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Enhancing Tourist Experience at Ponot Waterfall with a Mobile E-Ticket Application Using FAST Methodology

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Abstract

Technology played a crucial role in tourism management, particularly through mobile-based e-commerce, which facilitated transactions. This sector supported national development by creating business opportunities, employment, and promoting cultural preservation and environmental sustainability. Ponot Waterfall, located in Tangga Village, Aek Songsongan, Asahan, became a tourist destination due to its natural beauty and conservation efforts. However, the manual ticketing system often led to long queues and inconvenience, especially during holiday seasons. Additionally, the use of paper-based tickets posed environmental pollution risks. As the number of tourists increased, an application-based e-ticketing system emerged as a solution for accessing ticket information, making purchases, and processing online payments. This study aimed to develop a mobile e-ticketing application for Ponot Waterfall using the FAST method to optimize user needs and enhance the visitor experience in e-ticketing system development. The goal was to improve purchasing efficiency, reduce queues, and enhance the overall visitor experience. The application facilitated information access, supported online payments, improved tourism management, and minimized the environmental impact of paper-based ticketing. The results of this study indicated that the mobile-based e-ticketing application at Ponot Waterfall successfully enhanced transaction efficiency, reduced long queues, eliminated the use of paper tickets, and simplified access to tourism information. The majority of users utilized online ticket booking and digital payment methods as the primary features, proving that the system effectively addressed the challenges associated with the previous manual system.

Keywords: Mobile E-Commerce, Ponot Waterfall, E-Ticketing System, FAST Methodology

1. INTRODUCTION

In the digital era, technology has become an essential part of managing tourism destinations [1]. One of the most significant advancements in this sector is mobile e-commerce, which enables business transactions via mobile devices [2]. In Indonesia, Law Number 10 of 2009 on Tourism defines tourism as a set of

activities supported by various facilities and services [3]. Beyond offering new business opportunities, tourism also creates jobs and contributes to environmental preservation [4]. However, despite these benefits, many tourist destinations in Indonesia still rely on manual processes for essential services such as ticketing, leading to inefficiencies in visitor management.

One of the emerging solutions is e-ticketing systems, which facilitate seamless ticket purchases and access to information [5]. Ponot Waterfall, located in Tangga Village, Aek Songsongan District, Asahan Regency, North Sumatra, is a well-known natural tourist destination. However, its ticketing system remains manual, leading to long queues, visitor inconvenience, and potential environmental issues due to the excessive use of paper-based tickets. Given the increasing number of visitors, the implementation of a mobile e-commerce-based e-ticketing system is crucial to enhancing efficiency, improving visitor experience, and reducing paper waste.

While e-commerce platforms have already been applied in tourism for booking accommodations and tour packages [6], their integration into ticketing systems for natural attractions remains underexplored. A key aspect of such systems is online payment integration, which enhances transaction convenience [7]. To ensure the successful development of this system, this study applies the FAST (Framework for the Application of System Thinking) methodology, a structured approach used to analyze market trends, define user needs, and optimize digital solutions [8]. The FAST methodology has been successfully implemented in tourism-related e-commerce, improving marketing reach, operational efficiency, and data accuracy [9]. However, its application in mobile e-commerce-based ticketing for tourist attractions is still lacking in research, highlighting a significant gap in the literature.

A 2024 study applied the FAST methodology to develop a web-based tourism package booking system, addressing issues related to limited marketing reach and inefficient data processing. The study demonstrated that structured requirement analysis and systematic development led to enhanced features, such as online booking, payment confirmation, and tourist data management [9]. The successful implementation of this approach resulted in faster transactions, improved booking management, and better administrative oversight.

Similarly, the FAST methodology was also used in e-commerce system development for Community Enterprise Work Units, where it helped identify and resolve operational inefficiencies [10]. The structured approach ensured a phased and systematic implementation, leading to an efficient transaction system with enhanced data management and real-time updates. These studies highlight the advantages of the FAST methodology, particularly in providing structured system development, flexibility, and improved operational efficiency.

Despite these successes, previous research has mainly focused on tourism package booking systems and general e-commerce applications. There remains a research gap in applying mobile e-commerce for digital ticketing in tourism attractions. Existing studies have not extensively explored how a mobile-based e-ticketing system can improve operational efficiency, enhance visitor experience, and support environmental sustainability through paperless transactions.

This study aims to develop a mobile e-commerce-based e-ticketing system for Ponot Waterfall using the FAST methodology to enhance ticketing efficiency. The system will streamline ticket purchases, reduce visitor waiting times, and integrate digital payment methods for seamless transactions. Additionally, it seeks to improve data accuracy by automating visitor and transaction records, ensuring better tourism management. Beyond operational improvements, this research aims to support environmental sustainability by minimizing paper-based ticketing, promoting eco-friendly tourism. By adopting a structured development approach, the study ensures a user-friendly and scalable system, enhancing visitor experience and modernizing tourism management.

2. METHODS

2.1. FAST Method (Framework for Applications of System Thinking)

Framework for the Application of Systems Thinking method was a systematic approach in information system development that emphasized a deep understanding of user needs and a comprehensive system analysis. This method consisted of several interrelated stages to ensure that the developed system aligned with the organization's needs and objectives [11], as shown in Figure 1.

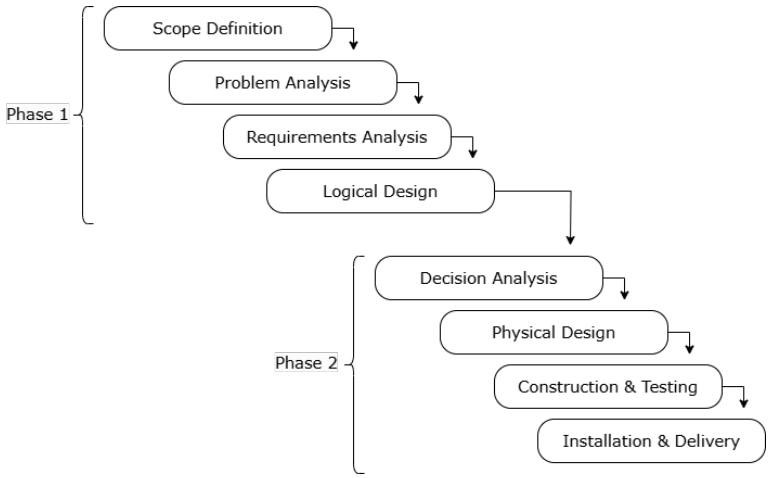

Figure 1. FAST Method

The FAST method in this study consisted of eight stages, divided into two phases [12] as follow.

2.1.1. Phase 1: Analysis and Design

In this phase there are several steps as follow.

1) Scope Definition

In this stage, the research scope was defined, including objectives, limitations, and final outcomes. Additionally, system stakeholders and their needs were identified[13]. Scope Definition was the initial stage in the FAST (Framework for the Application of Systems Thinking) method, aimed at identifying problems, opportunities, and key directions in system development [14]. At this stage, the development team collaborated with stakeholders, such as the management of Ponot Waterfall tourism and potential users, to understand business needs, existing challenges, as well as the vision and objectives of the system to be developed.

2) Problem Analysis

A problem analysis was conducted to identify root causes, impacts, and potential solutions[15]. Problem Analysis was a crucial stage in the FAST (Framework for the Application of Systems Thinking) method, aimed at understanding the root causes of the identified issues and their impact on the management of Ponot Waterfall tourism. At this stage, an in-depth evaluation was conducted on the existing ticket booking and management process, including the obstacles that led to inefficiencies. By thoroughly understanding the sources of the problems, the system to be developed could be optimally designed to enhance operational effectiveness and visitor experience.

At the time, the ticket booking system at Ponot Waterfall was still manual, requiring visitors to purchase tickets directly at the location. This process resulted in long queues, service delays, and ineffective visitor data recording. Additionally, the management faced difficulties in monitoring the number of visitors in real time, which affected capacity management and the overall safety of the tourist area. By thoroughly analysing these issues, it was concluded that the necessary solution was the development of a mobile-based e-ticket application that would allow visitors to book and pay for tickets online. This application would be equipped with features such as:

a) Online ticket booking to reduce queues at physical ticket counters.
b) Digital visitor data recording to assist management in analysing tourist numbers.
c) E-ticketing as a safer and more practical digital ticketing solution.
d) Real-time visitor monitoring system to help management in capacity planning.

e) Integration with various digital payment methods to provide convenience for visitors.

With this solution, the e-ticket system was expected to improve operational efficiency, speed up the ticket purchasing process, and enhance the overall visitor experience at Ponot Waterfall.

3) Requirements Analysis

This stage involved gathering and analyzing the needs of users and other stakeholders, achieved through interviews, surveys, and observations[16]. Requirement Analysis was a crucial stage in the FAST method, aimed at identifying and defining the requirements for the development of the mobile-based e-ticket application for Ponot Waterfall tourism. The functional requirements included essential features that the application needed to have, such as an online ticket booking system, digital payment options, and ticket validation. Additionally, the application was required to provide an automated visitor data recording feature to facilitate the analysis of tourist numbers and support capacity planning for the tourist site.

4) Logical Design

In this step, the data model and system architecture were designed, detailing system entities, relationships between entities, and the business processes the system would support[17]. System Design was a crucial stage in the FAST method, focusing on the architectural design of the system based on the requirements of the mobile-based e-ticket application for Ponot Waterfall tourism. From a system architecture perspective, the application was designed using Unified Modeling Language (UML), including use case diagrams and class diagrams. These diagrams illustrated the application's workflow and user interactions, providing a clear representation of how the system would function.

2.1.2. Phase 2: Implementation

The steps in this phase as follow.

1) Decision Analysis

Various implementation options were evaluated, selecting the best one based on factors like cost, time, and risk[18]. Decision Analysis was a stage in the FAST method aimed at evaluating various alternative solutions for the development of the mobile-based e-ticket application for Ponot Waterfall tourism. The decisions made considered factors such as efficiency, cost, ease of implementation, and user experience to ensure the system provided an optimal solution. One of the key decisions involved ticket validation methods. There were several alternatives, including the use of a unique code-based ticket that was manually verified by staff. This option offered cost advantages as it did not require additional hardware.

Additionally, for data storage selection, Firebase was chosen because it allowed ticket and transaction data to be updated in real time, supporting real-time visitor monitoring. Given the system's need to efficiently manage and integrate transaction data, Firebase was selected as the primary storage solution to enable tourism managers to monitor visitor activity more accurately and responsively.

2) Physical Design

This stage involved designing technical system details, such as hardware, software, and network configurations. Physical Design in the FAST method was a stage that focused on the technical design of the system, including the selection of hardware, software, and network infrastructure required to operate the mobile-based e-ticket application for Ponot Waterfall efficiently[19]. Decisions made at this stage needed to consider aspects such as performance, security, and scalability to ensure the system operated optimally. The development of the mobile-based e-ticket application utilized Android smartphones for staff to validate tickets and cloud servers to store transaction data and visitor counts. The application was developed using Android Studio and implemented Firebase Realtime Database for real-time data updates, facilitating visitor monitoring and transaction management.

3) Construction & Testing

In this phase, the system was developed and tested, which included coding, debugging, and performing unit, integration, and system testing. The Construction and Implementation stage in the FAST method involved developing the e-ticket application for Ponot Waterfall based on the previously designed system. At this stage, developers wrote program code, integrated the system, and conducted initial testing to ensure that each feature operated according to specifications [20]. The key features developed included digital ticket booking. Based on the completed system, testing was conducted on these features to ensure that the application functioned optimally and was free of errors before full implementation. The testing process covered functional aspects, ensuring that essential features such as ticket booking, payment processing, and ticket validation operated as required. If any bugs were identified, developers promptly carried out the necessary fixes before the application was fully deployed.

4) Installation & Delivery

The system was installed for Ponot Waterfall managers, users were trained, and documentation and support were provided[21]. The Installation and Deployment stage in the development of the e-ticket application for Ponot Waterfall aimed to launch the application into the production environment and ensure the system operated optimally through continuous maintenance. After passing the testing phase, the application was implemented and made available to users. Developers were responsible for monitoring the application's performance, responding to user

feedback, and making necessary improvements or feature enhancements as needed.

These stages of the FAST method supported the study, as this approach was used as a framework for developing an e-commerce application. The FAST method was more flexible compared to Waterfall, which was linear and less adaptive to changes, and more structured than Agile, which required rapid iterations and intensive communication. Compared to Waterfall, FAST allowed for in-depth requirement analysis without the need to follow a rigid sequence. While Agile was more dynamic, it was less ideal for complex systems that required thorough planning. By balancing structured planning with development flexibility, FAST became the best choice to ensure that the e-ticketing system was efficient, well-integrated, and capable of future expansion. The FAST method was more suitable for this project because it ensured that the developed system had strong analytical foundations, a well-structured design, and a systematic implementation process. With FAST, the e-ticketing system for Ponot Waterfall could be built in a more structured, accurate, and efficient manner, while also supporting the sustainable digitalization of the tourism sector.

3. RESULTS AND DISCUSSION

3.1 Analysis and Design

The ticket booking system at Ponot Waterfall still utilized a manual method, requiring visitors to purchase tickets directly on-site. This system led to long queues, service delays, and ineffective visitor data recording. Additionally, the management faced difficulties in monitoring the number of visitors in real-time, which impacted capacity management and the overall safety of the tourist area. The use of paper-based tickets also created environmental concerns due to the waste generated. As the number of tourists continued to increase, the manual system became increasingly inefficient in handling large-scale transactions. These limitations affected service quality, data recording accuracy, and the effectiveness of tourism management. Therefore, a digital solution was needed to optimize the ticket booking system and enhance operational efficiency.

To address these issues, a mobile-based e-ticket application was developed, allowing visitors to book and pay for tickets online. This solution was designed to reduce queues, improve data recording accuracy, and support the digitalization of tourism services. The application was equipped with several key features, including online ticket booking to reduce queues at physical counters and digital visitor data recording to assist management in analyzing the number of tourists. Additionally, the application supported real-time visitor monitoring, aiding managers in capacity

management, and integrated various digital payment methods to enhance transaction convenience for visitors.

The development of this system implemented the Framework for the Application of Systems Thinking (FAST) to ensure that the solutions applied were effective and aligned with the system's requirements. Through the application of the FAST method, the developed system successfully addressed major challenges in ticket booking, enhanced operational efficiency, and provided a better experience for both visitors and tourism managers at Ponot Waterfall. The architectural design of the system played a pivotal role in the application development lifecycle, encompassing phases ranging from initial planning to the deployment of essential functionalities that directly influenced overall system performance. The fundamental aim of this design was to guarantee that the implemented system effectively aligned with user requirements.

In this research, the system's architectural framework was designed using Unified Modelling Language (UML) diagrams, integrating use case and class diagrams to depict system operations, functional interactions, and interconnected components. The use case diagram was utilized to graphically represent the interactions between system actors (users) and the application, providing a structured depiction of its core functionalities and operational scope. Conversely, the class diagram provided a detailed representation of the system's internal architecture by outlining the essential classes, their associated attributes, and the methods that defined their functionality within the application. The inclusion of the class diagram allowed researchers to gain a more detailed understanding of the relationships among system components, thus strengthening the overall design structure of the application. This approach enabled the researchers to obtain a comprehensive understanding of the application's operation, as well as the interactions between users, the system, and its internal components. As a result, the integration of UML diagrams in system architecture served as a fundamental step in constructing a robust framework, ensuring a structured and effective application development process.

The Level 1 use case diagram represented in Figure 2 is the core interactions between the user and the administrator, outlining essential system functionalities. Through the authentication process, users could initiate ticket reservations, examine their profile information, and access a detailed history of transactions. The admin had access to view revenue and visitor reports for analysis purposes. The system was designed to facilitate ticket booking for users and to provide management tools for the admin.

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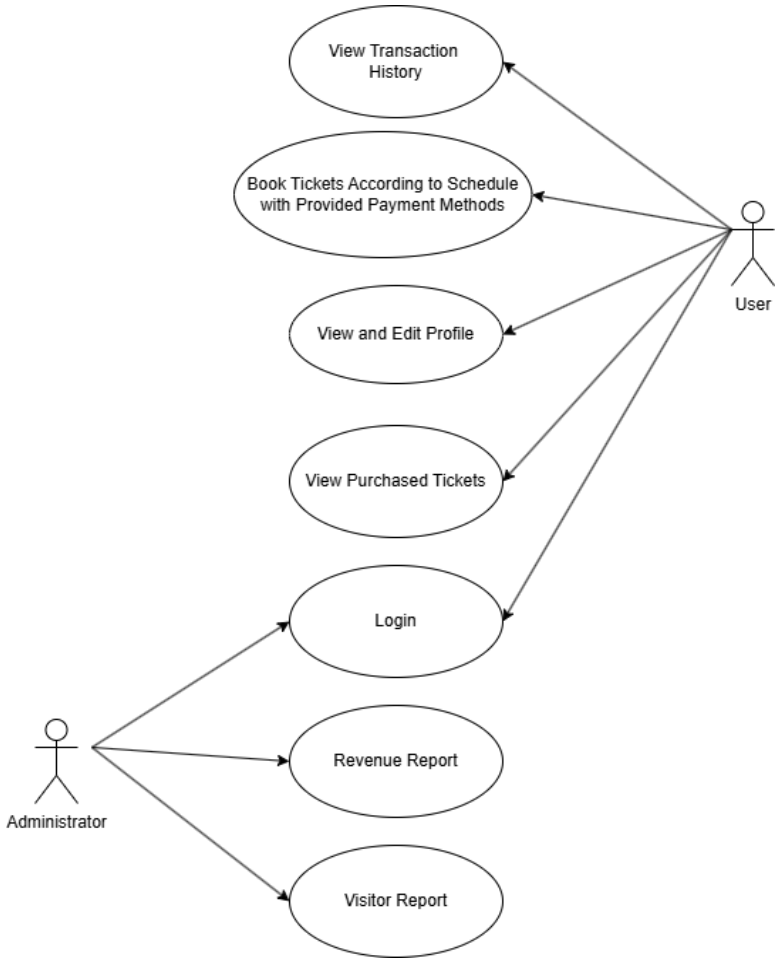

Figure 2. Use case Diagram Level 1

The aforementioned diagram represented a Level 2 use case diagram (Figure 3), providing a comprehensive depiction of the specific responsibilities and operational workflows assigned to both the user and the administrator. The user began by registering (if they did not already have an account), then logged in to access the system. Once logged in, the user could view information about tourist attractions, including visuals, facilities, and other details. If interested, the user could purchase tickets, make payments, and view purchased tickets along with their transaction history. The user also had the option to view and edit their profile. Meanwhile, the admin logged in to access the Report Page, which displayed general information such as the number of tickets sold and revenue. The admin could also generate revenue and visitor reports, as well as view detailed data on revenue and visitor numbers for further analysis.

Figure 3. Use case Diagram Level 2

Figure 4 is class diagram that illustrated the ticket management system for tourist attractions, involving two main types of users: the admin and regular users (users). The admin had access to log into the system, view the dashboard, and generate reports related to system activities, where each report contained information such as the report type, date, and other details. Regular users could register, log in, and view and edit their profiles. They could also purchase tickets for specific tourist attractions available within the system. Each tourist attraction contained information such as the name, description, location, ticket price, facilities, and related media. When a user purchased a ticket, the transaction was recorded in the system with details such as the transaction date, amount paid, and payment method used. The purchased ticket included visit data, ticket quantity, and its status. A user could make multiple transactions and hold several tickets, while each tourist attraction could have many tickets sold. This diagram demonstrated how various

entities within the system interacted to support the management of tickets and transactions for tourist attractions.

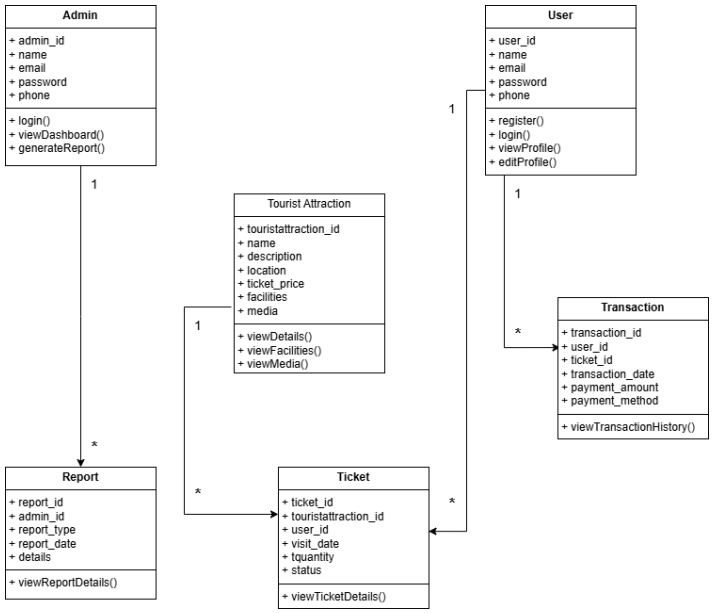

Figure 4. Class Diagram

3.2. Implementation

The implementation of the mobile e-commerce-based e-ticketing system for Ponot Waterfall demonstrates significant progress in addressing the problems and aims highlighted in the introduction. One of the core issues previously identified was the manual ticketing system, which caused long queues, inefficiencies, and contributed to environmental waste. The new system, developed using the FAST methodology, directly tackled these issues by offering a digital platform that is not only user-friendly but also sustainable and operationally efficient.

The first result of the system development is shown in the Dashboard View (Figure 5), which appears after a user successfully logs into the application. This page serves as the main interface, displaying relevant information such as the user's name, the tourist destination, images of Ponot Waterfall, and available on-site facilities. By centralizing this information, the system enhances user experience and allows easy access to features and decision-making tools.

Moving forward, the Details of Ponot Waterfall page (Figure 6) presents comprehensive content about the tourist site, including its description, history, and visual representations. This aligns with the goal of helping users make informed

choices before purchasing tickets. Such contextual information is essential for tourism apps, particularly for attracting first-time visitors or those unfamiliar with the location.

The system further supports user engagement and conversion through the Ticket Purchase Button View (Figure 7). Located at the end of the destination details, this feature integrates additional information such as user reviews and maps to the location. The strategically placed purchase button facilitates a smooth transition to the next stage, reducing user hesitation and increasing transaction completion rates.

A major improvement is visible in the Ticket Booking Details (Figure 8), which offers a structured form for users to fill in arrival dates, select vehicle type, choose ticket quantity, and complete the payment through digital methods. This directly supports the aim of reducing long queues and minimizing human error by automating the transaction process. The transparent cost breakdown and real-time confirmation further boost trust and usability.

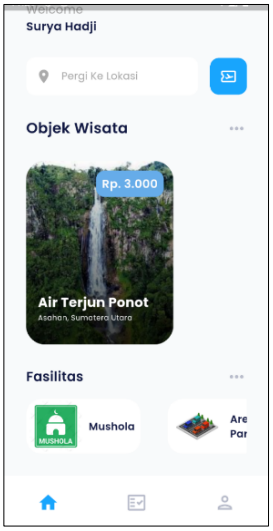

Figure 5. Dashboard

Figure 6. Info Details

Figure 7. Purchase

To enhance record-keeping and transparency, the system includes a Ticket Purchase History page (Figure 9), which logs all user transactions. Here, users can view the number of tickets purchased, total payment, unique ticket codes, and current status (e.g., pending or successful). This feature not only improves user control over purchases but also aids the management team in maintaining systematic data on visitor inflow.

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Finally, the Details of Tickets Already Purchased page (Figure 10) ensures that users can access essential information about their tickets anytime. This includes the ticket code, user's name, origin and destination, visit date, and instructions for presenting the ticket at the entrance. By digitizing ticket validation, the system eliminates the need for paper-based tickets, aligning with the aim of environmental sustainability.

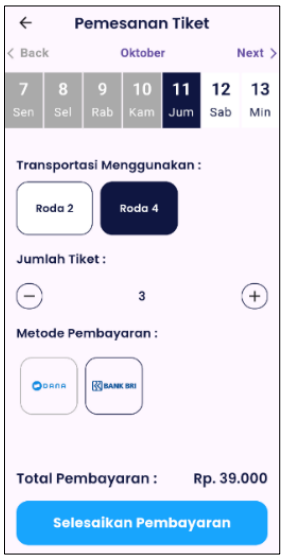

Figure 8. Booking

Figure 9. History

Figure 10. Purchased

Altogether, the results illustrate how the FAST methodology was successfully applied to design a system that is operationally effective, environmentally friendly, and user-centric. Each feature in the system contributes to addressing the initial challenges—particularly manual inefficiencies and poor visitor experience—while also enhancing the digital transformation of tourism management. The system not only meets but exceeds the original research aims by combining modern interface design, efficient workflows, and sustainable practices.

3.3. Testing

The system trial was conducted using the black box testing method, which focuses on evaluating system functionality based solely on the expected outputs for given inputs, without analyzing the underlying code or internal structure. This approach was particularly effective in verifying that each feature of the Ponot Waterfall E-Ticketing Application worked as intended in real-world scenarios. The goal was to ensure the reliability, usability, and correctness of all system components—ranging from input handling to transaction processing and output generation—prior to full deployment.

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Table 1. Blackbox Testing

Testing Scenario	Expected System Outcome	Conclusion
The user accessed the Ponot Waterfall Ticket Booking Application, and the login page was displayed.	The application opened the Login Page.	√
The user entered their username and password to access the dashboard page.	The application successfully verified the username and password and redirected the user to the dashboard page.	√
The user selected the Ponot Waterfall detailed information menu.	The application opened the detailed information page about Ponot Waterfall.	√
The user selected the "Buy Ticket" button.	The application redirected the user to the Ponot Waterfall ticket purchase page.	√
The user selected the visit date, transportation method, and number of visitors.	The application responded accordingly and displayed the ticket price based on the selected transportation option.	√
The user selected a payment method and completed the payment process.	The application processed the payment successfully and redirected the user to the Transaction History Page.	√
The user clicked on the details of the purchased ticket.	The application displayed the available ticket.	√

Table 1. Black Box Testing Results illustrates a series of testing scenarios simulating typical user interactions. These included actions such as logging into the application, accessing the Ponot Waterfall information page, selecting tickets, and proceeding through the payment process. In every scenario, the system responded in accordance with the expected behavior. For example, when a user accessed the application, the login page displayed correctly. After entering valid credentials, the user was seamlessly redirected to the dashboard. Similarly, selecting the "Buy Ticket" button led users to the ticket purchase page, where they could choose the date of visit, transportation type, and number of visitors—all of which triggered accurate responses from the system, including real-time ticket pricing based on user input. Additionally, payment processes were completed successfully, and users were automatically redirected to the Transaction History Page, where all purchase records were correctly displayed. Clicking on a purchased ticket revealed complete ticket details, fulfilling the application's role in digitizing the ticketing process effectively.

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The results of the black box testing affirm that the Ponot Waterfall E-Ticketing Application functions seamlessly and aligns with the initial system design. It effectively supports end-to-end operations—from login authentication and tourism information retrieval to ticket selection, payment, and digital ticket display. Each component met usability and performance expectations, ensuring that users can conduct transactions with ease, speed, and accuracy. These findings validate the system's readiness for full-scale implementation and suggest that it will significantly enhance the efficiency of ticket management and the visitor experience at Ponot Waterfall.

3.4. Discussion

The successful development and testing of the Ponot Waterfall E-Ticketing System underscore the importance of digital transformation in the tourism sector, particularly in response to growing visitor demands, environmental concerns, and operational inefficiencies associated with manual systems. The system was designed using the FAST (Framework for the Application of System Thinking) methodology, which allowed for a structured and iterative approach in identifying user needs, analyzing system requirements, and developing a responsive solution.

The use of black box testing to validate the system ensured that the application was evaluated purely from a user-centric perspective. This method was particularly effective in confirming that the system's functionality aligned with expected outcomes without the need to examine the internal codebase. Every component—from login and dashboard access to ticket selection and payment—was shown to operate reliably across different scenarios, confirming the system's readiness for practical deployment.

The core reason the system succeeded in meeting its design goals lies in its direct response to previously identified gaps. For example, manual ticketing at Ponot Waterfall had long been plagued by long queues, visitor dissatisfaction, and administrative inefficiencies. By digitizing the ticketing process, the system not only reduced wait times but also simplified data management for administrators. This is especially critical during peak seasons when transaction volumes are high and real-time data tracking becomes essential. Another key success factor is the integration of mobile e-commerce principles, which offer flexibility and accessibility. Visitors can now plan their trip in advance, purchase tickets remotely, and receive instant confirmation—all of which contribute to a smoother and more satisfying user experience. The system also supports multiple payment methods, allowing for broader usability and financial inclusivity.

From an environmental perspective, the shift to digital ticketing reduces the use of paper-based tickets, aligning with global trends in eco-tourism and sustainable

tourism development. This not only enhances the site's environmental image but also reduces operational costs over time. The system thereby supports sustainability on two fronts: environmental impact and long-term economic efficiency. Furthermore, the implementation of features like transaction history and digital ticket access helps address common concerns related to lost tickets or payment disputes. These functionalities provide transparency and build user trust, which are essential for increasing user adoption and satisfaction.

However, while the results indicate a robust and well-functioning system, the analysis also points to opportunities for further refinement. For example, while the black box testing proved functional adequacy, it did not assess performance under high-load conditions or explore deeper security vulnerabilities—both of which are crucial as the system scales up. Future work should consider integrating load testing, user feedback loops, and real-time data analytics to enhance resilience and adaptiveness.

In addition, the system could benefit from expanded integrations, such as QR code scanning at the site entrance for faster validation, push notifications for event updates, or partnerships with local tourism services to bundle offerings. These enhancements would not only enrich the user journey but also promote cross-sector collaboration and economic development within the region. the system's effectiveness stems from its ability to directly address the practical problems faced by both tourists and administrators at Ponot Waterfall. Through the use of a structured development methodology and user-focused testing, the application has proven to be a viable model for digital ticketing. The results highlight not just technical success, but also strategic alignment with broader goals of efficiency, sustainability, and digital innovation in tourism. The insights gained from this study may serve as a valuable reference for similar implementations across other tourism destinations seeking to modernize their service delivery.

4. CONCLUSION

This research successfully developed a mobile e-commerce-based e-ticketing system for Ponot Waterfall by applying the FAST methodology. The system was designed to address problems in the existing manual process, such as long queues, limited access to information, and inefficient data management. By enabling online ticket purchases and providing destination details, the application enhances visitor convenience and supports faster transactions. It also contributes to environmental sustainability by reducing the reliance on paper tickets. System testing using the black box method confirmed that all key features—including login, ticket selection, payment processing, and ticket display—functioned correctly and met user expectations. The FAST methodology proved effective in aligning system features with user needs, streamlining both development and usability. From a managerial

perspective, the system supports accurate and real-time transaction data, improving decision-making and operational transparency. It also creates opportunities for expanding digital tourism services to other destinations. Future enhancements may include integration with multiple payment options, cross-platform support for iOS and Android, and additional features like visit reminders or interactive maps. Overall, the system meets the research aim by improving the digital ticketing experience while strengthening sustainable and efficient tourism management at Ponot Waterfall.

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