Audiovisual Playground: A Music Sequencing Tool for 3D Virtual Worlds

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CHI'17 Extended Abstracts, May 06-11, 2017, Denver, CO, USA
ACM 978-1-4503-4656-6/17/05.
http://dx.doi.org/10.1145/3027063.3050428

Abstract

As electronic music has made its way into the mainstream, the popularity of music production tools for both professional and amateur use has grown. Although the users of music technology are becoming more prevalent and diverse, there have been very few innovations in their user interfaces. The onset of high-quality, consumer virtual reality has allowed for the development of unique user interfaces that are able to make use of an interactive 3D space, as opposed to a standard 2D interface. We present Audiovisual Playground, a 3D virtual reality music application developed for the HTC VIVE. Audiovisual Playground builds off of a programmable music device called a sequencer, and extends its design metaphors to a large-scale, 3D environment.

Author Keywords

Virtual reality; step sequencer; synchronization.

ACM Classification Keywords

H.5.1. Multimedia Information Systems: *Artificial, augmented, and virtual realities*.

Introduction

Background

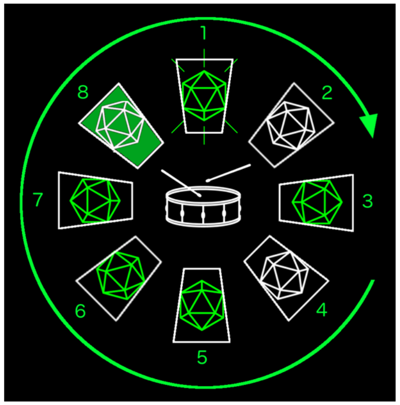

Figure 1: An aerial depiction of an instrument pedestal. A green lit step indicates the current beat that the sequence is on. The green light will loop clockwise around the steps of the instrument pedal; if it reaches an activated icosphere (see Fig. 2) Unity's audio mixer triggers the respective audio sample. In this image, step 8 is green but its icosphere is white so there will be no sound played; but, on the next beat (beat 1) the step and the icosphere are both green and therefore a snare drum sound will be triggered.

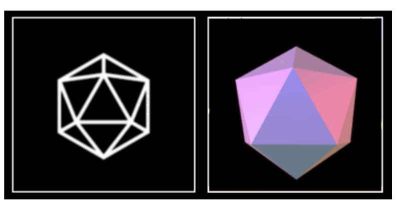

Figure 2: A 2D representation of an icosphere (left), and a 3D in-game representation of an icosphere (right).

The idea of Audiovisual Playground was inspired by designs of *music sequencers*, programmable devices used for automating the playing of music. Early music sequencers were mechanical and analog, and good for automating repetitive musical patterns [1]. Eventually, when computer music and digital instruments became widespread, step sequencers could be customized to play prerecorded audio samples and different kinds of digitally synthesized sounds [2]. Step sequencers became popularly used as *drum machines*, where users could program repetitive drum patterns; this was a very popular technique for Hip-Hop producers in the 80s and 90s where they could program beats for an artist to rap over, and also avoid the human error of a live drummer [3].

Audiovisual Playground

Our project is a mashup of music sequencing technology paired with 3D virtual reality (VR). We wanted to draw upon some of the design metaphors of music sequencers, such as the idea of programming repetitive patterns, while gaining the advantages of a 3D environment. The goal of this project was to let users interact with the interface using their bodies and gestures, while still maintaining the functionality of a music sequencer. One benefit of interacting through a 3D interface is that it increases users' feelings of engagement; the more users feel they have direct control over the manipulation of audio output, the higher their engagement [4]. Adapting an interface to a virtual environment (VE) utilizes the *model-world metaphor*, where the interface itself is a world that users can interact with [4]. Physical interaction paired with a 3D environment allows users to better relate and engage with the experience because natural movements and gestures evoke a greater sense of immersion and comfort within an unfamiliar space. Together, the model-world metaphor and high levels of engagement allow novices to easily learn the basic functionality of the music sequencer system, as well as let users see whether or not their actions in the virtual environment are helping them further their musical goals [4].

Technical Implementation

Audiovisual Playground is an application for the HTC VIVE. It was developed in Unity3D and utilizes the Steam VR and VRTK (Virtual Reality Toolkit) assets. Audiovisual Playground uses a step sequencer system [5] to synchronize five instrument tracks that users program. The step sequencer system allows users to choose what sound to play, and also *when* to play it (ex. Play a Hi-Hat on beat 4). Figure 1 depicts how our step sequencers work. In our VE there are five programmable instruments: Hi-Hat, Crash Cymbal, Kick Drum, Snare Drum, and Piano. Each instrument in the VE has eight programmable beats. Users can create unique musical compositions by activating specific beats of an instrument, and as the step sequencer driver is looping through each instrument's steps it will trigger its respective audio sample if it has been programmed to trigger on the current beat. The step sequencer driver synchronizes all of the instrument tracks to a tempo of 120 bpm.

Design Inspirations

We wanted to design an interface that is simple for users of different backgrounds, while also taking advantage of the 3D environment; for example, to make the behavior of the sequencer easier to understand. Since we were essentially building a 3D step sequencer, we modeled 3D steps that we placed

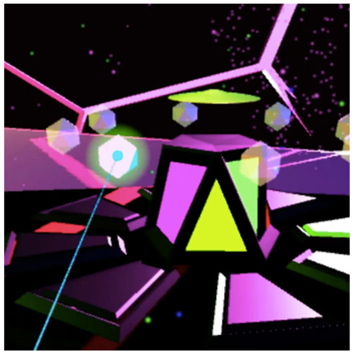

Figure 4: An in-game screen capture of a user pointing the controller at one of the icospheres around the crash cymbal pedestal.

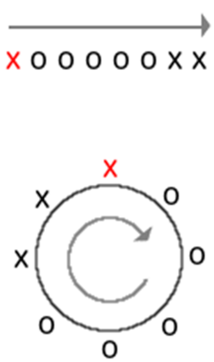

Figure 5: Two representations of the same sequence pattern.

Figure 3: An in-game screen capture of a user interacting with sound objects. There are several percussive instruments for users to interact with, this is the only melodic instrument (an instrument varies in pitch). The different columns of icospheres correspond to which beat to play the audio sample on, and the height of each icosphere maps to a particular pitch. The backing audio track [6] is in the key of A minor, so for proper harmonization we used pitches from the A minor pentatonic scale (A, C, D, E, and G). The column of icospheres with the glowing green haze signifies the step that is beat 1.

around each instrument pedestal to coincide with the step sequencer design metaphor. Most music production software (Logic, Reason, Ableton, etc.) is 2D with its x-axis representing time, and its y-axis representing a particular track. Sequencers repeat patterns, so we used circular sequencers to help represent the concept of a repetitive loop. We believe this visually helps users understand patterns better than a left to right representation because it shows the connection between the beginning and end of the pattern. Consider the sequence patterns in Fig. 5. The X's represent drum hits, and the O's represent rests. Both the top and bottom patterns are the same, but using the circular representation on the bottom we can see that as the pattern repeats we will hear 3 drum hits in succession. In order to design intuitive user interactions, we had to keep in mind that much of the general public has limited experience using high performance VR. On the right-hand controller we added a raycast that extends from the tip of the 3D model of the controller, essentially creating a laser pointer. We hoped that this would help users interact with objects. Additionally, when a user is pointing their raycast at an icosphere (Fig. 2) it glows blue to help users identify what object they are pointing at.

Demonstration Setup

Two poles will be placed on diagonal corners of a 3m x 3m floor space to enable motion tracking. Users will wear the VIVE head-mounted display (HMD) and use two hand-held controllers. The user in the VE will see 3D models of each controller that help identify exactly where they are in space. The left-hand controller serves as a manual that users may reference if they cannot remember how to use the controls. The right-hand controller is for interacting with objects. Users look around the VE by moving their head and also by moving their body. Users will be able to play in the VE for a few minutes and create their own musical compositions. Users will also wear a set of headphones over the HMD. A monitor and small set of speakers will be setup that displays everything that the current user is seeing and doing, as well what they are hearing. This allows people outside the VE to see what the experience will be like as they are waiting their turn.

Conclusion

Music sequencers are a powerful and fun tool for creating musical compositions; a tool that has not seen much innovation in its user interface. VR has given developers the power to redesign existing 2D interfaces as immersive 3D interfaces. During initial user testing of Audiovisual Playground we found that a 3D circular representation of music sequencers is more intuitive for new users, and offers a more accurate visual representation of what the resulting pattern will sound like. We propose that adapting the music sequencer interface to a 3D world results in increased levels of user engagement and an increased understanding of music development and audio sequencing.

Acknowledgements

We thank Christopher Koski and Alexander Goodwin for helping with the development of this project. We also thank Daniel Szafir and the ATLAS Institute for providing us with the tools to build this project.

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