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An Exploration of Virtual Reality Instruments

Virtual Reality is still a new and emerging technology and with new devices still being created with more functionality and quality, there is still a wide-open space for new and creative experiences that can be created for it. The experience being explored is the possibility of musical "instruments" in virtual reality; or more like a new method of interacting with sound synthesizers.

Virtual reality presents itself with some great advantages but also plenty of disadvantages through its technology. One of the main benefits that will be used is the ability for the computer to know precisely know where the controllers and player's head are located. This allows the exact positioning of a player's hands to be tracked accurately but not as imprecise as a technology such as the controllers found in Nintendo's Wii Console. The major limitation in virtual reality is the inability of the device to be able to track a player's fingers which limits what kind of interaction can be created to essentially just general arm and hand movements. This would rule out many real-world instruments being transferred into the virtual world as many real instruments rely on a large amount of finger dexterity.

This project utilizes the Godot game engine as the base for most of the logic behind the experiments. It also is the program that communicates with the virtual reality device and sound

synthesizer. The virtual reality system that the project is being tested on is the HTC Vive which consists of fully positionally tracked controllers and a headset. The controllers also contain various input methods such as triggers, trackpads, and buttons. The controllers can also provide haptic feedback to the player through vibration motors. For the sound synthesis, PureData will be utilized. PureData will be set up with a GUI program called PurrData which will handle exactly how sounds will be created. The flow of the project is as such: The virtual reality device will receive input from the player through movements and button presses and send that information to the Godot engine. The Godot engine will set up a virtual scene for the player to view and interpret the player's interactions as instrument interactions. The Godot engine will then send data through a protocol called Open Sound Control to PurrData. This could either be MIDI data or just even a float value describing volume or pitch. PurrData will then take that input and produce the sound to be played by the player's computer.

The first experiment was a simple pitched percussion setup. Multiple notes were visualized by colored rectangular boxes. Each box had an assigned pitched with 8 total pitches making up a C major scale. The VR controllers were visualized as mallets. When the player hits one of the notes, a sound is produced in PureData. There is visual and haptic feedback from the note as well. The visual feedback is the rectangle box growing in size when hit and quickly returning to its original size. The impact speed of the controller is also taken into account as a quicker hit will result in a greater amplitude of sound and greater visual and haptic feedback. The haptic feedback is achieved through the vibration motors on the controllers which increase in intensity as the volume of the note increases. Some key discoveries made during this experiment were the ability to move the controllers/mallets through a note and also be able to play it by moving the controller from behind the note to the front. This allows the player to play in a

‘weaving’ like motion moving the controllers through notes. This kind of functionality is nearly impossible to replicate in the real world and is unique to this type of virtual interaction.

The second experiment involves replicating a theremin in virtual reality. This implementation was straightforward as determining the exact positions of the controllers is easy with the setup especially when compared to a real theremin that must rely on antennas. The theremin worked as expected with the left controller controlling pitch with its horizontal distance to a modeled antenna and the right controller controlling volume with its vertical distance to another modeled antenna. One of the main problems with a normal theremin is pitch control. Because the player is completely free to move their hand any distance from the antenna and there are no visual or haptic indicators for notes in a scale, being able to play an exact note in a scale can be exceedingly difficult. To help with this, many theremin players have adopted a style of playing where they shape their hands differently to try and create a reliable standard for producing pitches. However, in the virtual world, this is not possible as finger tracking is not available. An idea was to create haptic ‘frets’ where the player would ‘feel’ the notes as they slide the controller closer and farther. This is done by creating a list of key pitches, in this case being the notes from the 12-tone equal temperament scale and increasing the vibration in the controller as a user gets close to one of those pitches. This creates a ‘bump’ where the player can feel where a note actually is. The implementation done during this experiment achieves this and allows a non-theremin player to quickly play an in-tune melody without good aural skills.

There are many other experiments being done with sound and virtual reality, however, many of these usually only heavily rely on the tracking that the controllers can provide. Others rely on hand tracking. In a paper titled “Experiments with Virtual Reality Instruments,” Teemu Maki-Patola and others explain how they use gesture control for sound synthesis. They also

discuss how they could also enhance the Theremin explaining, “the presented Gestural FM Synthesizer extends the expressiveness of the Theremin” (Maki-Patola et al). In the two experiments done in this project, the goal was to not only utilize the positional aspect of virtual reality, but also the speed of controllers, visual cues, and haptic feedback to create experiences and interactions that are not practical in the real world. In conclusion, the experiments conducted provided an understanding of the importance of the other aspects that virtual reality offers in terms of interaction. These new and unique interactions demonstrate that music-making does not have to be limited to just pure finger dexterity and could instead utilize other, purely virtual interactions.

Works Cited

Maki-Patola, T., Laitinen, J., & Takala, T. (2005). Experiments with Virtual Reality Instruments. Retrieved March 04, 2021, from https://www.nime.org/proceedings/2005/nime2005_011.pdf