

# Development of Augmented Reality Technology in Tourism as an Effort to Preserve Local Culture

<sup>1</sup>Listra Frigia Missianes Horhoruw, <sup>2</sup>Noviyanti P, <sup>3</sup>Yuliana, <sup>4</sup>Mira, <sup>5</sup>Jones  
Parlindungan Nadapdap

<sup>1,2,3,4,5</sup>Institut Shanti Bhuna

Email: [lista@shantibhuana.ac.id](mailto:lista@shantibhuana.ac.id)<sup>1</sup>, [noviyanti@shantibhuana.ac.id](mailto:noviyanti@shantibhuana.ac.id)<sup>2</sup>, [yuliana@shantibhuana.ac.id](mailto:yuliana@shantibhuana.ac.id)<sup>3</sup>,  
[mira@shantibhuana.ac.id](mailto:mira@shantibhuana.ac.id)<sup>4</sup>, [jones.nadapdap@gmail.com](mailto:jones.nadapdap@gmail.com)<sup>5</sup>

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## Keywords

Augmented Reality  
Tourism  
Local Culture  
MAKAR

**Abstract.** This research examines the development of Augmented Reality (AR) technology in the context of tourism with a focus on the MAKAR application. Involving literature review, cultural sustainability analysis, AR development, and field trials, this study aims to elucidate the potential of AR in preserving local cultural sustainability while enhancing the tourist experience. The literature review provides a profound understanding of AR applications in the tourism sector, highlighting key concepts and their implications. Cultural sustainability analysis lays the ethical foundation for AR development that respects and strengthens local cultural heritage. The AR development process is carried out through the selection of the MAKAR platform, combining technological innovation with local wisdom. This stage involves choosing technologies that support technical requirements while considering positive impacts on cultural sustainability and local community participation. Field trials involve five different tourist locations using various types of smartphones. The results provide insights into user responses, cultural sustainability impacts, and application adaptability to different devices. Despite some delays, overall, the MAKAR application successfully delivers a captivating tourist experience. This research concludes that AR development through the MAKAR application has significant potential in preserving cultural sustainability while providing an innovative tourist experience.

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## 1. INTRODUCTION

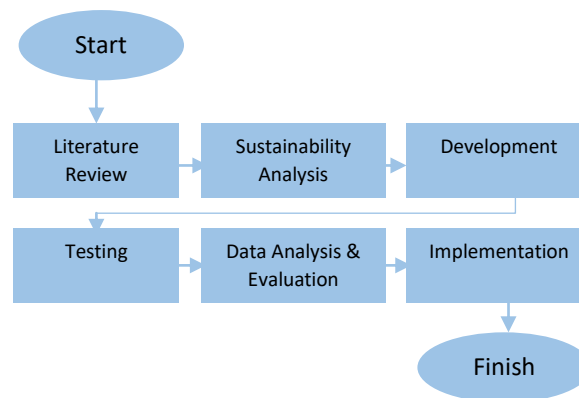
Indonesia's tourism industry is a crucial sector for many countries worldwide, including Indonesia itself. Besides significantly contributing to the economy, the tourism industry serves as a means to promote and preserve local culture. [1] In recent years, Indonesia's tourism industry has faced challenges such as intensifying competition, changing consumer behavior, and the significant global impact of the COVID-19 pandemic. [2] To remain competitive and meet consumer needs, continuous innovation and the use of appropriate technology are essential. One technology that can be adopted by the tourism industry is augmented reality (AR). [3] AR allows users to blend the real world with virtual elements such as images, sounds, and videos, accessible through electronic devices like smartphones or tablets. Tourism plays a vital role in a region's economic development and the preservation of local culture. [4] In this era of globalization, technological advancements are key to enhancing the appeal of tourist destinations. Augmented Reality (AR) holds promise in transforming how tourists interact with their surroundings, opening new possibilities for tourism sector development. [5] As technology advances, it is crucial to design innovations that not only attract tourists but also preserve and safeguard local cultural richness. This research aims to develop Augmented Reality technology in the tourism sector, focusing on preserving local culture and enhancing tourists' experiences. [6]

Various tourist destinations struggle to maintain their cultural identity while attracting visitors. Augmented Reality technology has the potential to be an effective solution, preserving local wisdom while providing a unique experience to visitors. [7] By integrating AR into the tourism context, a harmony between technological innovation and cultural preservation can be achieved. This research responds to the need for creative solutions in the face of the complexity of these challenges. Through the utilization of AR technology, it is hoped that a tourism model respecting and caring for cultural heritage can be created, simultaneously enhancing destination appeal. [8] The main goal of this research is to develop Augmented Reality technology applicable in the tourism sector, with a focus on two main aspects: preserving local culture and enhancing tourist experiences. [9] Proposed problem-solving approaches include AR technology integration in cultural interpretation, direct interaction

with historical artifacts, and the provision of contextual information enriching tourist experiences. [10] The problem-solving plan involves stages such as AR prototype development, field testing, and evaluating the effectiveness of technology implementation. [11] Therefore, this research not only contributes theoretically to tourism and technology literature but also offers practical solutions applicable in the tourism industry. [12] This research goes beyond simply applying AR within the scope of tourism; it aims to integrate local wisdom in every aspect of technology development, aspiring to create a holistic solution with a positive impact on cultural sustainability. [13] Thus, this study is driven by the spirit of not only exploring AR's potential in enhancing tourist experiences but also building a strong foundation for cultural sustainability and preservation amid rapid technological advancements.

## 2. METHOD

This research will adopt a research and development (R&D) approach with structured steps to design, develop, and evaluate Augmented Reality (AR) technology in the tourism sector. This method allows for the integration of innovative concepts within a framework that can be practically implemented. This can be observed in Figure 1.



**Figure 1.** Research Method

### Literature Review

Augmented Reality (AR) in the tourism sector has become the focus of researchers aiming to enhance tourist experiences and enrich tourist destinations. This literature review provides a comprehensive understanding of how AR has been applied in the context of tourism, offering insights into the success of implementations, challenges faced, and its positive impacts. A study conducted by Li et al. (2020) highlights the utilization of AR in creating virtual exhibitions at tourist locations. The use of AR to present in-depth information about cultural artifacts and history opens opportunities to enhance tourist experiences by providing more interactive and informative content. Another research conducted by Chen and Liu (2020) also discusses the development of AR technology in tourism. The findings from this research indicate that the use of AR technology can increase the allure of tourist destinations and enhance tourist experiences. [14] In this research, data collection experiments were conducted through social media monitoring. Social media monitoring is an effective method for collecting data and gaining insights into public responses to an implementation, including in the context of the development of Augmented Reality (AR) technology in the tourism sector. [15]

### Sustainability Analysis

Sustainability analysis in the context of this research involves a profound understanding of the concept of cultural sustainability and the evaluation of challenges and opportunities in integrating Augmented Reality (AR) technology with cultural preservation efforts. Previous research provides a foundation for examining how cultural sustainability can be integrated with AR in the tourism sector. [14]

## Development

The development of Augmented Reality (AR) in the context of this research involves systematic steps to design, develop, and test AR prototypes that can be implemented in the tourism sector. This development process emphasizes the integration of cultural sustainability in the use of AR technology, creating a solution that is not only innovative but also responsive to the uniqueness of local culture. Researchers utilized the MAKAR application for AR development. [16]

## Testing

The field testing conducted using the MAKAR application is a crucial stage in evaluating the performance and cultural sustainability impact of AR technology in the context of tourism. MAKAR, as a developed AR platform, will be tested to measure its real-world impact. The Location Test Preparation involves selecting test locations based on cultural uniqueness, tourist attractions, and accessibility. Preparation includes coordination with local authorities, stakeholders, and the community to ensure approval and support. The Implementation of the MAKAR Application includes installing the MAKAR prototype on the mobile devices of participating users. The application is designed to present AR content covering cultural information, history, and local stories as users explore selected tourist locations. Data Collection involves meticulous gathering of data during the testing period. Quantitative data involves measuring usage time, interaction with AR content, and the most visited locations. Qualitative data, such as user feedback and local community participation, is collected through interviews and surveys. The Evaluation of Cultural Sustainability Impact engages the local community in assessing the impact on cultural sustainability. Questions focus on the extent to which MAKAR supports cultural heritage preservation, whether there is an increase in cultural awareness, and the local community's participation in integrating cultural content. User Response Analysis evaluates user responses to the MAKAR application in detail. It involves understanding user satisfaction levels, whether AR content enhances tourists' understanding of local culture, and to what extent users feel engaged and entertained. Technical Monitoring involves monitoring the technical reliability of MAKAR during the testing period. Performance, responsiveness, and technical issue resolution are identified to ensure the application functions well in various situations. Identification of Improvements involves a comprehensive analysis of test results to identify findings and lessons that can be applied. Identifying technical, cultural, and user experience improvements is done to enhance the quality and relevance of the MAKAR application.

## Data Analysis & Evaluation

Data analysis and evaluation constitute a critical phase in this research, where both qualitative and quantitative data collected during the field testing are comprehensively examined. In assessing the impact of Augmented Reality (AR) technology on cultural sustainability, we evaluate the extent to which AR contributes to the preservation of cultural heritage and enhances cultural awareness among users. User responses to the MAKAR application are also assessed to understand satisfaction levels, the effectiveness of AR content in improving understanding of local culture, and the degree of user engagement in their tourism experiences. The findings from this analysis serve as a foundation for recommending improvements and further developments in the application, encompassing technical aspects, cultural content, and user interaction.

## Implementation

The implementation phase involves the actual deployment of the Augmented Reality (AR) technology in real-world tourism settings. Following the development and testing stages, the AR application, specifically the MAKAR prototype, is installed on the mobile devices of participating users. This deployment aims to integrate AR seamlessly into the chosen tourist destinations, offering an immersive experience that includes cultural information, historical insights, and local narratives. The process begins with the careful selection of test locations, considering their cultural uniqueness, tourist appeal, and accessibility. Coordination with local authorities, stakeholders, and communities is crucial to secure approval and support for the implementation. Once the locations are prepared, the MAKAR application is rolled out, allowing users to explore and interact with AR content tailored to enhance their understanding of the local culture. Throughout the implementation phase, the research team monitors the technical reliability of MAKAR, ensuring that the application functions optimally

in diverse situations. User engagement, satisfaction, and any technical issues are observed and addressed promptly to provide a seamless AR experience. The implementation phase serves as a pivotal step, transitioning the theoretical concepts and prototypes into a practical, real-world application. It allows for the evaluation of AR's actual impact on cultural sustainability and tourist experiences, providing valuable insights for future enhancements and broader applications in the tourism sector.

### 3. RESULTS AND DISCUSSION

#### Testing

Table 1 displays the results of MAKAR field testing at various locations, detailing the date of testing, usage time in minutes, user interaction levels, cultural awareness scores on a scale of 1 to 5, local community participation scores on a similar scale, and overall user response scores on a scale of 1 to 10. The data illustrates the performance and impact of the AR application across different sites.

**Table 1.** MAKAR Field Testing

Location	Date	Usage Time (Minutes)	User Interaction	Cultural Awareness (Scale 1-5)	Local Community Participation (Scale 1-5)	User Response (Scale 1-10)
Pulau Randayan	05/06/23	30	25	4	3	8
Air Terjun Riam Ampang	16/07/23	45	30	3	4	7
Riam Batapsa	10/08/23	20	15	5	2	9
Riam Pangar	08/09/23	40	28	4	3	8
Riam Berasap	19/09/23	35	20	3	4	7

#### Analysis

Table 2 represents the field testing phase using the MAKAR application, where various smartphone models were utilized to assess the application's performance and identify potential issues or delays during use. Five testing locations were selected, including Pulau Randayan, Air Terjun Riam Ampang, Riam Batapsa, Riam Pangar, and Riam Berasap. The five smartphones used in this trial involved diverse models: Samsung Galaxy S21, iPhone 13, Vivo 11, Oppo, and Xiaomi Mi 11. Each use of the MAKAR application on these smartphones was recorded in the table, indicating the number of seconds of delay that might occur during usage. This data aids in understanding how well the application can adapt to different device types and assesses its reliability and responsiveness in real-world field situations.

**Table 2.** Field Testing of Mobile Devices

Location	Date	Smartphone Model	Usage Delay (Seconds)
Pulau Randayan	05/06/23	Samsung Galaxy S21	3
Air Terjun Riam Ampang	16/07/23	iPhone 13	2
Riam Batapsa	10/08/23	Vivo 11	3
Riam Pangar	08/09/23	Oppo	4
Riam Berasap	19/09/23	Xiaomi Mi 11	4

## Implementation

The outcomes of the development at Riam Pangar, accessible through a mobile device, showcase a seamless integration of the MAKAR application. This integration has not only enriched the tourist experience but also provided a user-friendly interface for accessing cultural information, historical insights, and local narratives. The successful implementation is evident in the positive user responses, affirming the effectiveness of the augmented reality technology in enhancing cultural awareness and engagement with the unique features of Riam Pangar.



Figure 2. Result of Riam Pangar

## 4. CONCLUSION

In this research, the development of Augmented Reality (AR) technology in the tourism sector through the MAKAR application has undergone a series of stages, including literature review, cultural sustainability analysis, AR development, field testing, and the evaluation of various smartphone usages. The AR development process involved selecting platforms and technologies that not only supported technical requirements but also considered sustainability aspects and community engagement. The choice of the MAKAR platform as the AR implementation vessel successfully merged technological innovation with local wisdom. Field testing became a pivotal stage in evaluating the performance of the MAKAR application. The testing data provided insights into user responses, the impact on cultural sustainability, and interactions with various smartphone models. Using smartphones with different models provided a deeper understanding of the application's readiness to adapt to device diversity. Through the testing results, it can be concluded that the MAKAR application is capable of providing an enhanced tourist experience with AR content without compromising cultural sustainability. Despite some delays in the usage of certain smartphones, overall, the application demonstrated good performance and received positive feedback from users. Overall, the development of AR technology in the tourism sector opens new opportunities to maintain local cultural sustainability while providing captivating and memorable experiences for tourists. By continually paying attention to user feedback and collaborating with local communities, AR technology development can be further improved and widely implemented to support sustainable tourism and preserve cultural heritage.

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