



Web-Based Tourism Recommendation System for South Sulawesi: Design, Implementation, and Evaluation

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ABSTRACT

Tourism information delivery in South Sulawesi remains constrained by the absence of a digital platform that provides comprehensive and personalized data. Previous studies generally present only basic information without recommendation features that align with user interests. This study develops a web-based application named *Sering-Sering*, designed to provide both tourism information and personalized recommendations according to user needs. The application was developed using the Waterfall model, a structured and sequential software engineering methodology, and its functionality was evaluated through white-box and black-box testing to ensure completeness and reliability. Results demonstrate that *Sering-Sering* was successfully implemented through systematic stages of planning, analysis, design, implementation, and testing. The final system is stable, user-friendly, and capable of delivering informative outputs. Black-box testing across 15 scenarios, including login, registration, destination search, profile management, and deletion of favorites and notifications, produced a 100 percent functional success rate. These findings indicate that the application effectively supports tourists in identifying suitable destinations quickly and conveniently while also contributing to regional tourism promotion. Future research is recommended to expand the system by integrating online ticket booking and artificial intelligence-based recommendation features, thereby strengthening its potential contribution to smart tourism development in South Sulawesi.

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INTRODUCTION

Tourism is a strategic sector for economic development and the improvement of community welfare[1], [2]. South Sulawesi has considerable tourism potential, spanning natural, cultural, and culinary attractions [3], [4]. However, these assets remain underutilized because of limited promotion and inadequate digital information management[5], [6]. In the era of digital transformation, an integrated and easily accessible information system is crucial to stimulate sustainable growth in this sector[7], [8].

Digital tourism information systems have been widely recognized as effective tools for expanding access to and improving the quality of destination-related information at regional and local levels[9], [10]. In the context of South Sulawesi, recent studies indicate that mobile-based destination portals can provide integrated information on tourist attractions, culinary heritage, and local history through user-friendly interfaces [11]. Similarly, sentiment analysis of visitor reviews in Gowa Regency demonstrates that structured online information facilitates a more accurate understanding of tourist perceptions [12]. Nevertheless, the effectiveness of digital

tourism initiatives remains uneven. In Bulukumba, for instance, assessments revealed persistent challenges in terms of data accuracy, transparency, and accessibility due to continued reliance on manual practices [13], [14]. These findings underscore the continuing need for a centralized and credible digital platform capable of delivering comprehensive destination information across South Sulawesi.

This study aims to design and implement a web-based tourism information system that recommends destinations according to user preferences while enhancing promotional effectiveness in South Sulawesi. The *Sering-Sering* platform provides comprehensive information supported by search, filtering, reviews, user profiles, and weighted recommendations. Previous studies in the Indonesian context indicate that user-friendly tourism systems with integrated features significantly improve visitor interest and destination visibility [13]. Complementing this, international research highlights that web-based platforms presenting high-quality visuals, locational data, facilities, and pricing information substantially strengthen promotional effectiveness and tourist engagement [15], [16]. Building on these insights, the *Sering-Sering* platform is expected to foster more organized, appealing, and sustainable tourism development in South Sulawesi.

METHOD

The waterfall model was selected as the development methodology because of its linear structure and emphasis on documentation, which are suited for projects requiring predictable deliverables and controlled progress [17], [18]. This model is particularly relevant for systems that prioritize stability and traceability of requirements, since each stage must be completed before moving to the next. Unlike agile approaches that emphasize flexibility, the waterfall process ensures that stakeholders can review clear outputs at every stage, reducing ambiguity in scope. Figure 1 illustrates the general workflow of the waterfall model as adapted in this study.

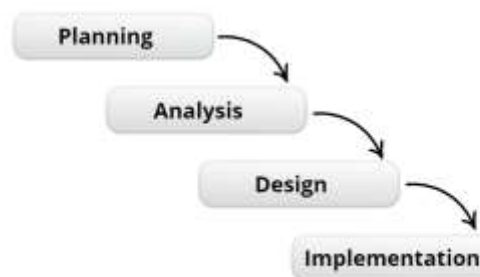


Figure 1.

The Waterfall Model of the System Development Life Cycle (SDLC)

The initial stages comprised planning and analysis, which focused on identifying system requirements for tourism recommendations such as search, filtering, and reviews. A feasibility study was conducted to evaluate economic, organizational, and technical aspects, ensuring alignment with stakeholder needs in South Sulawesi. Requirements were then specified in more detail, addressing functional aspects including usability and security, and non-functional aspects such as performance and maintainability.

The subsequent stages involved design and implementation. UML diagrams, including use case, class, and sequence, were developed to represent system logic and interactions, while user interface prototypes were built in Figma to ensure usability and consistency. The system was implemented using PHP for back-end logic and MySQL for database management, with Visual Studio Code as the integrated development environment. Validation employed both black-box and

white-box testing to verify functional compliance and code-level correctness. The evaluation was guided by the ISO/IEC 25010:2023 quality attributes, ensuring that the application achieved acceptable standards of reliability, usability, and performance [19], [20]

RESULTS AND DISCUSSION

A. Results

The *Sering-Sering* web application was developed to integrate destination information and recommendation features, addressing the gap in South Sulawesi's digital tourism services. It primarily serves two audiences: travelers in need of reliable and personalized destination insights, and tourism stakeholders who require structured digital media for effective promotion. Each development outcome under the Waterfall framework is outlined in the following stages:

1. Planning

Table 1. Feasibility Study

Technical Feasibility Study
<ol style="list-style-type: none">Risk Related to Familiarity with the Application: Low Users provided evaluations of "Good" and "Very Good" regarding their familiarity with the developed application. Both developers and users demonstrated sufficient understanding of the system's features and considered them aligned with user needs and expectations.Risk Related to Familiarity with Technology: Low Users and developers were rated "Good" and "Very Good" in their understanding of the employed technologies, including the platform, programming language, and integrated development environment (IDE). The technologies were considered relevant and consistent with current trends, thereby reducing the potential for technical risksRisk Related to Project Size: Low The project was planned to involve four developers over a six-month period, which is reasonable for the scale of a tourism information system. The project scope remains manageable, provided that planning and management are executed effectively.Risk Related to Compatibility: : Low User assessments of compatibility with other applications and with existing systems were rated "Good" and "Very Good." This indicates a high potential for successful integration of the developed system with external platforms.
Economic Feasibility Study
<p>Based on the conducted analysis, the Tourism Recommendation Information System demonstrates strong potential to enhance travel planning effectiveness and user engagement, which in turn can improve tourist satisfaction and simplify the process of selecting destinations aligned with individual preferences. The financial evaluation further supports the viability of the system:</p> <ol style="list-style-type: none">Return on Investment (ROI): The estimated ROI for the <i>Sering-Sering</i> platform is 248.01%.

2. Break-Even Point (BEP): The project is expected to reach its break-even point within approximately 1.3 years, or about 15.6 months, indicating profitability after the first year and three months of operation.
3. Total Profit after Three Years: The system is projected to generate a cumulative profit of IDR 1,783,000,000 over a three-year period.
Organizational Feasibility Study
The organizational risk associated with the development of this application is considered low. Overall, the organization is in a position of readiness and support for system development. The organizational feasibility study indicates that the Sering-Sering application is structurally and functionally aligned with organizational needs and processes, further reinforced by the presence of a relevant and competent team, thereby justifying its continued development.

Based on the findings in Table 1, the *Sering-Sering* Tourism Information System is feasible from technical, economic, and organizational perspectives. Technical risks were rated low, financial analysis showed an ROI of 248.01% with a break-even point at 1.3 years, and the organizational assessment confirmed readiness and structural alignment. These results indicate that the system is practical to implement and sustainable for long-term development.

2. Analysis

Table 2. Non-Functional Requirements

ID	Parameter	Requirement
NFR-001	Availability	The application must be available 24/7 with a maximum downtime of 1% per month.
NFR-002	Reliability	Minimum uptime of 99% with automatic recovery mechanisms for system failures.
NFR-003	Ergonomics	The interface must be user-friendly, provide intuitive navigation, and support accessibility for users with special needs
NFR-004	Portability	Must operate on Android 8.0 and above, and iOS 13 and above.
NFR-005	Memory Efficiency	Memory usage must not exceed 150 MB of RAM on mid-range devices.
NFR-006	Response Time	Search queries for destinations must respond in ≤ 3 seconds.
NFR-007	Safety	-
NFR-008	Security	User data must be encrypted using AES-256; authentication must use OAuth 2.0.
NFR-009	Language Support	All interactions must be presented in the Indonesian language.
NFR-010	Visual Identity	Each page must display the official Sering-Sering logo in the upper corner.

The analysis in Table 2 shows that the *Sering-Sering* system is feasible, with availability set at 99 percent uptime, low memory usage, and response times under three seconds. Usability, portability, and security requirements, including AES-256 encryption and OAuth 2.0, are

consistent with user expectations. Language support and consistent branding ensure cultural relevance and organizational alignment, forming a strong foundation for the design phase.

Table 3. Functional Requirements

ID	Feature	Requirement
FR-001	Account Creation	Users can register a new account using email, username, and password..
FR-002	Login	Users can access the system with a valid email and password.
FR-003	Destination Search	Users can search for tourist destinations by name and specific location filters.
FR-004	Add Favorite Destinations	Users can add tourist destinations to their personal list of favorites.
FR-005	Remove Favorite Destinations	Users can remove destinations from their list of favorites.
FR-006	View All Destinations	Users can view the complete list of tourist destinations available in the system.
FR-007	View Destination Details	Users can view detailed information about a destination, including photos, description, location, and ratings.
FR-008	Provide Ratings and Comments	Users can submit ratings and comments on destinations they have visited.
FR-009	Manage Notifications	Users can view their notification list and delete unnecessary notifications.
FR-010	Edit Profile	Users can update their profile information such as photo, username, full name, email, phone number, and date of birth.
FR-011	Logout	Users can log out of their accounts to end the active session; the system will clear session data and redirect them to the login page.
FR-012	Administrator Add Destinations	Administrators can add new tourist destinations by providing information such as name, description, address/location, category, images, operating hours, and available facilities.
FR-013	Administrator Edit Destinations	Administrators can update information on existing destinations, including modifying the name, description, location, images, operating hours, and other details to ensure data accuracy and relevance.
FR-014	Administrator Manage Destination Areas	Administrators can add new regional categories for grouping destinations or remove areas that are no longer relevant, provided they are not associated with active destinations.

Table 3 presents the functional requirements of the Sering-Sering system, covering features for both users and administrators. Users are supported through account management, destination search, detailed information access, personalization with favorites, and interactive feedback via ratings and comments. Administrators manage destination data and regional

classifications, ensuring that information remains accurate and sustainable for tourism promotion.

After defining the functional and non-functional requirements, the analysis phase incorporates UML (Unified Modeling Language) to represent the system visually. The Use Case Diagram specifies the functional requirements from the user's perspective, while the Activity Diagram illustrates workflows and process flows. In addition, the Class Diagram models the structural aspects of the system by defining entities, attributes, and their relationships, providing the foundation for database and object-oriented design. The Sequence Diagram captures the dynamic interactions between system components over time, showing the chronological flow of messages and processes that support key user and administrator activities.

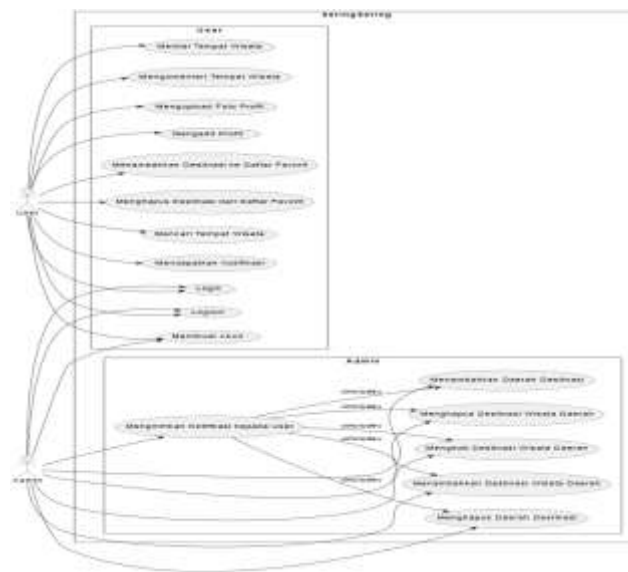


Figure 2. Use Case Diagram

The use case diagram in Figure 2 shows how users interact with the *Sering-Sering* system through features such as account management, destination search, favorites, reviews, and notifications. Administrators manage destination and regional data while also sending notifications, ensuring information accuracy and system maintenance. Together, these roles demonstrate a balance between user engagement and administrative control for effective tourism information management.

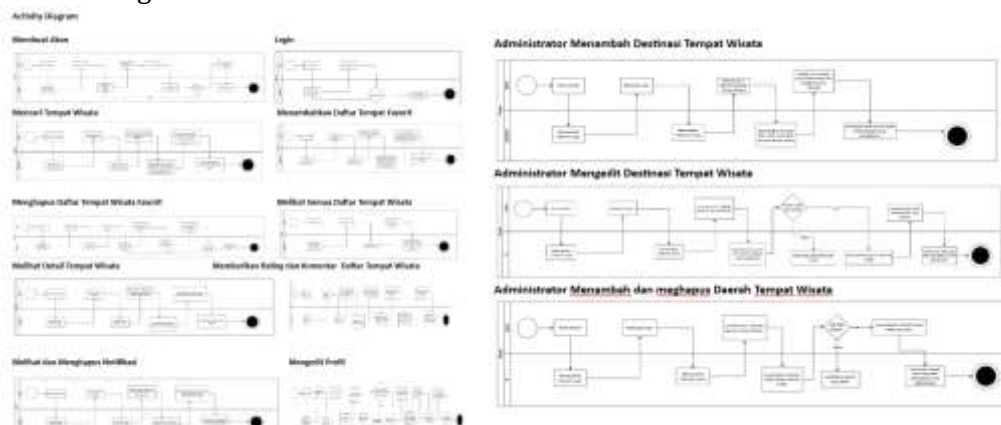


Figure 3. Activity Diagram

The activity diagrams in Figure 3 depict user workflows such as account management, destination search, favorites, reviews, notifications, and profile updates. Administrator activities include adding, editing, and removing destinations or regional areas to maintain accurate tourism data. These processes illustrate a structured integration between user interactions and administrative control within the Sering-Sering system.

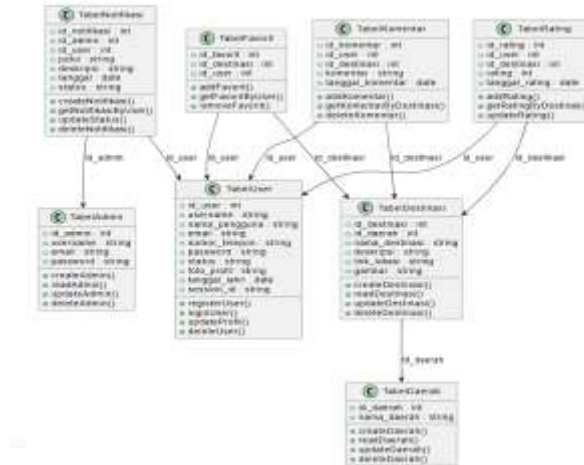


Figure 4. Class Diagram

The class diagram in Figure.4 shows the structural design of the Sering-Sering system, consisting of core entities such as *User*, *Admin*, *Destinasi*, and *Daerah*, along with supporting classes for *Favorit*, *Komentar*, *Rating*, and *Notifikasi*. These classes define attributes and operations that support key functions like account management, destination information, reviews, and notifications. The relationships among them illustrate how user activities are connected to destination data, while administrators maintain overall system integrity.

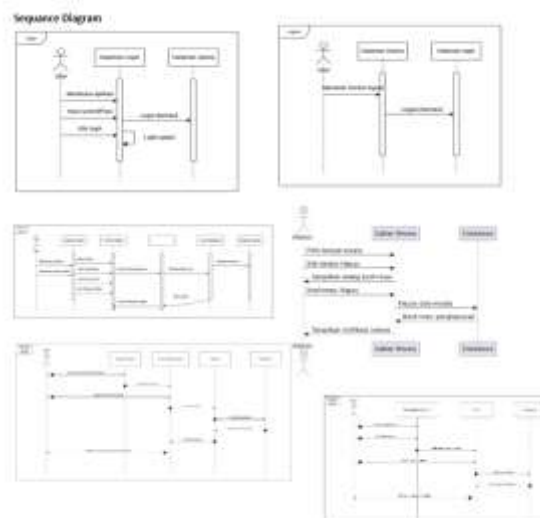


Figure 5. Sequence Diagram

The sequence diagrams in Figure 5 illustrate the dynamic interactions between users, administrators, and the system in the Sering-Sering application. They depict processes such as

account registration, login, logout, searching destinations, and managing favorite lists, as well as administrative tasks like adding or updating destinations and sending notifications. These diagrams emphasize the chronological flow of messages across system components, ensuring that both user and administrator actions are accurately supported and integrated with the database.

3. Design

After the core features of the Sering-Sering application were defined, the next stage involved designing the user interface (UI) using Figma, a web-based prototyping tool [21]. The design aimed to ensure that each feature could be accessed easily and intuitively, enabling users to search for and discover tourism destinations according to their preferences without difficulty.



Figure 6. User Interface (UI)

The UI prototypes in Figures 6 illustrate the functional design of the *Sering-Sering* tourism information system. The layouts provide structured access to features such as destination search, filtering, rating, and commenting, alongside profile management and notifications. Administrative interfaces allow the addition, editing, and organization of tourism data, ensuring content accuracy and system consistency. The design emphasizes usability through clean navigation, clear visual hierarchy, and responsive elements, supporting tourists in quickly accessing relevant information while maintaining an engaging visual identity.

4. Implementation

a. Source Code

The coding phase of this study resulted in the complete implementation of the Sering-Sering web application. Development was carried out using Visual Studio Code as the primary environment, chosen for its extensive support features such as syntax highlighting, bracket matching, auto-indentation, and IntelliSense [22], which facilitated efficient web development. For database management, phpMyAdmin was employed as the backend system, providing a web-based interface that simplifies database administration without requiring manual SQL queries. Additionally, phpMyAdmin's compatibility with multiple formats, including SQL, CSV, Excel, and XML, enabled seamless backup and data migration processes[23].

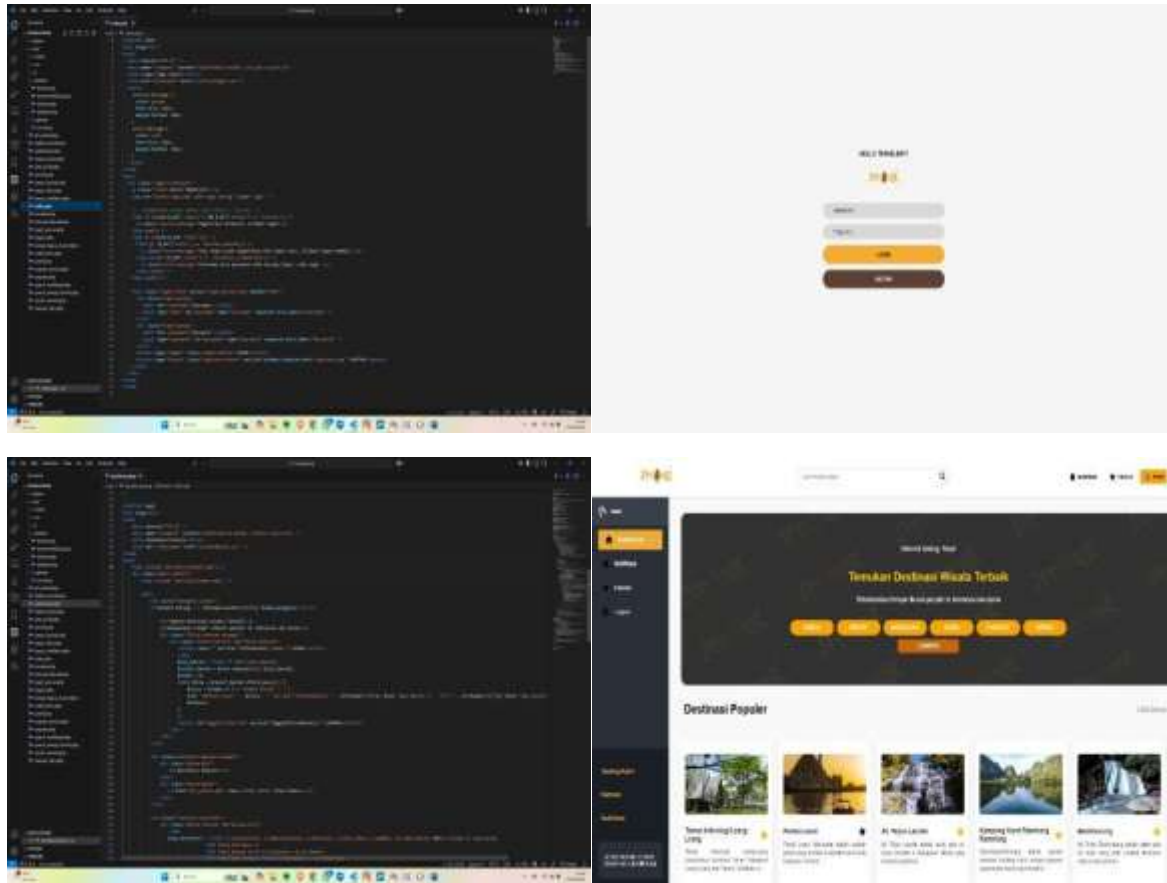


Figure 7. Source code and Program output

5. Testing

The testing phase was conducted using both white-box and black-box approaches to ensure comprehensive evaluation of the application. White-box testing involved examining the internal code structure to verify logical accuracy and system reliability. Conversely, black-box testing emphasized functional validation by focusing on the relationship between inputs and outputs from an end-user perspective, employing techniques such as equivalence partitioning and boundary value analysis. Together, these approaches effectively identified functional errors, structural issues, and performance limitations, ensuring that the application met the required standards before deployment.

Table 4. White Box Testing Results

No	Execution Path	Description	Test Condition	Status
Login				
1.	<code>\$_SERVER["REQUEST_METHOD"] == "POST"</code>	Check form method	Send GET → block skipped	Passed
2.	Username found and password correct	Successful login process	Valid user test	Passed

3.	Username found and password incorrect	Display error	Incorrect password	Passed
4.	Username not found	Display error	Invalid username	Passed
5.	resetSessionId() called if login fails	Remove old session	Multiple session test	Passed
6.	New Session ID stored	Check session hijack	Normal login path	Passed
7.	Session variable set	Check \$_SESSION	Username & ID stored	Passed
8.	password_verify()	Verify password hash	Mismatched hash test	Passed
Edit Profile				
1	!isset(\$_SESSION['id_user'])	Checks if the user is logged in	Access without login → redirected to login.php	Passed
2	\$_SERVER["REQUEST_METHOD"] == "POST"	Checks the form request method	Send GET request → POST block skipped	Passed
3	empty(...) on field validation	Validates empty input fields	Leave one field empty (e.g., email)	Passed
4	new DateTime(\$birthdate) and \$dob->diff(...)	Calculates age from birthdate	Enter a valid birthdate	Passed
5	\$age < 18	Assigns status = 'Student'	Enter junior high school birthdate	Passed
6	\$age >= 18 && \$age <= 22	Assigns status = 'University Student'	Enter college-age birthdate	Passed
7	\$age > 22	Assigns status = 'Adult'	Enter working-age birthdate	Passed
8	\$conn->prepare(...) fails	SQL query preparation failed	Simulate query error or broken connection	Passed
9	\$stmt->execute() fails	Failed to execute update	Enter email causing duplicate key	Passed
10	\$stmt->execute() succeeds	Profile updated successfully	All inputs valid and data updated	Passed
11	window.location.href = 'profil.php'	Redirects to profile page	Test after successful edit	Passed

Table 4 demonstrates the results of functional testing for the login and profile editing features of the Sering-Sering application. For the login module, all critical execution paths such as request method validation, username and password verification, session handling, and password hashing passed successfully, confirming the system's ability to handle both valid and invalid login attempts securely. Similarly, the profile editing module was validated through conditions including session checks, form request validation, input field constraints, age-based status classification, and SQL query execution. All scenarios, including error handling for failed queries and duplicate keys, were executed as expected, with successful updates leading to redirection to

the profile page. These results confirm that both modules operate reliably under diverse input conditions and error scenarios..

Table 5. White Box Testing Results

No	Feature	Scenario	Input	Expected Output	Status
1	Login	Enter username and password, then click Login	Valid username and password	Redirected to dashboard page	Passed
2	Register	Complete registration form and click Register	Valid data (name, email, etc.)	Account created and redirected to login page	Passed
3	Add Favorite Destination	Click the star icon on a destination	Click on icon	Destination marked as favorite	Passed
4	Rate Tourist Destination	Provide a rating by selecting the number of stars	Click on rating	Rating successfully stored	Passed
5	Post Comment	Type a comment and click Submit on the destination page	Comment text	Comment displayed below the destination	Passed
6	Edit Profile Picture	Upload a new image and click Save	Image file	Profile picture updated	Passed
7	Edit Profile	Modify name, email, etc., then save changes	Updated profile data	Profile successfully updated	Passed
8	Search Tourist Destination	Type a keyword and click Search	Destination name	Search results displayed	Passed
9	View Notifications	Open the notifications page	-	Notifications displayed	Passed
10	Search Notifications	Type a keyword in the notification search bar	Notification keyword	Relevant notifications displayed	Passed
11	Filter Destination by Region	Click the filter button by region name	Selected filter	Destinations filtered by region displayed	Passed
12	Logout	Click the Logout button	-	Redirected to login page	Passed
13	Remove Favorite	Click the star icon again to remove a favorite	Click on icon	Favorite successfully removed	Passed
14	Delete Notification	Click the Delete button on a notification	Click Delete button	Notification successfully deleted	Passed

15	Delete Profile Picture	Click the Delete Photo button on the profile page	Click Delete Photo	Profile picture reset to default or blank	Passed
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Table 5 presents the outcomes of white-box testing, confirming that all core features of the *Sering-Sering* application functioned as expected. Critical user operations such as login, registration, searching, filtering, rating, and commenting were executed successfully, ensuring smooth interaction with the system. Profile management features, including editing personal data and managing profile pictures, performed reliably, while administrative interactions such as handling favorites and notifications were validated without error. The consistent “Passed” status across all scenarios demonstrates that the application achieved functional completeness, stability, and reliability under the tested conditions.

B. Discussion

The tourism information system developed in this study, following comprehensive testing, demonstrates notable advantages compared to previous works. The system by Kharisman et al. [24] in Buol Regency only provided static destination information without security mechanisms such as input validation, session management, and password hashing. Similarly, Bagau and Chernovita’s [25] system in Salatiga City emphasized geographic information and transportation routes without interactive features. By contrast, the new system integrates advanced security measures and interactive functions, including favorites, comments, and notifications, all of which have been rigorously tested.

Additional comparisons highlight further limitations in earlier studies. Idris’s [26] PHP-based system in Donggala Regency offered limited interactivity and lacked in-depth white-box testing. Likewise, Annisa, Matondang, and Afrizal [27] in Nunukan Regency provided only restricted account handling and minimal two-way interaction. In contrast, the present system delivers a fully interactive platform, integrating account management, input validation, and session control, verified through 15 functional test scenarios.

The results of both white-box and black-box testing confirm that the proposed system excels in structural complexity and feature completeness, ensuring program reliability and robust interface functionality. Its strengths in security and interactivity demonstrate readiness for practical implementation, supporting the dissemination of tourism information that is interactive, personalized, and aligned with the needs of a digital society.

CONCLUSION

The *Sering-Sering* web-based tourism recommendation system for South Sulawesi, developed using the Waterfall model, achieved its objectives by delivering secure, reliable, and user-friendly features such as personalized recommendations, reviews, favorites, and profile management. Comprehensive functional and non-functional testing confirmed system effectiveness, while the integration of interactive components distinguishes it from previous regional initiatives. This study contributes to the advancement of digital tourism services and regional promotion, and future enhancements including online ticketing, social media integration, and artificial intelligence-based recommendations are expected to further strengthen its role in supporting sustainable tourism development.

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