that you want played in the background while playing MIDI sounds from the keyboard, this is the way to go. As long as the instrument on the N364 has been changed, you can click on individual keys of the Creative Keyboard to insert single samples. The only thing you have to remember is that the file that maps the keys on the keyboard to the digital sound samples, called a soundfont, needs to be reloaded when you are done playing the MIDI sounds. Otherwise the computer will not respond to the N364.

The ability to loop samples without noticeable interruption was another great advantage to using the N364. Loop points on any sample could be set within the Vienna Soundfonts software, which was what I used to perform the actual mapping of MIDI keys to digital sound samples. When the MIDI key on the N364 is held, the digital sample will loop between the designated start and end points. A problem arises when you want

to stop playing the sample. Simply lifting your finger off of the key will bring the sound to a sudden and usually ungraceful halt. You could slowly bring the faders on the audio mixer down until the sound stops, but this would bring all sound (with the exception of the actors' voices) out of the theatre, and you may still need to have other sound samples playing. What I did was take a five second chunk of the original sample, apply a four second fade-out to it, and save it as another sample. I assigned this new sample a key next to the original sample. When it came time to fade that particular sample out, I pressed the key containing the fade-out sample and released the key assigned to the original looping sample. If done properly, the audience will only hear the sound fade out and not have any clue that a second sample was even played.

Some skill at playing the piano or keyboard comes into play here. Because the keys on the N364 are touch sensitive, the fade-out sample could be played at a louder or softer volume than the original looping sample, and the audience will notice this sudden change. Your fingers will naturally press different keys with different amounts of pressure. Anyone with skill or experience at playing the keyboard or piano will have mastered the ability to control how much pressure each finger applies to a key at any given time. For those who have not played the piano, I suggest many hours of practice with fading out the sound effects so that the skill is mastered when it comes time to perform.

The touch sensitive keys on the N364 can work to the sound engineer's advantage and disadvantage. An obvious advantage is, through skill or practice, the ability to play the same sample at different volume levels on the fly without adjusting the volume of the

entire system. The flip side of this is that if the engineer is not careful, samples that need

to be played at the same level can easily be played at different levels each time.

Chapter 3

Formulation

Just as the actors on stage study the script and attend rehearsals, so should the sound engineer, if he wishes to truly perform. This gives the engineer an idea of what sound effects will be needed and what actions these sound effects are going to be reinforcing. Rehearsals are also the prime opportunity for the sound engineer to offer to the director his own creative ideas for background sound effects to reinforce certain scenes.

Often times the sound designer and sound engineer is the same person, which was the case with this project. As one of the sound designers I needed to create the sound samples that I would use during the performance. The *Monster Technology* IQP done in the summer of 2001 by James Nichols and Christopher Cenotti provided me with many of the sound effects that I needed. I was able to use many of these samples exactly as they were given to me, whereas with others, I simply cut portions out and used those portions as samples. Any samples the director and I decided we needed during the course of rehearsals I created myself.

All of the sound samples should be recorded or converted to have a sampling rate of 44.1Khz and a bit rate of sixteen bits, otherwise known as CD-quality. Samples not recorded at a lesser or even greater sound quality may not work properly with the Vienna Soundfont software. Unless you have a specific need for a stereophonic sample, all samples should be monophonic. Stereophonic samples must be assigned to two separate

keys on the MIDI keyboard when building the soundfont, thus using keys (and fingers) unnecessarily.

Creating the soundfont is the next step in the preparation process. The details of how to create a soundfont are described in the *Theatre Tech User's Manual for the Korg N364 Music Workstation and SB Live* (http://www.wpi.edu/~theatre/Keyboard) sufficiency project by Matthew Trachimowicz. The art of this whole process is in the planning. Samples will need to be used in different combinations for different cues and the same samples won't always be played together. The engineer should have a good idea of what the different cues for the show will be, so that he may place related sound samples close together. The same sample may even need to be assigned to multiple MIDI keys. When mapping out the sample-to-key assignments, the engineer should consider such things as comfort and finger reach.

Other than the advantages I have already mentioned, using soundfonts provides the engineer the ability to easily swap out a single sample without having to remix an entire cue. For example, if the thunder sample in a thunder and lightning storm were undesirable, the engineer would simply have to record a new lightning sample and load it into the soundfont. For complex cues this is a great time saver. It also affords the engineer the opportunity to create several different varieties of the same sample and swap them out during a rehearsal or even right before a show.

Finally, a sound system must be designed. The necessary sound system will vary from show to show, and there is a large amount of different types of equipment available to choose from. The *WPI Theatre Technology Handbook* IQP (http://www.gweep.net/~prefect/pubs/iqp/) by Steven Richardson and the *Theatre*

Technology Handbook

(http://www.wpi.edu/Academics/Depts/HUA/TT/TTHandbook/index.html) IQP by

Steven Hocurscak both describe various combinations of equipment that can be used.

For WPI's production of *Frankenstein*, I chose a four speaker, two sub-woofer sound

system with each speaker having a separate input signal. One each of the four speakers

was placed in a corner of the house and the two sub-woofers were centered to the left and

right of the house. This provided me with the ability to play sounds from a single speaker

or any combination of the four speakers based on where the action on stage was taking

place. The sub-woofers gave the sound system the extra bass it needed for certain effects

used in the show, such as the voice of the monster.

Chapter 4

Adroitness

The most artistic part of the whole process is in running the show. Instead of simply being a member of the tech crew, the sound engineer essentially becomes an actor. The sound samples are his lines and he must project them as best he can to the audience watching and listening below. Just like any actor, he is capable of fumbling, missing a line, and even putting on a flawless performance. No two performances of a show will sound the same.

The performance is the sound engineer's chance to shine. He has put a lot of time and effort into the preparation, and now has the opportunity to share his art with others.

My work with this project culminated with WPI's world premiere production of an adaptation of Mary Shelly's *Frankenstein* by Joseph Romagnano. This was my first experience performing audio in a theatre show. I have run audio for shows in the past, but they were all done using the traditional pre-recorded cue method. I sat behind the keyboard, waiting for the show to start, and felt much like an actor standing off stage waiting to walk on.

The artist's biggest fear is misrepresentation. Because art is subjective, people will have a wide variety of opinions and interpretations of it. The artist has something to say, and wants his art displayed is such a fashion that will accurately express his thoughts and feelings to the vast majority of people. If the artist feels that his art is displayed in such a way that people will misunderstand it, he will be miserable. I felt this same way about my performance during *Frankenstein*. If I liked how my performance sounded, I felt great, and no amount of criticism could change that. On the other hand, if I didn't

feel good about my performance, no amount of compliment or praise could bolster my spirits.

I also felt free to act on my own impulses and express myself. When following traditional sound engineering methods, you are bound to a rigid set of guidelines (the cues), which must be played in order at the appropriate time. With a full compliment of sound samples at my disposal, I had the ability, and often felt the need, to insert sound effects when none were called for. While engineering other shows, I have often found myself wishing that I could add background sounds to certain scenes, but was unable to do so. That was not the case with this show.

Visual cues were also much easier to act upon. If the cue is being played off of a CD, the actor is strictly playing off of the sound cue, as the engineer's attention is more focused on the CD player rather than the stage. This can lead to the actor and the audio not quite being synchronized. During *Frankenstein*, I had to play two gunshots when the actor on stage pulled out his gun. Because I was using the keyboard, I was able to ready my finger over the key that would play the gunshot sound sample and focus my attention on the stage. I was able to play the sample twice in a row, without any of the delay that comes from stopping and rewinding a CD track, giving the gunshots a much more realistic quality.

Working with the master electrician, I was also able to produce a much more realistic thunder and lightning storm. While looping rain and wind samples, I kept my eyes on the stage and watched for flashes of lightning. The volume of the thunder would correspond to the strength of the lightning bolt, and would change based on how hard I pressed the key on the keyboard.

Chapter 5

Finale

One of the goals of this project was to investigate the Korg N364 musical workstation to determine if it could be used by itself to generate sound effects. In the course of my investigation, I learned that this really wasn't feasible. Any sound effects that are created would sound computer generated rather than realistic. A large amount of time and effort would be required to create the effects, with little return on the investment. However, the keyboard proved essential to the live performance of audio effects during a theatre show.

The live performance of audio for a theatre show was an entirely new experience for me. At the beginning of this project I was very unsure of how well the methods that I proposed would work. Much to my delight, they not only worked, but far exceeded my expectations as to utility and flexibility. I reveled in the ability to instantly, either at the request of others or by my own volition, add audio to a scene during a rehearsal. I absolutely adored the fact that I could replace any sound sample I wanted with a better one without having to remix multiple cues. I have never felt the way I did when a performance was over and I was pleased with how I had performed that night.

The art would not have been possible without the technology. The computer and software that accompanied it provided me with the ability to create, store, and make available as many cues as I would ever need for a show, and the keyboard was the instrument on which I performed. I cannot imagine attempting to perform as I did during *Frankenstein* if I had to use a CD player. I don't think it would be possible.

The technology, however, would be useless without the art. Almost anyone can press a button when they are told to, but it takes an artist to perform. The equipment that I used for this project, while can be used to play traditional sound cues, is unnecessary for such a simple application. Only when one wishes to perform or express themselves does it become necessary.

I feel that the work that I have done on this project will greatly impact audio engineering at WPI in the future. I hope that others like myself will use this project not as an instruction manual, but as inspiration to bring out the artist inside, and not be fearful of trying something new. There are an infinite number of techniques and technologies that can be combined to bring a vision to life. While I hope to see the work I have done emerge in future shows, I would also like to see others expand it. I firmly believe that this is only the beginning, and its up to the future generations of engineers to take the art to an even higher level.

Appendix A

Summary of Equipment Used

Korg N364 Musical Workstation
Manufactured by Korg

The N364 is a 61 key MIDI sequencer with velocity and after touch sensitivity on the keys. More information is available at www.korg.com

Create Labs Sound Blaster Live!
Manufactured by Creative Labs

The SB Live is a PCI sound card with front and rear speaker outputs, line level input, microphone level input, digital input/output, and MIDI interface.

Vienna Soundfont Studio 2.3

This is the software that I used to map MIDI keys to digital sound effects. It is available for free download at www.soundblaster.com/goodies.

Sound Blaster Liveware v3.0

Liveware is the software that ships with the SB Live and provided me with software support for the four speaker sound system as well as various audio filters that were used when generating some of the sound effects.

PCDJ Red Version 5.1
Manufactured by Visiosonic Ltd.

PCDJ is a software package used by professional disc jockey's to play songs stored on the computer in MP3 format. It has many features such as cueing, sample looping, and automatic beat matching. More information is available at www.pcdj.com.

Appendix B

Project Proposal

I. Introduction

        In the past, sound engineers for theatre shows have simply played pre-recorded sound cues handed to them by the sound designer. Sometimes the engineer and the designer are one in the same, in which case this person assembles the sound cues in the order that they are needed and just presses play throughout the entire show. I intend to prove that this need not be the case. The sound engineer could be considered an actor, and give life to the audio support during a theatre show. One way to accomplish this is to work with single sound samples assigned to separate keys on a musical keyboard. During the show, the engineer will make different sounds play through, possibly, different speakers strategically placed in the theatre, and he or she may mix multiple samples together by pressing different keys on the keyboard, either singly or in unison.

        I also hope to establish communication between this musical keyboard and a MIDI capable lighting console. This would allow the sound engineer to cue different lighting effects simultaneously with sound effects. One area where this would be useful is the creation of a thunder and lightening effect.

        The results of this project will affect the audio engineering of WPI's world premiere production of <u>Frankenstein</u>, as well as audio engineers and technical directors of the future. Other audio engineers should be able to read this document and gain a good understanding of what they need to do to accomplish artistic sound engineering. The audience of the shows in which these methods are used will also be affected, as they will experience more life-like audio support.

After acquainting myself with the operation of the necessary equipment, I will begin the process of preparing the sound samples to be used in my testing. These sound samples have already been recorded for use with <u>Frankenstein</u> and, with minor modification, will become suitable for my needs. The actual performance of <u>Frankenstein</u> will be the testing ground for the methods set forth in this IQP. I am confident that my proposed methods will succeed, and that bringing forth the art of audio engineering will dazzle actors and audience alike.

II. Literature Review

Many outside materials will assist me on my quest. A Sufficiency project done at WPI in D-term of 2001 explains the basics of setting up and operating the Korg N381 musical workstation, in conjunction with the Creative Labs SoundBlaster Live, for digital audio playback. This document proved very useful. The N381's basic installation guide was also a great help in getting me started. A larger reference manual for the N381 is also available, and would provide much assistance in learning how to exploit the more advanced features of this MIDI workstation. I have ordered a copy of this manual and am waiting for its arrival.

The <u>Monster Technology</u> IQP done in the summer of 2001 will provide me with all the necessary sound samples that I will bring to life, along with a complete cue list. Because all of the sound design has been done, I am able to concentrate strictly on the performance aspect of sound engineering.

The script itself is a valuable resource. Not only does it provide information on what sounds are needed, but it also tells the sound engineer what the actors are doing at any given time. This can be useful when deciding what side of the room the sound should originate from, whether or not it should move, etc. Attending rehearsals is also strongly recommended. This way you have a good idea of where the actors are actually going to be on stage, where entrances and exists will be made, and other critical information. While the script provides all this information in words, directors will often interpret stage directions and adapt them to the space they will work in.

I will also draw heavily on my own personal experience as an audio engineer, both in and out of the theatre. My past experience gives me a solid knowledge base from which to draw; this will be essential when the time comes to bring <u>Frankenstein</u> to life.

The manual for the High-End Hog 500 lighting console will become useful later in the project, when I attempt to interface the keyboard and the lighting console.

A love of art is essential to successfully use the methods that will be described in this project. The methods that will described in the next section, and detailed in the remainder of the project, call for a sound engineer to abandon the traditional methods of pre-recording sound cues in the order they are needed and playing them in said order. The engineer essentially becomes an actor or performer. For this reason, a love for art, specifically theatre, is in the recipe for success.

III. Procedure

The first step toward completing this project is to familiarize myself with the necessary equipment. I am using a Korg N384 musical workstation to play digital sound samples stored on a personal computer. Inside the computer is a SoundBlaster Live

sound card. The keyboard is connected to the sound card through the MIDI interface. The sound samples are stored as Windows WAV files and mapped to keys on the keyboard using Vienna SoundFonts software. While I have some experience using the SoundBlaster Live, I have never attempted to perform MIDI communication with it. Thus, my first task will be to familiarize myself with this.

Once I am comfortable with setting up the keyboard and have established communication with the PC, I will need to familiarize myself with the Vienna SoundFonts software. To do this, I will create a sample sound (or use one of the pre-loaded Windows sound files) and attempt to map it to a key on the keyboard. Once this is accomplished, I can begin work on the major portion of this IQP.

With this IQP, I hope to bring the technical aspects of theatre together with the performance aspects. Traditionally, sound and lighting engineers generate a pre-defined list of cues prior to a show, record them to compact disc or other media, and simply advance to each sound cue in the necessary order. What I hope to do is bring audio engineering for theatre shows to another level. I hope to prove that the audio engineer is not merely a technical cog in the production staff, but actually an actor actively participating in the performance.

The musical keyboard is essential to accomplishing my goal. By assigning each sound sample to a key on the keyboard, the audio engineer may mix sound samples during the production. For example, the impromptu addition of seagulls and foghorns to waves crashing against a beach gives the audience and the actors less rehearsed, more realistic background sound for a beach setting. One sound engineer could mix as many as ten different samples together at any given time.

Some planning is still required. Sound samples must be chosen ahead of time and recorded onto the computer in a format acceptable to the SoundFont software. The engineer must have some idea of which sound samples may be used together so that they can be strategically assigned to keys near one another. The sound system must be carefully designed to ensure that the audience will receive the optimal audio experience.

There are two sub-goals that I hope to achieve with this project. I hope to produce a document that can be used by future sound designers and engineers on how to configure the SoundBlaster Live for four different channels of output. The SoundBlaster Live is equipped with two different stereo output ports. If the sound engineer can direct the sound output to a specific channel and port, the sound sample can be heard from different places in the theatre. Going back to the beach example, if a flock of seagulls is flying by, the sound of the seagulls could be made to move from one side of the room or another. If a gunshot were fired from down stage right, the sound of the gunshot would be heard from the house left rear speaker.

My other sub-goal is to use the MIDI interface on the keyboard and the computer to communicate with a lighting controller, allowing the keyboard to execute cues on the lighting controller. These cues could be synchronous with a sound effect, completely separate from a sound effect, or be delayed.

The artistic value of sound engineering in theatre is grossly underestimated. I hope that the work that I do on this project, in conjunction with my work on WPI's world premiere of <u>Frankenstein</u> will bring to light this artistic value. As the audio engineer for <u>Frankenstein</u>, I plan on using many of the methods I mentioned above.

Appendix C

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Appendix D

Supplementary Compact Disc

The supplementary compact disc contains this document in its entirety in both Microsoft Word and HTML format, as well as a sample of the sound cues I created with the keyboard.