

Digitalizing Outdoor Equipment Rental Services Through the Development of an Android-Based Information System Using the Waterfall Model

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ABSTRACT

Purpose of the study: This study aims to develop an Android-based outdoor equipment rental information system to support the digitalization of rental services. The system is designed to improve rental management, facilitate customer access to rental information, and enhance the efficiency of business operations through mobile technology.

Methodology: Qualitative research approach; Design and Creation method; Waterfall software development model; observation, interviews, and literature review for data collection; Android Studio development environment; MySQL database management system; Unified Modeling Language (UML) for system design; Black Box Testing for system validation; questionnaire survey using a five-point Likert scale involving 50 respondents for user evaluation.

Main Findings: The developed Android-based information system successfully integrated equipment information management, rental transactions, payment confirmation, and inventory monitoring into a single platform. Black Box Testing confirmed that all system functions operated properly. User evaluation results showed high acceptance levels, with usability achieving 91.2%, functionality 88.4%, and response speed 87.6%, indicating positive user perceptions of the developed application.

Novelty/Originality of this study: This study presents an integrated Android-based outdoor equipment rental information system that combines inventory monitoring, rental transactions, payment confirmation, and customer service features within a single mobile application. Unlike previous studies that mainly focused on web-based platforms, this research emphasizes mobile accessibility and service digitalization, providing a practical solution for improving rental service management and customer convenience.

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1. INTRODUCTION

The development of information technology has significantly transformed various business sectors, including rental service businesses [1], [2]. Digital technology enables organizations to improve service efficiency, expand market reach, and provide faster access to information for customers. The increasing use of smartphones has also encouraged businesses to adopt mobile-based information systems [3]. Android-based applications have become one of the most widely used platforms due to their accessibility and flexibility. Therefore, the implementation of mobile information systems is considered an effective strategy for supporting service digitalization in rental businesses [4], [5]. Outdoor activities such as camping, hiking, and nature

exploration have gained increasing popularity among young people and outdoor enthusiasts [6]. These activities require various equipment, including tents, backpacks, sleeping bags, jackets, and safety gear [7]. However, many customers prefer renting outdoor equipment rather than purchasing it because of the high acquisition and maintenance costs. Despite the growing demand, many outdoor equipment rental businesses still manage transactions, inventory, and customer services manually [8]. This condition often leads to difficulties in accessing information, monitoring equipment availability, and managing rental transactions efficiently.

Several previous studies have explored the development of information systems for outdoor equipment rental services. Previous research primarily focused on web-based rental information systems that facilitated equipment reservation and inventory management [9], [10]. Other studies also implemented online rental services but provided limited support for mobile accessibility and integrated transaction management. In addition, some systems utilized notification features to improve customer communication during rental periods [11]. Although these studies contributed to the digitalization of rental services, most of them were developed using web-based platforms and offered limited mobility for users. Despite the availability of previous research, several gaps remain in the implementation of rental information systems [12]. Many existing systems do not provide Android-based mobile applications that enable users to access services anytime and anywhere. Furthermore, some studies focus mainly on reservation functions without integrating inventory monitoring, rental management, and payment confirmation into a single platform [13]. The lack of comprehensive mobile solutions limits the effectiveness of digital services in supporting customer needs and business operations [14]. Therefore, there is a need for a more integrated and user-friendly information system specifically designed for outdoor equipment rental services.

The development of an Android-based rental information system is important because it can improve service efficiency and enhance customer experience [15], [16]. Through digital platforms, customers can easily obtain information about equipment availability, rental prices, and transaction procedures without visiting the rental location directly [17]. Business owners can also benefit from better inventory management, transaction recording, and promotional activities. In addition, the utilization of mobile technology supports broader market accessibility and contributes to business competitiveness in the digital era. Consequently, the adoption of a mobile information system becomes a strategic solution for addressing operational challenges in outdoor equipment rental businesses. This study offers novelty by developing an Android-based outdoor equipment rental information system that integrates equipment information, inventory monitoring, rental transactions, payment confirmation, and customer services within a single application [18]. The system is developed using the Waterfall model to ensure a systematic and structured software development process. Unlike previous studies that primarily focused on web-based solutions, this research emphasizes mobile accessibility and service digitalization through Android technology. The proposed system also supports real-time access to rental information, improving both operational efficiency and customer convenience. Therefore, this study contributes to the advancement of digital rental service management and provides practical value for outdoor equipment rental businesses.

2. RESEARCH METHOD

2.1 Research Design

This study employed a qualitative research approach combined with the Design and Creation method to develop an Android-based information system for outdoor equipment rental services [19]. The research was conducted at Dimitri Outdoor Rental Services in Makassar, Indonesia, where rental activities were still managed manually. A qualitative approach was selected to understand existing business processes, user requirements, and operational challenges [20], [21]. The Design and Creation method was applied to produce a technological solution capable of supporting rental service digitalization. This approach enabled the development of a system that addresses both business and user needs effectively.

2.2 Data Collection

Data collection was carried out through observation, interviews, and literature studies. Observation was conducted directly at the rental business to identify operational workflows, equipment inventory management, and customer service activities. Interviews were conducted with the business owner and employees to gather information regarding rental procedures, equipment availability, and customer requirements. In addition, relevant books, journals, and online resources were reviewed to support system development and strengthen the research framework. The collected data served as the basis for defining system requirements and application features. The data collection techniques were selected to obtain comprehensive information about the existing rental business processes and system requirements. Each technique provided specific information needed to support the analysis and development of the proposed application, as summarized in Table 1.

Table 1. Data Collection Techniques

Technique	Purpose
Observation	Identify existing business processes and operational activities
Interview	Gather requirements from owners and employees
Literature Study	Obtain theoretical and technical references

The collected data provided an overall understanding of the existing business processes, operational requirements, and user needs. These findings were subsequently used as a reference for determining the functional requirements and features of the Android-based rental application.

2.3 System Development Method

The system was developed using the Waterfall model because it provides a structured and sequential software development process. The development process consisted of five stages: requirements analysis and definition, system and software design, implementation and unit testing, integration and system testing, and operation and maintenance. The requirements analysis stage focused on identifying user needs and system functionalities. The design stage produced system models and database structures, while implementation translated the design into an Android application. Finally, testing and maintenance activities were conducted to ensure that the application functioned properly and met user expectations.

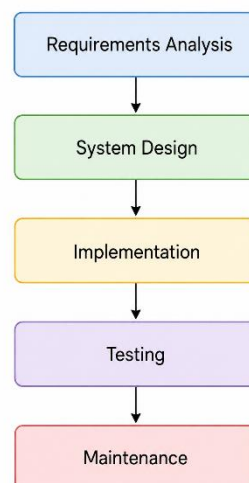


Figure 1. Waterfall Development Model

2.4 System Testing and Evaluation

System evaluation was conducted using Black Box Testing and user response assessment through questionnaires. Black Box Testing was used to verify whether each system function operated according to the specified requirements without examining the internal program code. The testing process covered login, rental transactions, equipment information access, payment confirmation, and administrative functions. Furthermore, a questionnaire based on a five-point Likert scale was distributed to 50 respondents to evaluate system usability and user satisfaction. The results of these evaluations were used to determine the effectiveness and acceptance of the developed Android-based rental information system.

3. RESULTS AND DISCUSSION

3.1 System Development Results

The development process successfully produced an Android-based information system designed to support outdoor equipment rental services at Dimitri Outdoor Rental Services. The system was developed using the Waterfall model, beginning with requirement analysis and continuing through design, implementation, testing, and maintenance stages. The developed application provides digital access to rental information, equipment availability, transaction processing, and payment confirmation. In addition, the system supports inventory monitoring to assist administrators in managing rental equipment more effectively. As a result, the developed application transformed conventional rental service activities into a more efficient digital process.

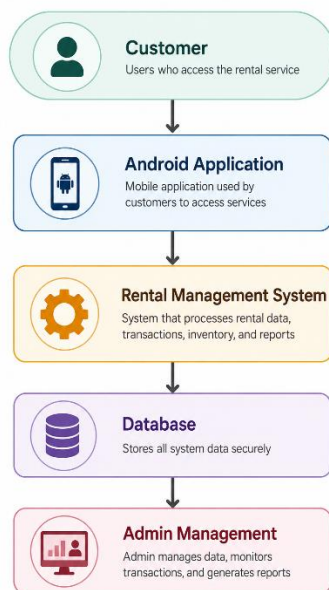


Figure 2. Overview of the Developed System

3.2 Application Implementation Results

The implementation stage produced a functional Android application consisting of several integrated modules designed to support the outdoor equipment rental process. The application provides login and registration features that enable users to create accounts and securely access the available services. Users can browse available outdoor equipment, view rental information, and manage rental transactions through the application interface [22]. A payment confirmation feature was also implemented to support transaction verification by administrators. In addition, rental history and profile management features were provided to improve user convenience and facilitate access to rental-related information. The main features implemented in the application are presented in Table 2.

Table 2. Main Features of the Developed Application

Module	Function
Login and Registration	User authentication and account creation
Equipment Catalog	Display available outdoor equipment
Rental Transaction	Manage equipment rental processes
Payment Confirmation	Verify rental payments
Rental History	Display previous transactions
User Profile	Manage user information

Table 2 shows the main modules developed to support the core activities of the rental service. The integration of these features enables users to complete the rental process from account access and equipment selection to payment confirmation and transaction history management. This implementation also provides administrators with information needed to verify and manage rental transactions efficiently.

3.3 Black Box Testing Results

Black box testing was conducted to verify whether the developed application performed according to the specified functional requirements [23]. The testing focused on essential functions, including user authentication, equipment information, rental transactions, payment confirmation, inventory management, and user management. Each function was tested by comparing the actual system output with the expected output defined in the functional requirements. The testing results showed that all evaluated functions operated as expected, with no critical functional errors identified during the testing process. The detailed results of the black box testing are presented in Table 3.

Table 3. Black Box Testing Results

Function Tested	Expected Output	Result
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Function Tested	Expected Output	Result
Login	Successful user authentication	Passed
Equipment Information	Information displayed correctly	Passed
Rental Transaction	Transaction processed successfully	Passed
Payment Confirmation	Payment data recorded correctly	Passed
Inventory Management	Data managed correctly	Passed
User Management	User information processed correctly	Passed

The results in Table 3 indicate that all tested functions achieved the expected outcomes. The successful results confirm that the main application features operate according to the defined functional requirements and can support the essential activities of the outdoor equipment rental process.

3.4 User Evaluation Results

User evaluation was conducted to assess the usability and performance of the developed application from the users' perspective. A questionnaire was distributed to 50 respondents using a five-point Likert scale covering several aspects of the application. The evaluation focused on ease of use, system functionality, and response speed. The results showed that ease of use achieved the highest percentage at 91.2%, followed by system functionality at 88.4% and response speed at 87.6%. These results indicate that the application received positive responses from users and was perceived as accessible and functional for supporting outdoor equipment rental activities. The detailed evaluation results are presented in Table 4.

Table 4. User Evaluation Results

Evaluation Aspect	Percentage (%)
Ease of Use	91.2
System Functionality	88.4
Response Speed	87.6

The results presented in Table 4 show that all evaluated aspects obtained percentages above 87%. Ease of use received the highest score, suggesting that respondents found the application relatively easy to operate. The results also indicate that the implemented functionality and system response were positively perceived by the respondents.

Development of the Android-based outdoor equipment rental information system successfully supported the digitalization of rental service activities. Application of the Waterfall model enabled a structured development process, ensuring that each stage was completed systematically according to user requirements [24]. Integration of equipment information, rental transactions, payment confirmation, and inventory monitoring into a single platform simplified operational activities and improved service efficiency [25]. Availability of these features reduced the dependency on conventional rental procedures that previously relied on manual processes. Successful implementation of the system demonstrates its capability to support modern rental service management. Results obtained from functional testing and user evaluation indicate that the developed application performed effectively in supporting rental operations [26]. Black Box Testing showed that all major functions operated according to the expected specifications without critical errors. User evaluation also revealed a high level of acceptance, as reflected by the usability score of 91.2%, functionality score of 88.4%, and response speed score of 87.6%. Positive responses from participants suggest that the application provides a convenient and reliable user experience. High acceptance rates further confirm the suitability of mobile technology for outdoor equipment rental services.

Findings of this study are consistent with previous research emphasizing the role of information systems in improving service efficiency and operational management. Earlier studies reported that digital platforms facilitate reservation activities, inventory management, and customer communication in rental businesses. Similar outcomes were observed in the present study, where digitalization improved access to rental information and streamlined service delivery [27]. However, previous studies have predominantly focused on web-based rental management systems, while limited attention has been given to Android-based platforms that integrate rental information, transactions, payment confirmation, and inventory monitoring specifically for outdoor equipment rental services. This gap indicates the need for a more accessible mobile-based solution that can support both customer convenience and operational management within a single platform. Positive evaluation results further strengthen evidence that technology adoption contributes to better service quality and customer satisfaction [28]. Consistency between the current findings and previous studies supports the

effectiveness of information system implementation in rental service environments. Novelty of this research lies in the development of an integrated Android-based platform specifically designed for outdoor equipment rental services. Previous studies primarily focused on web-based systems, whereas this research emphasizes mobile accessibility to support service digitalization. Multiple functions, including equipment information management, rental transactions, payment confirmation, inventory monitoring, and customer profile management, were integrated into a single application. Adoption of the Waterfall model also ensured a structured development process from requirement analysis to system testing. Combination of mobile accessibility and integrated service management represents the main contribution of this study.

Practical implications of this research can be observed from both business and customer perspectives. Business owners can utilize the system to improve inventory monitoring, transaction management, and service administration more efficiently [29]. Customers benefit from easier access to rental information, equipment availability, and transaction services through mobile devices. Broader accessibility provided by the application may also support promotional activities and expand market reach [30]. Implementation of digital rental services therefore contributes to improving business competitiveness in an increasingly technology-driven environment. Several limitations should be acknowledged when interpreting the findings of this study. Evaluation activities were conducted within a single outdoor equipment rental business, which may restrict the generalization of the results to different business settings. Participation was limited to 50 respondents, meaning that broader user perceptions may not be fully represented. System implementation was also restricted to the Android platform and did not include compatibility with other mobile operating systems. Future research is recommended to involve a larger sample size, expand implementation contexts, and incorporate additional technological features to improve system scalability and functionality.

4. CONCLUSION

This study successfully developed an Android-based outdoor equipment rental information system to support the digitalization of rental services at Dimitri Outdoor Rental Services using the Waterfall development model. Results demonstrated that the developed system effectively integrated equipment information management, rental transactions, payment confirmation, and inventory monitoring into a single digital platform, thereby improving operational efficiency and service accessibility. Functional testing confirmed that all system features operated according to the specified requirements, while user evaluation indicated a high level of acceptance with positive responses regarding usability, functionality, and response speed. Findings of this study indicate that the adoption of mobile information technology can provide practical solutions for addressing challenges associated with conventional rental service management. Contributions of this research lie in the implementation of an integrated Android-based rental system that supports service digitalization and enhances customer convenience in accessing rental services. Future studies are recommended to expand system implementation in different business environments, involve larger numbers of respondents, and integrate advanced technologies to improve system scalability, interoperability, and overall service performance.

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