
Development of a Metaverse-Based Virtual Heritage Experience for the Preservation of Bantengan Performing Arts and Cultural Knowledge

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Abstract

Bantengan is a traditional performing art originating from East Java that combines dance, traditional music, ritual elements, and local cultural values. As an important form of traditional cultural heritage, Bantengan faces preservation challenges due to modernization, changing lifestyles, and the decreasing interest of younger generations in traditional arts. Existing preservation efforts, such as photographs, videos, and written documentation, are often limited in providing interactive and engaging learning experiences. This study aims to develop a metaverse-based virtual heritage environment as an alternative medium for preserving and promoting Bantengan through an immersive digital experience. The research employed a Design and Development Research (DDR) approach involving cultural data collection through literature studies, observations, and interviews with Bantengan practitioners and communities, followed by virtual environment design, asset development, implementation using the Assemblr platform, and evaluation. The developed environment adopts a floating island concept that contains performer avatars, audience avatars, traditional musical instruments, ritual elements, and interactive information markers. Users can access the virtual environment through mobile devices by scanning a QR code. The results indicate that the developed virtual heritage environment successfully integrates cultural knowledge and interactive digital experiences, enabling users to explore and understand Bantengan more effectively. This study demonstrates the potential of metaverse technology as an innovative approach for preserving traditional performing arts and supporting cultural knowledge transmission in the digital era .

1. Introduction

Indonesia possesses a rich diversity of cultural heritage, one of which is Bantengan, a traditional performing art that has developed in East Java, particularly in Malang and its surrounding regions. Bantengan is a traditional performance that combines elements of martial arts (pencak silat), dance, traditional music, cultural symbolism, and community participation. Beyond serving as a form of entertainment, Bantengan also functions as a medium for transmitting cultural values and local wisdom to future generations [1].

Amid rapid technological advancements and changing lifestyles, the preservation of traditional performing arts faces various challenges. Younger generations increasingly engage with digital media rather than participating in or learning about traditional cultural activities. This situation has the potential to reduce public awareness and understanding of local cultural heritage, including Bantengan [2].

Current preservation efforts are generally limited to photographs, videos, and written documentation. Although these methods are valuable for recording cultural practices, they remain passive forms of preservation and often fail to provide engaging and interactive learning experiences. Therefore, innovative approaches are needed to combine cultural preservation with digital technologies that are more relevant to contemporary society [3], [4], [5], [6].

Recent developments in Metaverse and Virtual Heritage technologies offer new opportunities for cultural preservation [7], [8]. Virtual Heritage enables cultural assets and knowledge to be represented within digital environments that users can explore interactively, while the Metaverse provides immersive virtual spaces where users can interact with cultural content and digital assets in real time [7], [9], [10], [11], [12], [13], [14].

Several metaverse platforms have been introduced to facilitate the development of immersive digital experiences. One of these platforms is Assemblr, which enables the creation of interactive three-dimensional environments by integrating augmented reality (AR), three-dimensional (3D) objects, multimedia content, and QR-code-based access, making it suitable for educational and cultural heritage applications [15].

Previous studies have primarily focused on virtual museums, historical site reconstructions, and the digital documentation of cultural artifacts [16]. However, research specifically aimed at developing metaverse-based Virtual Heritage environments for preserving traditional performing arts remains limited. Furthermore, only a few studies have integrated cultural knowledge, traditional musical instruments, performer avatars, and educational content into a single virtual environment that is accessible through mobile devices [17], [18].

The novelty of this study lies in the development of a Metaverse-based Virtual Heritage environment specifically designed to represent Bantengan performing arts. The developed environment was implemented using the Assemblr metaverse platform, integrating performer avatars, audience avatars, traditional musical instruments, ritual offerings, and interactive information markers within a single virtual space [15].

Based on these challenges and opportunities, this study aims to develop a Metaverse-based Virtual Heritage environment as a medium for preserving and promoting Bantengan performing arts and cultural knowledge through an immersive and interactive digital experience.

2. Research Methods

2.1 Research Design

This study employed the **Design and Development Research (DDR)** method. DDR was selected because it focuses on the systematic process of designing, developing, implementing, and evaluating a digital product

based on user needs and contextual requirements. In this study, the product developed was a Metaverse-based Virtual Heritage environment aimed at preserving Bantengan performing arts and cultural knowledge [19].

The research process consisted of five stages:

1. Analysis
2. Design
3. Development
4. Implementation
5. Evaluation

2.2 Respondent Characteristics

Data were collected from individuals and communities actively involved in Bantengan preservation activities. The respondents were selected based on their experience, knowledge, and contribution to the development and preservation of Bantengan culture.

Table 1. Respondent Characteristics

Respondent	Role
Mr. Jani	Bantengan community leader, cultural preservation practitioner, and Bantengan mask craftsman
Lembu Sejati	Active Bantengan community involved in cultural preservation and player regeneration

2.3 Data Collection

Data collection was conducted through literature studies, observations, and interviews.

The literature study was carried out to obtain information related to Virtual Heritage, Metaverse technology, digital cultural preservation, and Bantengan performing arts from scientific journals, books, and relevant publications.

Observations were conducted to identify the visual and cultural elements of Bantengan performances, including traditional musical instruments, performer costumes, ritual properties, performance structures, and audience participation.

Interviews were conducted with Mr. Jani and members of the Lembu Sejati Bantengan Community to gain deeper insights into the cultural values, performance sequence, traditional instruments, player regeneration, and preservation efforts associated with Bantengan.

2.4 Data Validity

Data validity was ensured through source triangulation by comparing information obtained from observations, interviews, and literature studies. This process was conducted to verify the consistency and accuracy of cultural information before it was translated into digital assets and virtual representations.

3. Result and Discussion

3.1 Analysis Results

The analysis phase identified several cultural elements that should be represented within the virtual environment.

According to Mr. Jani, Bantengan is a traditional performing art that continues to preserve the use of traditional musical instruments as the primary accompaniment to performances. These instruments include the kendang, gong, and saron, which contribute significantly to the atmosphere and identity of Bantengan performances.

Mr. Jani also explained that the performance structure generally begins with a pencak silat demonstration, followed by a tiger (macan) performance, and concludes with the Bantengan performance as the main attraction. This information was later incorporated into the educational content provided through interactive information markers.

Furthermore, the interview revealed that player regeneration begins at an early age to ensure the continuity of cultural transmission. This finding highlights the importance of developing digital preservation media that can attract younger generations [2].

The Lembu Sejati Bantengan Community stated that one of their primary objectives is to preserve Bantengan culture and ensure that it can be inherited by future generations. This information strengthened the rationale for developing a Virtual Heritage environment as a cultural learning and preservation medium [5].

Table 2. Summary of Interview Findings

Cultural Information	Source	Metaverse Implementation
Use of traditional musical instruments	Mr. Jani	3D models of Kendang, Gong, and Saron
Bantengan performance structure	Mr. Jani	Educational content within information markers
Player regeneration from an early age	Mr. Jani	Foundation for digital cultural education
Cultural preservation for younger generations	Lembu Sejati Community	Main objective of the Virtual Heritage environment
Traditional Bantengan head design	Mr. Jani and Lembu Sejati	Visual reference for avatar and cultural asset design

3.2 Design Results

Based on the analysis results, a Virtual Heritage environment was designed using a floating island concept as a digital cultural space.

The environment consists of a central performance area surrounded by wooden fences and natural elements such as trees. The design aims to create a focused cultural space where users can explore and learn about Bantengan without distractions.

The virtual environment includes:

1. A floating island environment
2. Wooden fences surrounding the performance area
3. Green trees as environmental elements
4. Performer avatars representing Bantengan dancers
5. Audience avatars
6. Traditional musical instruments

7. Ritual offerings and punden structures
8. Interactive information markers

3.3 Development Results

The development process was carried out using the Assemblr platform. Cultural elements identified during the analysis phase were transformed into digital assets and integrated into a single virtual environment.

Table 3. Cultural Asset Implementation

Cultural Asset	Digital Representation
Bantenan Performer	Performer Avatar
Audience	Audience Avatar
Kendang	3D Model
Gong	3D Model
Saron	3D Model
Ritual Offerings	Digital Punden
Cultural Information	Interactive Information Marker

The visual appearance of the performer avatars was designed based on observations of traditional Bantenan costumes and masks. Information regarding the construction of Bantenan heads obtained from interviews was also used as a reference for developing the digital assets.

3.4 Implementation Results

The completed Virtual Heritage environment was successfully implemented using the Assemblr platform.

Users can access the environment through mobile devices by scanning a QR code linked to the project. Once accessed, users can explore the virtual space, observe cultural assets, and interact with information markers to obtain additional knowledge about Bantenan.



Fig. 1 Developed Metaverse-Based Virtual Heritage Environment for Bantenan

The virtual environment contains a central performance arena, audience area, traditional musical instruments, ritual offerings, and interactive educational elements.

3.5 Interactive Learning Features

To support cultural learning, interactive information markers were incorporated into the virtual environment. These markers provide educational content that users can access while exploring the environment.

Table 4. Interactive Information Markers

Marker	Content
Marker 1	History and Preservation of Bantengan
Marker 2	Traditional Musical Instruments in Bantengan
Marker 3	Structure of a Bantengan Performance

These interactive features transform passive observation into an active learning experience, enabling users to gain a deeper understanding of Bantengan culture.

3.6 Evaluation Results

Evaluation was conducted by comparing the developed virtual environment with the cultural information obtained from interviews, observations, and literature studies.

The results indicate that the major cultural components identified during the analysis phase were successfully represented in the Metaverse environment. These components include performer avatars, audience avatars, traditional musical instruments, ritual elements, and educational information.

The implementation also demonstrates that QR code-based access can improve accessibility, allowing users to experience the Virtual Heritage environment through commonly available mobile devices [14].

3.7 Comparison with Previous Studies

Table 5. Comparison with Previous Studies [17], [18], [20], [21]

Study	Research Focus	Contribution
Aditama, Yanti, & Sudipa [18]	Virtual Reality museum for Bali's Lontar Prasi manuscript heritage, accessed via headset/VR app	Demonstrates VR as cultural education media for Indonesian intangible heritage, but limited to single-user, static exhibition-style content
Innocente et al. [17]	Metaverse-based VR platform for Italian Resistance intangible heritage, with real-time multi-user interaction via Spatial SDK	Provides a genuine multi-user metaverse benchmark; shows what true multi-user implementation requires (dedicated networking SDK), useful as a contrast point for AR/QR-based platforms
Sahnir, Jamilah, & Makawi [21]	Immersive 360° VR for five traditional dances in South Sulawesi, evaluated with pre/post-test learning outcomes	Shows quantitative evaluation of cultural learning outcomes using VR, a method not yet applied in most Assemblr-based studies
Hermawan et al. [20]	Systematic review of AR applications in Wayang (Indonesian shadow puppet) heritage preservation	Confirms AR (rather than full VR/metaverse) is the dominant and most accessible approach for Indonesian performing-arts heritage on mobile platforms
This Study	Bantengan Virtual Heritage	Preservation of traditional performing arts through a Metaverse-based environment

4. Conclusions

This study successfully developed a Metaverse-based Virtual Heritage environment for preserving Bantengan performing arts and cultural knowledge. The environment integrates performer avatars, audience avatars, traditional musical instruments, ritual elements, and interactive information markers into a single digital space accessible through the Assemblr platform.

The findings demonstrate that Metaverse technology has significant potential to support cultural preservation by combining cultural documentation with immersive and interactive learning experiences. Through mobile accessibility and educational interaction, the developed environment can contribute to increasing public awareness and understanding of Bantengan culture, particularly among younger generations.

Future research may focus on implementing multi-user interactions, Virtual Reality integration, and user experience evaluation to further enhance the effectiveness of digital cultural preservation initiatives [17].

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