

# The Influence of Animation and Spatial Augmented Reality Integration on Audience Responses to Immersive Arts.

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**Abstract:** This research examines the integration of animation and Spatial Augmented Reality (SAR) to create immersive artworks in gallery environments. As part of exploring the unexplored domain of SAR-animation convergence, the study looks at the spectators' responses towards this innovative approach in the limited gallery spaces, focusing on viewers' engagement and acceptance. By utilising a combination of research approaches—including audience surveys and creative experiments—the study uncovers the potentials of animation-SAR-based immersive experiences. The results highlight the potential of this growing area, notwithstanding obstacles such as high costs and implementation complexity. The research indicates that immersive art engages viewers to a deeper level and can have an emotional impact; it enriches the viewers' experiences and may contribute as a tool to other significant disciplines, such as art therapy.

**Keywords:** Animation, Spatial Augmented Reality, Immersive Art, Audience Experience

## I. Introduction

In recent years, the rapid evolution of digital technologies has enabled new story-telling forms and fresh approaches to engage audiences with animation (Lange, 2009). The advent of developing technologies, such as Virtual Reality (VR) and Augmented Reality (AR), has introduced novel opportunities for art forms to be experienced, engaging in an immersive way. However, these experiences may be facilitated by various viewing tools and displays, such as Mobile Applications (Apps) or Head Mounted Displays (HMDs). In contrast, Spatial Augmented Reality (SAR), is an emerging technology that allows the overlaying of digital content onto the actual environment (Azuma, 1997). It fosters an innovative, immersive experience that does not require additional equipment.

The merging of animation and Spatial Augmented Reality (SAR) holds the potential for creating a fresh kind of immersive art that draws on the various features of these two technologies. The integration of animation with SAR promises to generate captivating and enduring experiences for viewers, enabling them to engage with the artwork in novel and inventive ways (Lee & Kim, 2016). The potential above has garnered attention and sparked an increasing interest in artistic works integrating animation with SAR. Numerous artists and organisations have begun to delve into this emerging art form (Kanjo, 2015).

### A. Objectives of The Study

The potential of the convergence of SAR and animation as a novel immersive art form remains to be thoroughly investigated, notwithstanding the growing interest in the subject. In particular, this research examines how animation and spatial augmented reality may work together to provide an immersive art experience appropriate for confined spaces like galleries and how audience acceptance and response towards the work produced. The study used a mixed-methods approach, including audience surveys and creative experiments, to investigate this potential and identify critical issues that must be addressed for successful implementation.

## II. Literature Review

Buchan (2013) noted that incorporating various media technologies such as Augmented Reality into the art setting has become an increasingly common and accepted practice. Artists and art organisations are no longer only concerned with providing visual stimulation; instead, they immerse audiences in situations stimulating active exploration. With viewers increasingly appreciating technology-based artistic creation, artists and designers actively investigate emerging technologies to improve viewer engagement with their work. An aspect of immersive technology that is particularly intriguing is its ability to go beyond conventional boundaries (Baía Reis & Ashmore, 2022). It transcends the natural world and allows designers and artists to create works of art in a hybrid setting.

Thus, the use of Augmented Reality technology in the art world has been a growing area of interest. Researchers have explored its potential in enhancing traditional art forms, such as painting and sculpture, by providing a digital layer to existing works (Jian, et al., 2018). The use of AR in the entertainment industry has also been widely researched, with applications in gaming and film being explored (Zhou, et al., 2016). On the other hand, Spatial Augmented Reality (SAR) is a form of technology that enables the overlay of digital content onto the physical world, creating a new type of immersive experience. SAR allows users to interact with the digital content in real-time, as if it were part of the physical environment without the need to use devices, such as smartphones, tablets, and head-mounted displays. This creates a unique experience that blends the physical and digital worlds, enabling new forms of storytelling and new ways of engaging audiences.

Interestingly, crafting immersive art experiences that emphasize on concepts that engaging spectators as a crucial component via interaction in mixed environments, holds the potential to produce lasting experiences. Such encounters may alter how an audience perceives art. Art exhibitions that aim to generate immersive experiences, whether presented in everyday galleries or site-specific installations, significantly contribute to fostering a deeper understanding and appreciation for the artwork and its fundamental concepts. Li and Huang (2023) stated that greater engagement is ultimately achieved by offering viewers an engaging and interactive approach to enjoying and comprehending the art.

### **III. Research Methodology**

The study used a multi-method approach that combines a survey of audiences, and creative experiments. The methods used in this study are designed to provide a comprehensive understanding of an immersive arts based on integrating of animation content and Spatial Augmented Reality and its potential for future development. Additionally, the findings from creative experiments serves to provide insights on the narrative aspect and technical aspect of the immersive art produced. Meanwhile, a questionnaire survey was conducted to evaluate the effectiveness of the immersive art displayed in a gallery setting and to collect data on the participants' reactions during the experience. The survey employed a five-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." It was conducted at a Higher Education Institution (HEI) in Sarawak, Malaysia which included 79 participants aged 21 to 25 with a background in arts and design, specifically animation and graphic design.

### **IV. Findings & Discussion**

#### **A. Narrative**

##### **Exhibition Space**

In creating narrative for immersive art experience outcome, the artist must first consider the space (Parker & Saker, 2020). The work basically responds to the space and the canvas size, as well as the distance of the projection subject. The installation space must allow for viewers to walkthrough inside and outside of the installation area to maximise the audience experience the immersivity of the installation artwork. Considering this aspect, the spectators can walk around and through the installation freely. They are imitating the natural flow where we walk freely around the trees. Observing this aspect draws inspiration for 'freedom' as the central narrative concept for the artwork created. The intention is to let the spectators feel immersed in the work.

##### **Visuals**

The presentation of content within "The Digital Forest" is executed through looped animation techniques intentionally used to elicit an effective and engaging visual experience. The intended adoption of a preferred motif pattern distinctive to Iban culture significantly shapes the process of conceptualising design material. The individual components of this motif pattern are slowly deconstructed and later reassembled in their original arrangement. These motifs were then generated as animated visualisations for sixty seconds. The procedure begins with the themes being traced into 3D software rendered in an animated sequence and utilised as projection content (see Fig.1). Then later been projected onto the physical sculpture which served as a projection canvas (see Fig.2).

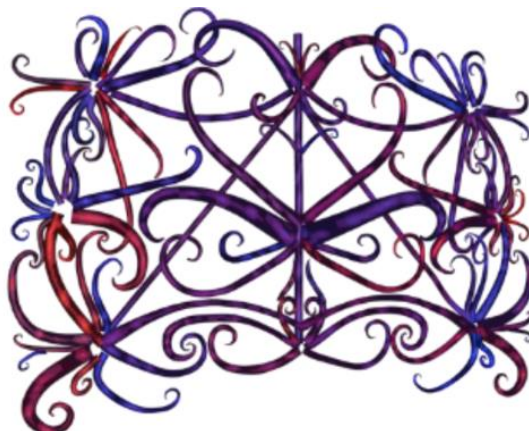


Fig. 1 Digitized of local cultural motifs in 3D software

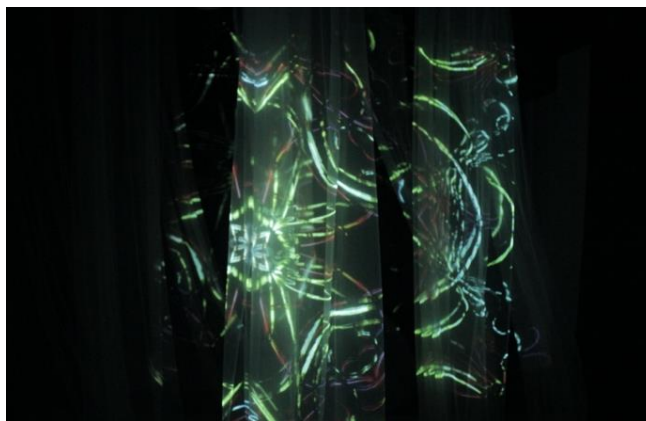


Fig. 2 Projection of the cultural motifs onto physical sculpture via Spatial Augmented Reality approach

## Sound

Sound is essential in creating an immersive experience because of its powerful ability to evoke strong emotions in people. Furthermore, sound enhances visual aspects that can move the audience into an elevated setting suggesting an entirely distinct world-like environment (Nikolic & Yang, 2020). From a technical aspect, optimising the impact on the audience demands using a surround sound system enclosing the installation, which results in a total soundscape effect. Furthermore, the sound emanating from every direction adds to the feeling of total immersion.

## B. Technical

### Projector

The specification of the projector, which is the primary instrument for creating immersive artwork in which virtual elements can be projected, is one of the main factors influencing the outcome of the artwork (Faria et. al, 2020). As the work is responsive to the environment, it will mostly depend on the projector's capacity and the projection's impact on the viewers corresponds to the size of the projection. Therefore, the location of the projector plays important role as it relies on the space ability of the exhibition area.

### Projection Canvas

An important factor in determining the effect on viewers is the selection of materials for the projection canvas. Given the narrative emphasis on replicating a forest-like environment with a desired soft ambience, elements with hard edges, such as boxes or rectangular objects, were carefully discarded from the overall layout. Instead, a set of transparent fabrics, specifically chiffon, was utilised. This decision enables artists to create a flowy and soft look to the space where spectators can walk through the installation work and feel the soft materials. It enables a sense of touch in the artwork apart from hearing and seeing.

### The Installation Layout

The primary purpose of the setup is to act as the surface for projecting images, requiring arrangements that enable the projected material to be easily seen. The installation involved the creation of physical structure, which is the fabrication of cloths imitating trunk of tree, animated visuals done using Autodesk Maya and later were mapped onto the physical structure using the video mapping software (see Fig.3).

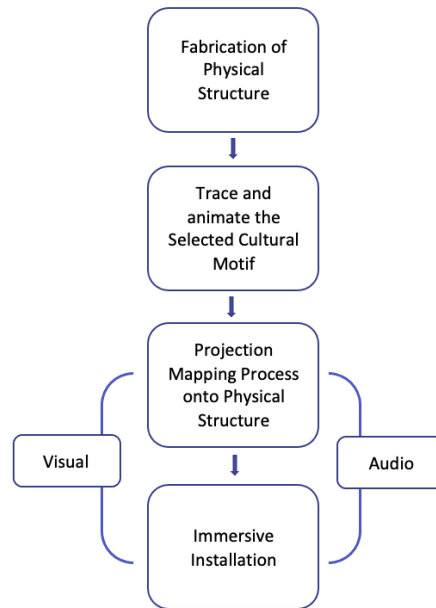


Fig.3 Digital Forest's architecture flow

It is intended to imitate an artistic installation rather than conforming to the conventional projection screen format usually used in a classroom setting (see Fig.4). In the Digital Forest installation, we replicate a natural environment, inviting spectators to traverse around a collection of suspended cloths resembling tree barks. The transparent nature of the cloth allows for visual projections to be visible not only on the front surface but also extend to the cloth's rear, fostering an immersive atmosphere where the visuals permeate nearly every section of the fabric.

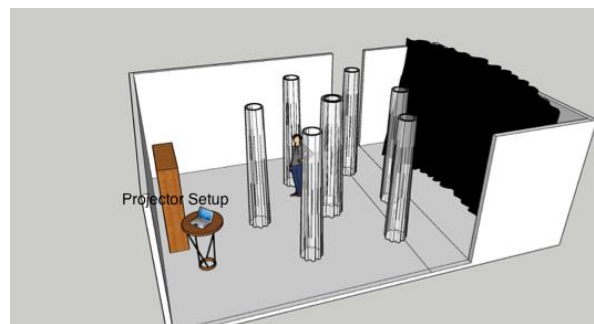


Fig. 4 Layout of the immersive installation in a gallery setting

The installation space was surrounded by four concrete walls, making it easy to set up the projection mapping because the room could be in complete dark due to the concrete walls. The exhibition area primarily centres around three key subjects: the projector, the projection space, and the physical structures of the artwork (see Fig.5). The venue was carefully arranged to provide enough space for the audience to navigate the installation area.

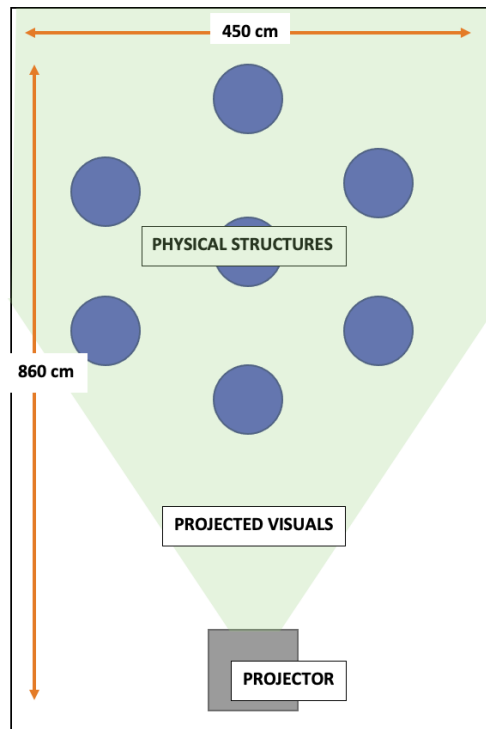


Fig. 5 The installation setup

### The Technical Approach

The integration of virtual content onto an actual sculpture is achieved by employing the principle of perspective projection. This procedure involves translating 2D computer picture coordinates ( $u, v$ ) to their corresponding 3D world coordinates ( $x, y, z$ ) (see Fig.6). In addition, the idea of parallel projection is used to project a two-dimensional visual representation onto three-dimensional objects. This is performed by translating the points of the objects in ( $x, y, z$ ) coordinates from a two-dimensional picture plane located in ( $x, y$ ) coordinates.

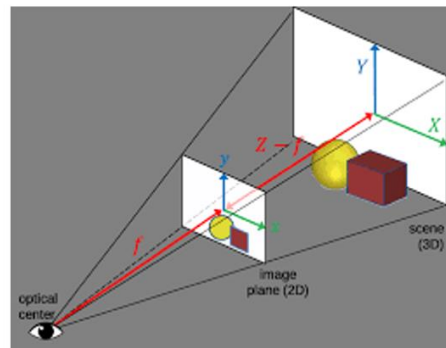


Fig.6 The concept of Perspective Projection (Amini et.al, 2016)

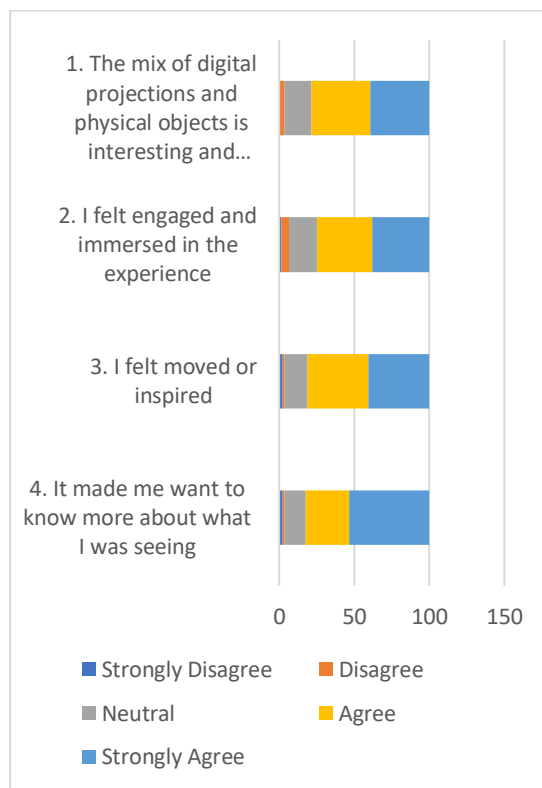
### C. Results – Audience Experience

A questionnaire and an open ended was conducted to viewers to evaluate their experience during the exhibition of the SAR-based animation installation. The questionnaire consisted of 5 questions, including 4 questions with five-point scale and one open ended question.

1. The mix of digital projections and physical objects is interesting and enriches my art experience.
2. I felt engaged and immersed in the experience

3. I felt moved or inspired
4. It made me want to know more about what I was seeing

Table 1. Results for questionnaire survey



Results on **“The mix of digital projections and physical objects are interesting and enriches my art experience”** indicate that quite a few of those who participated perceived the utilisation of SAR, where projecting the animation content onto the physical cloth sculptures, as highly engaging and effective in enhancing their overall experience. The combined percentage of those who expressed agree or strongly agreed totalled 78.4%. The data presented highlights the audience's apparent acceptance and appreciation of the intended integration exhibited within the display. The amalgamation undoubtedly profoundly impacted the participating audience, creating a more enriched and engaging experience.

Furthermore, the data on **“I felt engaged and immersed in the experience”** supports the above viewpoint. A significant 38% of respondents strongly agreed that this integrated display approach made them feel fully engaged and deeply immersed in the artistic experience, followed by 36.7% agreed. These figures demonstrate the audience's substantial agreement with the usefulness of using the SAR application in conjunction with actual cloth sculptures.

The chart illustrates the high degree of agreement among participants who reported **“being moved and inspired”** by the exhibition, adding to the positive findings. Following the desired effect of the art exhibition, many participants agreed with these responses. The result suggests the integration of SAR in the fusion of animation with physical materials stimulates and evokes emotional responses, effectively captivating and inspiring the viewers.

The result on **“It made me want to know more about what I was seeing”** shows that 53.2% strongly agreed that the artwork aroused their interest, inspiring them to want to learn more about the subject. It indicates that using projections in art goes beyond just making an audience feel immersed; it also creates a significant connection between the viewers and the stories and ideas interwoven throughout the installation. Interestingly, this proves that projection-based exhibition integrated with animated contents can educate visitors about significant matters, such as promoting awareness about climate change or preserving cultural stories. Hence, this demonstrates their adaptability beyond just being an artistic expression alone.



The open ended question focus on the students' responses with the immersive artwork, drawing upon their observations and personal experiences with the artwork display. Some of the students spend up to more than 15 minutes there. Three themes were identified from nearly identical responses provided by most of them.

1. Respond to the Artwork
2. New experience
3. Memorable

Table 2. Open ended question: Could you share your opinions and feelings with us about the artwork?

<b>Respond to the Artwork's concept</b>	"My feelings about this artwork is that was something cool n nice. Which is it combined with alpha sound that give you some relaxing music, fan that give you some cooling air and in the dark room and it feels like we were in a forest.."
	"Great, it helped me to understand can be in nature with artificial aspects."
	"The artwork bring us to the forest."
	"It feels like watching the Northern Lights."
	"I'm stepping into an artificial nature."
	"It's nice to see an artwork that did not been applied on paper or on screen..  For me it is outstanding."
<b>New Experience</b>	"Great and new experience but the artwork is not clearly presented."
	"This is the first time I saw this kind of artwork and it's a whole new experience to me, but I can't seem to know what I should do with it."
	"Amazing.. make us feel like in some unrealistic world."
	"This is really amazing, I have never feel or experience this before, so I'm glad to have this chance to experience it."

<b>Memorable</b>	“About this artwork, the visuals and the audio soothing, I feel more calming like than before. Feel the colourful visuals, audio soothing, I felt moved, become more calming and how amazing this kind of visuals. I conclude, these visuals explain somehow like a fantasy or in a dream world, escape from hassle life.”
	“Was perfect for relaxation.” “The slow movement of artwork make me remember the past.”
	“I think the artwork is very calming for certain people if they focus on the sound and the artwork.”
	“It feels like in another dimension.”
	“I feel more peaceful and think about my past when I came into the audiovisual performances.”

The responses from open ended results concluded in three themes that reflects the answers given by students. Which are:

**Respond to the Artwork**

Students responded by actively engaging with the artwork, which could include observations of specific features based on the colours, shapes, or themes included in the installation. Furthermore, the replies suggest that the artwork elicited specific feelings, moods, or thoughts in the students, showing an emotional reaction to the artwork.

**New Experience**

Students emphasised that the artwork offered a unique experience they had not previously encountered, highlighting the freshness of their interaction. Therefore, this theme might include students' experiences of exploring and engaging with the artwork in ways that differ from conventional art displays.

**Memorable**

The term "memorable" implies that students found the artwork significant and brought back nostalgia effects. It is likely to be remembered over time. This theme may suggest that the students saw the artwork as having potential for use in art therapy, possibly as a therapeutic material due to its' relaxing effect.

**V. Conclusion**

Overall, the creative experiment provided insights and proved that space, visuals, and sound are essential to the audience’s overall experience. Thus, they have to be carefully designed. Immersive art also relies on the layout of the immersive artwork. Allowing the audience to observe freely is crucial to influencing the audience to be immersed in the work. The study also demonstrates the audience’s high interest in this innovative immersive art form. It indicates an increasing need for immersive experiences that integrate animation with SAR. This is a significant factor for artists and cultural institutions that highlights the potential to present cultural narratives in innovative approaches to enhance and foster cultural awareness.

The study also unveiled challenges that limit the development of these innovative art forms. First and foremost, the high cost of the tools and software required to provide these experiences makes it challenging for artists and cultural institutions to begin. Furthermore, the need for standardised procedures and methods limits the initiation of projects in this domain, which may create barriers for artists.



In conclusion, the findings of this study show the potential of the connection of animation and SAR as an emerging form of immersive art. This area has substantial potential for future advancement, as evidenced by the significant interest expressed by audiences, the potential to create captivating and memorable experiences, and the challenges that must be overcome. It offers the basis for further and ongoing studies of immersive arts' potential.

### **Acknowledgement**

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