

ReInHerit a Museum: Enhancing Museum Experience and Broadening Audience Participation Through an Immersive Performance using Media-Art, and Augmented Reality

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Abstract

This paper delves into the immersive performance, “ReInHerit a Museum” held at the Bank of Cyprus Cultural Foundation. Through exploration and analysis of the conceptual framework and the audience’s interaction with an augmented-reality-based mobile application, it examines the ways in which artistic expressions blended with elements from emerging technologies aimed to enhance visitors’ experiences and engage a broader audience. By integrating interactive sound installations, live music performers, augmented reality, real-time generated visuals, and projection mapping, visitors immersed in a multisensory environment that deepens their understanding and emotional connection with cultural heritage. The performance, aimed to break away from traditional modes of spectatorship and encourage active participation and interaction, blending the limits between observer and participant. All the material and documentation for the performance are made available for open access.

CCS Concepts

• **Applied computing** → **Media arts**; • **Human-centered computing** → **Mixed / augmented reality**; **Auditory feedback**; **Collaborative content creation**;

1. Introduction

Effective audience engagement has been a challenge for heritage sites in recent years, however, immersive performances through the use of emerging technologies can help overcome these difficulties [Cer16]. Immersive performances represent a dynamic and evolving approach to engaging visitors and creating composite experiences within cultural institutions [KM19]. These performances aim to break away from traditional modes of spectatorship and encourage interaction and active participation from the visitors. Achieving immersiveness does not always require the use of interactive elements (e.g., The weather project: <https://olafureliasson.net/artwork/the-weather-project-2003/>). Immersiveness is not a new concept. In ancient Greece, theatrical performances often took place in amphitheaters, where the audience was seated around the stage. The circular shape of theater spaces, allowed maximum eye contact and intervisibility among the audience, fostering a shared experience. Greek tragedies and comedies sometimes involved direct interaction between performers and audience in choruses [Grz13]. Audiences could also influence the outcome of a performance through voting [Ros11].

The concept of immersiveness in museums was inherited after projects of media art such as art installations, performance arts, and

multimedia installations, gained recognition and popularity. These art forms introduced immersive elements by creating environments or experiences that deeply immersed the viewer and encouraged active engagement [Wie22]. The success of these immersive art practices paved the way for museums to adopt similar strategies in their exhibition design and programming [Wie22]. Today, museums actively seek to push the boundaries of immersiveness even further, as they continue exploring new ways to engage and captivate their audiences [KM19]. Researchers, artists, and museum professionals are investigating the potential of emerging technologies, such as extended reality and interactive storytelling, to enhance visitor participation and emotional connection [KM19].

For example, in 2013, the Museum of Modern Art (MoMA) showcased “Rain Room”, an installation by Random International Art Studio (<https://www.moma.org/calendar/exhibitions/1352>). This immersive experience featured a room with continuous rainfall. As visitors entered, sensors detected their presence, causing the rain to stop around them. This interactive artwork allowed visitors to walk through the rain without getting wet, merging art, technology, and nature in a unique and engaging way.

In 2015, Pace Gallery presented the immersive exhibition “Living Digital Space and Future Parks” (https://www.teamlab.art/e/living_digital_space/). It featured the works of team-

Lab, a renowned collective specializing in digital art installations (<https://www.teamlab.art/>). The exhibition showcased interactive environments where visitors could engage with dynamic digital projections and sculptures. By combining technology and art, the exhibition offered a unique and immersive experience, blurring the boundaries between the physical and digital worlds.

Another notable example is “teamLab Borderless” in Tokyo, Japan (https://www.teamlab.art/e/borderless_azabudai/). Since its opening in 2018, this digital art museum has captivated visitors with its array of immersive installations. Combining interactive sound, live music, AR, real-time visuals, and projection mapping, it offers a unique multi-sensory experience. Visitors can explore interconnected rooms filled with dynamic artworks that respond to their presence and movements.

In this paper, we present our work in the design of an immersive performance to enhance visitors’ experiences at cultural heritage sites. The performance encompassed various elements, including live music, performers, sound installations, real-time generated visuals, a large-scale dual channel projection mapping, and an augmented reality (AR)-based smartphone application. Audience and performers interacted with the performance space, collaboratively creating a unique soundscape. The audience used the AR application to engage with the projections and discover AR exhibits, personalizing their museum experience. Simultaneously, a media artist collaborated with the audience, enhancing, and developing the visual aspects in real-time. The primary objective was to create a holistic and personalized multimedia experience for visitors, offering a novel way of engaging with exhibits and spaces within the museum during the performance. In the following sections, we present the design of the participatory immersive performance, a discussion about the outcomes, and make available the materials, documentation, and a guide on how to replicate such a performance.

2. Design Framework

The performance was part of the setup of the ReInHerit Digital Hub (<https://reinherit-hub.eu/>), a digital platform that provides an open and collaborative space for museums, cultural heritage sites, policy makers, professionals, and communities to experiment, share, co-create, and innovate. The interdisciplinary nature of the project involved professionals from various fields who collaborated to create a unique experience for the audience.

Specifically, professionals from various disciplines, including a music composer, two programmers, a media artist, a graphic designer, a photogrammetry specialist, a museologist, a communication officer, a project manager, and the Cyprus Symphony Orchestra and the Cyprus Youth Symphony Orchestra provided 20 musicians for the event. The performance took place on May 19th, 2023, as part of the celebrations for International Museum Day, at the Bank of Cyprus Cultural Foundation (BoCCF) (Figure 1).

The main components of the performance were a live music performance from musicians that moved through the venue and sound stations installed at specific locations (Section 2.1, and generative visuals and video-art elements visualized through projection mapping (Section 2.2). The sound stations and parts of the visual ele-

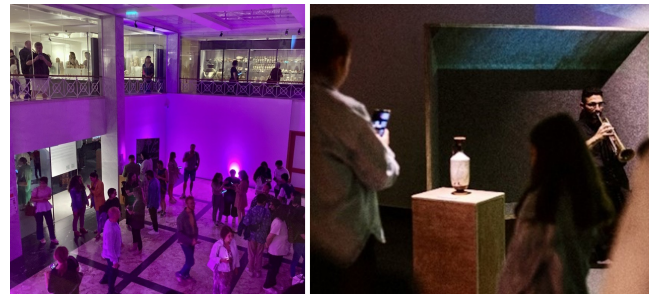


Figure 1: The venue of the performance.

ments were controlled by visitors using a location-based AR smartphone application (Section 2.3). This allowed for the creation of a participatory immersive performance, where musicians and audience created a unique and dynamic soundscape.

2.1. The Soundscape

The integration of a sound installation and live music performers played a crucial role in creating an immersive and interactive experience. The sound installation, featuring strategically placed sound stations controlled through the presented AR application, enabled the audience to engage with digital exhibits and trigger responsive sounds, fostering exploration and enhancing immersion.

Meanwhile, live music performers, following instructions to perform a composition for guided improvisation, dynamically interacted with the evolving soundscape, prompting audience movement as they navigated the performance space following loosely set trajectories and discretely interacted with adjacent audience members through movement or sounds produced.

2.2. Media Art

The visual component of the performance combined exhibits from the BoCCF with generative art and video art, resulting in a hybrid artwork (Figure 2). Historical artefacts and algorithms merged to create a unique audiovisual landscape that stimulated new interpretations, multiple perspectives, and a dynamic dialogue about the past, the present, and the future of the corresponding exhibits.

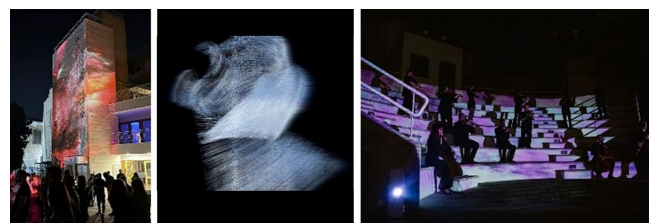


Figure 2: Visuals from the immersive performance.

In the subsequent phase, 8 area scans were generated, each corresponding to the location of a specific object, strategically positioned across various locations within the museum to encourage visitors to browse through and explore the building and its collections during

the event. The audience scanned the objects in the corresponding area, and consequently the three-dimensional model appeared on a tablet or their mobile devices along with object descriptions and historical information about the original exhibit.

Following this stage, these conserved reference points embarked on a gradual orbit around the central axis of each object within the dimensions of x, y, and z. The traces of these movements were captured and presented in real-time to spectators via the projection. This intricate procedure culminated in a visual effect reminiscent of the stroke of a brush as it gracefully glides across canvas or paper, thus achieving a uniquely creative and abstract visual outcome. This culmination stands as a testament to the museum's very essence and mission.

2.2.1. Technical Characteristics of the Real Time Visuals

The visual aspect encompasses algorithmic graphics and the aesthetics of video art. Initially, three-dimensional models of exhibits were created using photogrammetry, and architectural elements were retained in the node-based software, Touch Designer (<https://derivative.ca/>). Additionally, Artificial Intelligence-generated images of dancers were created using e-Dally (<https://openai.com/dall-e-2>) and integrated into a timeline, allowing for smooth transitions and intermediate states. These elements were integrated into a system created in Touch Designer, where audience input and MIDI controller interactions shaped the final artwork.

2.2.2. Projection Mapping

Projection mapping played a crucial role in the immersive experience. The exterior side of the venues' building and an amphitheatre in the courtyard were utilized for it (Figure 2). By selecting two opposing points in the courtyard, the audience was fully immersed in visuals and music, creating a sense of unity. Three programs worked simultaneously in real-time: Touch Designer generated the graphics, Syphon (<https://syphon.github.io/>) transported them to Mad Mapper (<https://madmapper.com/>), which facilitated the mapping onto the building's surface.

2.3. AR Application

A smartphone application was designed to offer the audience a virtual exhibition experience through AR using their smartphones (Figure 1). Audience could explore and access detailed information about access detailed information about twelve virtual artefacts from the BoCCF and interact with them before the performance. Each of the artefacts was 3D-scanned and its model optimized for use on smartphone devices through Blender (<https://www.blender.org/>). These twelve artefacts were then used to create a virtual exhibition by being placed relative to eight specific locations within the venue. The audience was presented through the application photographs of each of these locations, which they had to identify and go to within the venue.

The application displayed an outline of what the user should be aiming at with their smartphone camera to align to the expected view. This allowed the aligning of the virtual objects with the physical surroundings of the location. These objects were anchored at

specific pre-determined points and the correct alignment ensured that they would appear at that location. Their rendering was affected by the physical environment as well, which means that real objects at the venue could occlude the virtual objects as they would if they were real objects. This seamless integration of the virtual artefacts within the physical venue, created a treasure-hunt-like experience for the visitors, that had to find where these artefacts were located. Once the artefacts were located by the users, they could interact with them (e.g., change their size, view additional information). At the same time, by tapping once on an artefact, a user sent a trigger which changed the sound that the sound stations played. The application was implemented using the Unity game engine (<https://unity.com/>) and the Niantic Lightship Augmented Reality Developer Kit (ARDK - <https://lightship.dev/>).

2.4. Open Access

Aligned with the projects' mission to disrupt the current status quo communication, collaboration, and innovation exchange within museums and cultural heritage sites, as well as to ensure inclusivity, we have made the resources required to recreate the corresponding performance openly available to all users through a GitHub repository (<https://github.com/CYENS/ReinheritArApp>). This includes a comprehensive manual and unrestricted access to the source code of the AR application to encourage and facilitate the broader and wider adoption of our concept.

3. Results

Approximately 250 visitors attended, actively interacting, and engaging in discussions about cultural heritage and this new artistic form of performance. The combination of these elements sparked curiosity and, although it created some discomfort with the unknown, most attendees were eager to discover, play, and embrace the new experience that was presented. Notably, people of different ages, including children, elders, of different ethnicities, and people with disabilities were present, showcasing the broad appeal of the performance. Unfortunately, we were not able to get more specific demographic information about the attendees and the reported information are estimation based on the attendees of the event.

The audiences were very active throughout the performance, following and listening to the live music, utilizing the AR application, engaging with the visualizations, and taking in the physical exhibitions. The application was downloaded 137 times from the Android and iOS app stores combined. Of those, 74 actively viewed virtual artefacts, and 35 interacted with them. Each artefact was viewed on average by 69 visitors (SD: 41) and was interacted with on average by 9 visitors (SD: 3).

During the performance, some technical issues were observed, especially with the AR application. In particular, the sheer volume of attendees impacted its performance, leading to certain limitations with the operation of the experience. The problem occurred mainly because the number of people within the venue prevented the smooth operation of the depth detection motion and the localization within the physical space.

4. Discussion

4.1. Insights from Host Museum

The evaluation of “ReInHerit a Museum: Immersive Performance” provides valuable insights into the event’s outcomes and impact. In terms of attendance, the amount of museum visitors and audience exceeded that of similar events, indicating a greater level of engagement from the public. This outcome was both unexpected and promising, showcasing the success of the project in attracting a wider audience.

As the host organization, BoCCF, expressed overall satisfaction with the artistic and scientific results. The event successfully achieved the project’s objectives, effectively engaging groups from a younger demographic and enhancing the overall visitor experience. The seamless integration of music and technology created a captivating and immersive space, effectively delivering on the project’s goals.

However, there were challenges faced by the host organization, particularly related to the use of technical equipment and the AR application. The AR application experienced some issues, such as slow performance, due to compatibility with certain devices or operating systems. These challenges were addressed to the best of their ability, but it is noted that improvements can be made for future events.

The use of AR was seen as highly beneficial and added value to the event. According to feedback received in interviews of the hosting organisation’s officers, the integration of AR elements generated more interest from the public and provided a unique and immersive museum experience. Given the positive response, the organization expressed a willingness to repeat this type of event in the future and incorporate similar interdisciplinary events and technologies into upcoming projects.

Overall, the positive feedback and interest from visitors further support the value of incorporating AR elements in future projects, demonstrating a commitment to embracing innovative technologies for engaging museum visitors. The relationship between music and visuals was commendable, further enhancing the overall impact of the performance. Attendees were observed trying to follow the musicians, demonstrating their active engagement with the live music element. This entirely new form of artwork instilled a sense of curiosity and encouraged people to explore and embrace the experience.

In general, the performance not only attracted a diverse audience, including different age groups, but also challenged traditional notions of museum engagement by offering the dynamic and participatory experience that we were searching for. This highlights the potential of immersive performances to redefine the boundaries of museum experiences and engage audiences in novel ways.

On the other hand, some shortcomings were observed with the interaction of the audience with the virtual artefacts. Even though, on average 69 visitors viewed each of the artefacts, only a small fraction of those (i.e., 9 out of the 69) interacted with them. This indicates that the design of the specific feature was problematic and not well understood by the audience. Therefore, in the future, the application should be adjusted to provide better explanation on how the user can interact the artefacts.

Looking to the future, several thoughts for further research emerge from this performance. Firstly, there is a need to address technical challenges to ensure the seamless functioning of interactive elements, such as augmented reality apps, in large-scale immersive performances. Additionally, further research can be conducted to investigate the impact of immersive performances on visitor engagement through emotional and cognitive analysis. Understanding the audience’s feelings, interpretations and comments, provides valuable insights for refining and improving our work.

Moreover, exploring the potential of more or improved collaborations between artists, musicians, and technologists in creating immersive experiences can lead to better results. The interdisciplinary collaborations enrich the field and pushes the boundaries of immersive art practices.

5. Limitations and Conclusion

In conclusion, the immersive performance was an important case study that offered invaluable insights into audience engagement, technical considerations, and the integration of art and museum experience. Its significance lies in its ability to challenge traditional museum experiences, stimulate a dynamic dialogue between art and technology, and encourage for continued research and innovation within the realm of immersive art. By leveraging these insights, we can create performances that are even more captivating, influential, and resonant, with the goal of fully immersing the audience and forging a profound connection between the audience, art, museums, emerging technologies, and the future.

The performance described in this paper was very well received by the audience, however, the lack of more qualitative data, using questionnaires limits the proper assessment of all the outcomes from the performance and the better understanding of how the audience experienced the performance. With all these considerations in mind, we are willing to make further enhancements to our artwork in the future.

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