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Design of a web-based car rental service portal information system for 123 Lampung Utara

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ABSTRACT

This study aimed to design and implement a web-based car rental service information system for 123 Lampung Utara. The system was developed using the CodeIgniter framework with PHP as the programming language and MySQL as the database. The main features included vehicle category and data management, user registration and authentication, rental transactions, order status tracking, and transaction reporting in PDF format. The system was designed to enhance operational efficiency and customer satisfaction through the digitalization of the rental process. The development followed the Waterfall methodology and the Model-View-Controller (MVC) architecture. Black Box testing results showed that all system functions operated correctly according to predefined scenarios, and no critical bugs were found. Therefore, the system was deemed feasible for operational implementation and ready for further development through integration with a payment gateway and automated notification services.

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1. INTRODUCTION

The exponential advancement of information and communication technology (ICT) has become a major catalyst in transforming diverse sectors of human activity, including the transportation and vehicle rental industries. In the era of Industry 4.0, digitalization of business processes is no longer optional but a necessity for Micro, Small, and Medium Enterprises (MSMEs) to remain sustainable, competitive, and operationally efficient (Juwita & Handayani, 2022). The adoption of digital technology enables manual and repetitive processes such as record keeping, transactions, and data management to be performed automatically, accurately, and in real time, thereby improving productivity and decision-making quality (Apriani Nusa & Annisa, 2025).

One of the sectors most directly affected by this digital transformation is car rental services. In conventional practice, many providers still rely on manual recording systems, often using notebooks or simple spreadsheets such as Microsoft Excel. This operational model has led to systemic inefficiencies, including delays in service due to slow fleet availability checks, a high risk of human error in record keeping, and the absence of accurate real-time information for managerial monitoring (Ginting et al., 2022). These limitations not only hinder efficiency but also reduce customer trust and satisfaction (Setiawan, 2024).

A strategic solution to these issues is the implementation of a web-based car rental information portal. This online platform allows customers to access detailed vehicle information, make reservations, and complete transactions independently without time or location constraints. Such a system enhances customer convenience and adds service value, while simultaneously improving operational efficiency and data accuracy for business owners (Santoso et al., 2024).

Moreover, a web-based system empowers owners to monitor their fleet and analyze transaction data flexibly from any internet-connected device.

The case study in this research focuses on *123 Lampung Utara*, a car rental business operating in North Lampung, Indonesia. The company serves various transportation needs, ranging from personal trips and official duties to tourism activities. However, its reliance on manual operations has led to data redundancy, service delays, and difficulties in generating analytical reports for business evaluation. These challenges highlight the urgent need for a computerized information system capable of automating and integrating core business processes within the car rental domain.

The system developed in this study utilized the CodeIgniter 3 framework, based on the PHP programming language and adopting the Model-View-Controller (MVC) architectural pattern. This framework was selected for its modular structure, strong reliability in web application development, and long-term maintainability (Mustafafi & Nita, 2021). The Waterfall model was employed as the software development methodology due to its structured and sequential approach, which is particularly suitable for projects with well-defined requirements from the outset (Mallisza et al., 2022a).

Previous studies have consistently shown that web-based information systems positively impact business efficiency. For instance, Andriyanto et al. (2024) demonstrated that web-based loan systems significantly reduce human errors in record keeping, while Riyadi et al. (2022) confirmed that digital inventory systems accelerate data-driven strategic decision-making.

Building on these studies, the contribution of this research lies in expanding the literature on management information systems (MIS) for MSME-based transportation services in Indonesia. Specifically, this study introduces a practical framework for the digital transformation of traditional car rental operations through a scalable, maintainable, and user-oriented web architecture. The system's integration of core modules user management, vehicle data administration, booking and transaction workflows, and reporting provides empirical evidence of how MIS design principles can enhance operational transparency, customer experience, and managerial control within the MSME context.

Therefore, the main objective of this research was to design and implement a web-based car rental portal information system for *123 Lampung Utara*. The proposed system is expected to significantly improve internal efficiency, expand service coverage, and strengthen customer satisfaction through a modern, accessible, and data-driven digital platform that also contributes to advancing applied MIS research within Indonesia's MSME transportation sector.

2. RESEARCH METHOD

This study employed a software engineering approach by adopting the Software Development Life Cycle (SDLC) framework (ALazzawi et al., 2023). The specific model selected was the Waterfall model**,** which follows a structured and sequential workflow starting from requirement analysis to final testing. This approach was chosen because the functional requirements of the system could be clearly defined at the beginning of the project, allowing each phase to be completed thoroughly before proceeding to the next. Such a design minimizes the risk of mid-process revisions and ensures disciplined project management (Testorelli et al., 2024). The research methodology was divided into four main phases: requirement analysis**,** system design**,** implementation**,** and system testing**.**

Requirement Analysis

The requirement analysis stage served as the foundation for identifying and defining both functional and non-functional system requirements (Zakaria & Utami, 2024). Data were collected through two primary techniques: a) Observation — Direct observation was conducted on the operational workflow of the car rental business at *123 Lampung Utara* to understand the manual process, identify inefficiencies, and detect critical points that required automation; b) **I**nterviews — In-depth discussions were carried out with the business owner to gather specific needs, system limitations, and the desired functionalities from both the administrator and customer perspectives.

Based on these findings, two levels of system access were identified (Simanihuruk et al., 2024): a) Administrator functions included managing master data (vehicles, categories, and users), validating and processing rental transactions, and generating operational reports; b) Customer functions included account registration, vehicle search and browsing, independent booking, and

viewing transaction history. This analysis provided a comprehensive understanding of the operational problems and became the basis for system design and functionality mapping.

System Design

After the requirements were established, the system design phase was conducted to model the architecture and workflow visually. This phase utilized the Unified Modeling Language (UML) standard to represent both the structure and behavior of the system (Maesaroh et al., 2024). The main design artifacts produced included: a) Use Case Diagram Illustrates functional interactions between system actors (Admin and Customer) and core features (Albana et al., 2024); b) Activity Diagram Describes the business process flow for registration, booking, and payment confirmation procedures (Halim et al., 2025); c) Class Diagram Defines the static structure of the system, including object classes, attributes, and their relationships within the database (Fernandy et al., 2023).

Additionally, Entity-Relationship Diagrams (ERD) were designed to visualize table structures and data entity relationships (Palinggi et al., 2024), which were later translated into a physical database schema in MySQL**.** These design models ensured clarity in system architecture and facilitated structured coding during implementation.

Implementation

The implementation phase involved translating all design artifacts into a functional software application through coding (Mallisza et al., 2022b). The system was developed using the following technology stack: a) Programming Language: PHP (Hypertext Preprocessor) was chosen for server-side programming due to its open-source nature, extensive community support, and seamless integration with MySQL (Raharjo et al., 2025); b) Framework: CodeIgniter 3 served as the core framework, adhering strictly to the Model View Controller (MVC) architecture. This pattern clearly separates data logic (Model), user interface (View), and application flow control (Controller), ensuring modularity and maintainability (Fakhri et al., 2023); c) Database: MySQL was utilized as the relational database management system for storing both transactional and master data (Sidharta & Wibowo, 2020); d) User Interface (Front-End): Bootstrap 4 was employed as the CSS framework to ensure a responsive, consistent, and mobile-f riendly interface design (Putra, 2020).

The directory structure of the application strictly followed CodeIgniter's MVC standard to maintain separation of concerns and ensure scalability for future development (Ridwan et al., 2022). Table 1 presents the main modules of the system and summarizes their testing scenarios, expected outcomes, and actual results. All modules functioned according to design expectations.

Table 1. Main module testing scenarios and results

Module	Testing Scenario	Input Tested	Expected Output	Actual Output	Status
Authentication	Login with valid credentials	Correct username & password	User successfully logged in and redirected to dashboard	Successful	Passed
	Login with invalid credentials	Incorrect username/password	Error notification: "Invalid username or password"	Successful	Passed
Registration	Register with valid data	All fields filled correctly	Account created and redirected to login page	Successful	Passed
	Register with duplicate email	Duplicate email input	Error message: "Email already registered"	Successful	Passed
Transaction	Customer makes a car booking	Selects car, date, and duration	Booking created with status "Awaiting Payment"	Successful	Passed
Reporting	Admin generates transaction report	Selects date range	System produces downloadable PDF report	Successful	Passed

As shown in Table 1, all system functionalities ranging from user authentication and CRUD operations to rental transactions and PDF report generation were implemented successfully and validated during the testing process.

System Testing

The final stage of the methodology was system testing, aimed at verifying that the developed software was free from defects and met all functional requirements (Fariz Cahyo Hudi & Cut Maisyarah Karyanti, 2023). The Black Box Testing method was used because it focuses on validating functionality from the end-user's perspective without considering the internal code structure (Jailani & Yaqin, 2024).

Under this approach, the system was treated as a “black box,” where the tester provided specific inputs and verified whether the outputs matched expectations (Alvaro et al., 2024). Test cases were designed to cover all critical workflows, including authentication, registration, vehicle management, transaction processing, and report generation. Each test case used both valid and invalid data to evaluate how the system handled normal and error conditions. The testing results indicated that all modules operated as intended, producing accurate outputs under all scenarios. No critical bugs were detected, confirming that the system met the defined requirements and was ready for operational deployment.

3. RESULTS AND DISCUSSIONS

The systematic stages of analysis, design, and implementation produced a functional output in the form of a web-based car rental information portal. The system was successfully developed using a technology stack consisting of the CodeIgniter 3 framework with the Model View Controller (MVC) architecture, PHP as the programming language, and MySQL as the database management system. This section presents the results of the system implementation, including the user interface (UI/UX)**,** functional architecture**,** workflow**,** database structure**,** and functional verification results through systematic testing.

User Interface Implementation Based on User Experience Design

The user interface was designed according to usability principles, focusing on learnability, efficiency, and error prevention, as well as responsive design adaptability. Utilizing the Bootstrap framework**,** the system ensures consistent visual elements such as typography, spacing, and contrast providing an optimal experience across both desktop and mobile devices. Key interactive components, especially Call-to-Action (CTA) elements, were placed strategically to guide users intuitively through each process.

1. Public and Customer Interface

The homepage, as shown in *Figure 1*, functions as the main digital storefront. It features an engaging hero banner and a card-based car catalog that displays essential informationvehicle photos, names, categories, prices, and availability status in a compact and easily scannable layout. A category filter panel (“Car Type”) allows users to browse more efficiently by selecting preferred types such as MPV, SUV, or Sedan.

Figure 1. Homepage / car catalog interface

When a user selects a vehicle, the system displays a Detail Page Figure 2, providing complete information such as brand and model, license plate number, color, production year, rental price, and image gallery. The “Book Now” button is highlighted as the main CTA. To maintain a seamless transaction flow, unauthenticated users are redirected to the Login or Registration Form Figures 3 and 4. This simplified flow is designed to minimize friction and maintain user engagement. After successful authentication, the customer dashboard displays booking history and active transaction statuses.

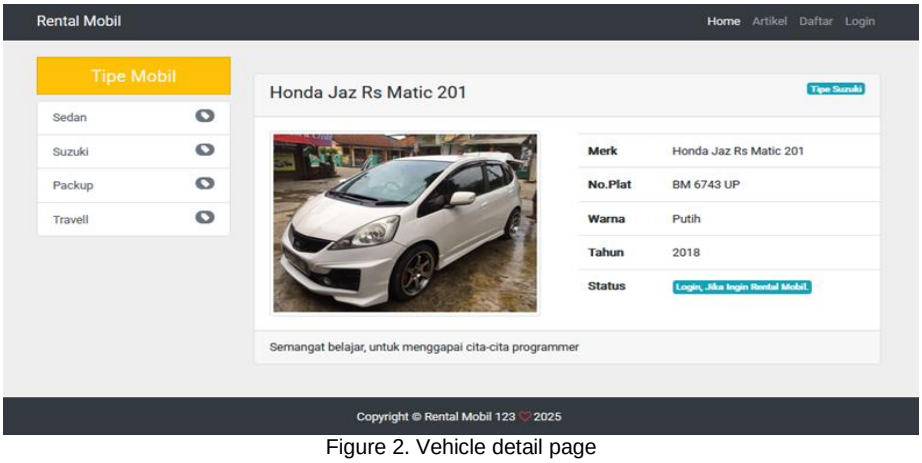

Figure 2. Vehicle detail page

Figure 3. Login form

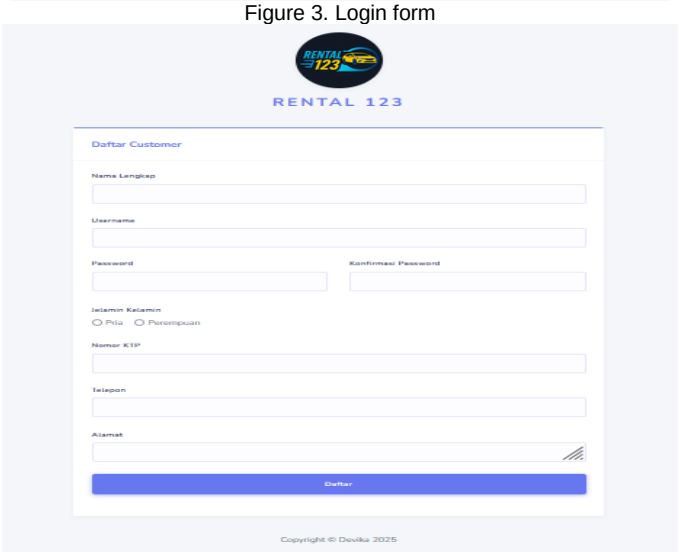

Figure 4. Registration form

The Checkout Form Figure 5 serves as the final step of the booking process, where the system automatically calculates the total rental cost and displays potential late-return penalties, ensuring transparency and trust in the transaction.

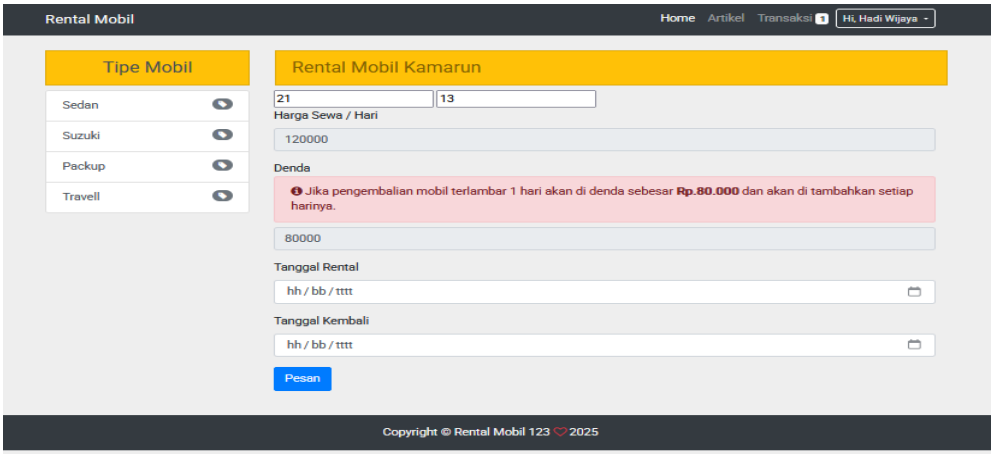

Figure 5. Checkout page (price and penalty calculation)

2. Administrative Interface

The Admin Dashboard, as shown in Figure 6, functions as the central operational control panel. After successful authentication, the administrator is presented with summary statistics including the number of customers, total vehicle units, and transaction counts. These visual indicators assist in daily monitoring and data-driven decision-making. A structured navigation menu provides access to all management modules, ranging from master data to transaction reports.

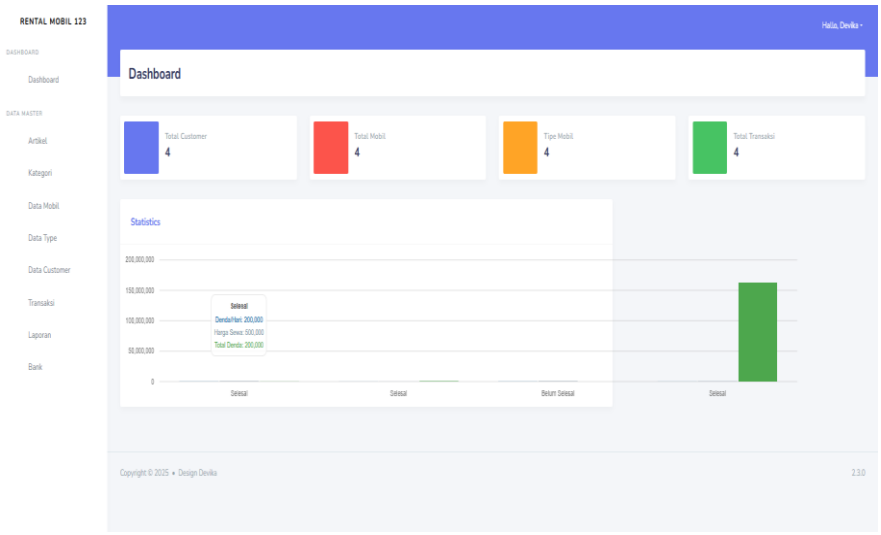

Figure 6. Administrative dashboard interface

Functional Architecture and Workflow

The overall system functionality is divided into two main access levels Administrator and Customer both interconnected to form a cohesive digital ecosystem that enhances operational efficiency and service quality.

1. Administrator Management Features

The administrative module serves as the operational backbone of the system. Implemented features grant administrators full control over content and transactions, including: a) Master Data Management: Comprehensive CRUD (Create, Read, Update, Delete) operations for vehicles, categories, and types; b) Transaction Management: Monitoring all active bookings, verifying payments, and updating order statuses; c) User Management: Viewing and managing registered customer accounts; d) Reporting Facility: Generating periodic transaction reports in PDF format, which are essential for business analytics, accounting, and documentation.

2. Customer Booking Workflow

The customer booking workflow, illustrated in *Figure 7*, is designed to be linear, intuitive, and automated. The system reduces administrative workload and minimizes human error by integrating validation at each stage—from vehicle selection and booking confirmation to payment and receipt generation.

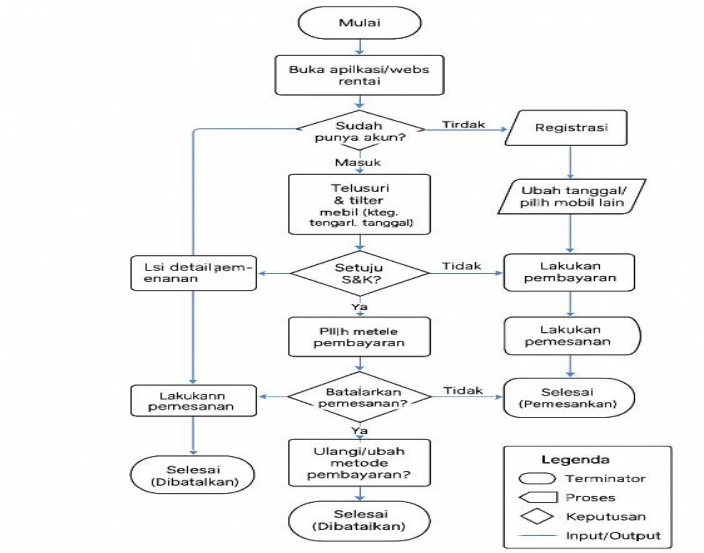

Figure 7. Car booking process flowchart

Relational Database Structure

The relational database model, depicted in Figure 8, ensures data integrity and minimizes redundancy through well-defined entity relationships among the primary tables: users, categories, cars, and transactions. This database schema supports the dynamic functionalities of the system, enabling real-time validation of vehicle availability and transaction records.

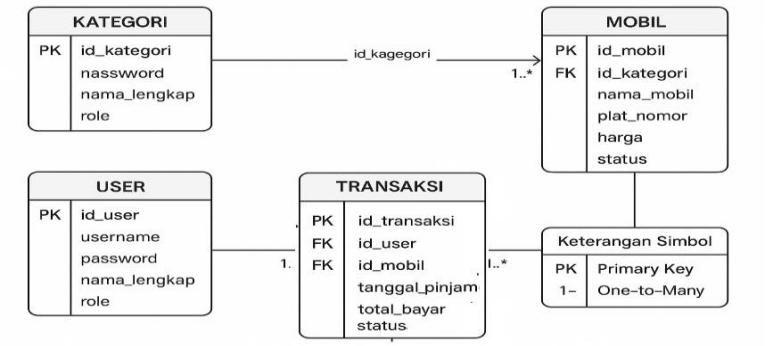

Figure 8. Entity relationship diagram (ERD) of the car rental information system

System Functional Verification

1. Testing Methodology

Functional testing was conducted using the Black Box Testing approach, focusing on validating the alignment between inputs and outputs from an end-user perspective without examining internal code structures. This method was chosen because it effectively evaluates user experience and system response accuracy during interaction.

2. Testing Results and Discussion

Testing was performed systematically across all main functional modules. The summarized results in Table 2 indicate that 100% of the test scenarios were successful, meeting the expected outcomes without any critical errors or bugs detected.

Table 2. Functional testing results

Module	Testing Scenario	Input Tested	Expected Output	Actual Output	Status
Authentication	Login with valid credentials	Correct username & password	User successfully logged in and redirected to dashboard	Successful	Passed
	Login with invalid credentials	Incorrect username/password	Error message: "Invalid username or password"	Successful	Passed
Registration	Register with valid data	All fields correctly filled	Account created and redirected to login page	Successful	Passed
	Register with duplicate email	Duplicate email entry	Error message: "Email already registered"	Successful	Passed
Transaction	Customer books a car	Selects car, rental date, and duration	Booking created with "Awaiting Payment" status	Successful	Passed
Reporting	Admin generates report	Selects date range	PDF report generated and downloaded	Successful	Passed

As shown in Table 2, every module from authentication and registration to transaction and reporting performed precisely as expected. The Black Box Testing success rate of 100% demonstrates that the developed system fulfills all defined functional specifications. Figure 9 illustrates the overall success rate per module, confirming complete functionality validation. Empirical results show that the developed system is both valid and reliable, effectively addressing inefficiencies in the previous manual processes and significantly improving the company's digital competitiveness.

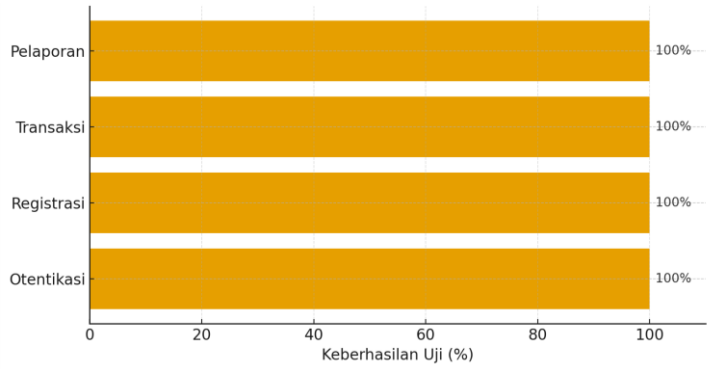

Figure 9. Black box testing success rate per module (100%)

Technical Implementation Notes

To ensure robust and sustainable system performance, several key technical considerations were implemented: a) MVC Pattern (CodeIgniter 3): Clear separation of concerns Controller handles requests, Model manages data interaction with MySQL, and View renders responsive user interfaces; b) Security Measures: Implementation of essential protection mechanisms, including Cross-Site Request Forgery (CSRF) tokens, input sanitization to prevent SQL Injection, rate-limiting for login attempts, and Functional Testing Results to secure user credentials; c) Media Management: Vehicle image uploads are stored in a dedicated directory and validated server-side to ensure file size and format compliance; d) Performance Optimization: Indexing on key database columns (e.g., cars.no_plat, transactions.id_car, and date fields) improves query efficiency and response time for availability checks one of the most critical processes in car rental operations. These technical implementations ensure the system's reliability, maintainability, and scalability for future integration with automated payment gateways and notification systems.

4. CONCLUSION

Based on the results of the analysis, design, implementation, and testing stages, this research successfully achieved its objective by developing a functional web-based car rental information portal for *123 Lampung Utara*. The system was developed using the Waterfall methodology and a technology stack consisting of the CodeIgniter 3 framework, PHP programming language, and MySQL database management system.

Functional testing using the Black Box Testing method demonstrated that all major modules including user authentication, master data management, booking transaction workflows, and reporting features operated successfully with a 100% success rate and no critical bugs detected. These results confirm that the developed system is valid, reliable, and fully meets the functional requirements identified during the analysis phase.

It can be concluded that the implementation of this information system provides an effective solution to address the operational inefficiencies of the previous manual process. The system successfully transformed business operations into a structured, efficient, and accurate digital workflow, thereby improving service quality for customers and simplifying operational management for administrators.

In line with the findings presented in the Results and Discussion chapter, this study fulfills the expectations stated in the Introduction by proving that digital transformation through a web-based information system can enhance both business efficiency and user satisfaction.

For future development, several improvements are recommended to enhance the system's functionality and scalability, including: a) Integration of a Payment Gateway: Implementing automated online payment features to facilitate faster and more secure transaction confirmations; b) Real-Time Notification System: Developing automated notification mechanisms via email or WhatsApp to provide instant updates on transaction statuses for both customers and administrators; c) Penalty Management Module: Creating a module to automatically calculate and manage late return penalties to ensure transparent and accurate billing.

Beyond these system enhancements, future research can explore more advanced directions such as integrating real-time GPS tracking to monitor vehicle location and optimize fleet management, or employing machine learning algorithms to predict vehicle demand patterns based on historical transaction data and seasonal usage trends. These extensions would not only enrich the system's intelligence and operational value but also contribute new insights to the growing body of research on digital transformation and decision-support systems in MSME-based transportation services.

Therefore, future work should focus on combining information systems, data analytics, and intelligent automation to create a more adaptive, data-driven, and customer-oriented digital ecosystem for car rental businesses in Indonesia.

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