

VR Music Instrument and Visualizer

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1 Concept

We will build a musical instrument in VR. The user will be able to use a wand-like device to modulate sound. The wand and the sound it creates will be visualized in a 3D VR environment to be viewed using the HMD.

2 Previous Work

There has been a lot of previous work in the space of interactive music in VR. Additionally, it seems to be just now acquiring substantial interest, and this continues to be a vibrant area of development.

Here are some Youtube videos of content that is similar to what we are going for:

- <https://www.youtube.com/watch?v=XbyW7w1AHR8>
This video illustrates the basic concept we are going for. We wish the user to be able visualize a stylus that can be manipulated to produce sound. There will be a visual reference in the scene for the stylus with respect to a 3D UI to guide the user to predictably find sounds.
- <https://www.youtube.com/watch?v=9gB5VJyArpQ>
This video depicts a commercial product's VR instrument platform. The particular time in the video shows the type of visual instrument interface we are going for: a simple setup of parallel vertical lines that correspond to different notes. The notes have an "otherworldly" sound, which we wish to emphasize the "VR" component of the experience.
- <https://github.com/macobo/WebGL-Audio-Visualization>
This repository based on Three.js may be of use to us. It has abstract visualizations that are in line with what we are planning.

3 Innovations

We reviewed the projects from last year and found that most are pretty different from what we have in mind. Additionally, we have seen few applica-

tions that combine abstract music visualization with music instruments. By abstract, we mean visualizers that go beyond simply showing the short-time spectrum in some type of graph. The challenge here may be that most current VR content is for purely recreational fun or professional music development (see <https://vimeo.com/155628376>). Neither of these applications lone themselves to abstract visualization, which aims to create an out-of-world, immersive experience.

4 Challenges

The actual technical challenges revolve around the precise positional tracking needed to have a reliable instrument. This is two-fold: high granularity in space as well as high granularity in time. The latency of the positional tracking cannot have high latency, or it may be difficult to play. It also needs reliable spacial tracking or notes may be imprecise and unpleasant. This Medium article does a good job explaining some of the challenges: <https://medium.com/@jespervega/building-a-virtual-reality-music-instrument-d97bdf9fc5d4>.

Other than that, the image and sound processing in this project are relatively straight forward.

5 Technical Milestones

- In order to be able to see a rendering of our wand in the virtual world, we will need to integrate position tracking with our scene rendering. The IMU will be attached to our wand in the real world so that we can stream its measurements.
- In order for the viewer to see the world and the wand reference in a way that makes sense, the view will need to assume the user is standing a particular location with respect to the light tower.
- In order for the user to be able to modulate sound, we will also need the IMU measurements to feed into audio processing. In the simplest cases, we will split the state space of the wand into a grid that will multiplex between different sounds.
- Finally, we will fine tune the scene and visualizations so that they look great. This will include possibly integrating 3rd party Unity assets for visualization of the instrument and the sound.