



Islamic Heritage Site: Up-Scaling Halal Tourism with Augmented Reality Technology at Sunan Giri Pilgrimage in Gresik

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ABSTRACT

The pilgrimage of Wali Songo, especially the Tomb of Sunan Giri in Gresik, is a religious tourist destination with millions of visits per year that holds extraordinary economic and spiritual potential. However, the method of conveying historical information is still conventional and limited. The Community Service Program (Abdimas) aims to develop an Augmented Reality (AR)-based mobile application platform that integrates three main focuses: (1) visualization of the historical site of the Sunan Giri Tomb and the Giri Kedaton Kingdom in three dimensions; (2) a digital directory of MSMEs and geospatial-based local products; and (3) transportation and accommodation guides for pilgrims. The implementation method uses a Participatory Action Research (PAR) approach for six months, involving collaboration between Telkom University, Muhammadiyah Gresik University (UMG), Giri Village Government, and Tourism Awareness Group (Pokdarwis). The results of the evaluation showed an increase in visitor engagement by 47%, understanding of historical content increased by 62%, and the turnover of partner MSMEs increased by an average of 35%. AR applications have succeeded in encouraging the organic viral marketing ecosystem through social media sharing content. This program emphasizes that AR technology is able to be a bridge between the preservation of Islamic historical heritage and the acceleration of sustainable digital halal tourism in the Society 5.0 era.

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A. INTRODUCTION

Indonesia has solidified its position as the world's leading halal tourism destination as recognized by the Global Muslim Travel Index (GMTI) which consistently ranks Indonesia at the top. Strengthening the halal tourism ecosystem is one of the national priorities in



encouraging the growth of the creative economy and the spirituality of the community. One of the main pillars in this ecosystem is religious tourism, with the pilgrimage of Wali Songo as its main magnet.

The Wali Songo Tomb area attracts millions of domestic and international pilgrims every year. Databoks data (2024) shows that the Sunan Ampel Tomb complex in Surabaya consistently records 1.5 to 2 million visitors per year. The Tomb of Sunan Giri in Gresik and the Tomb of Sunan Gunung Jati in Cirebon are each visited by more than 1 million pilgrims per year. Cumulatively, the total movement of pilgrims at all points of Wali Songo's tomb is estimated to reach 5-7 million people per year, making it one of the largest religious tourism circuits in Southeast Asia.

Giri Village, which is located in Kebomas District, Gresik Regency, is one of the historic villages in the development of Islam in Indonesia. In this village is located the Giri Kedaton Kingdom Site and the Tomb of Sunan Giri, one of the Wali Songo who spread Islam in the archipelago. Through the Giri Village Government, the royal site and tomb are managed with the support of the Tourism Awareness Group (Pokdarwis) which was formed to maintain the sustainability of pilgrimage tourism.

The problems identified in the field include three main aspects. First, the method of conveying historical information and cultural context is still conventional and limited to static information boards, verbal guides, and guidebooks that are not always practical. Second, MSME actors around the tomb area face limitations in digital adaptation to market their halal products in a modern way. Third, pilgrims, especially millennials and generation Z, have high expectations for interactive, immersive, and informative travel experiences digitally (Putra & Hidayah, 2023).

Augmented Reality (AR) technology offers innovative solutions to bridge this gap. AR is able to overlay virtual objects such as 3D reconstruction of buildings, genealogical visualizations, or dynamic information text into the real-world environment through smartphone cameras. Research by Syafrizal & Ardiansyah (2018) shows that the implementation of AR on cultural heritage sites can increase visitor engagement by 45% and understanding historical content by 60%. Maharani et al. (2024) also emphasized that AR is able to create a more interesting, efficient, and informative travel experience for tourists.

Based on this need analysis, the Community Service (Abdimas) team of Telkom University collaborated with the University of Muhammadiyah Gresik (UMG) to develop an AR-based mobile application platform entitled "SIAR" which focuses on three aspects: (1) visualization of the historical site of the Tomb of Sunan Giri and the Kingdom of Giri Kedaton; (2) a digital directory of MSMEs and local products; and (3) transportation and accommodation guides for pilgrims. This program is in line with Telkom University's Technology Based Management KK Roadmap in creating an independent digital-aware society.

B. METHODS

This Abdimas program was carried out for six months (September 2025 - February 2026) in Giri Village, Kebomas District, Gresik Regency using the Participatory Action Research (PAR) approach. This approach involves the active participation of the target community in every stage of implementation, ensuring the relevance and sustainability of the program.



1. Content Research and Development Stage (Months 1-2)

At this stage, an in-depth literature study and interviews with historians, cultural experts, tomb locksmiths, and community leaders were carried out to collect primary and secondary data related to the history of Sunan Giri and the Giri Kedaton Kingdom. Point of Interest (POI) mapping is carried out in all locations that will be trigger markers for AR, including the main gate of the tomb, the tomb cup, the Sunan Giri mosque, and heritage artifacts. The writing of narrative scripts and storyboards for visual and audio content was also completed at this stage through a Focus Group Discussion (FGD) with Pokdarwis, local historians, and scholars.

2. Application and Digital Asset Development Stage (Months 2-4)

The development of the "SIAR" application was carried out with the Unity3D platform version 2022.3 LTS which is integrated with the Vuforia Engine SDK 10.x for a marker-based AR recognition system. The creation of digital assets includes: (a) 3D modeling of Giri Kedaton's architecture using Blender 3.6, (b) animation of Sunan Giri's exemplary characters and stories, (c) reconstruction of an ancient mosque in the 15th century, and (d) a short documentary video with a duration of 3-5 minutes. The user interface (UI/UX) is designed using the principles of Material Design with accessibility in mind for all age groups. At the end of this stage, internal alpha testing is carried out.

3. Implementation and Socialization Stage (Month 5)

The implementation began with a Focus Group Discussion (FGD) and limited beta testing involving 30 participants consisting of tour guides, Pokdarwis representatives, MSME actors, and pilgrims. The workshop and training were held for two days with materials: how to use AR applications, AR integration in tour services, MSME content management on the platform, and AR-based digital marketing strategies. The installation of QR Codes and physical markers is carried out at 15 strategic points that have been agreed with the Giri Village Government.

4. Monitoring, Evaluation, and Dissemination Stage (Month 6)

The evaluation was carried out through the distribution of online questionnaires using a 5-point Likert scale to 150 application users and in-depth interviews with 20 key informants. Analyze app usage data (number of downloads, duration of use per session, most popular POIs) using Firebase Analytics. The measurement of the economic impact on MSMEs was carried out through a comparison of turnover before and after implementation over a two-month period.

C. RESULTS AND DISCUSSION

1. Description of the "SIAR" Application Platform

The "SIAR" application is developed for the Android platform (API Level 24+) and can be downloaded through the Google Play Store. The app integrates three main modules that are interconnected according to the needs of the three main user segments.



Figure 1. QR Barcode for Download SIAR Application

a. Historical Site Module - Immersive Pilgrim Experience

This module uses Vuforia Engine-based AR marker-based technology that allows pilgrims to point their smartphone cameras at physical markers installed at 15 strategic points in the Sunan Giri Tomb area and the Giri Kedaton Site. The content displayed includes:

1. 3D reconstruction of Giri Kedaton: an interactive visualization of the architecture of the Giri Kingdom in its heyday (15th to 17th centuries), showing the layout of buildings, mosques, and meeting halls that now only have their foundations left.
2. Sunan Giri's Interactive Biography: an animated story of the journey of Raden Paku (Sunan Giri's birth name) from childhood to becoming a spreader of Islam in the archipelago, equipped with audio narration in Indonesian and Javanese.
3. Wali Songo's Scientific Genealogy: a visualization of a genealogy tree that shows the relationship between teachers and students between Wali Songo and the path of spreading Islam in Java.
4. Digital Pilgrimage Manners Guide: animation of correct pilgrimage procedures according to Islamic law.
5. Smart Navigation: an interactive AR map that guides pilgrims to find facilities (ablution places, mosques, toilets, parking) and verified MSME locations.

b. MSME and Local Products Module - Digital MSME Directory

This module serves as a geospatial directory for 47 Muslim culinary, souvenir, and fashion MSMEs that have been verified for halal in the area around the Sunan Giri Tomb. The module's featured features include:

1. MSME Radar: an AR display that shows the location of the nearest MSMEs in real-time with distances and ratings of other pilgrims.
2. Product QR Code: each partner MSME product is equipped with an AR QR Code that displays a video of the product's manufacturing philosophy, production process, and halal certification when scanned.



3. Wali Culinary Pop-up: a unique feature that displays traditional culinary information linked to the historical narrative of Wali Songo, directing pilgrims to the nearest MSMEs.
4. Reviews and Ratings: a star-based rating system from verified fellow pilgrims.

c. Transportation and Accommodation Module - Smart Pilgrim Guide

The third module provides a complete guide to the pilgrim's journey that is integrated with real-time data. Available features include:

1. Integrated Pilgrimage Route: recommendations for Wali Songo pilgrimage routes complete with estimated time, distance, and modes of transportation from various cities of origin.
2. Halal Accommodation Directory: a list of hotels around Gresik that are verified halal-friendly with prayer room facilities, halal menus, and appropriate privacy.
3. Transportation Schedule: real-time information on bus, train, and other transportation modes to Gresik.
4. Emergency Contact: an emergency contact feature that displays important numbers including the nearest Health Center, Police Station, and Pokdarwis hotline.

2. Application Technical Architecture

The "SIAR" application is built with a three-tier architecture consisting of: (1) Presentation Layer using Unity3D with C# scripting and Vuforia AR SDK; (2) Business Logic Layer that manages dynamic content through Node.js-based RESTful API; and (3) Data Layer using Firebase Realtime Database for MSME content and PostgreSQL for historical data. Servers are hosted using Google Cloud Platform (GCP) to ensure the scalability and reliability of the service. The marker system uses a combination of image tracking (for 2D artifacts) and ground plane detection (for 3D reconstruction of larger buildings).



Figure 2. QR Code Media Content of Augmented Reality

3. Program Quantitative Achievement

Based on a comprehensive evaluation conducted in the sixth month, this program has succeeded in achieving the following achievement indicators:

Achievement Indicators	Target	Realization	Ket.
Number of App Downloads	500 downloads	1,247 downloads	Achieved
Increased Visitor Engagement	40%	47%	Achieved
Understanding Historical Content	50%	62%	Achieved
MSMEs Registered on the Platform	30 MSMEs	47 MSMEs	Achieved
Increasing the Turnover of MSME Partners	25%	35%	Achieved

Workshop Participants Trained	30 participants	38 participants	Achieved
User Satisfaction (Likert Scale)	4.0/5.0	4.37/5.0	Achieved
On-Site Installed AR Markers	12 points	15 points	Achieved

Tabel 1. Capaian Kuantitatif Program Abdimas SIAR

4. Impact on Pilgrims and Visitor Engagement

The results of the satisfaction questionnaire distributed to 150 application users showed an average satisfaction score of 4.37 out of a scale of 5.0. The dimension that received the highest score was ease of use with a score of 4.51, followed by relevance of historical content (4.43) and quality of 3D visualization (4.29). The content loading speed dimension scored the lowest (4.01) due to limited internet connections in some areas of the tomb area.



Figure 3. Workshop & Implementation SIAR Application

Firestore's data analysis shows that the average duration of usage per session is 18.7 minutes, far exceeding the average of similar travel apps which ranges from 8-12 minutes. The POI with the highest engagement is the 3D Giri Kedaton Reconstruction (visited by 89% of active users), followed by Sunan Giri's Interactive Biography (76%) and the Pilgrimage Adab Guide (64%). These findings are consistent with the results of Syaharani & Umami (2025) which states that AR creates more interesting, efficient, and informative exploratory experiences.

5. Impact on Local MSMEs

Of the 47 MSMEs registered on the platform, 32 MSMEs (68%) reported an increase in customer visits and turnover during the two-month monitoring period. The most significant increase in average turnover of 35% was felt by MSMEs who actively used the QR Code feature of their products (an increase of 42%) compared to those who were only listed in the directory (an increase of 24%). Giri motif batik products with QR Code displaying videos of the manufacturing process are the most purchased products by pilgrims through application references.



A significant indirect impact is the creation of an organic viral marketing ecosystem. Social media analysis showed #ZiarahSunanGiri and #GiriAR AR content generated more than 2,400 uploads during the implementation period, with total organic impressions reaching 1.2 million impressions. This phenomenon is in line with the concept of organic marketing identified in the press release of this program as one of the significant macro impacts.

6. Impact on Pokdarwis and Tour Guides

The training provided to 38 participants from Pokdarwis and tour guides succeeded in transforming their roles from conventional verbal narrators to facilitators of digital experiences. The post-training evaluation showed an increase in the average digital literacy score by 58%, from a pre-test score of 52.3 to a post-test score of 82.7 (scale of 100). Pokdarwis now plays an active role as a content curator by verifying the accuracy of historical information with local historians and scholars.

D. CONCLUSION

The Community Service Program with the title "Islamic Heritage Site: Up-Scaling Halal Tourism with Augmented Reality Technology on the Sunan Giri Pilgrimage in Gresik" has been successfully implemented and achieved all the target achievement indicators set. The "SIAR" application has been proven to be able to transform the pilgrimage experience into a more immersive, interactive, and informative one with a user satisfaction rate of 4.37/5.0 and an increase in visitor engagement of 47%.

Three main findings can be concluded from this program: First, marker-based AR technology can be effectively implemented on Islamic historical heritage sites without compromising spiritual value and cultural authenticity, instead strengthening pilgrims' understanding of the historical value of the site. Second, the integration of local MSMEs in the AR digital ecosystem has been proven to increase turnover by an average of 35% and create effective organic marketing through social media. Third, the Participatory Action Research approach involving Pokdarwis, historians, and scholars as co-creators of content ensures the validity and sustainability of the program.

The program recommends: (1) the development of the iOS version and expansion to all 9 points of Wali Songo's tomb; (2) integration of artificial intelligence for personalized content recommendations; and (3) the development of subscription-based business models for MSMEs for platform sustainability. Collaboration between universities and local governments and local communities is the key to the successful implementation of digital technology at cultural heritage sites.

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