Hagoromo XR: co-creating an extended reality arts performance to support inclusion.

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Abstract

In this short paper we reflect upon the development of Hagoromo XR, a live extended reality experience showcasing a contemporary interpretation of a Japanese Noh performance co-created by artists with and without disabilities. Utilizing volumetric video capture technology, we have developed a hybrid performance involving neurodiverse sound artists and a professional Noh artist. We blend traditional Japanese theatre with contemporary sonic arts to foster creativity and build a sense of community. Prerecorded 3D augmented reality performances of the Noh artist are integrated into the live production to accommodate the neurodiverse artist's needs. Based on the artists' reflections during rehearsal workshops we report on the positive impact on inclusion and sense of belonging for the artists, showcasing the potential of XR technologies to bring diverse individuals together in a shared creative hybrid space.

Keywords

Virtual Reality, Augmented Reality, Sonic Arts, Performing Arts, Inclusive Arts.

Introduction

Individuals with disabilities have often encountered barriers that limit their active participation in the arts, denying them the opportunity to fully engage in the creative process and experience the numerous benefits that artistic engagement can offer. [1] To address this issue, our research focuses on the establishment of innovative avenues for collaboration between individuals with and without disabilities with the arts, employing interactive technologies as a platform. [2] Through a multifaceted approach encompassing workshops, performances, and exhibitions, we aspire to create inclusive opportunities that embrace people of diverse abilities, empowering them to co-create art and harness the inherent potential of digital technologies as enablers.

Our prior research has laid the groundwork for this endeavor by delving into the synergistic relationship between social interactions within a group setting and the transformative capabilities of digital technology in enhancing participation of individuals with disabilities in co-creative artistic practice. In this context, our definition of participation encompasses a multifaceted approach that can contribute to positive personal experiences, including increased self-confidence, the reinforcement of individual preferences, a profound sense of belonging to a supportive community, and the acquisition of specific skills that can be readily applied in the future. This paper extends these concepts and builds upon our prior research to further advance the field of inclusive arts through the integration of interactive technologies.

We report on the creation and technical execution of a sound art performance called *Hagoromo*, which emerged from a hybrid workshop initiative that incorporated online interactions between artists in Australia and Japan. We reflect upon the experiences encountered by the participating artists in both the workshop program and the subsequent performance in Japan. Through the artists reflections we offer preliminary insights into the collaborative endeavors of neurodiverse artists, as well as their ability to establish connections with others in the process of conceiving and presenting a performance that is mediated through extended reality (XR) technologies.

Hagoromo XR

The development of the *Hagoromo* performance is the result of an arts and cultural collaboration between RMIT University and Ritsumeikan University to develop a proof-of-concept live public sound and visual performance aimed at enhancing the participation of artists and individuals with a disability. The performance builds upon common interests between the researchers who explore inclusive design and assistive technologies for populations with motor and cognitive impairment. [3] This collaborative relationship was augmented to include a community arts organization JOLT Arts who mentor an ensemble of neurodiverse musicians called The Amplified Elephants, and a professional Noh performer Ryoko Aoki, with whom the researchers had cultivated long term partnerships to develop audio-visual technology for live performances. [4]

The Hagoromo Story

As a catalyst for our collaboration, we focused on creating a contemporary interpretation of *Hagoromo*, a traditional Japanese tale presented through Noh theatre performance. Noh theatre originated in Japan during the 14th century and is characterised by its combination of music, dance, and drama. In this traditional form of theatre, the stage is a

simple and symbolic space adorned with hand-drawn or painted pine or bamboo trees on the backdrop. The story of *Hagoromo* unfolds as follows: a fisherman discovers the *Hagoromo*, a magical feathered cloak belonging to *Tennin*, an ethereal spirit or celestial dancer, found hanging from a tree branch. The celestial dancer insists on its return. The fisherman engages in an argument with the *Tennin* and eventually agrees to give it back on the condition that the *Tennin* teaches him a celestial dance. Accepting his offer, the Tennin performs the dance for the fisherman before ascending to the celestial realm with the feathered cloak [5].

The Hagoromo Performances

Three iterations of the performance were developed over time from January 2021 – October 2023. The first iteration was developed as a proof-of-concept 15-minute online performance broadcast on YouTube Live on March 28, 2021, as part of an event called SLOW MOVEMENT Showcase and Forum vol.5. Due to government imposed COVID-19 restrictions and health and safety guidelines in Japan and Australia at that time the collaboration between the artists were facilitated via online platforms. The cross-border rehearsals were conducted through video conferencing technology, connecting Spiral Hall in Minato-ku, Tokyo, with Kindred studios located in Melbourne, Australia. The fundamental idea behind the event involved synchronizing the live performance in each venue and streaming it in real-time to a global audience. The live video stream originating from Australia was blended with live footage from Spiral Hall in Japan before broadcast.

The second and third iterations were developed as a 40-minute live face-to-face performances as part of The Big Anxiety festival in Melbourne 13-15 October 2022, and remounted as part of a JOLT Arts showcase at Bank ART Station, Yokohama, 24 October 2023, and Urban Guild, Kyoto, 28 October 2023. Due to other scheduling commitments the Noh artist was not available to attend the rehearsals or the actual live performances in Melbourne in 2022. Faced with this issue, we decided to explore the possibility of recording a virtual version of the artist we could project on the stage. The recorded performer could then be used flexibly as a surrogate virtual avatar by the sound artists in Melbourne in developing, rehearsing, performing and sound recording.

Technical Implementation

To tell the *Hagoromo* story we embraced volumetric video capture technology to explore how virtual performers can be prerecorded to augment the development and rehearsal of live performances. Volumetric video is a technology used to capture three-dimensional (3D) representations of real-world objects, scenes, or people. It records a subject from multiple viewpoints, often using an array of cameras or depth-sensing devices, to create a detailed 3D model of the subject's shape and appearance. This 3D model allows for the subject to be viewed from any angle, manipulated in a virtual environment, and seamlessly integrated into augmented reality (AR), virtual reality (VR) or mixed reality (MR) experiences.

Using XR technologies, we aimed to provide support for artists with disabilities while introducing a novel approach for creative expression. We used standard VR production methods to capture the Noh artist's performance by utilizing three Microsoft Kinect Azure™ depth cameras and DepthKit™ software to process the three volumetric video point cloud data streams as shown in figure 1 and figure 2.

Figure 1. Volumetric video capture of the Noh artist using the Virtual Studio at RMIT University. ©Photo courtesy of Jonathan Duckworth.

Figure 2. Volumetric video point cloud data of the Noh artist.

Using the captured data, we facilitated rehearsals and a live performance where the musicians and the virtual Noh artist interact together on a hybrid AR projected stage as shown in figure 3. To facilitate this performance, we developed a Unity™ application that incorporated the volumetric video playback, Vuforia™ for AR tracking, and customized visual effects to enhance the overall experience and narrative. An AR video stream from a mobile phone camera is projected onto the stage. The projected avatar of the performer can then be used by the musicians for rehearsals and performances.

Figure 3. The augmented 3D Noh artist in the foreground captured from the AR video stream.

Performance Development and Approach

We represented the collaboration as a fusion of cultures between Japan and Australia by incorporating elements of Noh theatre, contemporary sonic art, and technology as central themes to shape the development of the performance. In developing the first and second iteration we designed a twelve-week program to enable online collaboration among the artists, with activities taking place from January to March 2021 and August to October 2022. The workshop structure was implemented through a hybrid approach, combining online sessions involving artists in Japan with in-person sessions in Melbourne. These workshops were organized into three successive four-week phases. The initial phase emphasized performance development and ideation, the second phase revolved around experimentation and collaborative exploration of sound technologies, and the final stage centered on composition and rehearsal for the performance. An additional one-day introductory AR workshop was held in Tokyo in October 2023. This introductory session allowed the artists to familiarize themselves with basic AR concepts, to freely play with the AR tracking, and experiment with positioning the AR camera for aesthetic effect.

Over the course of the workshop programs, JOLT Arts provided mentorship and oversight to the musicians. Their involvement was made possible through an arts program funded by the Australian National Disability Insurance Scheme (NDIS), which facilitated travel to Japan. Participation in the program is voluntary, and the recruitment, training, and individual consent procedures are coordinated by JOLT Arts management in consultation with the participating individuals and their respective parents or legal guardians. Throughout the rehearsal process, the musicians receive support from trained support workers and JOLT Arts Health Officer, a registered nurse specialized in mental health triage. These support personnel undergo specific training by JOLT Arts to meet the unique care needs of each participant. In compliance with ethical standards, approval from RMIT University was obtained to secure consent from the artists to use the publicly available performances for broader dissemination.

The project's primary objective was to create a proof-of-concept performance that utilized hybrid XR technologies. Our role involved facilitating and implementing the technology's use for the artists while reflecting on the performance's development. Our aim was to glean initial insights into how these technologies bolstered the creative and collaborative processes. Our intention was not to interfere with the artists' established creative methods or seek to establish formal scientific evidence through empirical observations and qualitative analysis. Instead, our focus was on leveraging the artists' existing relationships with technology to drive the performance's development, all motivated by our aspiration to enhance participation outcomes for the artists.

Artists Reflections

Following the performances, James Hullick provided written reflections that were founded on the observations of the experience and responses from the AR workshop. The written reflections were prompted by four questions that provided an initial appreciation of (a) the artists experience of AR technology; (b) the artists experience of collaborating with the Noh artist using AR technology; (c) the benefits of using these technologies for the performances, and (d) how the artists would like to use the technology in the future.

One approach that enables neurodiverse artists in professional arts events is using bespoke technology, crafted for the specific abilities of the users. [6] The Amplified Elephants were greatly advantaged by XR technologies in their capacities to blend the ancient art of Noh with the synthesizer technology used to make sound in this project. In particular, AR technology was found to render physical challenges obsolete when driving AR experience and immersing users in bodiless encounters. AR technologies enabled the artists to reimagine the dynamics of control, of who is the leader, who is the follower, who is the audience and who is the creator. Certainly, the artists have requested further collaboration with the researchers with an emphasis on how they can design and implement AR experiences.

The artists reported that the AR technology gave them further voice, agency, and interaction with the character of the *Tennin* played by Ryoko Aoki. The Amplified Elephants authored the electronic music that ran throughout the show. AR technology was then ‘performed’ to the sonic score. The pacing, events, durations and shaping of sound in time was therefore authored by musicians with the Noh artist’s avatar and vocals fitting into that design. AR technology doubled the live performer’s presence and provided a deeper way of articulating the sonic design. The Amplified Elephants therefore felt equal as collaborators and owned their responsibility of shaping the time flow and emotional flow of the work. This was highly empowering and underlined the importance of collaborations between artists of widely different abilities.

The AR technology provided the neurodiverse artists with an important negotiation tool, where old and new technologies, people of different abilities, and multicultural

backgrounds could freely invent and imagine a culturally entwined future of their own collective design and vision. This powerful tool has the capacity to shed many of the hang-ups associated with cross-ability and cross-cultural arts making, precisely because the technology is new and without creative protocols and habituations.

A key advantage of recording the celestial dancer character in AR for the musicians is that they can perform the work without the Noh artist being present. When the non-Disabled artist is captured as an AR avatar, this means that the neurodiverse artists have the capacity to keep performing the work without being constrained by the availability of the other.

There are many possible applications of this technology, but for *Hagoromo*, the primary request by the artists is that they are transformed into avatars that the Noh artist can then perform with. This means that the production can have a life that continues without them. This is important because the ensemble is constantly creating new shows and do not necessarily want to endlessly perform the same work.

Beyond this initial step, the ensemble indicated their interest in creating immersive visual and sonic interactive AR worlds that reflect their varied experiences of neurodiversity. With AR technology there is the capacity to create sensory experiences that better enable audiences to be empathetic with how other people experience the world; how other people imagine the world; and how other people can create ever more varied experiences of imagination as a de-homogenized lived experience.

Discussion and Conclusion

Upon reflecting on the participants' experiences during the development of Hagoromo XR, we have gained insights into the sustainable processes that empower artists to use technology in crafting virtual performances. These processes consider the individual perspectives on interactive technology and the adaptable nature of XR media, which allows artists to engage in the creative process. Establishing virtual spaces for intercultural dialogue and performance fosters a sense of agency for individuals and nurtures the development of competencies that can be carried forward.

Our initial reflections, coupled with the success of the *Hagoromo* performances, affirm that XR technology have the potential to enable participation tailored to individual needs, thereby enhancing inclusivity, and fostering a sense of belonging within community arts practice. While we consider our contribution a work in progress in the context of interaction design and inclusive community art, we acknowledge various challenges that lie ahead.

These challenges encompass economic considerations, such as the affordability of technology for underfunded community arts organisations, as well as issues related to accessibility and the requisite skillsets for operating this technology. Additionally, persistent latency problems associated with online media and remote virtual technology present hurdles to be overcome. To realize co-creative collaborations in distant locations, it is imperative to employ technologies that mitigate the latency in sharing video data. In this regard the XR technologies enable the artists to collaborate with a virtual surrogate performer in real-time using AR without the inherent issues with collaborating over online video. Using XR technology offers flexibility in the development process and allows for the creation of artistic performances in various settings, including face-to-face settings with AR or on imaginative stages using VR. By incorporating performers into an AR environment, it becomes possible to provide an immersive experience that can replicate and enhance performances for audiences. This not only translates to an additional medium for dissemination but potentially enhances the overall impact of the work that demonstrates the power of XR to facilitate inclusive art forms and diversity.

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Authors Biographies

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