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VR Rehearse & Perform - A platform for rehearsing in Virtual Reality

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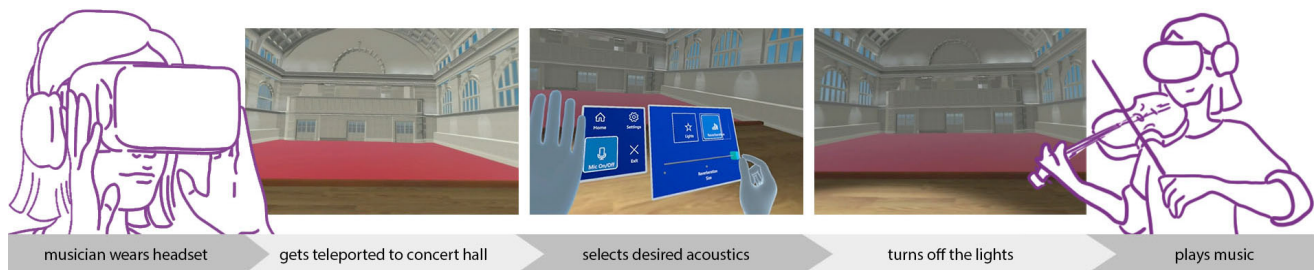Canterbury, United Kingdom

musician wears headset → gets teleported to concert hall → selects desired acoustics → turns off the lights → plays music

Figure 1: *VR Rehearse & Perform* - a Virtual Reality system to support musicians' practice.

ABSTRACT

In this paper, we propose *VR Rehearse & Perform* - a Virtual Reality application for enhancing the rehearsal efforts of performers by providing them access to accurate recreations - both visual and acoustical - of iconic concert venues.

KEYWORDS

Virtual Reality, Rehearsing, Musicians, Acoustic Environments

*Both authors contributed equally to this research.

1 INTRODUCTION

The COVID-19 pandemic has heavily impacted artists' ability to rehearse and perform [7]. Musicians and performers are training from home spaces which bear no resemblance - visual nor acoustical - to rehearsing and concert venues. Musical rehearsal rooms act as an acoustical transformer and have a significant influence on improving the musicians' ability to perceive and present their unique sound [4]. Therefore, practicing from home can affect performers' unconscious adjustment to source levels [1, 2], severely limiting rehearsing effectiveness. The current context has only exacerbated

an existing problem, as access to venues, particularly iconic ones, is limited in terms of time, and often comes at a high cost.

Because of its ability to bring users in new fictional worlds, Virtual Reality (VR) is used in a variety of applications, across numerous domains of knowledge [6]. However, VR applications have not addressed the enhancement of musicians' practice. In this paper, we address this gap and we propose *VR Rehearse & Perform* - a proof of concept of a VR solution aimed to support performers' rehearsal efforts by exposing them to accurate simulation of the visual and acoustic features of concert venues. Specifically, with *VR Rehearse & Perform*, we aim to deliver accessible concert hall-like immersive experiences where musicians have the illusion of being on stage and benefit from realistic soundscapes based on real-time 3D sound and reverberation.

2 VR REHEARSE & PERFORM

In *VR Rehearse & Perform* we followed a *research through design* approach [3], and together with experts in performance and musicians, we explored the potential for technology inclusion in music practice. The following design requirements were gathered: 1) create an audio-visual simulation which combines auralisations with visualizations of an iconic concert hall; 2) allow the customisation of both visual and acoustic stage parameters; 3) use hand tracking to interact with the VR application, thus allowing musicians to play their instruments freely.

Based on the design requirements we developed the *VR Rehearse & Perform* prototype (Figure 1), for the Oculus Quest, using Unity 2020.3.7f1 and C# as the main programming language. In *VR Research & Perform*, musicians are positioned in the middle of the stage of a 3D reconstructed, concert hall. They can interact with the lights of the auditorium – adjusting their intensity – and choose between four types of acoustics (three with different degrees of *Plausibility* and one *Authentic* - the Room Impulse Response (RIR) of the hall). The scene has a real-time microphone input feature which enables the performer to sing or play an instrument and listen back to their performance rendered in real-time based on the type of acoustics they select. Hand tracking was used as the main form of user interaction in our prototype, using Microsoft's Mixed Reality Toolkit.

3 PRELIMINARY USER EVALUATION

3.1 Participants and procedure.

We invited eight musicians (5 male and 3 female, age: 21-40, 4 vocalists, 1 guitarist, 1 keyboard player, 2 piano players) to evaluate the potential of *VR Rehearse & Perform* to support their music practice. All the participants signed an informed consent, and gave us permission to use the screen/audio recordings from their sessions. We asked participants to play their instruments while interacting with *VR Rehearse & Perform* (see Figure 2), followed by a short interview.

3.2 Preliminary results.

Overall, participants had the feeling of "being there" in the concert hall and saw potential benefits of playing in VR. The user evaluations showed that *VR Rehearse & Perform* has potential to enhance musicians' rehearsals by allowing them to adjust to the acoustics and reverberation of performance halls. The application is also

Figure 2: Performer playing music in *VR Rehearse & Perform* (left) and using hand-tracking to change the settings (right)

well suited for musicians who want to improvise and experiment within a new venue, hence potentially developing performances explicitly designed for specific venues' acoustics. However, one of the limitations of our system is that participants could not see their instrument while playing in VR. This was especially problematic for two of the pianists in our study, therefore further work is needed to incorporate instruments in the software.

We observed that real-time reverberation enhanced the usefulness of VR as a performance preparation tool and was perceived as important for immersion, increasing the value of the application. The introduction of the *Authentic* acoustics came with significant latency due to the limited processing power of the Oculus Quest. The *Plausible* acoustics were better received, with musicians finding the sound reproduction realistic and enjoying the options that emulate the general reverberation characteristics of a full (shorter decay) or empty (longer decay) concert hall. This suggests that for musicians, approximations of real environment acoustics in VR might work better than accurate reproductions, but further investigation is required to identify the threshold for the evaluation of acoustics. Moreover, it is important to explore the factors (e.g., visual cues, time of exposure to the VR environment, genre of music, experience of the musicians, etc.) that could help musicians adapt to the inherent latency produced by such systems [5].

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