

UTILIZATION OF AUGMENTED REALITY FOR LITERACY AND HISTORICAL KNOWLEDGE MANAGEMENT IN ACEH

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ABSTRACT

This research proposes an innovative solution to overcome the challenges of cultural preservation and historical literacy in Aceh by utilizing 3D Augmented Reality (AR) technology. Known as *Virtual Space*, this system is designed to provide users with an interactive experience in exploring Aceh cultural heritage. Key challenges, such as the lack of interest of the younger generation and accessibility to cultural collections, were identified and addressed with the *Virtual Space* innovation. Through a Research and Development (R&D) approach, this research involves the steps of Analysis, Design, Development, Implementation and Evaluation (ADDIE). Analysis stage by conducting an interview with one of the guards at the *Rumoh Aceh Museum*. Design includes planning 3D models with Blender and developing AR experiences with Unity. The Development Phase involves creating a designed 3D model and adjusting textures. The implementation resulted in *Virtual Space* as an innovative system that combines AR and 3D content to bring Aceh cultural heritage to the digital world. This system allows users to view and interact with cultural collections in 3D via smartphones and books.

Keywords: Innovative Culture, Aceh, Augmented Reality, 3D

I. Introduction

Aceh, a province located at the western tip of Indonesia, is a fascinating place with an extraordinary cultural and historical heritage. Known as the "Serambi Mecca" Aceh has an important role in its long maritime history and international trade. This province is also rich in cultural riches that reflect ethnic and religious diversity. These extraordinary relics of the past are valuable assets that must be preserved and disseminated so that they can be appreciated by future generations.

However, we currently face a number of critical challenges related to preserving cultural and historical knowledge in Aceh. One of them is the lack of digitization of cultural collections in Aceh, even throughout Indonesia. Another problem that is currently occurring is the lack of interesting educational media to bring cultural knowledge to the public effectively. The lack of educational media will reduce understanding of Aceh culture and history. Over time, public understanding may further erode due to a lack of effective educational resources or waning interest (Agustinova, 2022)

In addition, researchers identified a number of crucial problems that need to be addressed in efforts to preserve and educate Acehese culture. One of them is the lack of accessibility to collections of typical Acehese items, which can often only be found in certain physical locations. This makes it difficult for some people to experience the beauty and history of the collection. Rapid social and economic changes can also impact the preservation of traditional culture (Sari, 2020). Urbanization and economic change can shift society's focus away from preserving cultural heritage. In a world that is increasingly connected and moving towards the 5.0 era, the presence of interesting and interactive media is becoming increasingly important in maintaining cultural interest and literacy among the public.

One of the innovative solutions that researchers offer is the use of Augmented Reality (AR) technology which utilizes a three-dimensional (3D) representation of a collection of typical Acehese items. Researchers combine AR and 3D technology called *VirtualSpace* for cultural preservation with the aim of keeping cultural interest and literacy in Aceh strong, by utilizing existing technological advances. With *VirtualSpace*, users can easily access collections of Acehese items in 3D form just by using a smartphone and a guidebook. Through Augmented Reality (AR) technology, users can see the collection from all sides, as if they were in front of the real item. This creates an experience as if users can see the collection of Acehese cultural items directly without having to be at the location (Firmansyah, 2021).

Challenges in cultural literacy in Aceh, such as low access to information and lack of interesting educational media, are addressed innovatively by *VirtualSpace*. By utilizing Augmented Reality (AR) technology and 3D format, *VirtualSpace* is not only a source of information, but also creates a unique and interesting cultural experience.

VirtualSpace's main innovation lies in its ability to present cultural collections in 3D format that can be easily accessed via smartphone. Users can view the collection from various angles, gain an in-depth perspective, and feel as if they are interacting directly with these historical objects. This creates a new dimension in cultural literacy, where information is not just passively conveyed, but is also integrated into the user experience.

Apart from that, *VirtualSpace* also opens the door to creativity and exploration. Users can interact with cultural objects, rotate, zoom and explore every detail freely. This capability not only provides more in-depth information, but also stimulates curiosity and exploration, overcoming the limitations of conventional educational media. By utilizing modern technology, *VirtualSpace* presents an innovative solution to the cultural literacy challenge in Aceh. As a tool that not only provides information but also creates interactive and immersive experiences, *VirtualSpace* is expected to be a driver of greater interest and understanding of Aceh cultural heritage among the public. In this way, it is hoped that *VirtualSpace* can play a role in increasing historical literacy and cultural preservation in Aceh, by bringing innovation to the way we interact with valuable cultural heritage.

Based on the description above, this scientific work aims to provide concrete solutions to the challenges of cultural literacy in Aceh. By designing and implementing *VirtualSpace*, we strive to provide an innovative solution that not only provides cultural information, but also creates an interactive and immersive experience for users. Through an Augmented Reality (AR) technology approach and 3D format, we hope that *VirtualSpace* can be an effective solution in overcoming low access to information and the lack of attractiveness of educational media in the field of cultural literacy in Aceh. The main aim of this scientific work is to make a positive contribution to the understanding, preservation and increasing interest in Aceh cultural heritage among the community, especially the younger generation.

II. Theoretical Framework

In the era of digital technology, especially among the younger generation, we see a trend of decreasing understanding and interest in local culture. They are more likely to be fixated on their handheld devices than their own cultural heritage (Prof. Dr. Drs. Ersis Warmansyah Abbas, 2022). Globalization has brought about significant changes in the way local culture is influenced by global culture. This can cause the younger generation to lose touch with their own culture and traditions (Arif, 2019).

Augmented Reality could be a solution to reignite the younger generation's interest in their own culture. With the deepening tide of globalization and the penetration of technology in everyday life, the younger generation is often glued to their handheld devices, resulting in a decline in interest in local traditions and cultural heritage. However, through the use of AR, research shows that digital experiences can be built that combine the real world with virtual elements in a local cultural context. It not only awakens curiosity about cultural heritage, but also creates a bridge between the past and the present, allowing the younger generation to experience and appreciate their cultural heritage through engaging interactive experiences. Thus, AR technology is considered an innovative tool that can save and enrich the younger generation's relationship with their own culture (Mustaqim, 2019).

III. Research question

Based on the explanation above, the questions in this scientific work are:

1. How can Augmented Reality (AR) technology in the form of three-dimensional (3D) representation be used to strengthen understanding of Aceh culture and history among the younger generation?
2. What is the positive impact of using AR 3D technology in introducing the beauty, history and uniqueness of the collection of typical Acehnese items?

IV. Research purposes

The aim of this scientific work is to explore the potential and effectiveness of using 3D Augmented Reality technology as an innovative historical literacy and cultural preservation tool in Aceh through *VirtualSpace*.

V. Review the Literature

1. Cultural Product Knowledge Management

Cultural Product Knowledge Management is an approach that focuses on collecting, documenting, presenting and preserving cultural and historical knowledge of a particular society or region. This can include arts, crafts, architecture, folklore, traditions and cultural items that form the cultural identity of a community. There are several basic concepts in cultural product knowledge management, namely:

a) Knowledge Collection

The process of gathering cultural knowledge through a variety of sources, including written documentation, interviews with cultural figures, direct observation, and digital resources. This information includes cultural artifacts, local history, traditions, art and everything related to cultural heritage.

b) Documentation and Organizing

Compile and document cultural knowledge in an accessible and secure format. This includes the use of images, videos, written notes, narratives, and digital databases.

c) Presentation

Communicate cultural knowledge to a wider audience through various media. This involves developing exhibitions, websites, applications or interactive learning tools that enable the public to explore and understand cultural heritage.

d) Preservation

Ensuring the continuity and preservation of cultural and historical heritage. This includes actions to care for and preserve cultural items, as well as devising strategies to protect cultural knowledge from extinction.

2. Cultural and Historical Preservation in Aceh

Preserving culture and history in Aceh has a crucial role in maintaining the identity and traditional values that have been embedded in Acehnese society for centuries. Aceh, as a province in Indonesia, has a rich and diverse cultural heritage, including art, traditions and history involving influences from various civilizations that have passed through it. Cultural preservation in Aceh does not only include historical objects, but also traditional values, norms and practices that continue to be maintained and preserved.

One aspect of cultural preservation in Aceh is through maintaining historical sites, such as palaces, mosques and tombs which reflect the splendor and grandeur of the past. This is a silent witness to Aceh long journey in absorbing various historical events, including the reign of the Aceh Sultanate which was known to be strong and influential.

In addition, Aceh traditional arts and culture, such as the Saman dance and Rencong carvings, are an integral part of conservation efforts. The younger generation is invited to understand, appreciate and inherit this cultural richness through various educational programs and cultural activities. Cultural centers and museums in Aceh play an important role in storing and presenting historical artifacts and providing insight into the long journey of Acehnese culture.

Efforts to preserve culture and history in Aceh also rely on the active involvement of the local community and government. Preservation, training and research programs are directed at increasing public awareness of the importance of preserving their cultural heritage. Thus, this section reflects the commitment and joint efforts in maintaining the rich culture of Aceh so that it remains alive and relevant in the modern era.

3. 3D Augmented Reality

Augmented Reality (AR) 3D is a combination of Augmented Reality technology and three-dimensional (3D) representation to create experiences by combining real world elements with virtual elements in three dimensions. In the context of 3D AR, users view the real world through devices such as smartphones or AR glasses, while the objects, characters, or additional information displayed are 3D models that appear as if they exist within the physical environment.

4. Digital Literacy

Digital literacy is the ability to discover, work on, evaluate, use, create and utilize digital technology wisely, intelligently, carefully and appropriately according to its use (Kompas.com, 2023). Digital literacy includes digital skills, digital culture, digital ethics, and digital safety. With these four areas, users are expected to have the ability to build national insight in interacting in digital spaces, adapt and think rationally and prioritize internet ethics, understand the function and

workings of devices. Information Technology hardware and software and also able to increase awareness about the protection and security of personal data ((Aptika.kominfo.go.id, 2023).

5. Blender Application

This software is used to build 3D objects, on the other hand this application can also be used to create virtual effects, the supporting features are animation, rendering, motion tracking. Blender's animation features give users great freedom to create movement and compelling visual narratives. Users can customize detailed animations of characters, objects, or even environments, creating a more vivid and engaging visual experience. With support for time series animation, Blender becomes an effective tool for developing complex animation projects.

6. Unity 3D

Unity 3D provides a comprehensive solution for developers to create stunning 2D and 3D interactive experiences. With its advantage as a cross-platform platform, Unity 3D allows developers to create virtual games and applications that can be accessed via a variety of devices, including PCs, mobile devices, game consoles, and even virtual reality.

Unity 3D's advantages are not just limited to game development. The platform has also been widely used in the development of simulations, virtual training, and mixed reality applications. Advanced visualization features, realistic physics handling, and support for virtual reality technology make Unity 3D a strong choice for projects involving human interaction and virtual environments.

Additionally, Unity 3D offers an extensive asset store, where developers can purchase or share resources, scripts, and 3D models to speed up the development process. This creates a dynamic community ecosystem around the platform, enabling collaboration and exchange of ideas between developers.

VI. Research methodology

1. Research Approach

The approach that researchers apply in this research is the Research and Development (R&D) approach. In this approach, researchers combine creative and technical elements to develop solutions based on 3D AR technology in the context of historical literacy and cultural preservation in Aceh. R&D in this scientific work has five stages, starting from the development process which begins with Analysis, Design, Development, Implementation, Evaluation (Quigley, 2023), which is usually referred to as ADDIE.

2. Tool

The tools used in this research are:

- 1) Blender application, used for creating 3D models
- 2) Unity will be used to integrate 3D models with tracking features, so that 3D objects can be tracked in AR experiences.

3. Technique

Several techniques used in this research are:

- a) Modeling and texturing techniques in Blender to create 3D models that fit the historical and cultural context of Aceh.
- b) VR integration techniques use Unity to create VR experiences that involve tracking 3D objects

- c) Evaluation techniques involve monitoring audience responses, analyzing the effectiveness of historical literacy, as well as identifying problems or improvements that may be needed.

4. ADDIE Stages

Analysis

The first step taken is analysis. At this stage the researcher conducted an interview with the guard of the Rumoh Aceh Museum in Banda Aceh. One of the challenges identified is the lack of interest from visitors, especially from the younger generation. Museum keepers also acknowledge the limitations of currently available educational media in conveying cultural information. They see the key role of technology in cultural preservation, and the hope is that *VirtualSpace* can facilitate easier access and deeper understanding of Aceh cultural heritage. In addition, the museum's guardians expressed hope for collaboration between traditional cultural institutions and technological solutions such as *VirtualSpace*, and expressed support for innovation as a positive step in maintaining cultural relevance in the modern era.

Design

At this stage, researchers carefully designed all the elements necessary to create an AR experience that combines historical literacy and cultural preservation in Aceh. Researchers plan to create a 3D model that will be built using Blender software, including modeling Acehnese cultural objects with accurate details. Researchers also consider texture design to present these objects in interesting visual detail. Figure 3.1 shows the Design Process using the Blender Application.

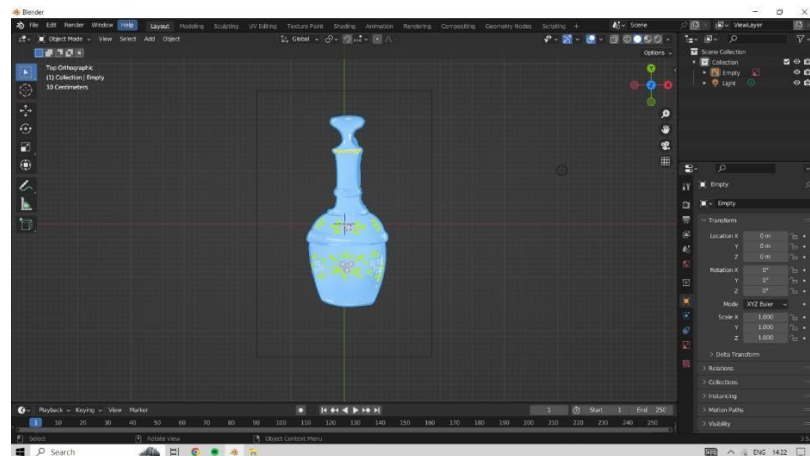


Figure 3. 1 Design Process

Development

The development stage is the stage where the researcher begins to turn the conceptual design into reality. Here, researchers are actively involved in creating pre-designed 3D models in the Blender application.

Next, the researchers made texture adjustments to the model used to provide an appropriate and realistic visual appearance. At this stage, researchers also use FBX to export the finished 3D model. FBX is the ideal file format to ensure that these models can be seamlessly integrated into the AR experiences that researchers will create using Unity at a later stage. Figure 3.2 is the initial view of the Unity application

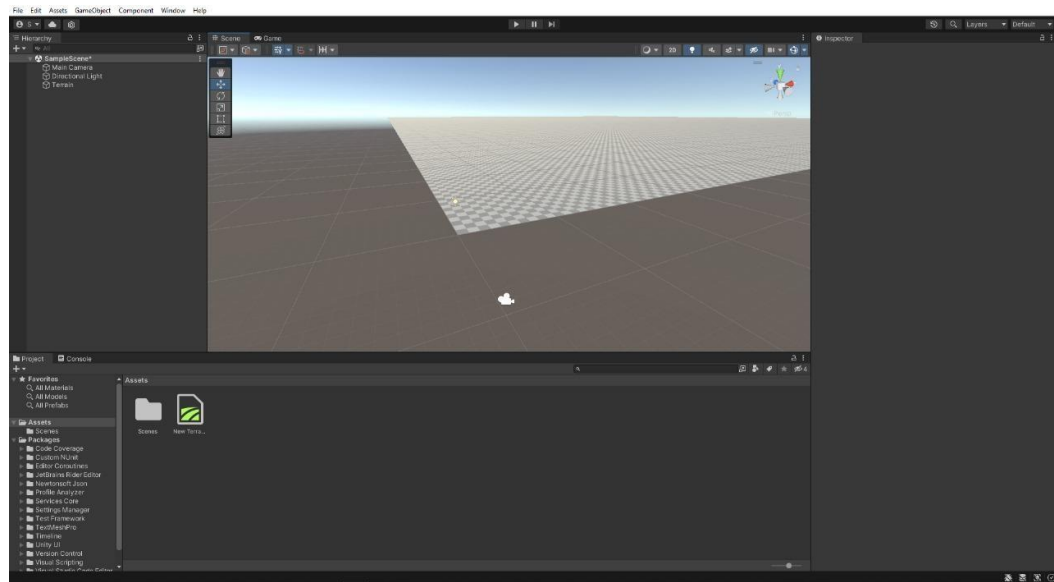


Figure 3. 2 Unity App View

Implementation

The evaluation stage is the final step in the ADDIE method which is very important. Here, researchers will critically evaluate the extent to which the 3D models that have been created and the AR experiences that have been developed meet the previously established research objectives.

VII. Results

In designing this research, we named the system we created, namely *VirtualSpace*. *VirtualSpace* is an innovative system designed as a virtual environment to enrich historical literacy and preserve culture and collectibles in Aceh. This system was created with the aim of providing users with an immersive interactive experience, combining augmented reality (AR) technology and 3D content to bring Aceh cultural heritage to digital life. *VirtualSpace* is designed as a platform that allows users to explore Aceh cultural heritage through the lens of modern technology. Users can experience the beauty, uniqueness and history of various Acehnese cultural artifacts and objects in realistic 3D form. Through the use of AR, it is made as if they can see cultural objects from various angles just by pointing their smartphone camera at the book.

In this system, we present a number of superior features. First, the system will display scanned collectibles in 3D format, allowing users to view the items from various angles. Second, during the scanning process, the system will also display important information regarding the item, including the year of manufacture, name of the item, and a brief explanation of its characteristics. Figures 1 and 2 are examples of initial designs that researchers have created using the blender application.



Figure 4. 1 Rencong Meucugek Appearance Design when Tracking

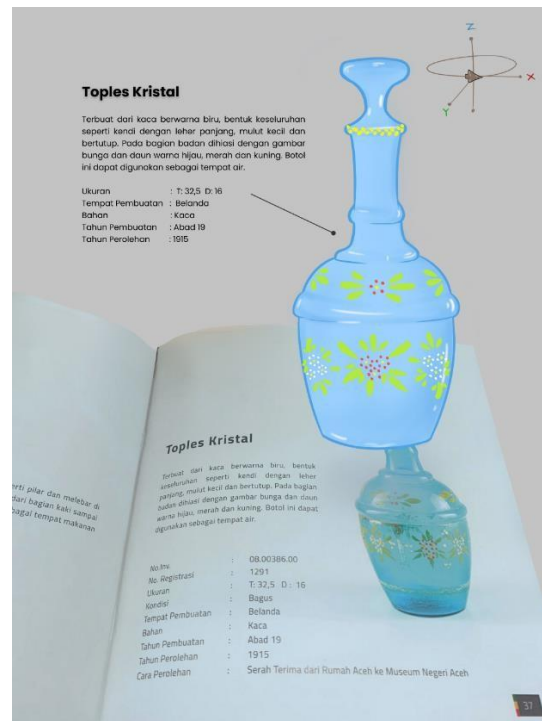


Figure 4. 2Design of Crystal Jar Appearance when Tracked

VIII. Conclusion

This research resulted in *VirtualSpace*, an innovative system that combines 3D Augmented Reality (AR) technology to overcome the challenges of cultural preservation and historical literacy in Aceh. By designing and implementing this solution, this research aims to make a positive contribution to the understanding, preservation and increasing interest in Aceh cultural heritage, especially among the younger generation. Through *VirtualSpace*, users can explore Aceh cultural heritage with realistic 3D object displays via smartphone.

REFERENCE

- Agustinova, D. E. (2022). Strategi Pelestarian Benda Cagar Budaya Melalui Digitalisasi. *Jurnal Pendidikan dan Sejarah*.
- Aptika.kominfo.go.id. (2023). *Kominfo Gandeng Pandu Digital JSDI Ajarkan Empat Pilar Literasi*. Retrieved from <https://aptika.kominfo.go.id/2022/09/kominfo-gandeng-pandu-digital-jsdi-ajarkan-empat-pilar-literasi-digital/>
- Arif, M. (2019). *Individualisme Global di Indonesia*. Stain Kediri Press.
- Firmansyah, D. F. (2021). Perancangan Arca 3D Sebagai Karakter Augmented Reality (AR) Dalam Meningkatkan Minat Sejarah Masyarakat. *Jurnal Inovasi Teknologi Pembelajaran*, 266-276.

- Kompas.com. (2023). *Literasi Digital*.
- Mustaqim, I. (2019). Pemanfaatan Augmented Reality Sebagai Media Pembelajaran. *Jurnal Pendidikan Teknologi dan Kejuruan*, 174.
- Prof. Dr. Drs. Ersis Warmansyah Abbas, B. M. (2022). *Peran dan Inovasi Generasi Milenial dalam Mewujudkan Indonesia Emas 2045*. Banjarmasin: Program Studi Pendidikan IPS .
- Sari, I. P. (2020). Potensi Pariwisata Bersejarah Sebagai Peluang Ekonomi Masyarakat.