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Design and Implementation of a Construction Budgeting Application for Residential Projects on Android Platform Using the Waterfall Method

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Abstract
Building a home is one of the most important and basic human needs. However, uncertainty around construction schedules and cost details often pose significant obstacles for individuals and families. The process can be overwhelming, especially for those with less experience in building homes. This is where information technology can play a vital role in streamlining the home-building process. By harnessing the power of technology, the building process can be simplified, providing greater transparency and convenience to users. To address these challenges, the Halo Rumah app was developed. The app helps users choose the right design and materials for their home construction. The app has an intuitive interface that allows users to explore a variety of home designs tailored to different preferences and choose materials that suit their needs and budget. Additionally, the app offers a range of advanced tools that help users estimate and calculate the costs of building a home, giving them a clear picture of their financial needs before starting the building process. By integrating these features, the Halo Rumah app ensures that users can make informed decisions, reduce uncertainty, and plan their dream home more effectively. Based on black box testing of 5 features tested on the Halo Rumah application, the research results show that the 5 features in the application can function according to the expected results.

1. Introduction
Along with the rapid advancement of information technology, its benefits are increasingly felt in various aspects of life. Information technology has become the backbone of fast, practical, and flexible access to information. This ongoing development is reflected in the emergence of various high-tech devices that can improve work and daily activities. In addition to providing convenience, technology expands knowledge beyond spatial and temporal boundaries [1]. Technology plays an important role in supporting various fields, including work and education [2]. Every innovation is designed to provide a positive impact, simplify tasks, and increase efficiency in various sectors. Over the past decade, various technological innovations have significantly improved various aspects of human life [3].

One of the basic needs for individuals and families is to have a home, which represents not only shelter but also security and comfort. In general, a house is defined as a building used as a residence for a certain period [4]. However, building a house presents various challenges, such as determining the right time to start, budget constraints, and inadequate planning. Limited land availability further complicates the process, requiring efficient utilization [5]. In addition, preparing a detailed budget plan can be complicated, especially for those who are not familiar with construction requirements. Poor planning and lack of understanding of functional home design often led to cost overruns, time inefficiencies, and unsatisfactory construction results [6]. Therefore, addressing these challenges requires practical, accessible, and cost-effective solutions.

Advances in information technology provide opportunities to streamline home-building planning. One such innovation is Halo Rumah, a digital application designed to help users choose the right home design and construction materials while preventing unnecessary expenses. Unlike existing tools, Halo Rumah integrates key features such as cost estimation, project scheduling, and real-time progress monitoring, offering a comprehensive and easy-to-use solution. The application aims to make home building more efficient, affordable, and accessible. Through this study, we analyze the effectiveness of Halo Rumah in improving construction planning and decision-making. These findings are expected to contribute to the development of digital solutions for home building, ultimately simplifying the process for a wider audience.

2. Research Method

This study applies to the Waterfall Method, which is a software development model known as a linear and systematic approach. The Waterfall Method is a method that provides a sequential or ordered software life cycle approach [7]. The waterfall model provides a sequential or ordered software life cycle approach starting from analysis, design, coding, and testing [8].

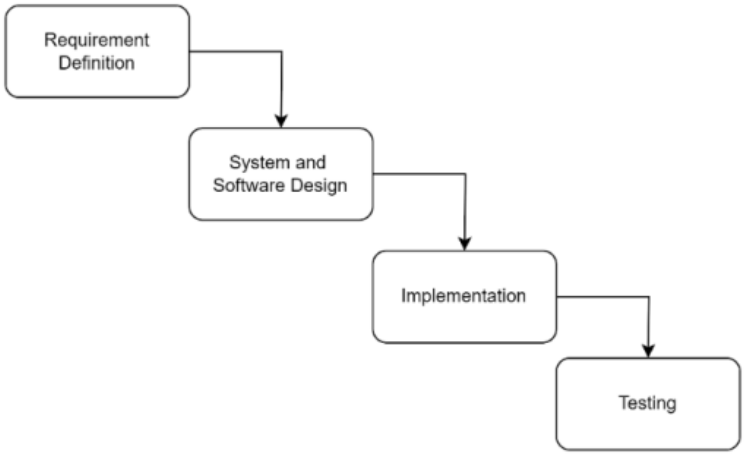

Figure 1. Waterfall method

The Waterfall model is a linear and sequential software development approach, where each phase must be completed thoroughly before moving on to the next phase. The first phase is Requirements Gathering and Analysis, where system developers are required to communicate to understand the software expected by users and the limitations of the software. Information can be obtained through interviews, discussions, or direct surveys. Information is analyzed to obtain data needed by users [9].

Next begins the System Design phase, System design is a design process that starts with the use of case diagrams, activity diagrams, and class diagrams to create user interface designs for the system to be created. The function of this system design is so that during the implementation process or writing code it is easier, because what will be created already has a clear picture [10].

Then, in the Implementation stage, the interface design of the application to be built is carried out. At this stage, coding or creation of application programs that have been designed so that they can be used by users is carried out [11]. After the software has been completely developed, the Integration and Testing stage begins. At this stage, the modules that have been developed are integrated into a complete system. Testing is carried out from the program aspect, combined, and verified to see if the system is ready to meet the desired needs [12]. The testing method used is black box testing, namely testing that is carried out based on application details such as application display, functions in the application, and the suitability of the function flow with the work system desired by the designer [13]. Any bugs or problems found during testing will be fixed before the software moves to the next stage.

After the software is considered ready, the Deployment stage begins, namely when each program or program unit is combined and tested as a complete system to ensure whether it meets the software needs or not. After testing, the software can be handed over to the customer [14]. The last stage is Maintenance, where the implemented software is continuously maintained to ensure optimal performance. This maintenance can include software updates, fixing bugs discovered after implementation, and enhancing the system to meet evolving user needs. This maintenance phase often lasts for a long period because the software needs to adapt to changing requirements and the environment [15].

3. Results and Discussion

3.1 Business Queue of the Proposed System

The proposed system includes several key features to assist users in planning construction projects. First, the Budget (RAB) Calculation feature allows users to input the land and house area, determine the number of rooms, and receive an estimate of the construction cost based on the data provided. After that, users can access the Consultation Service feature to select and directly contact a consultant for further discussion. In addition, the Reference Input feature allows admins to provide references for prices, materials, furniture, and design options, which users can view through the Unit Price, House Concept, Material, Furniture, and Search features.

3.2 Data Flow Diagram (DFD) in System

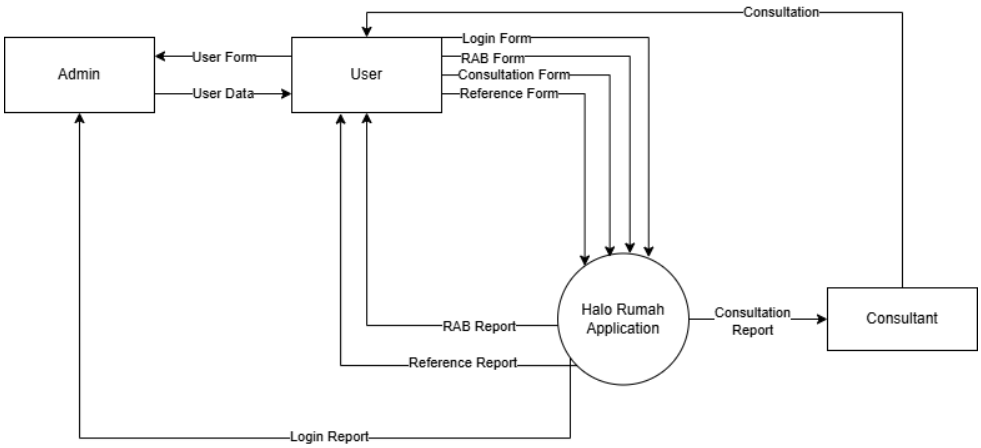

Figure 2. Data flow diagram

The Data Flow Diagram (DFD) in Figure 2 illustrates the data flow in the Halo Rumah Application, detailing how each entity processes information in the system. The system involves four main entities: Admin, User, Halo Rumah Application, and Consultant. The admin is responsible for managing user data and reference information by entering and updating user records, monitoring reference details, and generating Login Reports to monitor user activity. Users interact with the system by submitting various forms, including the Login Form, RAB Form, Consultation Form, and Reference Form. These inputs are then processed by the system, which validates and securely stores the data before generating reports such as RAB Reports and Reference Reports for users. Through the application, users can also access the consultation service, which allows them to select and communicate with consultants.

As the core of the system, the Halo Rumah Application manages all incoming data by ensuring that user input is validated and stored correctly. The application also processes Consultation Forms and generates Consultation Reports, which are then forwarded to consultants. Consultants use these reports to review the details provided by users and offer relevant feedback or guidance. The integration of these processes within the system ensures a structured and efficient workflow, facilitating smooth data exchange between all system components.

3.3 Proposed ERD System Design

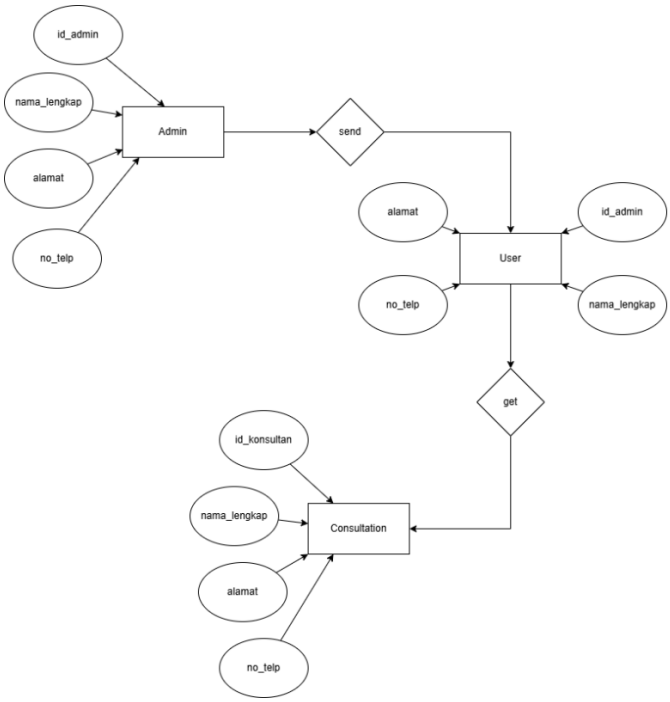

Figure 3. ERD Diagram View

Based on Figure 3 illustrates the relationships and data flow within the Halo Rumah Application system, involving three main entities: Admin, User, and Consultation. Admin is responsible for managing user data and has attributes such as id_admin, nama_lengkap, alamat, and no_telp. Admin sends data to User through the send process, including address and phone number information. The user then receives and stores this information and has attributes like id_admin, nama_lengkap, alamat, and no_telp. Additionally, the user can retrieve consultation-related data through the get process.

Meanwhile, the Consultation entity stores information about consultants, including id_konsultan, nama_lengkap, alamat, and no_telp. This data can be accessed by users when they want to request a consultation. The relationships between these three entities show that the admin manages user information, the User interacts with the system to access consultation services, and the Consultation contains consultant information available in the system. This diagram represents how data flows within the system to ensure smooth administrative and consultation processes.

3.4 Implementation Stage

At the implementation stage, the development and application of various pages in the system were carried out. In Figure 4, the Consultation page displays a list of consultants that clients can contact for assistance or consultations regarding house design and planning. Clients can choose a consultant that best suits their needs. Next, in Figure 5, the Create Page Display serves as the house creation page. This page includes a Budget Plan (RAB) calculation feature and a form for submitting house design requests according to the client's preferences.

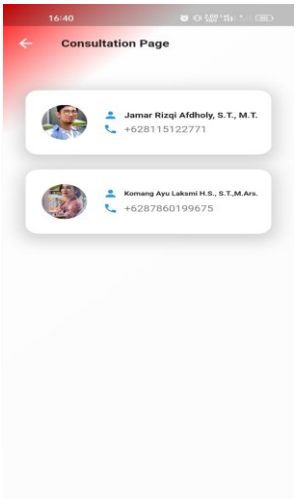

Figure 4. Consultation Page View

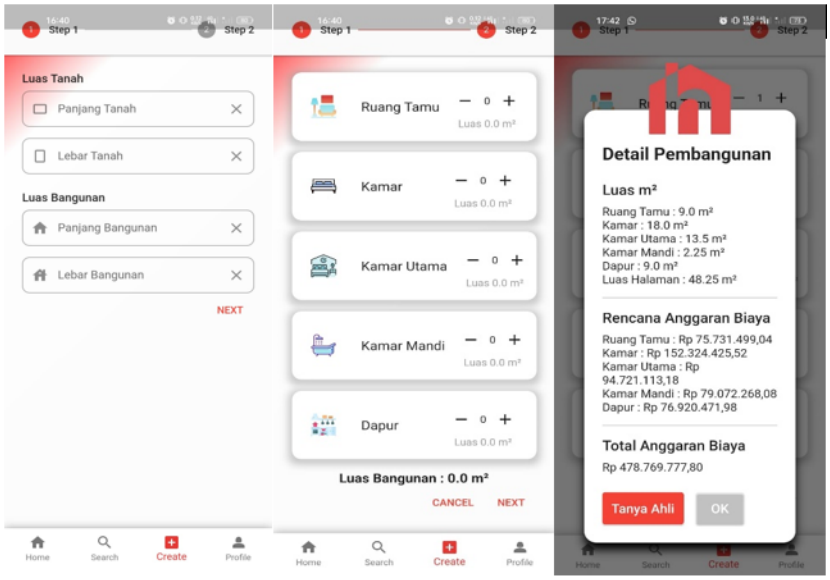

Figure 5. Create page view

3.5 Testing Stage

At this stage, testing focuses on the input given to the software and the output produced, without considering the internal structure, source code, or other implementation details. This testing is done to verify whether the application or software functions according to the specifications set in the design stage. Black-box testing is presented in the following table. Based on Table 1, Black-box testing was performed on 5 features, and the results show that all tested features meet the expected results.

Table 1. Blackbox testing

No.	Type of Testing	Test Condition	Expected Results	The Result Obtained	Information
1.	Login Page	Displaying Login Page	The application displays the login page	The application successfully displays the login page	Matching
		If clicked login	The user logs in and enters the dashboard page	The user successfully logged in and entered the dashboard page	Matching
2.	Dashboard Page	Displaying Dashboard Page	The application displays the dashboard page	The application successfully displays the dashboard page	Matching
3.	Search Page	Displaying the search page	The application displays the search page	The application successfully displays the search page	Matching
		If you click on the living room feature	The application displays the living room page	The application successfully displays the living room page.	Matching
4.	Consultation Page	Displaying the consultation page	The application displays the consultant page	The application successfully displays the consultant page	Matching
5.	Create Page	Displaying the create page	The application displays the create page	The application successfully displays the create page	Matching

4. Conclusion

Based on the research that has been conducted, it is concluded that the Halo Rumah application is an effective solution to help people calculate the Cost Budget Plan (RAB) for building a house efficiently so that it can minimize additional time and costs. This conclusion was obtained through the development and testing process, based on black box testing of the 5 features tested on the Halo Rumah application, the results showed that the 5 features in the application can function according to the expected results. The test results show that all features function as expected, this shows that this system has good reliability and usability.

For further research, further research can examine the integration of real-time material price updates to improve cost accuracy. In addition, the development of a system with artificial intelligence-based recommendations for budget optimization can provide more personalized advice for users. This improvement will not only improve the functionality of the application but also be the basis for further research on digital budgeting tools for construction planning.

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