Soundscape

Virtual Reality Audiovisual Experience

Megan E. M. Washburn

Liberal Arts and Engineering Studies:

Computer Graphics and Music

California Polytechnic State University

12 December 2018

**Soundscape:  
Virtual Reality Audiovisual Experience**

Megan Washburn

Liberal Arts and Engineering Studies:

Computer Graphics and Music

Senior Project Advisors: Michael Haungs and David Gillette

California Polytechnic State University

San Luis Obispo, CA USA

12 December 2018

Contents

[1 Introduction 3](#_Toc529282603)

[1.1 Problem Statement 3](#_Toc529282604)

[1.2 Project Goal 3](#_Toc529282605)

[2 Application / Product 3](#_Toc529282606)

[2.1 Start 3](#_Toc529282607)

[3 Background 3](#_Toc529282608)

[3.1 Finish 3](#_Toc529282609)

[4 Design 3](#_Toc529282610)

[4.1 VR Structure in Unity 4](#_Toc529282611)

[4.2 Structure of Audio 4](#_Toc529282612)

[4.2.1 Background Ambient Music Compositions 4](#_Toc529282613)

[4.2.2 Sound Effects for Interactable Objects 4](#_Toc529282614)

[4.2.3 MIDI Arpeggiator 4](#_Toc529282615)

[4.3 Version Control 4](#_Toc529282616)

[5 Implementation 5](#_Toc529282617)

[5.1 Unity Development Kits 5](#_Toc529282618)

[5.2 Ableton Live 10 Music Editing 5](#_Toc529282619)

[5.3 Obstacles 5](#_Toc529282620)

[5.3.1 Platform Capabilities 5](#_Toc529282621)

[6 Analysis and Verification 5](#_Toc529282622)

[6.1 Playtesting 6](#_Toc529282623)

[6.1.1 Survey Results 6](#_Toc529282624)

[6.1.2 Reviews 6](#_Toc529282625)

[6.2 Industry Specialist Review 6](#_Toc529282626)

[7 Interdisciplinary Connections 6](#_Toc529282627)

[7.1 Start. 6](#_Toc529282628)

[8 Related Work 6](#_Toc529282629)

[8.1 VR: Music Visualizers / Interactive Applications 6](#_Toc529282630)

[8.1.1 Playthings VR 6](#_Toc529282631)

[8.1.2 Beat Saber 7](#_Toc529282632)

[8.1.3 Raybeem VR Music Visualizer 7](#_Toc529282633)

[8.2 Music Visualizers / Interactive Musical Applications 7](#_Toc529282634)

[8.3 Personal Previous Work 7](#_Toc529282635)

[8.3.1 Band Wagon 7](#_Toc529282636)

[9 Future Work 8](#_Toc529282637)

[9.1 Thesis Lead-In 8](#_Toc529282638)

[10 Conclusion 8](#_Toc529282639)

[11 References 8](#_Toc529282640)

# Introduction

## Problem Statement

Current audio implementation in most VR experiences is underutilized. This project aims to demonstrate the power of audio when developing a VR environment or experience. By setting up an environment for a user to interact and experiment with, this project aims to achieve a deeper impact on the user via interactive visual and audio cues.

## Project Goal

To develop a visually and auditorily immersive virtual reality experience to further explore the capacity of audiovisual components of VR environments. The user will be able to interact with virtual instruments in the environment via controller input and microphone input, to generate correlated audiovisual output in the environment.

# Application / Product

## Start

# Background

## Finish

# Design

Before implementation in Unity [1]

## VR Structure in Unity

Given the multi-component nature of this project, I wanted to be sure to start with a solid organizational structure to maintain sustainable development. Previously, I’ve worked on game projects that all too often end up with bloated file structure and outdated asset libraries, that ran into issues with versioning and concurrent development. Therefore, going into this project, I kept in mind some recommended best practices for organizing Unity project directories [2]; these recommendations for structuring have served me well up through the close of development on this project.

In terms of porting this project to VR, there was not much else needed in the backend other than to implement the joint documentation for Oculus and Unity developers’ Oculus Utilities for Unity. Using the OculusVR Plugin (OVRPlugin) [3] made the conversion from development in a single-screen format to a virtual reality environment seamless, when followed correctly. Again, I must reiterate the importance of access to the correct tools and hardware; after transferring development to a machine better suited for VR development (as noted by Oculus’s specification requirements [4]), the rate of productivity and creation greatly increased.

## Structure of Audio

While arranging in Ableton Live 10, I wanted to keep my compositions organized not only for ease of development, but to smoothly integrate changes when I ported over the compositions to Unity. Of the variety of recommended song structures, I decided to take inspiration from pieces of Ableton’s guide on arrangements [5].

FMOD studio greatly aided in development, as this sound effects engine and authoring tool is primarily designed for video game scoring and sound design. [6]

### Background Ambient Music Compositions

### Sound Effects for Interactable Objects

### MIDI Arpeggiator

I composed audio to feed into Unity scripts that allows the player to automatically step through a sequence of notes based on their input, thus creating an arpeggio.[7] By converting the floating stones to triggers, the players can layer arpeggiations to build their musical work.  
  
Allowing this kind of leniency for the player in triggering sounds required implementing musical structure, to ensure that most combinations would still sound pleasing to the ear. To do so, I composed audio clips using standard arpeggiated patterns [8] that allowed both freedom in creation for the user, yet substantial structure to yield sounds that would be pleasing to the Western ear. [9]

## Version Control

For ease of personal record keeping and the ability to revert back to prior editions in the case of fault, I used GitHub [10] to document my changes and have a reliable backup of version of my project.

# Implementation

Overview of the development process, including technologies used and the nuances of working with these technologies. Structure of this section is largely chronological in terms of my work process.

## Unity Development Kits

Bulleted list.

## Ableton Live 10 Music Editing

Bulleted list.

## Obstacles

This section documents the most notable impediments that arose during development, from platform issues to nuances of designing for virtual reality environments.

### Platform Capabilities

Initial development was conducted on a MacBook Pro, Mid 2012; though a versatile machine, due to the architecture and design The OculusVR development kits [3] were able to be installed and developed with in the Unity version of MonoDevelop, but this machine has no support for running the actual headset. Developing in this manner was a tedious process, as testing could only occur at a much slower rate.

For example, post-processing effects – such as chromatic aberration and motion blur (included in Unity’s post-processing plugin – immediately caused discomfort once displayed in the Oculus headset. When testing on-screen, these effects seemed harmless; it is important to note that discrepancies in quality can be easily overlooked if development is not concurrently checked in the VR environment.

# Analysis and Verification

Bulleted list.

## Playtesting

### Survey Results

Link to Google Forms…

### Reviews

First-hand accounts.

## Industry Specialist Review

Thanks Dad.

# Interdisciplinary Connections

## Start.

Computer Science, Music, and Computer Graphics happily married. Polyamorous. Woo lol

# Related Work

Finish.

## VR: Music Visualizers / Interactive Applications

The following sections catalog previous work done in virtual reality for music visualization, or in interactive musical experiences. To varying degrees of complexity, interactivity, and visual and auditory intensities, the following examples proved to be great sources of inspiration.

### Playthings VR

Link and speak of its awesomeness. [11]

### Beat Saber

Freakin awesome. So fun, cool, and relaxing. [12]

### Raybeem VR Music Visualizer

Rinse and repeat of above. [13]

## Music Visualizers / Interactive Musical Applications

## Personal Previous Work

### Band Wagon

Prior (and concurrently) to developing Soundscape, I contributed in development to a rhythm-based game developed entirely in Unreal Engine 4 [14]. Programming rhythm-based mechanics helped develop familiarity with game programming with audio as the premier attribute to the application. This project also greatly helped familiarize with FMOD studio, a tool that proved to be very valuable to the functionality of Soundscape’s interactive musical aspects.

#### Sound Design and Soundtrack

Between Ableton Live 10 [15], Studio One [16], and Garage Band [17], I had accumulated ample experience designing audio for an interactive experience. Viewed too often as independent entities in the game development process, I concurrently crafted both the soundtrack and audio cues to mesh with one another.  
  
In terms of soundtrack, creating a background track that was repeatable without being distracting yet while avoiding becoming overly repetitive was key.  
  
Sound effects (SFX) were integral to this game as it was one of the main cues the player got that indicated their performance. Player performance and enjoyment was significantly improved with refined SFX rather than solely visual cues. Adding subtle cues and balancing with the current cues, rather than increasing – and thereby risking overdoing – different cues to the player yielded better results during playtesting.

# Future Work

## Thesis Lead-In

# Conclusion

# References

|  |  |
| --- | --- |
| [1] | Unity Technologies, "Unity," Unity, San Francisco, 2011. |
| [2] | Unity Technologies, "Large Project Organisation," Unity Technologies, 2018. [Online]. Available: https://unity3d.com/learn/tutorials/topics/tips/large-project-organisation. [Accessed 6 November 2018]. |
| [3] | Oculus VR, LLC, "Oculus Utilities for Unity," Facebook Technologies, LLC, Menlo Park, 2017. |
| [4] | Oculus Rift, LLC, "Recommended System Specifications," Facebook Technologies, LLC, Menlo Park, 2017. |
| [5] | Ableton Live, "Play with song structures," Ableton Live, January 2018. [Online]. Available: https://learningmusic.ableton.com/song-structure/song-structure.html. [Accessed 6 November 2018]. |
| [6] | Firelight Technologies, "FMOD," Firelight Technologies, Melbourne, Victoria, 2017. |
| [7] | WikiAuthor, "WikiAudio - Arpeggiator," 5 April 2018. [Online]. Available: https://www.wikiaudio.org/arpeggiator/. |
| [8] | J. Albaugh, "Musical Chord Progression Arpeggiator," CodePen.io, 2018. [Online]. Available: https://codepen.io/jakealbaugh/full/qNrZyw/. [Accessed 6 November 2018]. |
| [9] | J. Smith, "Dissonant tones only unpleasant to a Western ear," CMuse, 21 July 2016. [Online]. Available: https://www.cmuse.org/dissonant-tones-only-unpleasant-to-a-western-ear/. [Accessed 6 November 2018]. |
| [10] | GitHub, Inc., "GitHub," GitHub, Inc., San Francisco, 2018. |
| [11] | Always & Forever Computer Entertainment, "Playthings VR," Always & Forever Computer Entertainment, Brooklyn, 2016. |
| [12] | Hyperbolic Magnetism, LLC; Split; Lokiman;, "Beat Saber," Czech Republic. |
| [13] | Sokay, LLC; Whiteman, Bryson; Cryptic Circuitry; Roman, Ramiro; Estrada, Jennifer;, "Raybeem VR," Sokay, LLC, Los Angeles, 2018. |
| [14] | Epic Games, Inc., "Unreal Engine 4," Epic Games, Inc., Cary, 2018. |
| [15] | Ableton Live 10, "Ableton Live 10," Ableton Live, Berlin, 2018. |
| [16] | PreSonus, "Studio One," PreSonus Audio Electronics, Inc., Baton Rogue, 2018. |
| [17] | Apple, Inc., "GarageBand," Apple, Inc., Cupertino, 2010. |