Immersive Dreams: A Shared VR Experience

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ABSTRACT
This paper reports on a project that aimed to break apart the isolation of Virtual Reality (VR) and share an experience between both the wearer of a headset and a room of observers. *Immersive Dreams* presented the user with an acoustically playable virtual environment in which their interactions with objects spawned audio events from the room's 80 loudspeakers and animations on the room's 3 display walls. This required the use of several Unity game engines running on separate machines and SuperCollider running as the audio engine. The audience's visual and aural perspectives on the actions of the headset wearer allowed for simultaneous participation in the installation.

Author Keywords
Virtual Reality, Immersive Audio, Interactive Installation

CCS Concepts
• **Applied computing → Sound and music computing**; Performing arts; • **Computing Methodologies** → Computer Graphics → Graphics Systems and interfaces → Virtual Reality;

1. INTRODUCTION
This project intersects with both the fields of Virtual Reality (VR) and sonic interaction design. It creates an immersive experience for the wearer of the head mounted display (HMD), while also keeping them in touch with the audience in the room by having the wearer think about how their actions are guiding the experience for those around them. The research question explored with this installation was "How could VR be made more of a shared experience with the use of loudspeakers and multiple displays?". The hypothesis was that by using loudspeakers for the audio and sharing different perspectives of the virtual scene with the audience, the isolating experience of VR could be opened up and enjoyed as a group, rather than just a single person at a time.

2. RELATED WORK
Much impressive work on musical interfaces for virtual reality was built upon for this project. A previous NIME paper explored shared experience in the form of a networked collaboration between performers that used VR and Leap Motion devices to create a theremin-like instrument [1]. In another work, nine design guidelines were proposed for virtual reality instruments and highlighted some challenges that were considered during the development of *Immersive Dreams* [6]. The points in this paper regarding low latency, preventing cybersickness, and representing the player's body were especially prevalent in the design of *Immersive Dreams*. Another paper's comments regarding the disparity between the headset wearer's perspective and the audience's perspective were especially taken into consideration when deciding how the user would interact with objects in the environment in musical ways and how these interactions would be portrayed to the audience [2]. As Winkler has noted, systems that are very interactive are certainly more complex, but have the potential to be rewarding in terms of new gestural possibilities [7]. Another paper suggested that in virtual instrument design, a convergent mapping approach can provide more expressivity by coupling gestures together to output a single musical parameter while a divergent mapping approach provides more macro-level control [5]. A combination of these two strategies would appear to be a flexible solution that this author sees as desirable for supporting different types of users.

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3. METHOD
At the beginning of the project a prototype was created to kick off initial discussions of the possibilities this endeavor would entail. Firstly, the Unity game engine was used to create a very simple 3D environment in which the user had a rod in each hand that could be used to hit four floating cubes in the space. A connection with individual cubes played back a single note. The notes were all heard through the loudspeakers in the Networked Imagination Laboratory (NIL) at McMaster University rather than the VR headset's headphones. To play the notes through the loudspeakers, the software SuperCollider was used as the audio engine and ran as a server in the background and listened for OSC messages from Unity that were triggered when a rod connected with a cube [4].

To begin expanding upon the prototype, a setting for the virtual scene was chosen and developed. Considering the need to allow for a number of interactions with various objects, a forest environment was deemed appropriate. In this scene there were three groups of objects that the user was able to interact with.

The first musical grouping was an assortment of floating rocks the user could play with two polls from the table. The notes chosen for each rock formed a chord so they could be played in any order without being concerned about playing out of key. The synth running on SuperCollider for these rocks was a bell-like saw synth, appropriate for melodies. As it has previously been reported, this correspondence between audio and visual was especially important for the user to get the most out of their VR experience [3].

A second musical grouping was an axe and a stump. When the user would hit the stump with the axe, a distorted bass line would play from SuperCollider. The connection between something as big and heavy as a tree stump and a loud bass line was intended to be obvious to people. This author believes that metaphors such as this are crucial in the development of clear, usable VR sound environments. These virtual worlds allow for absolutely any objects to become playable instruments. Careful, creative consideration for the objects that produce sound has the potential to provide impactful messages.

Finally, the third musical grouping in this environment was a target and smaller, throwable rocks. When the user would throw a rock and hit the target, a few chords would be heard from SuperCollider. The desire here was to offer this audio event as a reward to people who hit the target. These three musical object groups in the setting of a forest helped to provide the user with enough interactions in order to spend several minutes exploring the scene and learning to play the "instrument".

In order for fixed camera angle views of different places in the virtual scene to be shown on the displays, additional Unity engines were running on the other computers in the room that were connected to external displays.

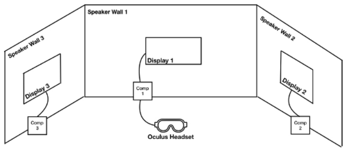

Figure 1. The room layout

Spectator cameras were created in Unity for the three interactive objects and these camera angles were shown on the three external displays. When the user interacted with an object, an OSC message would be sent from the main Unity engine to the computer connected to the display showing the same object. The Unity engine on that computer would receive the OSC message and then trigger an animation for that object as the sound played through the loudspeakers.

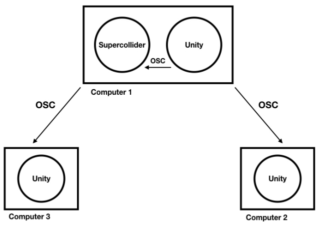

Figure 2. The network architecture

The audience in the room would see this and be able to relate what the wearer of the headset was doing with the sound they were hearing, and the animation shown on the display.

4. RESULTS

During a public showcase of the project, people were invited to come to the Networked Imagination Laboratory at McMaster University and experience this work for themselves. One at a time, each participant got to try on the headset and lead the experience for the other people in the room. When the leader would gesture towards one of the objects on the displays in the room, the others would turn their heads towards the appropriate display. This revealed that a clear connection was made thanks to the alignment of the virtual and physical worlds. This also required that the person wearing the headset was positioned so that they started off facing the correct wall. While slightly limiting, this was not at all a problem for anyone. The sound for each of the objects was also emitted from the same wall the player would gesture towards, making it even more clear for them and the audience that the response was coming from their gestures.

5. FUTURE WORK

Several ideas for future improvements to this project came up during the development of this first iteration. For this project a forest was used as a general example, but any scene could be created that caters to a specific audience. Powerful messages could be built into the scenes to produce empathy for marginalized groups and ask questions about certain issues in our world, just to name a couple of examples. Additionally, the sounds used in each scene could be inspired by the setting itself and samples could be recorded from a real space and reinterpreted in the virtual space.

Another potential improvement is that there could be actual physical objects in the room that relate to the scene. They would be placed a safe distance from the person wearing the headset but something like a guitar laying on the ground as the player strums a virtual guitar would combine the physical and virtual worlds even more tightly.

Non-player characters in the scene would also help liven the experience further. In the forest scene produced for this project there could have been birds, bees, and other creatures that move around in both the VR headset and on the external displays. Their sounds could follow them as well on the wall-mounted speakers giving them an almost 3D sense of placement. This addition would really help bring the scene alive.

Finally, it would be interesting to make this a multiplayer experience and allow people to explore (and play) the scene together. People could potentially be in the same room or one person could be connected remotely over a network. The powerful action of exploring something like these virtual scenes together would create strong connections between individuals as they uncover the secrets of these virtual rooms together.

6. CONCLUSIONS

The early results from this experiment indeed show that the isolating VR experience can be opened up to audience members with the use of loudspeakers, external displays, and aligning the virtual and physical worlds. The opportunity to explore these virtual rooms together by playing the environment allows for engaging experiences to be had by both the person wearing the headset and the audience members in the room.

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