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Design and Implementation of a Ticketing Management System for Tourism Villages with RFID and IoT Integration

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ABSTRACT

Sustainable tourism villages in Indonesia, such as Alamendah in Ciwidey, play an essential role in community empowerment and tourism development but still face challenges in visitor management and information access. This study presents the Dewala, an integrated e-ticketing system designed to enhance operational efficiency and visitor experience. The system combines a Flutter-based mobile application, a Laravel web dashboard, IoT hardware (RFID and ESP8266), and real-time Firebase synchronization. Tourists can access updated information and purchase e-tickets via the app, while administrators monitor visitor activity through the dashboard. The IoT module enables automated access verification using RFID e-tickets with buzzers, LCDs, and audio prompts. Black-box testing validated all system functionalities with a 100% success rate, including RFID detection within a 4 cm range. Usability evaluation using the System Usability Scale (SUS) scored 80.25%, categorized as "excellent." These results demonstrate that the Dewala App effectively supports digital transformation and sustainable management in rural tourism contexts.

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1. INTRODUCTION

Tourism remains one of the most vital and strategic industries in fostering national economic growth. Indonesia exemplifies this potential, with more than 6,000 officially registered tourist villages, each possessing distinct natural, cultural, and social assets that can strengthen local economies (Ministry of Tourism and Creative Economy, 2024). Nevertheless, the adoption of digital innovations particularly electronic ticketing systems has not been evenly implemented across these destinations.

This study takes Alamendah Tourism Village, situated in the Rancabali District, as its focus area. The village promotes an agro-based tourism concept known as the Alamendah Trip, in which visitors participate directly in local farming, cow milking, interactions with MSMEs, and appreciation of regional art performances (Agiyanti & Hafizah, 2023). Despite its growing popularity and diverse tourism offerings, the village's management system remains largely manual, particularly in ticketing and visitor registration processes.

Such reliance on manual operations has led to several managerial and operational challenges. From the managerial standpoint, the absence of a digital system increases vulnerability to fraudulent activities, including fake or duplicated tickets and unauthorized entries, which in turn result in financial losses and inaccurate visitor data. Administrators also face obstacles in maintaining transparent financial records and efficiently monitoring attendance. From the visitor perspective, the lack of an integrated platform makes it difficult to access reliable information about attractions, schedules, and available facilities, which can reduce satisfaction and overall experience quality (Sukmadi et al., 2023).

Technology provides a clear pathway to address operational challenges in tourism management by enhancing transparency, efficiency, and visitor engagement (Zhang et al., 2022). The widespread adoption of mobile technology has encouraged tourism managers to implement digital and application-based systems, modernizing ticketing and reservation processes (Mumtaz & Karmilah, 2022; Mandalia & Khairunnisa, 2023; Rafi & Santoso, 2023). Previous studies have demonstrated various approaches to digital solutions. For example, a Laravel-based booking platform integrated with Midtrans was successfully developed to streamline ticket reservations (Christi et al., 2023) , while RFID technology has been applied to automate fare calculations in public transportation systems (ElZeweidy & Sayed, 2022). Web-based platforms have also been employed to digitalize booking processes; however, many lacked real-time synchronization with on-site access validation mechanisms. Integrating Internet of things (IoT) technologies, such as RFID for visitor access management in tourism villages, has been shown to improve operational efficiency, security, and overall visitor experience (Utami et al., 2021). These studies collectively highlight the potential of combining mobile applications and IoT solutions to optimize tourism operations and enhance user satisfaction.

While previous studies have offered relevant insights, most existing solutions remain limited in scope, emphasizing specific technologies such as mobile or RFID systems, and lacking a unified, real-time integration between managerial, operational, and user-level components. To address this gap, the present study introduces a fully integrated e-ticketing architecture that merges three key technological domains: (1) a Flutter-based mobile application for tourists. The mobile application developed in this study, referred to as Dewala App, (2) a Laravel based web dashboard for administrative monitoring, and (3) IoT hardware employing RFID and ESP8266 microcontrollers for physical access control. The Dewala App,

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developed using Flutter, enables cross-platform compatibility for both Android and iOS systems from a single codebase, ensuring efficient resource utilization and consistent performance across devices. In parallel, the Web Monitoring Dashboard, implemented with Laravel, utilizes its robust Model–View–Controller (MVC) framework to support scalable development, secure authentication, and efficient data management for transactions and visitor monitoring.

To bridge communication among these systems, Firebase functions as a real-time Backend-as-a-Service (BaaS), facilitating continuous synchronization between mobile clients, the administrative web dashboard, and IoT access points (Fauzi et al., 2021). This configuration ensures that all ticket statuses, transactions, and access logs remain instantly updated across the platform (Charles et al., 2022).

The distinct contribution of this research lies in its holistic integration of mobile, web, and IoT subsystems into a single, seamless ecosystem. Tourists can purchase and register their e-tickets via the Dewala App, which are then encoded onto RFID cards. Upon arrival, these cards are authenticated at IoT-enabled gates, where successful validation triggers both visual and auditory confirmations while simultaneously recording real-time access data on the admin dashboard.

This study aims to design and develop an integrated e-ticketing system that combines mobile, web, and IoT technologies for tourism management. The system includes RFID-based access control to minimize potential ticket misuse. Its functionality is evaluated using Blackbox Testing, while usability is assessed through the System Usability Scale (SUS) (Mahendra & Asmarajaya, 2022). The findings are expected to provide insights into improving operational efficiency and visitor management through appropriate technology adoption. The Alamendah Tourism Village is presented as a case study illustrating the potential application of smart systems in rural tourism contexts.

2. METHODS

This study develops an integrated tourism village ticketing management system incorporating RFID technology using the Waterfall methodology. The development process follows a structured sequence of phases requirements analysis, system design, implementation, testing, and maintenance. The Waterfall model was selected due to its linear and systematic workflow, which is particularly suitable for projects with well-defined requirements established at the outset. This methodological approach ensures that all components the mobile application, web-based monitoring dashboard, and RFID hardware are developed cohesively and function as an integrated system.

2.1. Data Collection

In the data collection stage, the researcher gathers essential data through interviews, observations, and literature studies. Interviews with Alamendah Tourism Village management and IoT personnel focus on user experiences, issues, and suggestions. Application and IoT technology usage observations, including RFID readers and related hardware, help identify potential problems and evaluate system performance. The literature review explores IoT, Flutter, Firebase, Laravel and RFID-based access management to understand key concepts, best practices, and potential challenges for the application.

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2.2 Requirement analysis

The functional requirements of the ticketing management system application specify the functions or features that the system or software must perform to meet user needs. Table 1 presents the functional requirements for the ticketing management system, covering various essential features. In the category of node requirements, each member card is equipped with a unique RFID tag linked to booking information, which is read by an RFID reader and transmitted by the NodeMCU ESP8266 to the database.

Table 1. The functional requirements.

ID	Functional Requirements Description	Category
F1	Each membership card is equipped with a unique RFID tag, linked to booking information.	Node
F2	The RFID Reader will read the tag for access.	Node
F3	The NodeMCU ESP8266 sends the data to the database.	Node
F4	The application allows administrators to register and manage the app.	Application
F5	The app must restrict service access to anyone other than the admin (administrator).	Application
F6	The app allows for filling in booking details and making payments.	Application
F7	The app allows real-time monitoring and management of visitor RFID data.	Monitoring
F8	The app can perform CRUD operations on accounts, destinations, availability, and ticket prices.	Monitoring

2.3 Design

2.3.1 Use Case Diagram

The use case diagram describes the interactions between the actors within the system. The first step in creating a use case is identifying the actors involved in the system. As shown in Table 2, the primary actors involved are the user and the administrator and Figure 1 illustrates the use case diagram for the Tourism E-Ticketing System, defining the interactions for the two primary actors: the Visitor and the Admin.

Table 2. Actor Identification.

No	Actor	Description
1.	Visitor / User	This actor can only access the application to view destinations and make payments.
2.	Administrator	This actor can manage user data, destination data, and transaction data, as well as monitor visitor activity.

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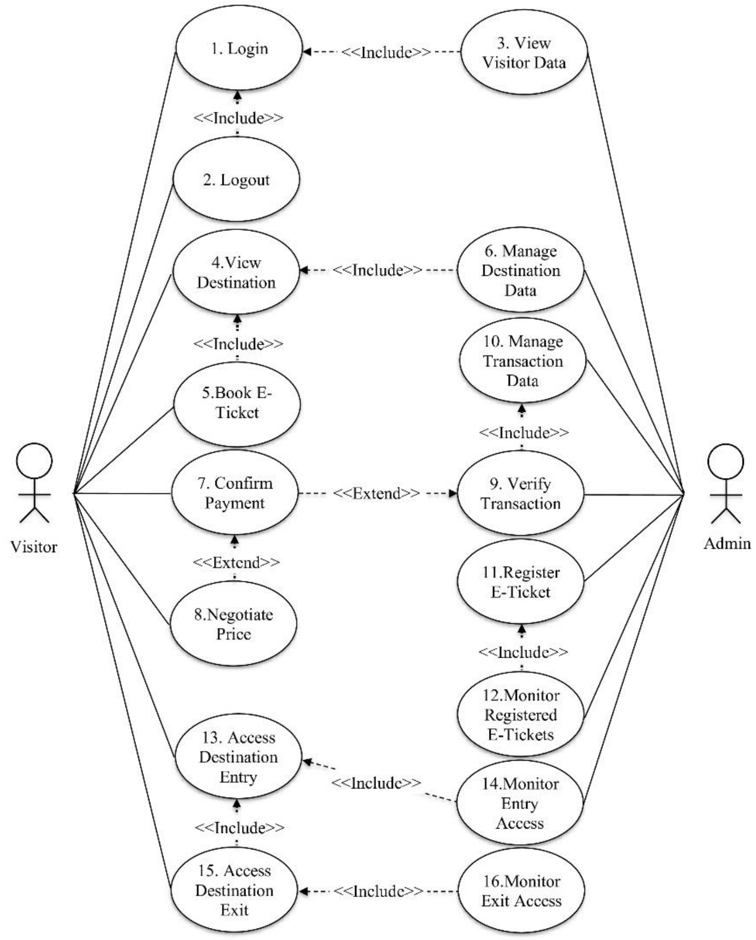

Figure 1. Use case diagram.

2.3.2 E-Ticketing System Architecture

In general, the system design for the development process of the Android-based village tourism management system using RFID technology is shown. Figure 2 presents the architecture of the e-ticketing system.

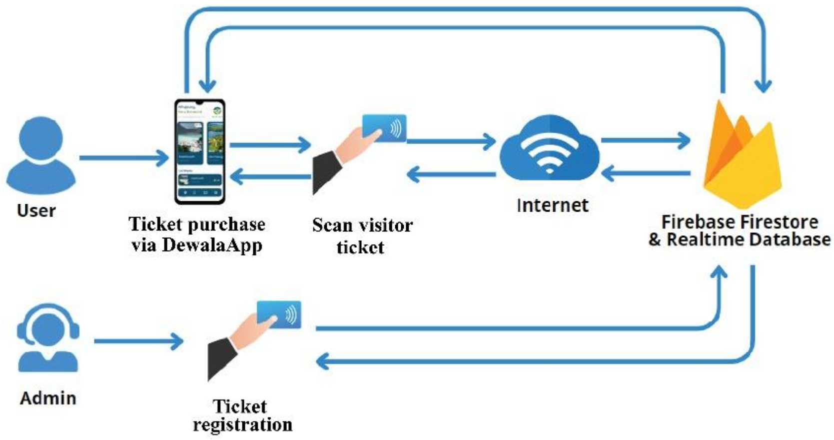

Figure 2. E-ticketing system.

Figure 2 explains how the DewalaApp system integrates Firebase Firestore and Firebase Realtime Database to manage the ticket purchase process. Firestore stores user data, destination information, and ticket purchase transactions, while the Realtime Database tracks and updates attendance status in real time. With this integration, the ticket purchasing process is carried out in real time, eliminating the need for manual intervention from users.

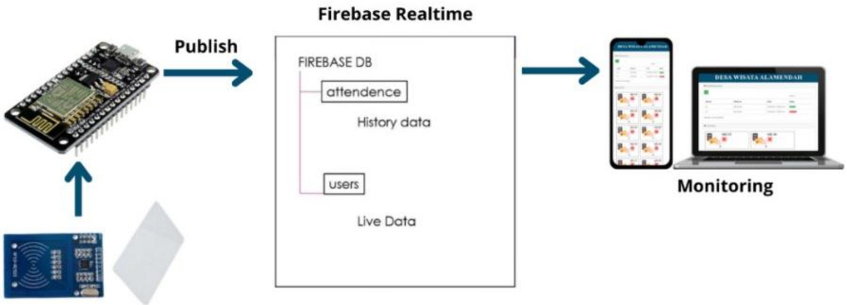

Figure 3. System monitoring architecture.

Figure 3 explains the DewalaApp monitoring system architecture, which consists of several key components that work in an integrated manner. When visitors scan their e-tickets with the RFID reader, the ESP8266 module sends the ticket ID to the Firebase Realtime Database. Firebase then stores this information, including user data and attendance records. Admins can monitor check-in and check-out activities in real-time through WebApp, which retrieves and displays data from Firebase.

2.3.2 Class Diagram

The class diagram represents the static structure of the system and serves as the foundation for database design using Firebase. It defines key classes, including Admin (system and transaction management), User (ticket booking and payment confirmation), Destination (tourist site data), Ticket (e-ticket details), Transaction (payment and verification), and Monitoring (access tracking and ticket status). As shown in Figure 4, the class diagram provides an overview of the system's main components and their interactions.

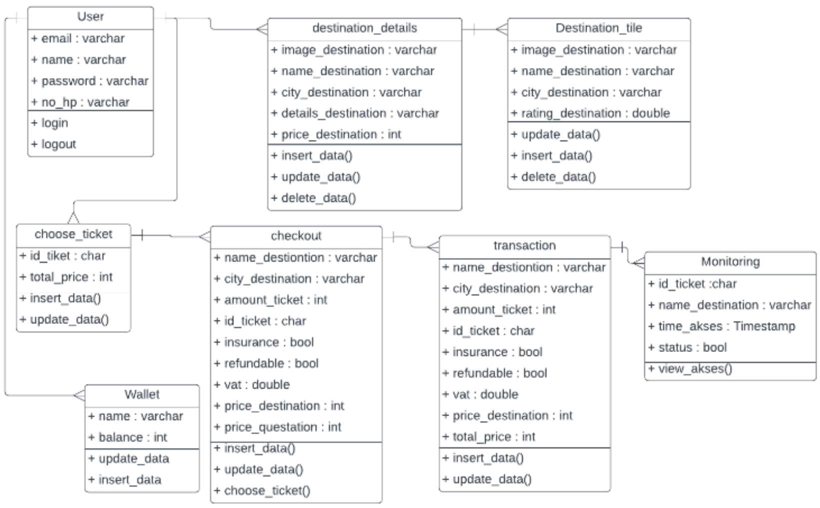

Figure 4. Class diagram

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2.4 Implementation

After completing the design phase, the implementation of the Android-based Tourism Village application with IoT integration begins. The primary focus of the e-ticketing system being developed is a ticket purchasing mechanism that combines a Flutter-based mobile application with IoT devices through the Firebase Realtime Database. Additionally, a web-based monitoring dashboard is created using the Laravel framework to oversee transactions, users, and visitor data in real time. The ESP8266 acts as the control center, linking the RFID reader, LCD I2C, DFPlayer MP3, and mini speaker to facilitate effective access management. It also connects to the Firebase Realtime Database via Wi-Fi, thereby linking the Flutter application to the server. An application implements an RFID-based (IoT) destination access system as a result of this integration. Users register through the Dewala app and pay the ticket fees offered within it. Once registration and payment are finalized, the RFID e-ticket is activated for entry and exit access at each attraction. Figure 5 showcases the Dewala App mobile application developed for Alamendah Tourism Village.

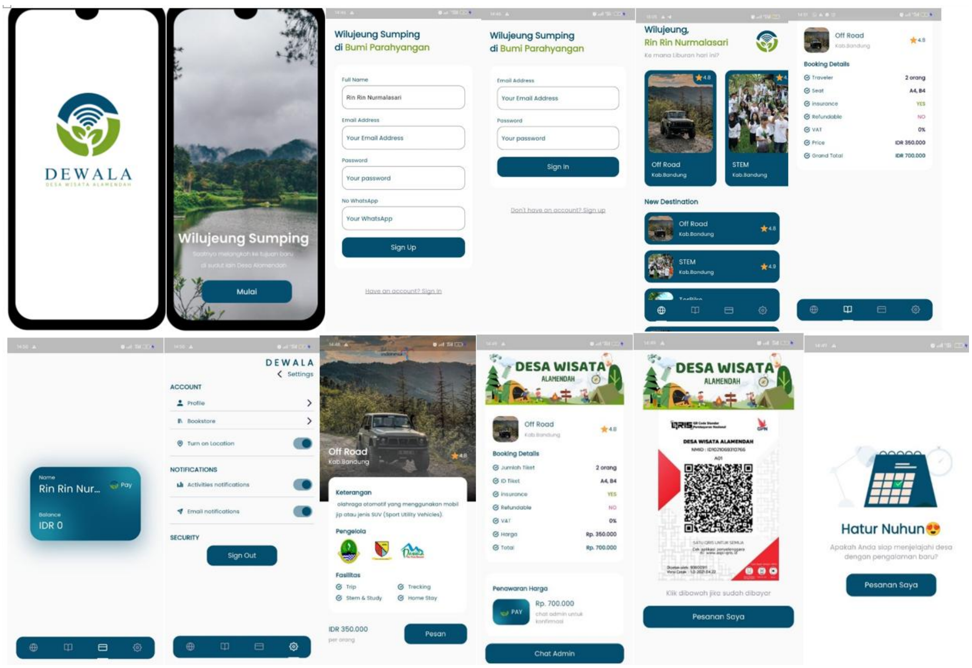

Figure 5. Dewala App.

The following figures, Figure 6 and Figure 7 show the ticket registration device and the access device for entering the Alamendah tourism village area.

Figure 6. E-ticket Registration Device.

Figure 7. Visitor access in/out device.

The RFID card in Figure 8 in this system functions as an electronic ticket, an E-Ticket. Each E-Ticket has a unique ID, such as A1, and a unique RFID code, 1144117807. When the RFID module reads data from this E-Ticket, the information, including the E-Ticket ID and its unique code, is processed by the MFRC522 RFID sensor module. The data is then sent through the ESP8266 microcontroller to the database.

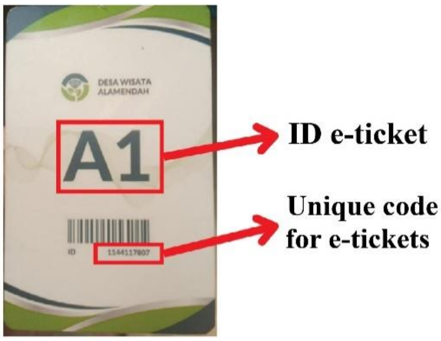

Figure 8. E-ticket.

Figure 9 shows the monitoring page, which allows the admin to track user activity in real-time. It provides detailed information such as the unique ticket ID, accessed location, and entry and exit times.

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Figure 9. Monitoring Page.

2.5 Testing

Testing of the Android-based tourism village ticketing system integrated with RFID technology included E-ticket scanning, black-box testing, and usability evaluation. Black-box testing, conducted by an external QA expert, focused on verifying correct input-output functionality at the end of development to ensure objective and unbiased results. Usability testing assessed system functionality and user experience through trials involving 20 respondents (10 tourism village managers and 10 visitors). The evaluation employed the System Usability Scale (SUS), a validated tool widely used to measure perceived usability and satisfaction, capturing ease of use and learnability in digital and IoT-based applications (Lewis, 2018; Sauro & Lewis, 2016). Table 3 presents the questions used in the usability testing questionnaire.

Table 3. Questions used in the usability testing.

ID	Question	Purpose
Q1	I think that I would like to use this application more frequently.	To evaluate user interest in continued application usage.
Q2	I found that the application is unnecessarily complex.	To measure user perception of the application's complexity.
Q3	I thought the application was easy to use	To assess users' perception of the application's ease of use.
Q4	I think that I would need technical assistance to use this application.	To evaluate the level of ease of use without technical help.
Q5	I found the various functions in this application were well integrated.	To assess how well the features are integrated within the application.
Q6	I thought there was too much inconsistency in this application	To measure user perception of the application's consistency.
Q7	I would imagine that most people would learn to use this application very quickly	To evaluate the application's potential for quick learnability by most users
Q8	I found the application very cumbersome to use	To assess user perception of the application's complexity or difficulty
Q9	I felt very confident using the application	To measure users' confidence in operating the application

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Q10	I needed to learn a lot of things before I could get going with this application	To evaluate the level of preparation required before using the application

The System Usability Scale (SUS) score is calculated using the standard procedure. For odd-numbered items in Table 1, the obtained score is reduced by one, whereas for even-numbered items, the adjusted score is computed as five minus the obtained score. The total of all adjusted scores is then multiplied by 2.5 to generate the overall SUS score. The average SUS score is determined by summing all individual SUS scores and dividing by the total number of respondents. The formula for computing the SUS score is shown in Equation (1), and the formula for calculating the average SUS score is presented in Equation (2) (Ilyas et al., 2022).

$$SUS\ Score = [(Q_1 - 1) + (Q_3 - 1) + (Q_5 - 1) + (Q_7 - 1) + (Q_9 - 1) + (5 - Q_2) + (5 - Q_4) + (5 - Q_6) + (5 - Q_8) + (5 - Q_{10}) \times 2{,}5 \quad (1)$$

$$\tilde{x} = \frac{\sum x}{n} \quad (2)$$

Based on the calculation results, the average SUS score can be interpreted using the Net Promoter Score (NPS) scale. Scores ranging from 62 to 100 indicate a high level of acceptability, 49 to 61 indicate a low level of acceptability, and 0 to 50 indicate that the system is not acceptable. Furthermore, the SUS score can also be mapped to qualitative rating categories: scores above 86 are classified as Best Imaginable (Grade A), 72–85 as Excellent (Grade B), 52–71 as Good (Grade C), 38–51 as OK/Fair (Grade D), 25–37 as Poor (Grade E), and below 25 as Worst Imaginable (Grade F). These classifications help in interpreting the system's usability and overall user satisfaction.

3. RESULT AND ANALYSIS

The testing was conducted directly at the Alamendah Tourism Village. The evaluation involved measuring the designed system, covering the input, process, and output aspects, followed by an analysis of the results. The application testing included Black-box testing, which was carried out by a QA expert, and Usability testing. The Usability testing was conducted with 20 participants, consisting of 10 tourism village managers and 10 visitors. The purpose of this testing was to determine whether the system met the expected requirements.

3.1 System Functionality Testing

Blackbox testing focuses on the system's external functionality without considering its internal structure or implementation details. Table 4 shows the system's black box testing. Based on Table 4, the application has been evaluated for its functionality and has been shown to operate as expected. This testing method focused solely on the system's input and output behavior without considering the application's internal workings. During the test, various scenarios and user inputs were simulated to verify if the application produced the correct outputs and responded as intended. The results confirm that the application performs its intended functions correctly, providing the expected outcomes for ticket registration, access

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control, and data management, ensuring that the system works efficiently and meets user requirements.

Table 4. Result of system functionality testing.

No	Test Scenario	Expected Result	Status
1	Upload image (JPG/PNG)	Image saved and displayed	Passed
2	Delete image	Warning: "Delete data? Cancel/Start Delete"	Passed
3	Save incomplete destination data	Data not saved, error message	Passed
4	Save complete destination data	Data saved and displayed	Passed
5	Delete destination	Warning: "Delete data? Cancel/Start Delete"	Passed
6	Delete transaction	Warning: "Delete data? Cancel/Start Delete"	Passed
7	Delete user	Warning: "Delete data? Cancel/Start Delete"	Passed
8	Login empty username/password	Access denied, error message	Passed
9	Login partial username/password	Access denied, error message	Passed
10	Login incorrect username/password	Access denied, error message	Passed
11	Login correct credentials	Access granted, redirected to Home	Passed
12	Sign up empty email/password	Registration denied, error message	Passed
13	Sign up existing email	Registration denied, error message	Passed
14	Sign up valid credentials	Registration successful, redirected to Bonus	Passed
15	Bottom navigation	Menus displayed correctly	Passed
16	Home page	User info and destinations displayed	Passed
17	Transaction page	Booking details displayed	Passed
18	Wallet page	Balance displayed	Passed
19	Logout page	Redirected to Sign In	Passed
20	Detail page	Destination info displayed	Passed
21	Ticket page	Ticket info displayed	Passed
22	Checkout page	Booking and payment info displayed	Passed
23	QRIS page	QR payment info displayed	Passed
24	Monitoring page (app/web)	Layout adjusts to screen	Passed
25	Download monitoring summary	Excel file generated	Passed
26	Search/filter e-ticket	Correct results displayed	Passed
27	Live e-ticket scan	Shows ID, Device, Time, Status	Passed

3.2 Testing and Analysis of the E-Ticket Scanning Device

The testing evaluates the system's performance, ensuring it functions as expected and provides accurate and consistent results. This research's testing is divided into two parts: testing on the e-ticket registration device (Input 1 and Output 1) and on the visitor access device (Input 2 and Output 2).

1) Testing and Analysis of RFID Tag Calibration and RFID Reader

Figure 10 shows the testing of data from the e-ticket, which is in the form of ID data stored in an RFID tag. The reader reads this data, which is then sent to the microcontroller to be processed in the program and transmitted to the computer via serial communication. Below are the test results, some examples of ID data, and the results of the RFID data communication sent to the computer.

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Figure 10. E-ticket testing.

The testing was conducted on the RFID tag and reader to determine their effective working range when the tag is brought near the reader. The test was performed with and without obstacles or interference. The results are shown in Table 5.

Table 5. Result of RFID tag calibration and RFID reader.

No	Distance	Condition	
		Unobstructed	Obstructed by non-metallic objects
1	8 cm	Not detected	Not detected
2	7 cm	Not detected	Not detected
3	6 cm	Not detected	Not detected
4	5 cm	Not detected	Not detected
5	4 cm	Detected	Detected
6	3 cm	Detected	Detected
7	2 cm	Detected	Detected
8	1 cm	Detected	Detected

Table 5 on RFID Testing: In testing the reading distance of RFID data, the tag requires A distance of ≤ 4 cm between the tag and the reader to be read, regardless of whether there is an obstruction. The analysis shows that, according to the RFID datasheet, the maximum reading distance specification is 8 cm, whereas, in testing, the effective reading distance was only ≤ 4 cm.

2) RFID Testing and Analysis

The RFID sensor testing on Input 1 of the e-ticket registration device, where the sensor is placed on the registration box to detect the e-ticket ID (RFID tag) and used for e-ticket registration. Meanwhile, Input 2 tests the RFID sensor on the visitor access device, where the sensor is placed on the second box to detect the registered e-ticket ID (RFID tag) as a tool for monitoring visitor access. Based on the test outcomes, the reading results from these sensors can be seen in Table 6 below.

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Table 6. Result of RFID Testing

Sensor	Condition	Description
RFID 1	Detecting RFID Tags and sending them to the Database to Be Displayed on the web App Monitoring, Then Activating the Buzzer.	Success
RFID 2	Detecting RFID Tags and Sending Them to the Database to Be Displayed on the WebApp Monitoring, Then Activating the " selamat datang/terimakasih" Speaker and the LCD Displaying " Selamat datang/terima kasih telah berkunjung".	Success

The testing of the RFID sensor-based system for the e-ticket registration and visitor access application was conducted to ensure accurate detection and response. During the e-ticket registration, once the RFID sensor detects the tag, the data is sent to Firebase and displayed on the WebApp Monitoring. The buzzer then activates as an indication that the registration is successful. For visitor access, the RFID tag detection also sends data to Firebase and WebApp Monitoring, but in response, the system plays a voice message through the speaker and displays the message on the LCD screen. This testing ensures that each component functions correctly and provides the appropriate response, whether through the buzzer for registration or the speaker and LCD for visitor access.

3) Testing data transmission to Firebase

This testing ensures that the ESP8266-based RFID system can transmit data accurately to the Firebase Realtime Database according to the defined scenarios. The testing process involves scanning the RFID card on RFID Reader 1 and then scanning the previously scanned RFID card again on RFID Reader 2. Table 7 shows the result of testing data transmission.

Table 7. The result of testing data transmission.

No	Test Description	RFID ***Read*****er**	Card Status	The expected result	Result
1	Registered RFID card scanned on RFID Reader 1	1	Registered	Data UID of the card sent to Firebase (Users section)	Passed
2	Unregistered RFID card scanned on RFID Reader 1	1	unregistered	No data sent	Passed
3	Registered RFID card scanned for the first time on RFID Reader 2	2	Registered	Data ID Device, Status: 1, Time, UID sent to Firebase	Passed
4	Registered RFID card scanned for the second time on RFID Reader 2	2	Registered	Data ID Device, Status: 0, Time, UID sent to Firebase	Passed
5	Unregistered RFID card scanned on RFID Reader 2	2	unregistered	No data sent	Passed

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2.4 Testing of WebApp Monitoring

This test aims to ensure that the WebApp monitoring can display real-time status information when interaction occurs between the RFID card and the RFID Reader connected to the system. The RFID card is scanned by RFID Reader 1 and registered into the system. The WebApp, connected to the Firebase Realtime Database, must immediately update the information to indicate that the card has been registered. This includes displaying the card ID in the live status section. This test ensures that the WebApp provides immediate feedback on the card registration activity in the system, as shown in Figure 11.

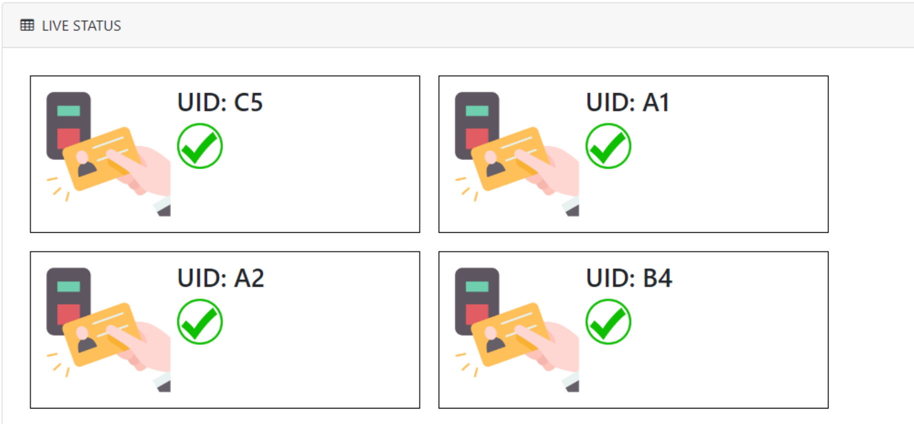

Figure 11. The e-ticket display has been registered.

The registered RFID card is scanned by RFID Reader 2, and the WebApp must display the user's detailed information, access time, and check-in or check-out status, depending on whether it is the first or second scan. This ensures that the WebApp can monitor and record the user's attendance status in real-time, as further illustrated in Table 8.

Table 8. Results of web app monitoring testing.

No	Testing Description	Expected Results	Result
1	The registered RFID card is scanned on RFID Reader 1.	It is displaying the "RFID Registered" indicator with the card ID in the live status.	Passed
2	The unregistered RFID card is scanned on RFID Reader 1.	There are no changes or displays in the live status.	Passed
3	The registered RFID card is scanned for the first time on RFID Reader 2	Displaying the user, access time, and "Check-in" status in the attendance.	Passed
4	The registered RFID card is scanned for the second time on RFID Reader 2.	Updating the user, access time, and "Check-out" status in the attendance.	Passed
5	The unregistered RFID card is scanned on RFID Reader 2	There are no changes or displays in the attendance.	Passed

D. Usability Testing

Usability testing of the Dewala Identification application was conducted using the System Usability Scale (SUS) method with 20 participants, consisting of managers, internship students from the Alamendah tourist village, and end-users. The SUS scores were calculated based on

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Equation (1) and Equation (2) described in the theoretical framework. Each participant's score was computed using these equations, and the average SUS score was obtained by dividing the total score by the number of respondents. The results of these calculations are presented in Table 9.

Table 9. Results of web app monitoring testing

Respondent	Raw Score	Calculation (×2.5)	SUS Score
R1	33	33 x 2.5	82.5
R2	28	28 x 2.5	70
R3	33	33 x 2.5	82.5
R4	31	31 x 2.5	77.5
R5	31	31 x 2.5	77.5
R6	31	31 x 2.5	77.5
R7	30	30 x 2.5	75
R8	37	37 x 2.5	92.5
R9	35	35 x 2.5	87.5
R10	34	34 x 2.5	85
R11	36	36x 2.5	90
R12	29	29x 2.5	72.5
R13	35	35x 2.5	87.5
R14	31	31x 2.5	77.5
R15	32	32x 2.5	80
R16	32	32x 2.5	80
R17	27	27x 2.5	67.5
R18	30	30x 2.5	75
R19	36	36 x 2.5	90
R20	31	27 x 2.5	77.5
	Average		**80.25**

Based on the results in Table 9 from 20 respondents, the total System Usability Scale (SUS) score obtained was 1605. The average score was calculated by dividing this total by the number of respondents. The average SUS score can be calculated using Equation 2, generally expressed as:

$$\tilde{x} = \frac{\sum x}{n} = \frac{1605}{20} = 80.25$$

The comparison of the final SUS results is presented in Figure 12. The line chart illustrates the scores of 20 respondents (R1–R20), where the blue line represents individual scores and the orange line indicates the mean score, approximately 80. Most scores are clustered around the mean, while a few respondents scored above (R8, R10, R13, R19) or below (R2, R7, R17). The distribution shows that the majority of scores cluster near the mean, indicating a relatively consistent evaluation among respondents, with only a few outliers deviating significantly.

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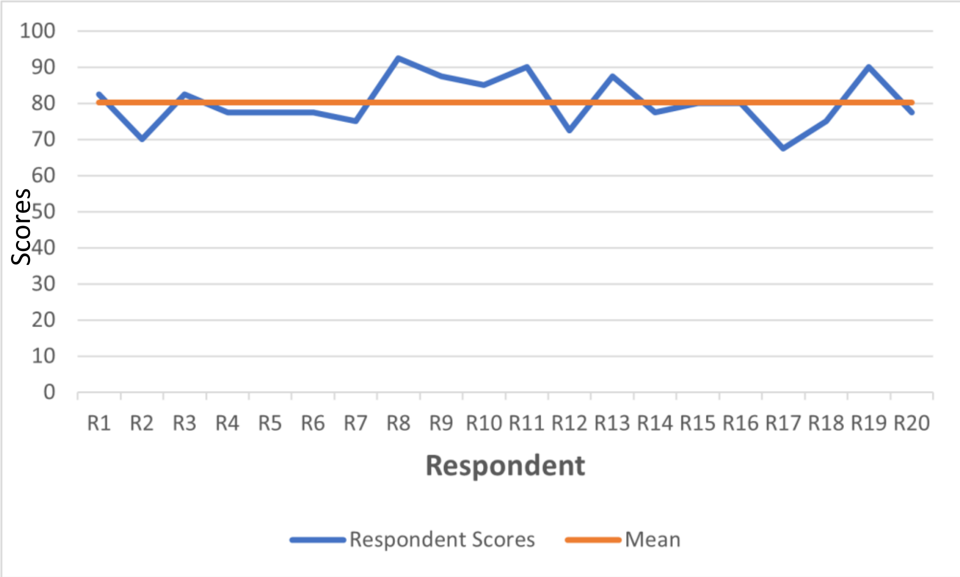

Figure 12. Comparison of the Final SUS Results.

Based on the satisfaction results obtained, the user satisfaction level for the Dewala application is 80.25%. According to the SUS score by Bangor (Bangor et al., 2009), this score is classified as a B grade. B grade falls into the acceptable category, which means it is well-received by users and has an adjective rating of "excellent." Therefore, it can be concluded that the Dewala application's satisfaction aspect is good and capable of making users satisfied with the application they use.

4. CONCLUSION

The tourism village ticketing management system was successfully developed using the Waterfall method, integrating an Android-based Flutter application, a web monitoring dashboard, and IoT technology for seamless management and visitor interaction. The Dewala App enables users to access information, purchase e-tickets, and connect with tourism services, while ESP8266-based IoT devices manage access and enhance security through real-time synchronization with the Firebase Realtime Database. RFID technology supports e-ticket registration, providing visual and auditory feedback through an LCD and speaker. System performance was evaluated using Blackbox testing for functionality and the System Usability Scale (SUS) for usability. Results indicate that the Dewala App achieved a user satisfaction score of 80.2% (Grade B – Excellent), reflecting its effectiveness and reliability in improving user experience.

However, the study's scope was limited to a single tourism village and a small respondent sample. The system also depends on continuous internet connectivity for Firebase synchronization, which may hinder performance in low-signal areas. Future enhancements include offline data caching, and broader multi-site testing to evaluate scalability. Further development may also involve predictive maintenance, and AI-driven analytics to advance smart and sustainable tourism management.

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