Ingénierie des Systèmes d'Information
Vol. 30, No. 10, October, 2025, pp. 2747-2761
Journal homepage: http://iieta.org/journals/isi

Developing a Smart Religious Tourism App (ReligiGO) to Enhance Visitor Engagement: A Case Study in Batam, Indonesia

Ririt Dwiputri Permatasari[1], M. Ansyar Bora[2*], Luki Hernando[3], Amanda Puspita Sari[1], Angga Kurniawan[1], Teddy Elvaro Siagian[1], Vinsensius Fendy Kurniawan[1], Erica[2], Hisyam Ma'wa Abdullah[2], Nur Shilah[1], Haidil Fauzan[1]

[1] Information Systems Department, Faculty of Information Technology, Batam Institute of Technology, Batam 29425, Indonesia
[2] Engineering Management Department, Faculty of Industrial Technology, Batam Institute of Technology, Batam 29425, Indonesia
[3] Computer Engineering Department, Faculty of Information Technology, Batam Institute of Technology, Batam 29425, Indonesia

Corresponding Author Email: ansyarbora@gmail.com

https://doi.org/10.18280/isi.301020

Received: 15 September 2025
Revised: 17 October 2025
Accepted: 28 October 2025
Available online: 31 October 2025

Keywords:
Smart Tourism, religious tourism, mobile application, Smart Religious Tourism (SRT), usability testing, System Usability Scale (SUS), Indonesia

ABSTRACT

Digital transformation in the religious tourism sector has become a strategic necessity for Batam City as one of the centers of religious tourism in Indonesia. This research aims to develop the ReligiGO application, a Smart Religious Tourism platform that integrates technical features such as Geographic Information System (GIS) for navigation of places of worship, virtual tours, historical information of destinations, and a simple recommendation system based on user preferences. The application development was carried out using a Design Thinking approach through five main stages: empathize, define, ideate, prototype, and testing. This study did not use a control group, but an effectiveness evaluation was conducted by measuring the level of user engagement and perceptions of increased tourist attractions after using the application. The prototype was tested using Black Box Testing to ensure functionality ran as needed. User experience evaluation was conducted through a System Usability Scale (SUS) and a perception survey involving 30 respondents consisting of local tourists and visitors to religious destinations in Batam. The Black Box Testing results showed that all features functioned correctly, while the SUS evaluation results obtained a score of 82.5, which placed ReligiGO in the "Excellent Usability" category. Furthermore, the survey results showed that 73% of respondents felt the app improved access to destination information, 68% reported increased interest in visiting religious destinations, and 81% felt the app enriched their religious tourism experience. These findings demonstrate that the integration of GIS technology, intelligent navigation, and virtual tours within ReligiGO can increase visitor engagement while strengthening the appeal of religious tourism in Batam through the support of a digital-based information system.

1. INTRODUCTION

Batam City, located in the Riau Islands, Indonesia, has long been known as a strategic area in the fields of trade, industry and tourism [1, 2]. Its geographical proximity to Singapore and Malaysia makes Batam an easily accessible international gateway and an attractive destination for both domestic and international tourists [3, 4]. In recent years, Batam has not only developed as an industrial city, but has also begun to gain recognition as a center for cultural and religious tourism.

The diversity of religious tourism destinations in Batam is one of its main attractions [5]. The Batam Grand Mosque stands as the region's most prominent Islamic landmark, while the Maha Vihara Duta Maitreya, known as one of the largest Buddhist temples in Southeast Asia, attracts tourists seeking a Buddhist spiritual experience. Meanwhile, the Tian Hou Temple reflects the rich history and cultural heritage of China, while the Tanjak Mosque near Hang Nadim Airport showcases contemporary architecture with a distinct Malay touch. Equally important, the Sultan Mahmud Riayat Syah Mosque, Batam's largest mosque, underscores its role as a spiritual center and a growing religious tourism destination.

The presence of these various places of worship underscores Batam's potential as a religious tourism destination, attracting tourists from diverse backgrounds. This potential is further bolstered by data from the Riau Islands Central Statistics Agency (BPS), which shows that the number of international tourist visits to Batam from January to June 2024 reached 125,384 [6]. Batam City's popularity reflects the strategic role of the tourism sector in supporting the local economy. It is estimated that the tourism sector contributes approximately 20% to Batam City's Gross Regional Domestic Product

(GRDP) [7], making it a key driver of regional economic development.

However, despite its immense potential, promoting religious tourism in Batam still faces significant challenges. Destination promotion largely relies on conventional media, such as printed brochures, physical information boards, or limited publications through non-digital channels. These promotional methods are considered ineffective in reaching modern tourists who increasingly rely on digital platforms for information and travel planning [8, 9].

This disparity creates various obstacles for tourists. Comprehensive and accurate information about the history, facilities, and access to destinations is often difficult to obtain. Furthermore, the lack of a unified digital platform makes it difficult for tourists to access integrated, interactive, and up-to-date information [10], resulting in a less than optimal travel experience. This situation also weakens Batam's competitiveness compared to other destinations, such as Thailand, Malaysia, and Singapore, which have already implemented digital-based Smart Tourism systems [11].

Globally, digitalization has become a major trend in the tourism industry, bringing significant changes to promotion, destination management, and interaction with tourists. Various technologies, from Geographic Information Systems (GIS) and mobile applications to Artificial Intelligence (AI), have been proven to enhance the attractiveness of destinations [12-17]. Mobile-based applications, for example, allow tourists to access interactive maps, historical information, and even real-time visitor reviews. Internet of Things (IoT)-based technologies and big data analytics are also increasingly being used in destination management to optimize services and marketing strategies [18].

In this context, the concept of Smart Religious Tourism (SRT) emerged as a relevant and strategic solution for Batam. SRT integrates information and communication technology into the management and promotion of religious-based tourism destinations, aiming to provide easily accessible, interactive, and data-driven information. Through the implementation of the SRT information system, religious tourism destinations can present their historical, cultural, and spiritual narratives in a more engaging and comprehensive manner. This will not only enhance the quality of the tourist experience but also strengthen Batam's identity as a modern and inclusive center for religious tourism.

Various international practices have demonstrated the success of digitalization in increasing tourist arrivals. Thailand, Vietnam, and China, for example, have implemented Smart Tourism platforms featuring multilingual content, virtual tours, and AI-based recommendations, significantly enhancing the attractiveness of their destinations [19, 20]. In Europe, mobile apps and big data analytics are being used to manage visitor flows, preserve cultural sites, and promote lesser-known alternative destinations. This experience demonstrates that digital transformation is an urgent need to maintain competitiveness in the global tourism market.

The implementation of an SRT-based information system in Batam is believed to provide several benefits. First, this system will increase the visibility and accessibility of religious tourism destinations, both for domestic and international tourists. Second, SRT can support the diversification of Batam's tourism, so that the city is known not only as an industrial and entertainment center, but also as a destination with high cultural and spiritual value. Third, strengthening the religious tourism sector through digitalization has the potential to create economic multiplier effects, such as increased tourist length of stay, greater spending on accommodation, transportation, and local MSMEs. Fourth, the implementation of SRT aligns with Indonesia's national agenda of encouraging digital transformation and technology-based economic development.

More than just an economic aspect, the digitalization of religious tourism also brings social, cultural and educational impacts [21, 22]. Providing narrative digital information about the history, architecture, and spiritual values of each destination can strengthen cross-cultural understanding, foster tolerance, and preserve intangible cultural heritage. This is crucial in the context of Batam as a multicultural city, where diversity is a distinctive identity and attraction.

However, the transformation process toward digital tourism is not without challenges. Issues such as technological readiness, digital literacy levels, cultural sensitivity in content creation, and inclusivity for tourists less familiar with technology are all factors that must be considered [23]. Furthermore, the development of an SRT information system requires collaboration across actors, including local governments, religious destination managers, tourism industry players, and technology providers. Therefore, academic research is crucial to provide an empirical basis, identify best practices, and formulate implementation strategies appropriate to Batam's socio-economic context.

Thus, although Batam has significant potential for developing religious tourism, the current limitations of digital-based promotion remain a major obstacle. The global trend toward Smart Tourism demands that Batam adapt quickly to keep up with other destinations. By implementing Smart Religious Tourism based on a digital information system, Batam can strengthen its tourist appeal, increase tourism's contribution to the regional economy, and position itself as a pioneer in digital tourism innovation in Indonesia.

In addition to addressing the practical need for digitalization of religious tourism in Batam City, this research also offers significant novelty in both academic and practical contexts. First, most previous research on digital tourism in Indonesia has focused on ecotourism, cultural tourism, and general tourism [24-27], while studies specifically focusing on digital-based religious tourism are still very limited. This research aims to fill this gap by examining the application of Smart Religious Tourism (SRT) as an approach that focuses more on the spiritual, cultural, and multi-religious dimensions that characterize Batam City. Thus, this research not only strengthens digital tourism studies but also enriches the literature on religious tourism from an information technology perspective.

Second, this research offers a novelty in the integration of an SRT-based information system that functions not only as a promotional medium but also as an educational platform, cultural preservation platform, and facilitation of a more interactive tourism experience. Rather than simply presenting static destination information, the developed system is aimed at delivering a dynamic experience, for example through multimedia-based historical narrative features, virtual tours, data-driven recommendations, and integration with GIS technology to facilitate tourist navigation. This approach aligns with the needs of modern travelers who prioritize convenience, interactivity, and personalization in every trip.

Third, the novelty of this research lies in its location, Batam, which holds a strategic position as a gateway for international

tourists. Batam is unique not only because of its proximity to Singapore and Malaysia, but also because of the diversity of interfaith religious destinations rarely found in other cities in Indonesia. This diversity creates a significant opportunity to make Batam a natural laboratory for the development of digital-based multicultural religious tourism concepts. Therefore, this research can serve as a reference for other cities with similar characteristics, both in Indonesia and in Southeast Asia.

Thus, this research makes an important contribution in expanding the study of Smart Tourism by including the religious dimension which has been relatively marginalized in global discourse.

2. LITERATURE REVIEW

2.1 Smart Tourism as theoretical foundation

The concept of Smart Tourism has evolved as part of the digital transformation in the global tourism industry [28]. Theoretically, Smart Tourism is rooted in the integration of information and communication technology, big data, the Internet of Things (IoT), artificial intelligence, and mobile-based systems that collectively form what is known as the Smart Tourism Ecosystem. Key figures such as Gretzel, Sigala, and Buhalis explain that this ecosystem works through a dynamic relationship between tourists, service providers, government institutions, and technology, enabling the creation of a more personalized, adaptive, and data-driven tourism experience [29]. Smart Tourism is not just a digital phenomenon, but a theoretical framework that positions technology as a catalyst for improving service quality and optimizing interactions between users and tourist destinations.

In this ecosystem, technology has three main roles, namely increasing accessibility of information, enriching the tourism experience, and facilitating decision-making [30]. Therefore, Smart Tourism is always associated with a destination's ability to provide real-time information, precise navigation, automated recommendations based on user preferences, and digital services that can enhance the destination's added value.

2.2 Conceptualization of Smart Religious Tourism

Smart Religious Tourism is a theoretical extension of Smart Tourism, but it has unique characteristics because it focuses on religious, spiritual, and cultural destinations. Literature shows that religious tourism is not only about physical travel but also touches on emotional, spiritual, and symbolic dimensions of experience. Therefore, the integration of technology into religious tourism must be able to provide in-depth interpretations of the historical value, religious significance, and culture inherent in each destination.

Several researchers have suggested that Smart Religious Tourism requires an integrative approach that combines religious information, cultural visualization, navigation technology, and interpretive elements into one digital platform [31-33]. However, the literature addressing Smart Religious Tourism conceptually remains very limited, especially in the Southeast Asian context. Most existing research tends to focus solely on mosque digitization, the management of worship information systems, or the promotion of pilgrimage tourism without theoretically explaining how technology can shape a more immersive religious tourism experience [34].

These limitations indicate that Smart Religious Tourism is still in its embryonic stage as a theoretical framework, requiring more systematic research to clarify its theoretical elements. Thus, this study contributes to broadening academic understanding of how technology can create more meaningful and interactive religious tourism experiences through digital integration.

2.3 Key technologies in Smart Religious Tourism

In the Smart Tourism literature, several key technologies form the foundation for developing Smart Tourism systems. One of the most dominant technologies is the Geographic Information System (GIS), which can provide accurate spatial information regarding destination locations, travel routes, supporting facilities, and tourist movement patterns. GIS allows tourists to access historical sites or places of worship more efficiently, while also providing benefits to destination managers in understanding visitor patterns [35, 36].

Another important technology is the virtual tour, which provides a pre-visit experience through a 360-degree visual representation or digital simulation of a place of worship. Research shows that virtual tours can increase interest in visiting, increase trust in a destination, and foster an initial understanding of a location's historical value or religious significance [37]. However, most virtual tour studies still focus on non-religious tourist destinations, leaving research in the context of religious tourism very limited.

Information system-based mobile applications have also received attention in the Smart Tourism literature. These applications provide 24/7 access to information, personalize content, and facilitate social interaction among visitors. However, research developing mobile applications specifically for religious tourism is still limited and tends to provide only basic information without integrating intelligent navigation, cultural interpretation, or richer visual technologies such as virtual tours.

In the context of religious and cultural interpretation, the digital storytelling approach is also beginning to be widely discussed as a means of enriching the user experience. Historical narratives, stories of religious figures, and explanations of religious values have been shown to increase user engagement [38-40]. However, this approach has not yet become standard practice in religious tourism systems due to the lack of research applying this method.

2.4 Research paradigms in Smart Religious Tourism

A literature review shows that research on Smart Religious Tourism is still scattered and lacks a strong methodological paradigm. Existing studies often focus solely on technical system development and fail to comprehensively incorporate user perspectives [41]. The dominance of studies using a technical approach leaves a void in user-centered design-based methodologies such as Design Thinking, which allow for in-depth exploration of user needs.

In addition, most previous studies also lacked system evaluation using standard methods such as Black Box Testing for functionality or the System Usability Scale (SUS) to measure usability [35, 42]. Both approaches are essential for assessing the effectiveness of a Smart Religious Tourism application in increasing tourist engagement.

Existing research paradigms also rarely explore the relationship between digital technology and increasing the

attractiveness of religious tourism. Many studies focus solely on system implementation without measuring the actual impact on tourist behavior, visit intention, or perceived information quality. This lack of empirical analysis highlights the need for a more comprehensive research approach.

2.5 Systematic critique and theoretical gaps

Based on the overall literature, it can be concluded that there are several fundamental gaps that have not been addressed by previous research. First, studies on Smart Religious Tourism remain theoretically shallow and have not developed a clear theoretical framework regarding how technology influences spiritual experiences, historical understanding, or tourist engagement. Second, no research has integrated key technologies such as GIS, virtual tours, mobile interfaces, and digital storytelling into a single integrated application, even though this integration is at the heart of Smart Tourism.

Third, most previous research has not utilized a user-centric approach, resulting in applications that often fail to meet tourist needs. Fourth, there has been no comprehensive empirical measurement of how digital applications can increase the appeal of religious tourism, user engagement, or interest in visiting.

These weaknesses reveal significant theoretical and research gaps. This study aims to address these gaps by developing ReligiGO, a Smart Religious Tourism application that integrates various key technologies and is designed using a Design Thinking approach with empirical evaluation. Therefore, this research makes a significant contribution to the development of Smart Religious Tourism theory.

3. METHODOLOGY

3.1 Evaluation and testing of system usability

System usability evaluation is the initial step to ensure that the ReligiGO app functions according to user needs and provides an intuitive experience. This process uses the System Usability Scale (SUS), an evaluation instrument proven valid and reliable in measuring user perceptions of system usability.

Table 1. Question SUS

No	Question SUS
1	I think this application is simple to use.
2	I found this application quite difficult to learn.
3	I feel this application makes it easy to find the features I need.
4	I think this application does not provide the information I require.
5	I can quickly master how this application works.
6	I need extra effort to understand how to use this application.
7	I believe this application is well-designed and clear.
8	I found this application has processes that are too complicated.
9	I think the interface of this application is pleasant and comfortable to look at.
10	I feel the interface of this application is dull and unattractive.

Prior to completing the SUS questionnaire, the application prototype was functionally tested using black box testing to ensure all core features, including user registration, login authentication, destination search, access to prayer times, map navigation, and the virtual tour feature, functioned properly. After the prototype was declared stable, a trial was conducted with 30 respondents representing domestic and international tourists.

The SUS instrument used consists of ten statements with a five-point Likert scale (1 = strongly disagree, 5 = strongly agree) covering aspects of ease of use, system consistency, and overall user satisfaction. A complete list of statements used in this study is shown in Table 1.

3.2 Collection of user interaction data

Data collection was conducted between May and August 2025 at five major religious tourism destinations in Batam City: the Batam Grand Mosque, the Sultan Mahmud Riayat Syah Mosque, the Maha Vihara Duta Maitreya, the Tian Hou Temple, and the Tanjak Mosque. These locations were selected based on their popularity as religious tourism icons and their diversity, reflecting Batam City's multicultural identity.

Primary data were obtained through three methods: (1) a questionnaire, designed to measure information needs, satisfaction levels, and app feature preferences; (2) semi-structured interviews with five destination managers, aimed at exploring digital promotion constraints and collaboration readiness; and (3) field observations to record tourist information-seeking behavior on-site. Additionally, secondary data were obtained from official Batam Statistics Agency (BPS) reports on the number of tourist visits and regional tourism policy documents.

3.3 User grouping and profiling

User grouping and profiling were conducted to capture variations in user needs and behaviors relevant to the ReligiGO application. The grouping process applied a rule-based approach, rather than a clustering algorithm, because the purpose of this study is to understand user requirements and evaluate usability rather than to build predictive models.

Users were divided into three categories based on three key criteria:

(1) digital literacy level,
(2) prior experience using mobile tourism applications, and
(3) frequency of visits to religious tourism destinations.

The beginner group consists of users with basic digital literacy and minimal experience using tourism applications, thus requiring simple interfaces and straightforward navigation. The regular group represents users with moderate experience and general information needs, such as standard navigation and basic destination descriptions. The advanced group includes users with high digital literacy, frequent tourism app usage, and expectations for more sophisticated features such as virtual tours and detailed GIS-based mapping.

This grouping was determined through preliminary surveys and short interviews conducted during the empathize stage of the Design Thinking process. The results informed the define stage by shaping user requirements and ensuring that feature development accommodates varying levels of user experience.

3.4 Data analysis and system improvement

The data analysis phase was conducted in an integrated manner by combining the results of questionnaires, interviews,

and observations. Quantitative data from the questionnaires were analyzed descriptively to generate percentages and average SUS scores, while qualitative data were analyzed using thematic coding techniques to identify key themes from user comments and interviews with destination managers. The analysis results were used to iteratively improve the application design. For example, if it was discovered that novice users had difficulty finding prayer times, shortcuts and tooltips were added to facilitate access. After the improvements were implemented, retesting was conducted using the SUS method.

4. RESULTS AND DISCUSSION

4.1 Information system design methods

Figure 1 shows the conceptual architecture of the ReligiGO application, which includes data flows between users, servers, and application modules. This diagram illustrates the logical relationships between components so that each feature can function in an integrated manner. The relevance of this diagram lies in its ability to ensure that the system design meets users' information needs while supporting the research objective of improving the accessibility of religious tourism through digitalization.

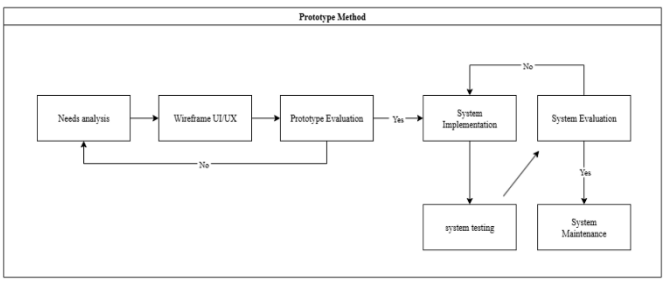


Figure 1. Information system design methods

4.2 System testing methods

Figure 2 visualizes the main actors (tourists, destination managers, and system administrators) and their interactions with the application's features. This representation helps validate that all user needs have been addressed. Therefore, this figure serves as the basis for developing test scenarios to ensure the system's completeness and reliability before field trials.

4.3 System analysis

4.3.1 Use case diagram

Figure 3 illustrates the relationship between the main actors, tourists, destination managers, and administrators, with the core features of ReligiGO. This diagram serves to systematically demonstrate the functional scope of the system and ensure that each stakeholder's needs are consistently translated into the application's construction. At a theoretical level, this diagram clarifies how the user-centered design concept is applied through user-centered interaction mapping. Thus, Figure 3 supports the research objectives by providing a strong conceptual foundation for designing a Smart Religious Tourism application that is adaptive, informative, and easy to use.

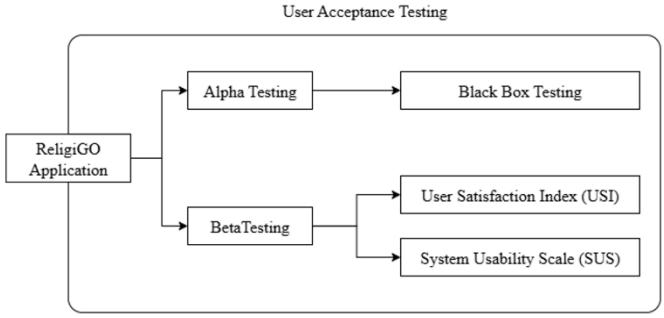


Figure 2. System testing methods

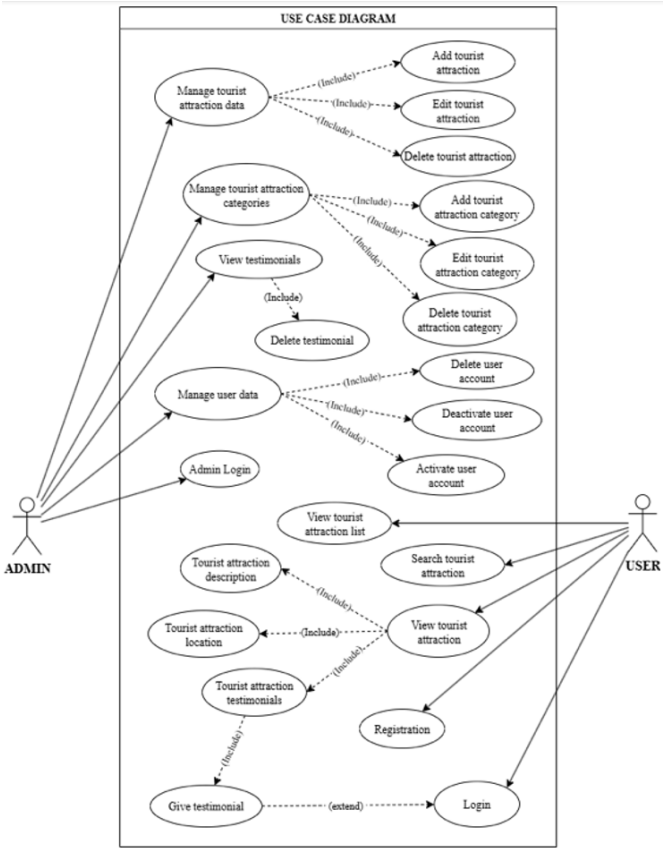


Figure 3. Use case diagram

4.3.2 Activity diagram

Figure 4 this diagram describes the flow of user activity from logging into the application to browsing destinations and accessing supporting information. This visualization emphasizes how the workflow is designed to reduce cognitive load and minimize points of confusion in navigation. This diagram also illustrates how the system responds to each user action in a logical and structured manner. Academically, this diagram demonstrates the application of the principle of flow efficiency in Smart Religious Tourism (SRT) refers to process efficiency that influences perceived usability and user satisfaction. Therefore, Figure 4 is a crucial element in demonstrating that interaction design supports an enhanced religious tourism experience.

4.3.3 Context diagram

Figure 5 presents a context diagram showing the system boundaries and ReligiGO's relationships with external entities. This diagram explains how the application receives user input, manages destination data, and presents information back

through a simplified interface. This context diagram has theoretical relevance because it illustrates the principles of system interoperability and modularity in the context of Smart Tourism. By clearly defining the system boundaries, this diagram emphasizes how the information architecture supports the research objective of producing a digital platform capable of providing integrated and consistent religious tourism information.

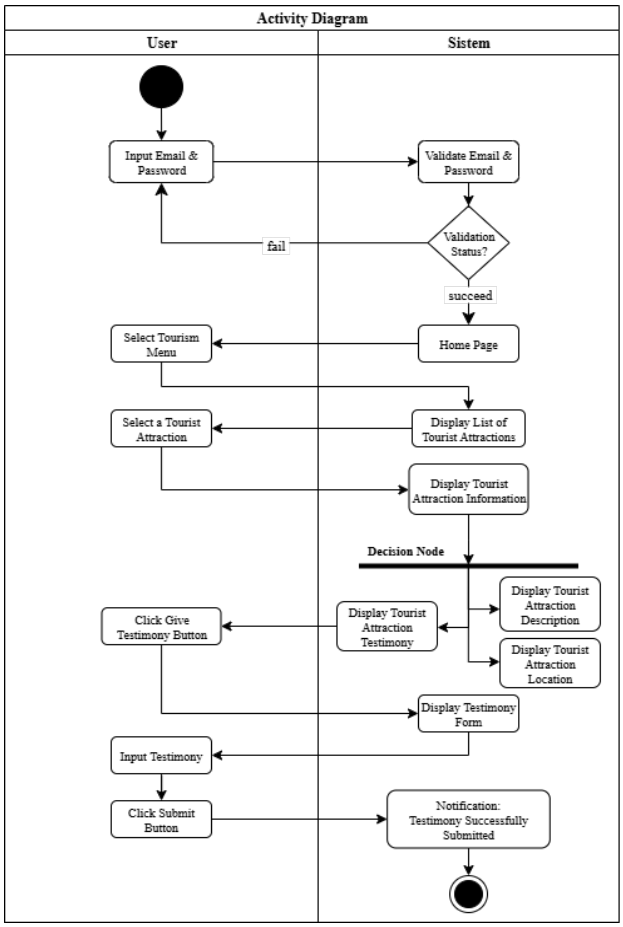


Figure 4. Activity diagram

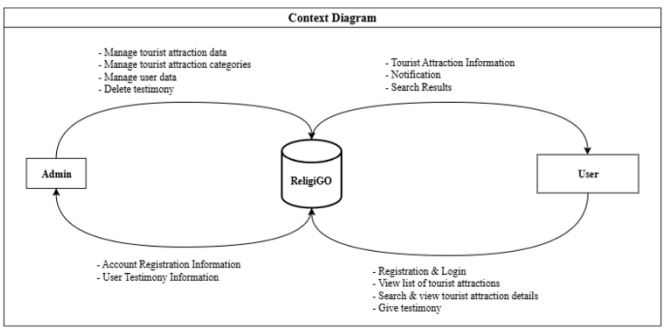


Figure 5. Context diagram

4.3.4 Data flow diagram

Figure 6 shows a data flow diagram that visualizes the flow of data from user input to information processing and output. This DFD illustrates how the system ensures data integrity, consistency of destination information, and efficiency in data retrieval. From a scientific perspective, this DFD reflects the application of information flow optimization in Smart Religious Tourism, demonstrating how the quality and speed of information access can improve the perceived value of a destination for tourists. Thus, this diagram serves not only as a technical artifact but also supports the argument that efficient data structures contribute to an enhanced tourist experience.

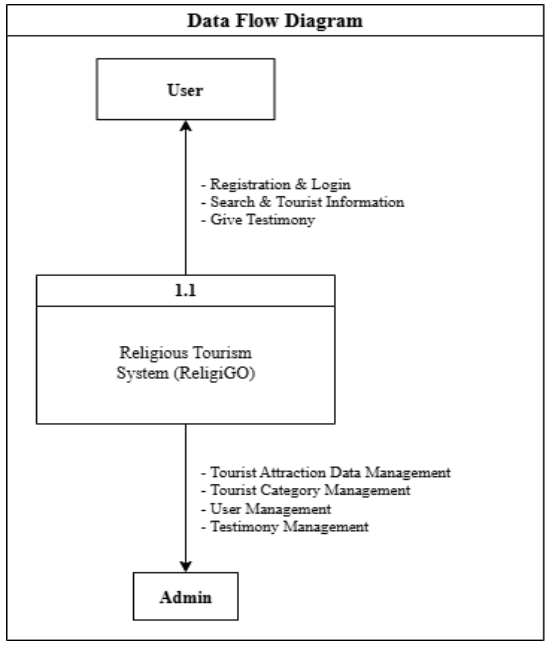


Figure 6. Data flow diagram

4.4 Application testing

Application testing was conducted to evaluate the performance and usability of the ReligiGO system based on pre-designed scenarios. The testing method used was black box testing, which examines the application's functionality without considering its internal structure. This testing aims to ensure that the application performs according to user expectations and meets established specifications.

Table 2 illustrates the test scenarios used to measure system performance and reliability. Each test was conducted using data relevant to each application feature, such as user registration, login, destination management, and testimonial provision and management.

The results of the System Testing Scenario carried out using the Black Box method can be seen in Table 3.

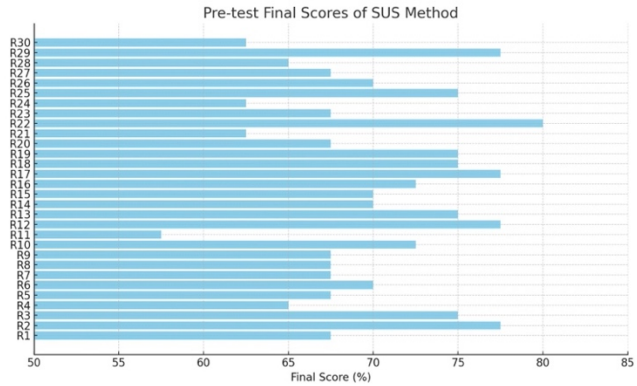


Figure 7. Pre-test final scores of SUS method

The results of this test were then analyzed using the System Usability Scale (SUS) to assess the system's usability based on user perception. The SUS questionnaire completed by 30 respondents in the pre-test phase was analyzed to obtain an

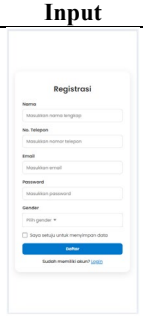
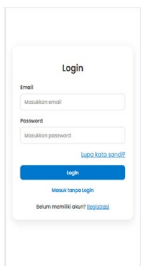
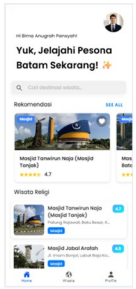
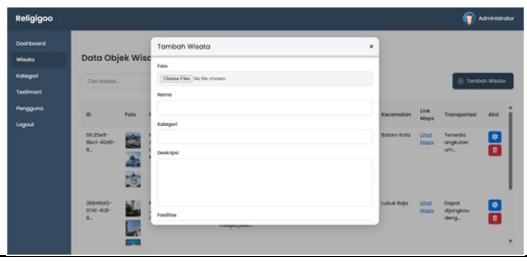
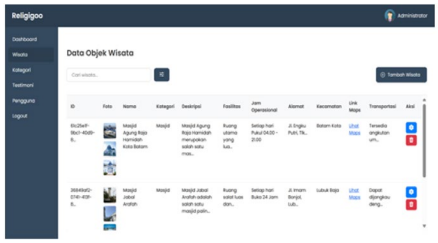
average score reflecting the level of user satisfaction with the ReligiGO application. Figure 7 displays the distribution of SUS scores in the pre-test phase and provides an initial overview of the level of user acceptance of the ReligiGO application.

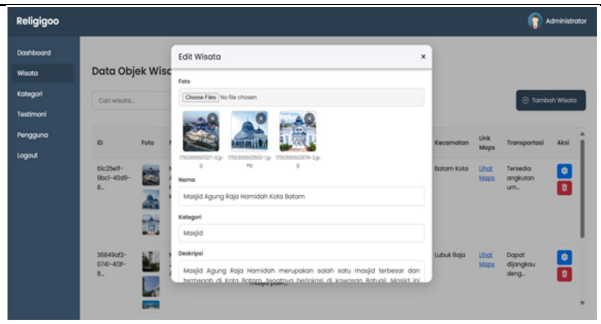
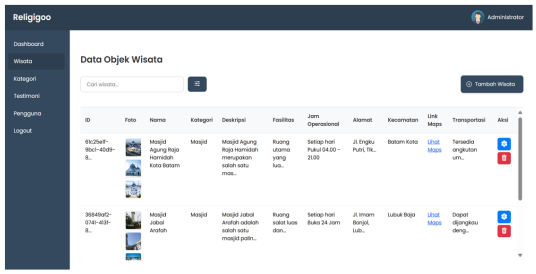
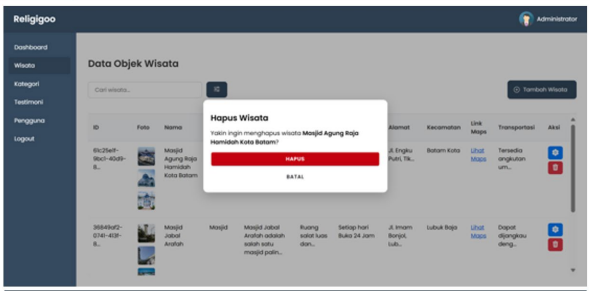
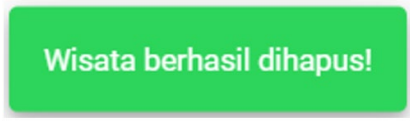
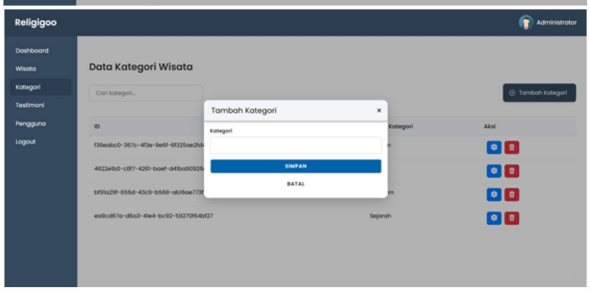
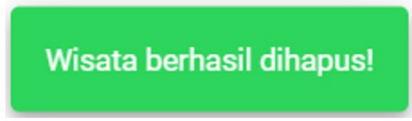
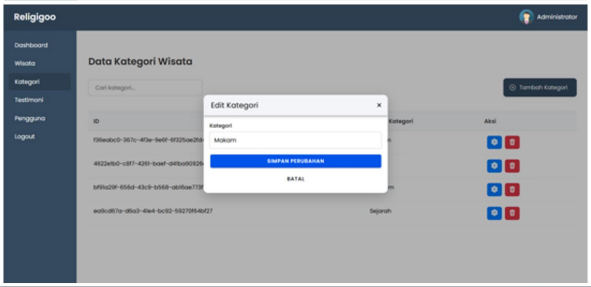
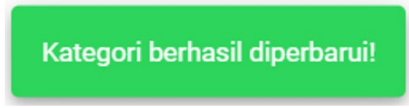
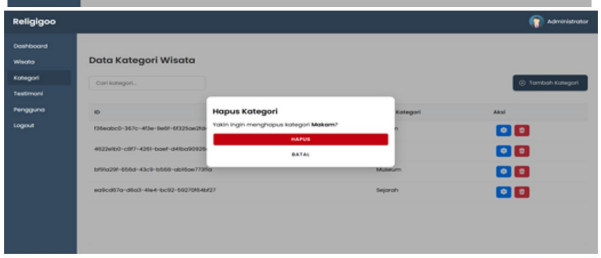
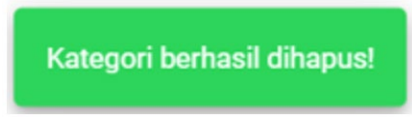
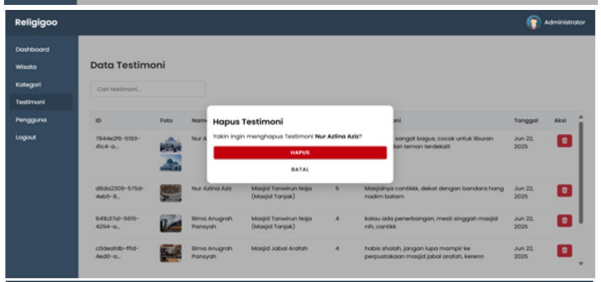
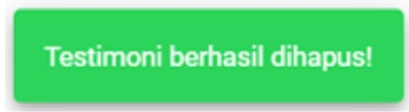
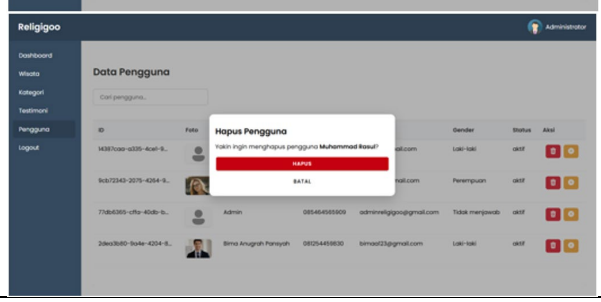
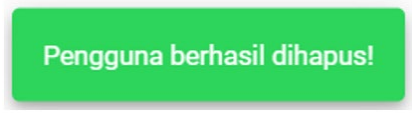
As seen in Figure 7, the average pre-test score was 70.2, which falls into the marginally acceptable category. Although most respondents gave a positive assessment, there was significant variation in scores, indicating that some users experienced difficulty navigating the interface or understanding the app's usage flow. This finding provides an important basis for design iterations, focusing on simplifying the navigation flow, improving icon consistency, and making button placement more intuitive.

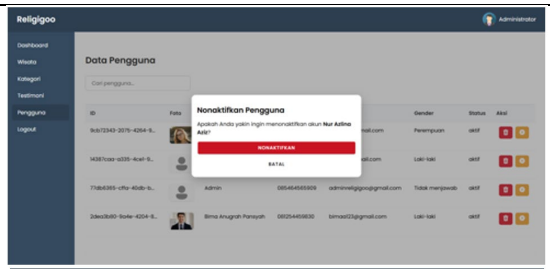
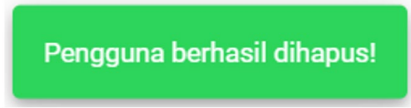
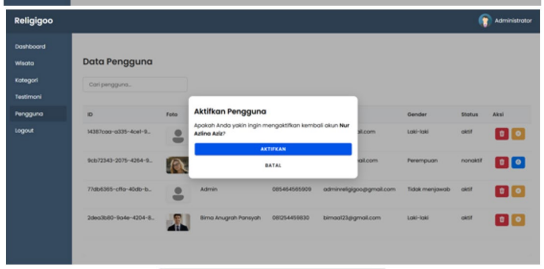
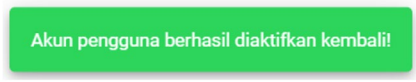
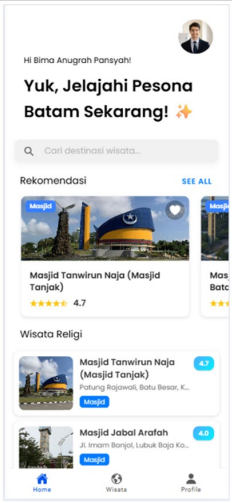
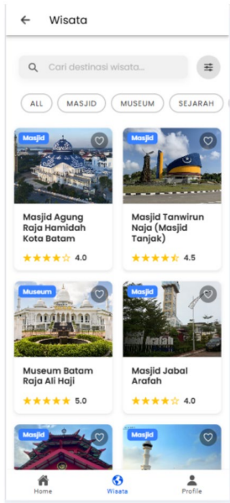
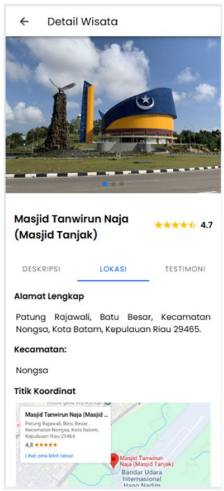
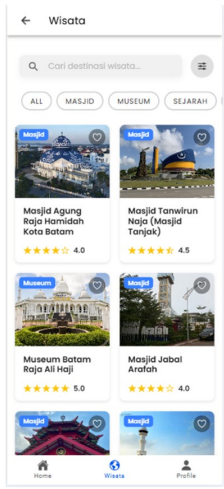
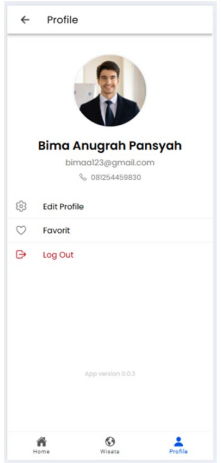
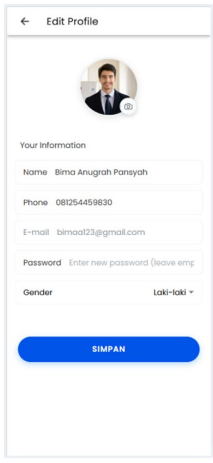
Table 2. Application testing scenario tables

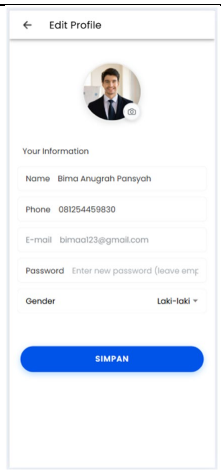
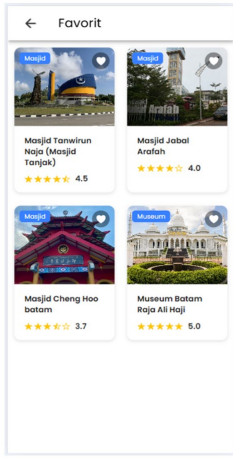
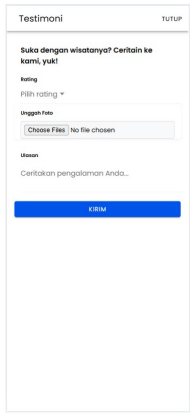
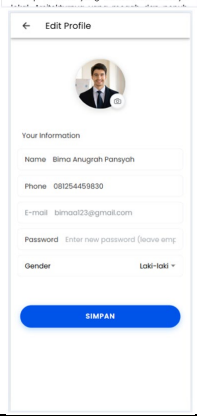
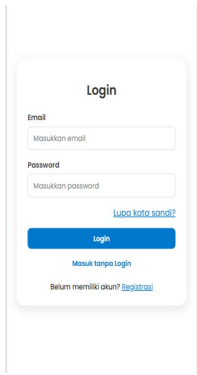
Test Class	Test Details	Method
User Registration	Testing the registration process is carried out by entering new user data to ensure the system can receive and store information correctly.	Black Box
User Login	Testing the authentication (login) process is performed using a combination of username and password, and ensuring that the user is redirected to the homepage or dashboard.	Black Box
Manage Tourist Attractions	Testing the addition of tourist attraction data.	Black Box
	Testing the modification of tourist attraction data.	Black Box
	Testing the deletion of tourist attraction data.	Black Box
Manage Categories	Testing the addition of tourist category data.	Black Box
	Testing the modification of tourist category data.	Black Box
	Testing the deletion of tourist category data.	Black Box
Manage Testimonials	Testing the deletion of testimonials.	Black Box
Manage Users	Testing the deletion of a user account.	Black Box
	Testing the deactivation of a user account.	Black Box
	Testing the reactivation of a user account.	Black Box
Provide Testimonials	Testing to ensure that users can give testimonials about their tourism experience, and verifying that the data is stored and displayed correctly.	Black Box
Edit Profile	Testing to ensure users can update their personal data, and verifying that the changes are stored and displayed correctly.	Black Box
User Logout	Ensuring the logout button functions properly.	Black Box
System Evaluation for ReligiGO Application Users	This testing is conducted to determine whether the system meets user requirements.	System Usability Scale (SUS)

Table 3. Systems table testing by using Blacx Box method

No	Testing	Input	Output
1	Registration		
2	Login		
3	Admin – Add Tourist Attraction Button		

4	Admin – Edit Tourist Attraction Button		
5	Admin – Delete Tourist Attraction Button		
6	Admin – Add Category Button		
7	Admin – Edit Category Button		
8	Admin – Delete Category Button		
9	Admin – Delete Testimonial Button		
10	Admin – Delete User Button		

11	Admin – Deactivate User Button		
12	Admin – Activate User Button		
13	User – View Tourist Attraction List		
14	User – View Tourist Attraction Description		
15	User – Edit Profile		

16	User – Select Favorite Tourist Attraction		
17	User – Provide Testimonial		
18	Logout		

After design improvements were made based on the pre-test analysis results, the application was retested to assess the effectiveness of the changes. Post-test results obtained from the same respondents completing the SUS questionnaire are presented in Figure 8, which shows a significant increase in scores.

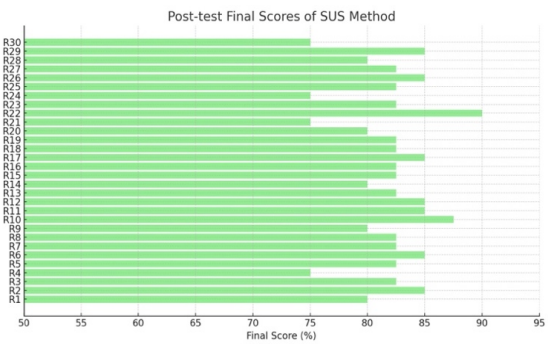


Figure 8. Post-test final scores of SUS method

Interpretation of Figure 8 shows an increase in the average score to 82.5, which is considered "good." This improvement confirms that the interface improvements and simplified interaction flow have a positive impact on the user experience. Furthermore, the variation in scores between respondents has decreased, indicating a better consistency of user experience compared to the pre-test results.

The increase in the average SUS score from 70.2 in the pre-test to 82.5 in the post-test indicates a significant improvement in the app's usability after the design iteration. To provide a more comprehensive picture of the comparison of results before and after the improvements, a data visualization was created that displays the SUS scores from both stages side by side. This visualization is important so readers can immediately see the trend differences and confirm the effectiveness of the design changes. Figure 9 presents a comparison of SUS scores between the pre-test and post-test for all respondents.

As seen in Figure 9, scores improved for nearly all respondents, indicating that the design changes had a

consistent positive impact on the user experience. The relatively uniform improvement also indicates that the design iterations successfully addressed challenges previously experienced by some respondents, such as confusing navigation or unintuitive menu placement. These results reinforce the evidence that the user-centered design approach is effective in improving interface quality and overall user satisfaction.

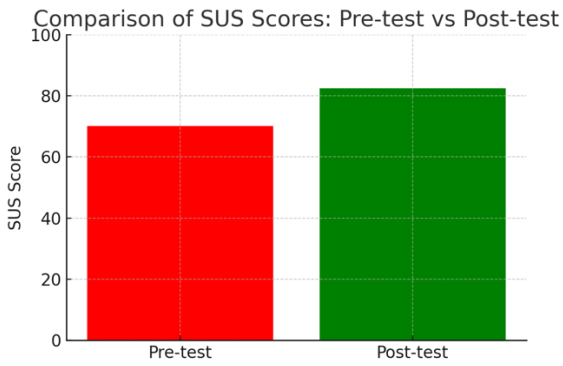


Figure 9. Comparison of SUS scores pre-test vs. post-test

The results of this study showed an increase in the SUS score from 70.2 in the pre-test to 82.5 in the post-test, which is categorized as "good." This finding is in line with a study conducted by Ismail et al. which reported that the application of user-centered design in tourism applications can increase the SUS score to more than 80. A similar thing was also found by Hyzy et al. [42], which emphasizes that user feedback-based design iterations can significantly reduce error rates and improve user experience. Thus, this study supports previous literature and strengthens empirical evidence that iterative approaches are effective in improving the quality of digital tourism applications.

In addition to evaluating usability through SUS scores, this study also analyzed app usage patterns to understand how users interact with the various available features. This analysis was conducted by recording the frequency of interactions with key features, such as logging in, searching for destinations, accessing prayer schedules, tagging favorite destinations, and providing testimonials. The analysis results were visualized in a heatmap to facilitate identification of the most frequently used features by each user group. Figure 10 presents this visualization.

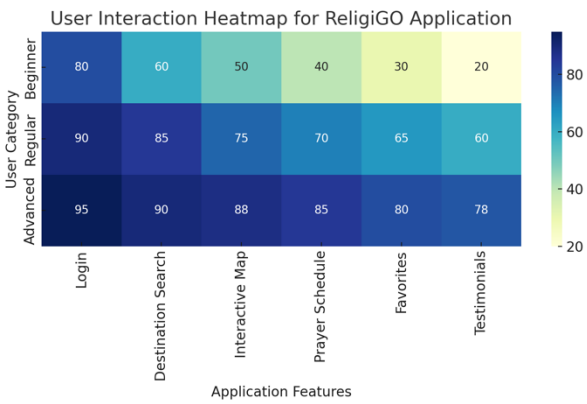


Figure 10. User interaction heatmap for ReligiGO application

Figure 10 presents a heat map illustrating the distribution of ReligiGO feature usage intensity across three user categories: beginners, regular users, and advanced users. This visualization reveals significant differences in interaction patterns between user segments based on their level of digital literacy and familiarity with the system. Beginner users tend to focus on basic features such as destination search, access to general information, and standard navigation functions. This pattern indicates that this group is still in the initial system adaptation stage, where the primary focus is on understanding the basic structure of the application. In contrast, regular and advanced users demonstrate significantly higher and more diverse levels of interaction, reflecting the advanced engagement stage, characterized by exploration of advanced features and utilization of the system in more complex travel planning contexts.

In addition to differences in user segmentation, this heatmap shows that interactive features, particularly GIS maps, virtual tour previews, and user testimonials, are the features with the highest usage intensity. Theoretically, this phenomenon is consistent with the concept of technology-enabled pre-experience, which states that digital representations of destinations play a crucial role in shaping tourists' initial perceptions, strengthening destination image, and increasing familiarity before the actual visit. The GIS map feature provides a comprehensive spatial representation, thereby enhancing spatial awareness and reducing location uncertainty, while the virtual tour preview provides visual cognitive cues that facilitate the formation of expectations about the destination atmosphere. User testimonials, on the other hand, function as a social proof mechanism that can reduce perceived risk and increase trust in the quality of the tourism experience. Thus, the usage intensity of these features not only reflects application usage patterns but also provides an empirical indication of how digital experiences have the potential to change users' perceptions of religious tourism destinations.

Furthermore, the relationship between the intensity of interaction on interactive features and the likelihood of exploratory behavior can be clearly observed in the heatmap. Users with the highest levels of interaction on GIS features, virtual tours, and testimonials showed a greater tendency to search for and consider alternative destinations, including those not previously considered. This pattern supports the tourist engagement theory, which emphasizes that high levels of technological interaction can trigger cognitive and affective engagement, which in turn increases exploration intentions. This finding also provides a richer context for explaining the survey results, which showed an increased interest in visiting new destinations among the majority of respondents. Thus, interpreting Figure 10 goes beyond simply depicting feature usage statistics but also explains the behavioral mechanisms that bridge digital interactions with actual visit intentions.

To complement the evaluation, a user satisfaction survey was conducted, assessing perceptions of ease of use, information quality, and the app's influence on travel behavior. The survey results are presented in Figure 11.

As seen in Figure 11, The study shows that the increased appeal of religious tourism through ReligiGO occurs through mechanisms directly related to user interaction patterns and utilization of the app's core features. The integration of intelligent technology into the system not only improves usability but also shapes destination perceptions, broadens tourists' horizons, and encourages changes in visiting

behavior.

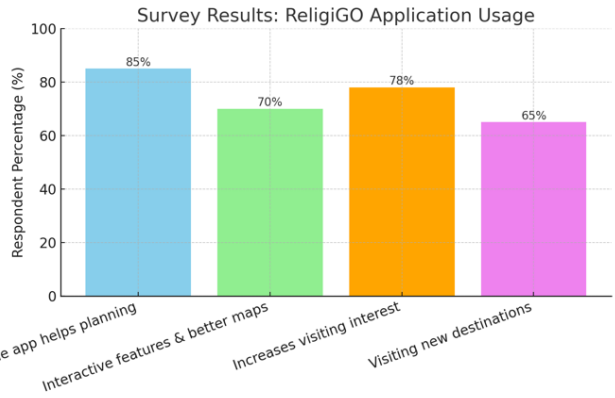


Figure 11. Survey results ReligionGO applications usage

First, the survey findings, which showed that 78% of respondents were interested in visiting new destinations, were closely related to two key features: interactive GIS-based maps and multimedia-based historical narratives. These features provide context-rich, detailed, and visual information, enhancing tourists' clarity and understanding of previously unknown destinations. This aligns with the concept of information accessibility, where increasing the availability and quality of information directly contributes to strengthening destination image and increasing perceived destination value, which has been empirically proven to drive visitor interest.

Second, the 65% of respondents who subsequently visited a place of worship they had not previously considered demonstrates the strategic role of the virtual tour preview feature and user testimonials. Based on the heatmap analysis (Figure 10), advanced users consistently utilized these two features before making their visit decisions. Visual simulations and other users' verified experiences helped lower perceived risk, clarify visit expectations, and increase trust in the destination. These findings align with the technology-enabled destination pre-experience model, which emphasizes that initial interactions through digital media significantly influence actual travel decisions.

Third, the high usage of the favorite destination tagging and religious category search features indicates that the system supports a high level of personalization in travel planning. The heatmap indicates that these features are dominated by regular users, suggesting that ReligiGO facilitates customized travel pathways. The literature on tourist engagement confirms that personalization is a critical determinant of strengthening tourist engagement, increasing planning effectiveness, and increasing opportunities for exploring alternative destinations.

Fourth, the finding that 85% of respondents felt helped in planning their trips confirms ReligiGO's function not only as an information provider but also as a comprehensive travel support system. The integration of routes, operating hours, locations of religious facilities, and other supporting information reduces barriers to travel planning. Based on the Smart Religious Tourism (SRT) framework, increased perceived usefulness at this level is consistently associated with increased actual travel intentions and behavior.

Overall, empirical evidence from surveys, user interaction patterns, and the smart features integrated into the app demonstrate that ReligiGO plays a role in enhancing the appeal of religious tourism by increasing the perceived value of destinations, reducing perceived risk, broadening travel horizons, and enhancing personalization of experiences. Thus, Smart Religious Tourism (SRT)-based digitalization has been proven to significantly contribute to increasing tourist interest and exploratory behavior in Batam City.

4.5 Research limitations and further research directions

The results of this study demonstrate important findings, but there are several methodological and empirical limitations that need to be considered to provide a proportionate context for the interpretation of the results. The number of respondents was limited to 30 participants, the majority of whom resided in Batam City, thus limiting the scope for generalizing the findings. The varying characteristics of tourists from other regions or international tourists were not adequately represented. Furthermore, the testing process was conducted in a laboratory environment, so it does not reflect the conditions of application usage in the field over the long term. Given that technology-based tourism behavior is dynamic and influenced by various situational factors, a longitudinal study is needed to more comprehensively capture ReligiGO adoption patterns.

Methodologically, this study relies on perceptual data obtained through surveys and observations. The absence of objective behavioral data such as GPS track records, actual travel logs, or destination visit statistics means that the evaluation of ReligiGO's influence reflects only intentions and perceptions, not actual travel behavior. This limitation reduces the study's ability to assess the app's impact on actual travel decision-making.

Furthermore, there is the potential for self-selection bias. Respondents tend to be individuals with an interest in digital technology or religious tourism, so the research results may provide a relatively more positive picture compared to populations with different preferences or levels of digital literacy. Therefore, the representativeness of the findings to general tourists should be interpreted with caution.

System integration is also limited. ReligiGO is not yet connected to external data platforms such as destination ticketing systems, real-time visitor statistics, or local government databases. This limitation hinders empirical assessment of the system's potential implementation at a city scale and its contribution to broader tourist flow management.

To address these limitations, future research is recommended to expand the sample size and diversity, involve both local and international travelers, and integrate technologies such as artificial intelligence for personalized destination recommendations and big data analytics for real-time user behavior monitoring. Furthermore, testing the app in the context of actual travel is necessary to achieve a more comprehensive and evidence-based evaluation of ReligiGO's impact.

5. CONCLUSION

This research successfully developed and evaluated the ReligiGO application as an implementation of Smart Religious Tourism (SRT) to enhance the attractiveness of religious tourism in Batam City. Through a user-centered design approach and iterations based on user feedback, the developed application showed significant improvements in usability aspects. Test results using the System Usability Scale

(SUS) recorded an increase in the average score from 70.2 (pre-test) to 82.5 (post-test), indicating that interface improvements and simplified user flow effectively improved the user experience.

Analysis of user interaction patterns revealed that the destination search feature and interactive map were the most frequently used components, while user surveys indicated that 78% of respondents were encouraged to visit new destinations and 65% visited places of worship they had not previously considered. This underscores ReligiGO's role as a catalyst, not only facilitating access to information but also encouraging broader exploration of religious tourism.

The primary contribution of this research is to offer an app-based SRT integration model that combines destination information, prayer schedules, and user interactions within a single, adaptive digital ecosystem. Further research is recommended to involve a larger sample size, including international travelers, and explore the integration of advanced technologies such as artificial intelligence for personalized destination recommendations and big data analytics for real-time monitoring of traveler behavior.

ACKNOWLEDGMENT

The author would like to express his gratitude to the Ministry of Higher Education, Science, and Technology of the Republic of Indonesia for the research grant funding support provided through the 2025 fiscal year program based on master contract No.138/C3/DT.05.00/PL/2025 and derivative contract No. 019/LL17DT.05.00/PM/2025without whom the completion of this article would not have been possible. Special thanks are also extended to the Institute for Research and Community Service, Batam Institute of Technology, for their guidance, administrative assistance, and ongoing institutional support throughout the research process.

REFERENCES

[1] Hasibuan, B., Salsabila, L., Dompak, T. (2025). The free trade zone policy: A pathway to the development of a special economic zone in Batam City. International Journal of Social Welfare and Family Law, 2(3): 48-57.

[2] Permatasari, R.D., Bora, M.A., Hernando, L., Saputra, T. Fauzan, H., Shilah, N., and Salsabila, T.A. (2025). Evaluating usability and clustering of SILCARE system for MSME shipping: A data-driven approach using SUS and user behavior analysis. Journal of Applied Data Sciences, 6(2): 997-1011. https://doi.org/10.47738/jads.v6i2.590

[3] Widowati, N., Lituhayu, D., Subowo, A., Nirmala, R.J. (2025). Public service performance of the department of culture and tourism in developing tourism destinations in Batam, Riau Islands. In Proceedings of the 9th International Conference on Indonesian Social and Political Enquiries (ICISPE 2024), pp. 22-40. https://doi.org/10.2991/978-2-38476-436-5_4

[4] Amalia, E., Abnur, A., Rais, S. (2022). Indonesia-Singapore cross border tourism facts. In Proceedings of the International Academic Conference on Tourism (INTACT) "Post Pandemic Tourism: Trends and Future Directions" (INTACT 2022), Atlantis Press SARL, pp. 214-226. https://doi.org/10.2991/978-2-494069-73-2_16

[5] Dailami, D., Thandzir, M., Pristiwasa, I.W.T.K., Sukmamedian, H., Lubis, T.B.U., Rhomadani, M. (2025). Optimalisasi potensi daya tarik wisata religi Masjid Raya Sultan Mahmud Riayat Syah Kota Batam. Jurnal Ekonomi Manajemen Dan Bisnis (JEMB), 4(1): 287-297. https://doi.org/10.47233/jemb.v4i1.2795

[6] Badan Pusat Statistik Kota Batam. (2024). Perkembangan Pariwisata Kota Batam, Juni 2024. https://batamkota.bps.go.id/id/pressrelease/2024/08/02/580/perkembangan-pariwisata-kota-batam--juni-2024.html.

[7] Indrawati, L., Lim, I., Goh, A., Ginting, W., Lilik, L. (2021). Tourism sector strategy for increasing GRDP in Batam City in the New Normal Era. Eduvest-Journal of Universal Studies, 1(6): 398-408. https://doi.org/10.59188/eduvest.v1i6.77

[8] El Archi, Y., Benbba, B., Kabil, M., Dávid, L.D. (2023). Digital technologies for sustainable tourism destinations: State of the art and research agenda. Administrative Sciences, 13(8): 184. https://doi.org/10.3390/admsci13080184

[9] Armutcu, B., Tan, A., Amponsah, M., Parida, S., Ramkissoon, H. (2023). Tourist behavior: The role of digital marketing and social media. Acta Psychologica, 240: 104025. https://doi.org/10.1016/j.actpsy.2023.104025

[10] Nadee, W., Kaewkitipong, L., Ractham, P., Sayruamyat, S. (2024). An investigation of the intention to visit smart tourism destinations: Domestic travelers vs. international travelers. Sustainability, 16(23): 10484. https://doi.org/10.3390/su162310484

[11] Amir, S., Dura, H., Yusof, M.A., Nakamura, H., Abu Nong, R. (2020). Challenges of smart tourism in Malaysia eco-tourism destinations. Planning Malaysia, 18(4): 442-451. https://doi.org/10.21837/pm.v18i14.844

[12] Sousa, A.E., Cardoso, P., Dias, F. (2024). The use of artificial intelligence systems in tourism and hospitality: The tourists' perspective. Administrative Sciences, 14(8): 165. https://doi.org/10.3390/admsci14080165

[13] Wang, L.L. (2024). Enhancing tourism management through big data: Design and implementation of an integrated information system. Heliyon, 10: e38256. https://doi.org/10.1016/j.heliyon.2024.e38256

[14] Savino, G. L., Sturdee, M., Rundé, S., Lohmeier, C., Hecht, B., Prandi, C., Nunes, J.N., Schöning, J. (2021). MapRecorder: Analyzing real-world usage of mobile map applications. Behaviour & Information Technology, 40(7): 646-662. https://doi.org/10.1080/0144929X.2020.1714733

[15] Zhuang, X.Q., Jiao, H.H., Lu, K. (2022). Retracted: Augmented reality interactive guide system and method for tourist attractions based on geographic location. Journal of Electrical and Computer Engineering, 2022: 9851629. https://doi.org/10.1155/2022/9851629

[16] Tom Dieck, M.C., Han, D.I.D., Rauschnabel, P.A. (2024). Augmented reality marketing in hospitality and tourism: A guide for researchers and managers. International Journal of Contemporary Hospitality Management, 36(13): 97-117. https://doi.org/10.1108/IJCHM-09-2023-1513

[17] Hernando, L., Permatasari, R.D., Melia, S.D.A., Bora, M.A., Alhamidi, Dermawan, A.A. (2025). Artificial intelligence-based intelligent navigation system for alleviating traffic congestion: A case study in Batam

City, Indonesia. International Journal of Computational Methods and Experimental Measurements, 13(2): 309-321. https://doi.org/10.18280/ijcmem.130208
[18] Parra-Sanchez, D.T., Viviescas-Jaimes, P.A. (2024). Application of digital technologies in nature-based tourism: A scientometric analysis. Journal of Digital Economy, 3: 249-259. https://doi.org/10.1016/j.jdec.2025.05.003
[19] Dao, T.T.H., Dang, T.T.M. (2025). The current state of smart tourism in Da Nang City and a proposed model for measuring tourist satisfaction via destination image, perceived smart tourism technologies, and memorable tourism experiences. International Journal of Engineering Inventions, 14(5): 285-291.
[20] Sharafuddin, M.A., Madhavan, M., Wangtueai, S. (2024). Assessing the effectiveness of digital marketing in enhancing tourist experiences and satisfaction: A study of Thailand's tourism services. Administrative Sciences, 14(11): 273. https://doi.org/10.3390/admsci14110273
[21] Örnek, N.A., Örnek, S., Münüsoğlu, H. (2025). Tourism's impact on the everyday lives of locals: A case study from Uçhisar. Tourism Planning & Development, 1-21. https://doi.org/10.1080/21568316.2025.2552970
[22] Wu, W.S., Xu, C., Zhao, M., Li, X.P., Law, R. (2024). Digital tourism and smart development: State-of-the-art review. Sustainability, 16(23): 10382. https://doi.org/10.3390/su162310382
[23] Tan, Y.N., Jiang, G.L., Merajuddin, S.S., Zhao, F. (2025). Analyzing the impact of digital technology on consumers' travel intentions. Journal of Innovation & Knowledge, 10(2): 100685. https://doi.org/10.1016/j.jik.2025.100685
[24] Jokom, R., Semuel, H., Wijaya, S. (2025). Sustainable tourism experiences: The role of digital technology and government support in creating tourists' memorable experiences. Cogent Business & Management, 12(1): 2482026. https://doi.org/10.1080/23311975.2025.2482026
[25] Karim, M.F., Mursitama, T.N., Riyadi, S.F., Affandi, R.A., Muzdalifa, F. (2024). Informality, paradiplomacy, and cross-border cooperation: The development of tourism on Bintan Island, Indonesia. Asian Studies Review, 48(2): 370-388. https://doi.org/10.1080/10357823.2023.2259080
[26] Suyadnya, I.W., Prianti, D.D., Kanto, S., Putra, I.N.D. (2025). The local dynamics of global ecotourism trends in the old Balinese village, Indonesia. Cogent Arts & Humanities, 12(1): 2451516. https://doi.org/10.1080/23311983.2025.2451516
[27] Wang, X.N. (2025). Exploring the relationship between destination image, tourist satisfaction, and loyalty among overseas visitors to Taishan using structural equation modeling. Acta Psychologica, 260: 105533. https://doi.org/10.1016/j.actpsy.2025.105533
[28] Lawelai, H., Sadat, A., Harakan, A. (2024). The level of local community involvement in sustainable tourism marketing of the World Coral Triangle in Wakatobi National Park, Indonesia. International Journal of Sustainable Development and Planning, 19(12): 4831-4841. https://doi.org/10.18280/ijsdp.191230
[29] Uyuni, B., Arief, K.M., Adnan, M., Hamid, A., Sutiono. (2024). Exploration of wali-songo (nine saints) ziyarat in Indonesia from religious tourism (pilgrimage) perspective. Cogent Arts & Humanities, 11(1): 2395110. https://doi.org/10.1080/23311983.2024.2395110
[30] Choe, J. (2025). Religious tourism. Tourism Geographies, 27(3-4): 830-839. https://doi.org/10.1080/14616688.2024.2423168
[31] Mileva, S., Krachanova, M. (2024). In search of new dimensions for religious tourism: The case of the Ancient City of Nessebar. Heritage, 7(10): 5373-5389. https://doi.org/10.3390/heritage7100253
[32] Zhang, Y.C. (2021). Transnational religious tourism in Modern China and the transformation of the Cult of Mazu. Religions, 12(3): 221. https://doi.org/10.3390/rel12030221
[33] Lelawatty, P., Sudarnice, Sudarman, L., Jejen, L. (2025). Exploring the potential of digital platform-based tourism markets towards international tourism markets to realize the green economy concept. International Journal of Sustainable Development and Planning, 20(4): 1767-1777. https://doi.org/10.18280/ijsdp.200437
[34] Suanpang, P., Pothipassa, P. (2024). Integrating generative AI and IoT for sustainable smart tourism destinations. Sustainability, 16(17): 7435. https://doi.org/10.3390/su16177435
[35] Mutmainah, I., Yulia, I.A., Setiawan, F.A., Setiawan, A.S., Nurhayati, I., Rainanto, B.H., Harini, S., Endri, E. (2025). Analysis of factors influencing digital transformation of tourism villages: Evidence from Bogor, Indonesia. Tourism and Hospitality, 6(2): 57. https://doi.org/10.3390/tourhosp6020057
[36] Veseli, A., Bytyqi, L., Hasanaj, P., Bajraktari, A. (2025). The impact of digital marketing on promotion and sustainable tourism development. Tourism and Hospitality, 6(2): 56. https://doi.org/10.3390/tourhosp6020056
[37] De Ascaniis, S., Mutangala, M.M., Cantoni, L. (2018). ICTs in the tourism experience at religious heritage sites: A review of the literature and an investigation of pilgrims' experiences at the sanctuary of Loreto (Italy). Church, Communication and Culture, 3(3): 310-334. https://doi.org/10.1080/23753234.2018.1544835
[38] Shah, A.A. (2024). Enhancing Hajj and Umrah rituals and crowd management through AI technologies: A comprehensive survey of applications and future directions. IEEE Access, 12: 120398-120417. https://doi.org/10.1109/ACCESS.2024.3487923
[39] Showail, A.J. (2022). Solving Hajj and Umrah challenges using information and communication technology: A survey. IEEE Access, 10: 75404-75427. https://doi.org/10.1109/ACCESS.2022.3190853
[40] Aina, Y.A., Abubakar, I.R., Almulhim, A.I., Dano, U.L., Maghsoodi Tilaki, M.J., Dawood, S.R.S. (2023). Digitalization and smartification of urban services to enhance urban resilience in the post-pandemic era: The case of the pilgrimage city of Makkah. Smart Cities, 6(4): 1973-1995. https://doi.org/10.3390/smartcities6040092
[41] Ismail, N.A., Nizam, S.F., Yuen, S., Hasan, L., Mohamed, S.E., Leng, W.Y., Allah, K.K. (2021). User-centred design and evaluation of web and mobile based traveling applications. International Journal of Advanced Computer Science and Applications, 12(8): 463-470. https://doi.org/10.14569/IJACSA.2021.0120854
[42] Hyzy, M., Bond, R., Mulvenna, M., Bai, L., Dix, A., Leigh, S., Hunt, S. (2022). System usability scale benchmarking for digital health apps: Meta-analysis.