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Development and Implementation of an Android Application for Camping Equipment Rental at Langit Adventure

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Abstract: This study aims to develop and deploy an Android application for camping equipment rental for Langit Adventure. For the rental process that was previously carried out conventionally, this application was created to optimize it and increase efficiency, reduce chaos. Researchers use the Rapid Application Development (RAD) methodology to develop with the integration of rapid development and feedback. The results of the Black Box functional testing have been successfully met. This makes camping equipment rental easier to use and serves as a digital solution that is beneficial to renters and service providers. This application simplifies the management of camping equipment rentals, improves user experience, and provides a practical digital solution for renters and service providers.

Keywords: Android Application; Camping Equipment Rental; Rapid Application Development; Black Box Testing.

1. Introduction

The rapid development of information technology in the digital era has made technology an integral part of everyday human life. One significant impact of this development is the increasing use of mobile applications in various aspects of life, including to facilitate interaction and transactions between users and certain services or products. Rental transactions, as an important element in the modern economy, have also experienced a paradigm shift with the increasing adoption of digital technology. Camping equipment rental, such as carrier bags, portable stoves, tents, shoes, jackets, and other relevant equipment, is one sector that shows great potential in terms of technological innovation. The demand for these rental services continues to increase

along with changes in people's lifestyles. However, the rental process, which is still widely carried out conventionally, creates its own challenges in terms of efficiency and regularity of operational processes.

Various studies have tried to answer this problem through the development of technology-based systems. One of them is research by Akra and Syukhri (2023) who developed a web-based Camping Equipment Rental Information System. This system uses the CodeIgniter framework and MySQL database to support the management of camping equipment rental transactions at the Andalas Adventure agency. The results of the study show that this system is able to facilitate the process of recording transactions, payments, and returns of goods. However, the study has limitations because it only focuses on a web-based platform without mobile features, which are increasingly relevant amidst the high penetration of mobile devices in society. In addition, the system also does not provide features to support the delivery of rental items, which can provide added value to customers [1]. Similar problems were found in a study by Afriza Malna *et al.* (2023) who developed a web-based system to facilitate the rental of hiking equipment. Although successful in solving some manual process challenges, such as recording transactions, this study remains limited to a web-based solution and does not include the integration of mobile-based features [2]. This web-based solution, although efficient for certain contexts, is less than optimal to meet the needs of users who increasingly rely on mobile devices in their daily activities. Another study by Suhenda and Hirawan (2018) tried to bridge the gap by developing an Android application to help users find campsites, rent camping equipment, and get information related to camping events. This study used Location-Based Services (LBS) and Google Cloud Messaging (GCM) technology. However, the application faced challenges in terms of performance and user interface. This shows that although the move towards mobile-based digitalization has begun, further development is needed to improve efficiency, performance, and user experience [3]. From these studies, there is a clear need for the development of more integrated and effective mobile-based solutions. This study aims to overcome these limitations by adopting a mobile application-based approach. The focus of this study is on the development of an Android application to manage the camping equipment rental process efficiently, both for service providers and renters. This application is designed to improve the efficiency of rental transactions, provide a better user experience, and reduce dependence on conventional methods.

The method used in this study is Rapid Application Development (RAD), an approach that allows rapid application development by involving continuous feedback from users. This method is very relevant for projects that require short development time without sacrificing quality. With this approach, the developed application is expected to be able to answer the specific needs of users, including ease of access, structured data management, and flexibility in managing the rental process. The main objective of this research is to create an Android application that can be used by camping equipment rental shops to manage their services in a more structured and efficient manner. By utilizing digital technology, this application is expected to not only simplify the transaction process but also provide practical solutions to various challenges faced in renting camping equipment. As a case study, this research focuses on developing a system to support activities at Langit Adventure, a camping equipment rental service provider located in Yogyakarta. Through this research, it is hoped that an application model will be created that can be a reference for the development of similar systems in the future. In addition, this application is also expected to provide a real contribution in encouraging the digitalization of the rental sector in Indonesia, especially in services related to outdoor activities such as camping and hiking. With this technology-based solution, the rental process is expected to be more efficient, easily accessible, and relevant to the needs of modern society.

2. Research Method

The research methodology applied in the development of this Android application is Rapid Application Development (RAD). RAD is a software development approach that focuses on an object-oriented design for building new systems, aiming to speed up the development process while maximizing efficiency. One of the primary advantages of RAD is its ability to reduce the time spent on modifications after the system has been launched. By using RAD, the development team can quickly respond to feedback from users, allowing for fast adjustments and iterations. The main goal is to expedite the transition from the design phase to the implementation and operational stages. RAD is particularly suited for projects that require fast development without compromising on the quality of the end product, and it encourages rapid iteration with continuous user feedback throughout the development process [4]. According to [5], RAD is a software development method that utilizes prototypes to accelerate and iteratively refine the development process over shorter cycles. RAD is divided into four main phases: Requirement Planning, System Design, Development Process, and Implementation. In the first phase, Requirement Planning, the identification of the needs and

requirements of both users and the system is carried out. This phase is crucial to ensure that the application being developed aligns with the users' expectations and operational needs. The next phase, System Design, includes the planning of the system's architecture and the elements that will be used in the application. This design must cover various aspects, including data structure, application workflow, and user interface design to ensure ease of use. The third phase, Development Process, involves the creation of prototypes and testing of application features that have been designed, focusing on rapid iterations based on feedback gathered from users. This process allows developers to quickly identify shortcomings or errors in the initial design and correct them in the development cycle. Finally, the Implementation phase is the stage where the application is deployed in a real-world environment. At this stage, the application is tested again to ensure that all functions operate properly, and the system performs stably according to the predefined specifications.

2.1.1 Research Framework

The research framework outlines the steps undertaken from the initial condition to the expected final outcomes. The research begins with identifying the main problems related to the existing camping equipment rental system, which is still being conducted conventionally, resulting in inefficient processes. Based on this identification of issues, the researchers propose a solution in the form of a mobile-based system through the development of an Android application for camping equipment rental services. This application is designed to facilitate and improve the rental process that was previously conducted manually or traditionally. The first step in the research framework is the identification of the main issues regarding the camping equipment rental system, which is disorganized and inefficient. This issue makes the development of an Android mobile application for camping equipment rental both highly relevant and necessary to modernize the rental process. After the problems are identified, the next step involves designing a mobile-based system that will be implemented to improve the rental process. This system application is expected to integrate various features to help both users and service providers manage rentals more efficiently.
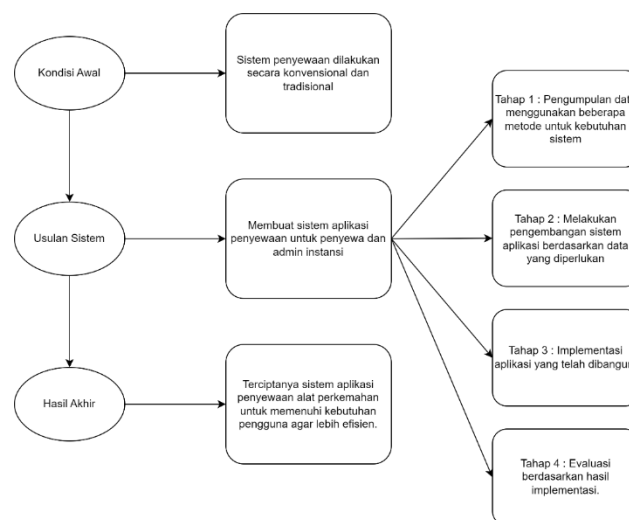

Figure 1. Research Framework

After designing the system, the next phase is the development of the system based on the collected data and requirements. This development includes the creation of various features, such as transaction recording, inventory management, and payment processing. This phase is carried out using the RAD method, which allows for faster development with continuous user feedback. Once the system application is developed, the next step involves implementing the application and conducting functional testing to ensure that the application operates as expected. During the implementation phase, the developed application is tested to ensure that all features work properly and meet user requirements. The results of this testing are then evaluated to make improvements or add any missing features. This evaluation also includes bug fixing or error correction discovered during testing. By following this process, the researchers aim to ensure that the developed system meets the users' needs and improves the efficiency of the camping equipment rental process.

2.1.2 Data Collection Methods

This study employs several methods to gather the necessary data for the development of the camping equipment rental application system. Each method is designed to efficiently collect accurate and relevant data that can be used to design and develop an effective and efficient application.

1) Observation

Direct observation was conducted by visiting the camping equipment rental location to better understand the current rental system in operation. This observation aimed to identify the weaknesses of the existing system and highlight processes that could be improved. By observing firsthand, the researchers were able to gain insights into the challenges faced by both renters and service providers in conducting the rental process manually.

2) Interviews

Interviews were conducted with employees and the owner of Langit Adventure to gather more detailed information about the company's operations, the types of equipment available for rent, the location, and the challenges encountered in running the business. These interviews provided a deeper understanding of the practical needs of both users and service providers, which are critical for designing the appropriate features in the application.

3) Documentation

This phase involved gathering documents, records, reports, or other relevant information from various sources. The information obtained through documentation was used to draw conclusions and design a system that aligns with users' needs. Documentation also serves as a reference that can be used throughout the development and testing phases of the application.

2.1.3 System Architecture

System architecture, in the context of software development, refers to the framework that defines the overall structure of a software system. In the development of the camping equipment rental application, several key elements make up the system architecture. These elements include the User or Renter who accesses the Android mobile app, the System Admin who uses the web-based app, the Internet, the REST API for communication between the systems, and the Database Server that stores transaction data and other information. Users of the Android application will open the app, which will automatically load data such as information about the equipment available for rent, transaction history, and so on. This data is retrieved from the database server via the REST API, which allows data exchange between the Android app and the server. The system admin is responsible for managing the data, such as verifying payments, processing rental requests, and maintaining the system data.
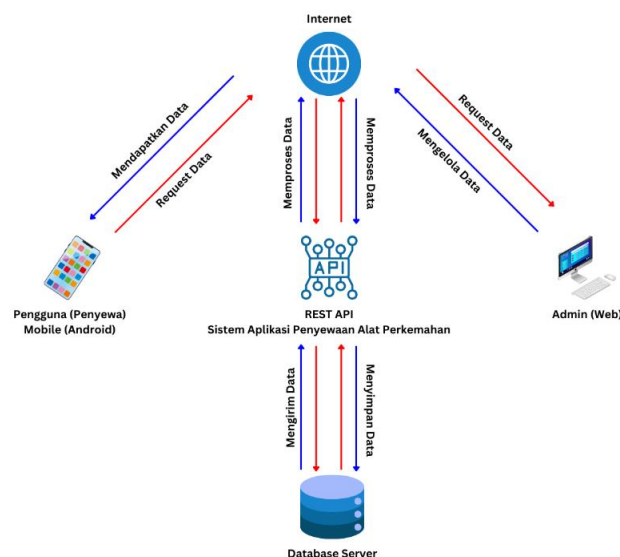
Figure 2. System Architecture
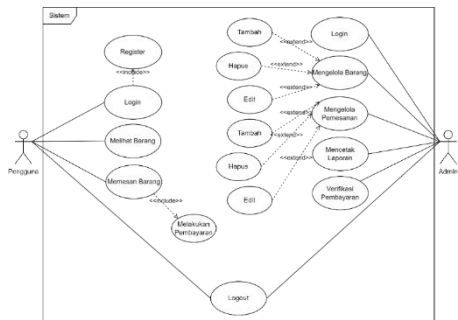
2.1.4 Conceptual Design

Conceptual design is a critical stage in the development of a system, where ideas and concepts about the proposed system or application are detailed in a more concrete form and presented through diagrams that illustrate the process flow, user interactions with the system, and data structure. A flowchart is a visual representation of the processes within the system, designed to help developers understand the application's workflow. In this study, the flowchart is used to represent the sequence of processes followed by users when using the app. This helps clarify how each stage of the system functions and makes it easier for developers to

make modifications or improvements when needed [6]. Figure 3 shows the general user flow for this Android-based application, from opening the app to placing an order.
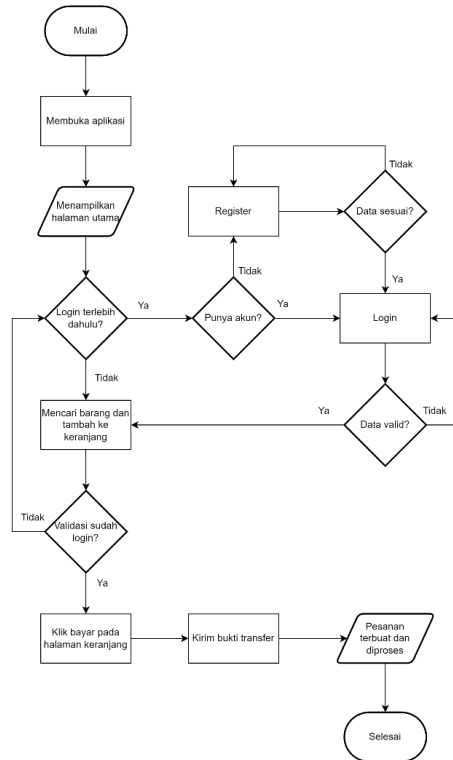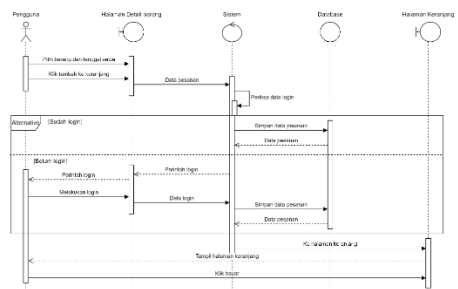

Figure 3. User Flowchart

UML is a method used in software engineering to describe the flow, functions, and objectives of a system. In this study, UML is employed to design various system elements, such as use case diagrams, activity diagrams, and sequence diagrams that depict how users interact with the application [7].

Figure 4. Use Case Diagram

Figure 6. Sequence Diagram
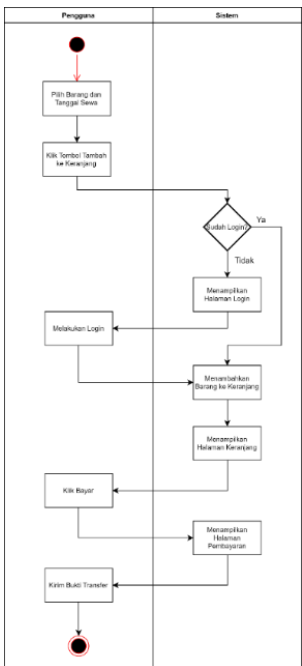
Figure 5. Activity Diagram

The ERD is a high-level conceptual model used to describe the database structure within the system. This diagram helps in designing the database by defining the relationships between entities and their attributes in the application.
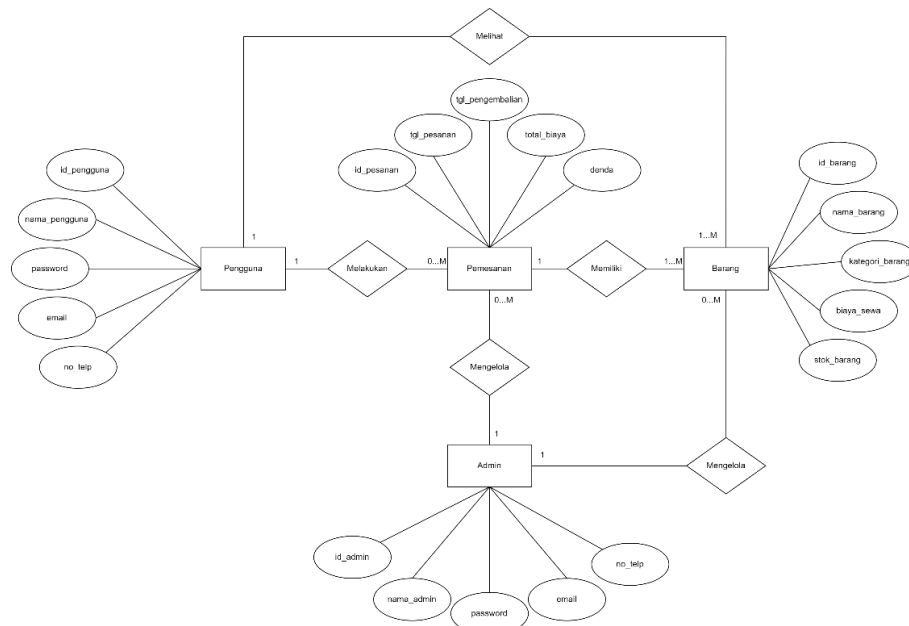
Figure 7. Entity Relationship Diagram

Table relationships illustrate how tables in a database are connected and how data from one table relates to data in another table. The design of table relationships ensures that data is organized effectively and can interact efficiently within the system.
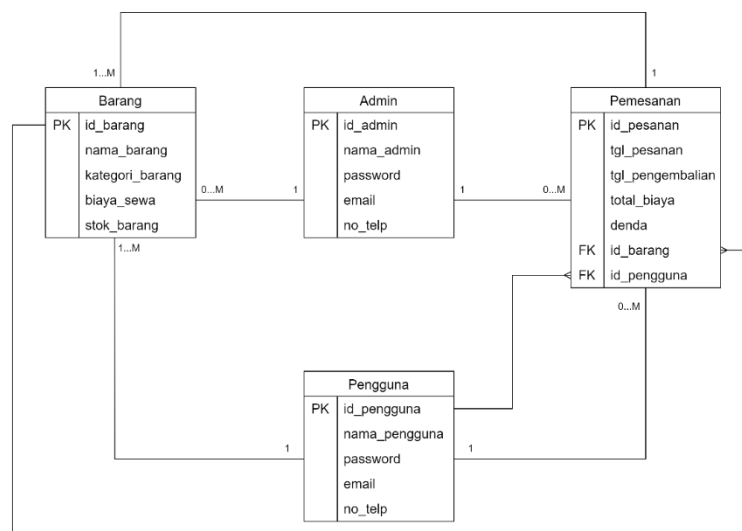
Figure 8. Table Relationships

This study provides a structured and detailed overview of how RAD methodology is applied to the development of a camping equipment rental application, utilizing various diagrams and design models to facilitate the creation of an efficient and effective system. The research framework, data collection methods, and system architecture are explained thoroughly to ensure that the system meets user needs and enhances the rental process.

3. Result and Discussion

3.1 Results

The system developed in this study consists of several pages and features, each functioning as designed. The application includes key components ranging from the login and registration pages to the order placement page, with each page developed to meet its specific purpose. The system was designed to be user-friendly, with seamless navigation between these components. The main pages of the application are as follows: the Splash Screen, Login, Register, Homepage, Category Selection, Item Details, Shopping Cart, Payment, Payment Successful, Order History, User Profile, and Edit Profile. Each of these pages is integral to the smooth operation of the application, ensuring that the user experience is efficient and straightforward.
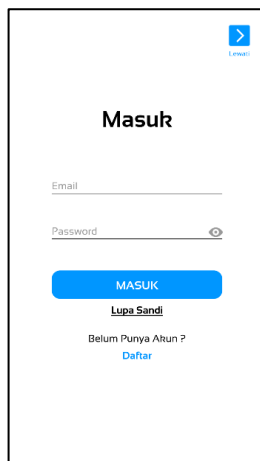
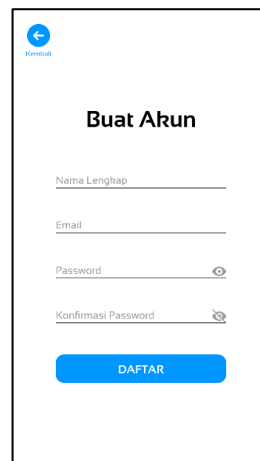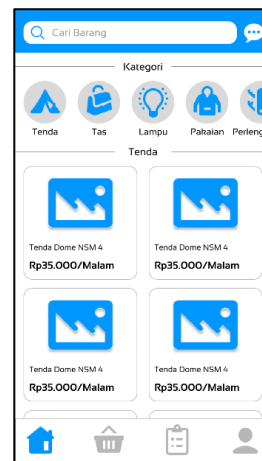Figure 9. Splash Screen   Figure 10. Login   Figure 11. Register   Figure 12. Homepage
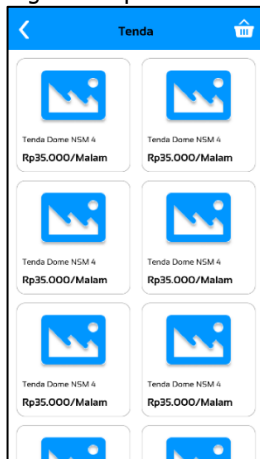
Figure 13. Category Selection   Figure 14. Item Details   Figure 15. Shopping Cart   Figure 16. Payment
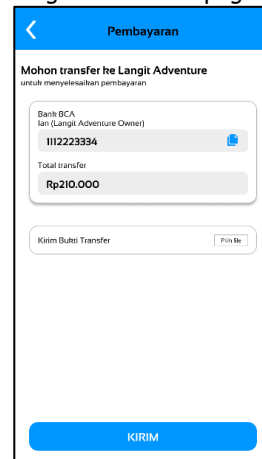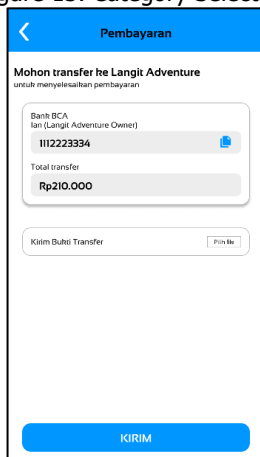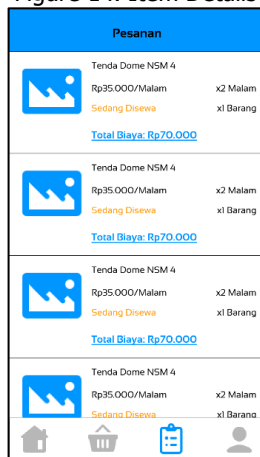
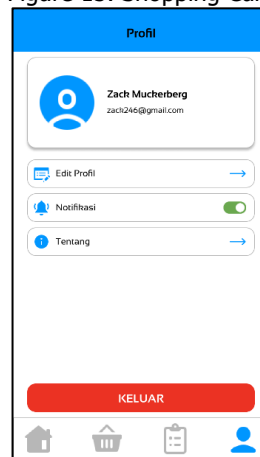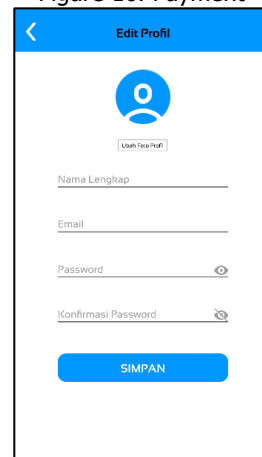Figure 17. Payment Successful   Figure 18. Order History   Figure 19. User Profile   Figure 20. Edit Profile

The design of these pages followed standard conventions for mobile applications, ensuring compatibility and ease of use. Each page is linked to the functionality it supports, contributing to the overall efficiency of the system. The splash screen, for example, provides a brief introduction to the application before transitioning to the login page, while the user profile and order history pages enable users to access their data and review previous rentals.

3.2 Discussion

The discussion of the results centers on the evaluation and comparison of the application's performance through black box testing. Black box testing is a technique that focuses on assessing the functionality of the system based solely on input and output, without any knowledge of the internal structure or code of the application. This testing methodology is particularly useful in confirming that the software performs as expected and meets user requirements, independent of its underlying technical details. In this case, black box testing was applied to evaluate the core functionalities of the system, ensuring that the application is user-friendly and performs all required tasks effectively. Throughout the testing process, the application was evaluated under both normal and non-normal conditions to assess its stability and responsiveness. The expected results were compared with the actual performance to identify any discrepancies. The following table summarizes the findings from the black box testing, which highlights the system's functionality across various pages and features:

<div align="center">Table 1. Black Box Testing Results</div>

No.	Test Case	Expected Outcome	Test Results	Conclusion
1	Splash Screen	The splash screen should display for 2 seconds before transitioning to the main application page.	The splash screen appeared for 2 seconds and transitioned directly to the login page.	Normal
2	Login Page	The login page should allow users to enter their credentials (email and password) to access the system.	The login page correctly allowed users to log in using their email and password.	Normal
3	Registration Page	The registration page should enable users to create a new account by entering the required personal information.	The registration page functioned correctly, enabling users to register by entering their required details.	Normal
4	Homepage	The homepage should display main application elements, such as category choices, item lists, and a navigation bar.	The homepage successfully displayed the required elements for the application, including categories and items.	Normal
5	Category Selection Page	The category selection page should display a list of items based on the selected category.	The category selection page correctly displayed items based on the chosen category.	Normal
6	Item Details Page	The item details page should display detailed information about an item, including photos and descriptions.	The item details page displayed detailed information about the selected item.	Normal
7	Shopping Cart Page	The shopping cart page should display information such as the item, rental duration, and total cost, once added to the cart by the user.	The shopping cart page accurately displayed the information according to the user's input.	Normal
8	Payment Page	The payment page should display the recipient's bank account number and the total cost to be paid by the user, with a button for uploading payment proof.	The payment page displayed the bank account number, total cost, and a feature to upload payment proof.	Normal
9	Payment Successful Page	The payment successful page should indicate that the payment was successful, confirming that the transfer proof has been successfully sent to the system.	The payment successful page correctly displayed a confirmation that the payment proof had been received.	Normal

10	Order History Page	The order history page should display a list of orders previously made by the user.	The order history page successfully displayed the history of past orders made by the user.	Normal
11	Profile Page	The profile page should display the data of the logged-in account, as well as provide options for modifying account settings.	The profile page displayed the user's account data and available system settings.	Normal
12	Edit Profile Page	The edit profile page should allow the user to modify the personal data associated with their logged-in account.	The edit profile page successfully allowed the user to modify their account data.	Normal

The results from the black box testing indicate that the system performed well in all tested scenarios, with all core functionalities—such as user registration, login, browsing, ordering, and payment—working as expected. This outcome demonstrates that the application is functioning according to its design specifications and user requirements. The system's ability to handle these core features effectively confirms its potential to offer a seamless user experience. By focusing on the application's external behavior, black box testing provided an objective evaluation of the system's usability and performance. The testing confirmed that the user-facing features of the application, such as the user interface, functionality, and data processing, meet the expected standards. The successful execution of these features highlights the system's reliability in performing the tasks users will depend on.

Furthermore, the results reveal that the application is robust enough to handle typical user interactions and transactions smoothly, with minimal issues detected during testing. This outcome suggests that the system can support a wide range of user needs and that its performance is stable under normal operating conditions. However, while the results of the black box testing are promising, there are areas for further improvement. Future versions of the application could focus on enhancing the user interface design, improving system security, and adding more advanced features. Additionally, the application should undergo stress testing and performance optimization to ensure it can handle increased user loads and continue to perform effectively as the system scales. The system's successful performance in black box testing validates its ability to meet the functional requirements set forth in the research. While the system has proven to be reliable in its current form, further development and iteration are recommended to enhance its capabilities and address any emerging user needs. Continuous feedback and testing will ensure that the application remains a viable and user-friendly solution for camping equipment rentals

4. Related Work

The development of rental systems, especially those based on mobile and web technologies, has been an important area of research in recent years. Several studies have explored how technology can streamline rental processes, enhance user experience, and improve operational efficiency. While many advancements have been made, challenges such as mobile accessibility, real-time functionality, and user experience optimization still persist, making it crucial to further innovate and adapt rental systems to meet evolving user expectations.

One of the most relevant studies is by Akra and Syukhri (2023), who developed a web-based rental system for camping equipment. This system leveraged the CodeIgniter framework and MySQL database for managing transactions and inventory at Andalas Adventure in Padang, Indonesia. While the system successfully streamlined rental operations and inventory management, its reliance on a web-based platform posed limitations, particularly for mobile users. The lack of features for equipment delivery further restricted user convenience. These shortcomings highlight the need for mobile-first solutions, which can enhance accessibility and streamline rental processes by integrating delivery features, as addressed in the present research [1]. Similarly, Afriza Malna *et al.* (2023) developed a web-based system for hiking equipment rental, which automated transaction recording and inventory management. Despite the system's efficiency in managing inventory and transactions, it was restricted to web access, making it less useful for users who require on-the-go solutions. This research highlights the necessity of transitioning from traditional web-based systems to more flexible, mobile-based applications. The growing use of smartphones for daily tasks calls for

rental services that provide instant access to information and transactions, which can be better achieved through mobile applications [2].

In contrast, Suhenda and Hirawan (2018) proposed an Android-based application for both camping location identification and equipment rental. The application incorporated Location-Based Services (LBS) and Google Cloud Messaging (GCM) to assist users in finding camping locations and renting equipment. While this approach incorporated a mobile solution, the system faced performance issues and suboptimal user interface design. The interface was not fully optimized, which hindered the overall user experience, and the system encountered performance bottlenecks. These issues underline the importance of optimizing mobile applications to enhance both usability and performance in the rental industry [3]. Further expanding the scope of mobile-based rental systems, Virtalioka *et al.* (2024) explored a mobile-based car rental application that used Rapid Application Development (RAD) methodology. The use of RAD allowed for a quick and efficient development process, helping to streamline the car rental process. However, the study identified challenges related to payment security and transaction verification, highlighting the need to address security concerns in mobile applications, especially those dealing with sensitive financial data. This research stresses the importance of ensuring that rental systems not only function effectively but are also secure and trustworthy, particularly when dealing with user transactions and financial information [5].

In a different domain, Manu and Tantrisna (2020) studied the development of mobile applications for managing data in educational institutions for internal research and community service. While their system was not focused on rental services, it shared several similarities in terms of real-time data processing and mobile accessibility, both of which are critical components for modern rental services. This study underscores the importance of real-time data management in rental systems, ensuring that users and service providers can access up-to-date information quickly and efficiently, a requirement that the present study also seeks to address [12]. Additionally, Yulianto *et al.* (2021) developed an Android-based mobile application for equipment rental in the construction industry. This system integrated features such as inventory tracking and delivery management, which are also highly relevant for camping equipment rental services. Their study demonstrated the need for seamless integration between rental systems and delivery management. By offering features such as real-time tracking and efficient delivery processes, the research aligns with the goals of this study to enhance the user experience through improved logistics and service delivery [6]. Wibowo and Dwi (2022) examined the development of a mobile-based tool rental system for urban infrastructure projects. Their system utilized cloud-based storage for real-time updates, enabling users to track tool usage and maintenance. The integration of cloud technology for real-time monitoring and reporting is highly applicable to the camping equipment rental sector. The ability to monitor equipment availability and usage status in real time is crucial for both users and rental service providers, enhancing operational efficiency and customer satisfaction. This feature aligns with the objectives of the current study, which seeks to incorporate similar capabilities for better resource management in the camping equipment rental market [7].

Moreover, Nofrison and Widjaja (2023) explored the development of a mobile-based equipment rental application for sports equipment in urban areas. Their system focused on providing a user-friendly interface and seamless payment integration. Their research highlights the importance of making the rental process intuitive and secure, a concern that is directly addressed in the current study. By emphasizing user-friendly navigation and secure payment systems, this study aims to provide a seamless and trustworthy experience for users seeking rental services [8]. The research presented here demonstrates a clear trend towards the increasing adoption of mobile-based rental systems. These systems offer greater accessibility, real-time functionality, and ease of use compared to traditional web-based platforms [9][10]. However, many mobile rental solutions still face challenges related to user interface design, performance optimization, and security [11][12][13]. This study aims to address these gaps by implementing a mobile-first design, focusing on user experience optimization and secure payment processing for camping equipment rental services. By leveraging the Rapid Application Development (RAD) methodology, this research ensures that the solution is not only efficient but also adaptable to meet the growing needs of users in the digital age.

In addition to these studies, more recent research also suggests that rental systems can be improved by focusing on specific technological advancements. Riyanti (2024) examined the prototyping method for developing rental applications, underscoring the importance of adapting to technological trends, especially in emerging markets where such systems are still underdeveloped [14]. Similarly, Yunita (2024) explored the benefits of Android-based outdoor equipment rental systems, highlighting how mobile applications can transition rental services from traditional document-based systems to more efficient digital solutions [15]. Despite these advancements, there remain significant gaps in user experience optimization and system performance under varying user loads. Findings from black box testing of rental applications suggest that, while these systems handle typical user interactions effectively, there is still room for improvement in areas

such as interface design and security features [16]. This aligns with the observations made by Tuyambaze (2024), who emphasized the need for cloud-based solutions to enhance the operational efficiency and scalability of rental services, particularly in the car rental sector [17]. Furthermore, stress testing and performance optimization are necessary to ensure that rental systems can maintain reliability as user demand grows.

Future versions of rental applications should address these gaps by improving user interface design and incorporating advanced features that cater to diverse user needs. As suggested by Johnson and Plepys (2021), continuous feedback and iterative development are crucial for adapting to shifting user preferences and market dynamics [18]. The need for robust security measures in rental systems is also critical, as highlighted by Alghobiri (2020), who stressed the importance of secure processing systems that could be applied to rental applications [19]. While current rental systems show promising capabilities in functionality and user interaction, ongoing research and development are essential to address existing limitations and enhance overall user experience. By integrating user feedback, adopting advanced technological features, and implementing rigorous testing protocols, rental applications can continue to evolve, remaining effective and user-friendly in a rapidly changing digital landscape.

5. Conclusion

This research successfully developed an Android application for camping equipment rentals at Langit Adventure. The study focused on the design and implementation of a rental system aimed at improving the existing rental process, which was traditionally conventional and inefficient. The application was developed to assist rental shops in promoting their products and to simplify the process for renters to search for and rent equipment based on their specific needs, using the Android Studio platform. The results from black box testing confirm that the designed system meets the expected requirements. However, to ensure that this rental application meets the standards and expectations of users, several key aspects must be addressed in its development process. These aspects include various elements that will guarantee the application not only functions effectively but also provides an optimal and satisfactory user experience. Such improvements may involve further development of the system, bug fixes, and additional features to enhance the overall functionality and usability of the application. This research highlights the importance of continuous evaluation and iteration to keep pace with the evolving needs of users and to ensure that the system remains effective and user-friendly. Further improvements in the application will help in meeting the growing demands for more efficient and accessible rental solutions in the camping equipment sector.

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