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Web and Mobile-Based Online Watch Auction Application Using Waterfall Method

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ABSTRACT

The advancement of mobile technology has driven the creation of digital solutions that simplify various activities, including the auction process. This study aims to design and develop a mobile-based online watch auction application using Flutter as the user interface development framework. In addition to the mobile application for users, a web-based admin dashboard was also developed to manage auction data, including creating auctions. The backend system was developed using Node.js with PostgreSQL as the database management system. The mobile application provides key features such as user registration, login, viewing auction lists, placing bids, and viewing bidding history. Meanwhile, the web admin system enables administrators to manage auction items and monitor the auction process efficiently. The test results show that the main features function according to user needs, and the system runs stably on both mobile devices and web platforms. This application is expected to serve as a practical and easy-to-use digital auction platform.

Keywords: *Auction, Flutter, Node.Js, Postgresql, Mobile Application, Web-Based System.*

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INTRODUCTION

Social media has become an important platform for communication and online transactions. In addition to conventional buying and selling activities, social media is also widely used to conduct online auctions, allowing participants to place bids without physical presence.

According to Gunawan et al. (2023), online auctions are an information technology-based system for procuring goods and services that facilitates the process of planning needs, requests and offers, and conducting auctions. The implementation of online auctions aims to increase the efficiency and transparency of procurement and to obtain goods and services of optimal quality.

In the auction system on social media, auctions are held by individuals who have popularity and trust from consumers. With the auction system, auction participants will

obtain products at prices that are competitive with other participants who follow the auction system (Farisi and Kusumawati, 2022).

In this context, online auctions make it easy for consumers to participate in the auction process without having to be physically present, and provide benefits for sellers in obtaining the best price for their products (Zaenuri and Arifin, 2023). This auction system is in high demand for certain product categories, especially items that have high collection or aesthetic value, one of which is watches.

Auction organizers use social media by creating posts containing product information and writing various rules and instructions on how to participate in the ongoing auction (Zaenuri and Arifin, 2023). Interested auction participants then submit bids at prices set by the organizers, and the auction winner is announced by the auction account after the auction time ends.

Transacting through social media has problems. The first problem is that social media platforms have policies that prohibit users from conducting certain sales transactions to protect users from risky transactions (Pranata, 2023). Online auctions on social media do not have a clear legal basis, which may result in the loss of legal protection for participants and sellers (Chandra et al., 2025).

The second problem is that transactions via social media carry the risk of cyber crimes such as fraud (Fauzi et al., 2023). In online transactions conducted through social media platforms, the lack of consumer protection mechanisms can increase the risk of problems and financial losses for users (Ponten, 2023).

An online auction application system that supports the mobile technology-based watch auction process is a solution to several problems caused by transactions via social media. The waterfall method was chosen as the system development approach because it has a number of advantages. The waterfall method is a phased system development approach, in which each phase must be completed before entering the next stage (Batubara et al., 2023). The waterfall method was chosen because the process is structured, systematic, and well-organized.

The development of web-based auction systems has been carried out extensively by previous researchers. Sawqi and Juaniato (2023), for example, designed a website-based used clothing auction application using the Rapid Application Development (RAD) method with four types of users, namely visitors, bidders, auctioneers, and administrators. In addition, Surya and Haromain (2023) also developed a web-based car auction system using CodeIgniter 3, MySQL, and Socket.IO with the support of several admin levels for more complex data management. Unlike previous studies that mainly focus on web-based auction platforms, this research develops an integrated mobile and web-based auction system. The mobile application is built using Flutter to support cross-platform devices, while a web-based admin dashboard is used to manage auction data. This integration allows administrators to manage auctions efficiently while enabling users to participate through mobile devices.

Technology selection is an important consideration in system development. For the web-based admin system, Node.js is used as the server-side programming language and

PostgreSQL as the database management system. Node.js was chosen because it is flexible, easy to implement, and has extensive community support and documentation, which speeds up the development process. Meanwhile, PostgreSQL was chosen because it is open-source, has a high level of reliability and security, and supports advanced features such as ACID compliance transactions, optimal indexing, and complex data processing capabilities, enabling it to support the needs of an integrated and scalable sales system.

The mobile system is designed to facilitate customers in conducting online watch auction transactions in a practical and real-time manner. In its development, Flutter was chosen as the main framework due to its ability to build cross-platform mobile applications using the same code base. Flutter is an open-source framework developed by Google that allows applications to run on Android and iOS operating systems without requiring separate development for each platform (Wijaya et al., 2023). As part of the Software Development Kit (SDK), Flutter is designed to produce a responsive user interface (UI) with high performance close to native applications. In addition, updates to Flutter 2 further expand cross-platform support with more comprehensive capabilities for various operating systems (Frendiana, 2024), making it highly relevant for supporting the development of dynamic and interactive auction systems. In addition, this research provides a REST API architecture design that enables real-time data synchronization (Pangestu et al., 2023). REST API synchronizes data between the web-based admin system and the customer's mobile application, including updates on the highest price, auction status, and bidding history.

This research contributes by developing an integrated web and mobile-based auction system that improves transparency, accessibility, and efficiency in online watch auction transactions. That can be adopted by similar businesses with relatively affordable technology investments. This study also demonstrates the effectiveness of the Waterfall method in building auction systems through structured stages, including requirements analysis, design, implementation, and testing.

METHOD

The method used in this study was the waterfall system development model. This model generally includes analysis, design, coding, testing, and implementation (Mukhlis, 2023). The Waterfall method was chosen because it provides a structured and systematic development process. This approach is suitable for systems with clear requirements, such as the auction application developed in this study. Each stage, including analysis, design, implementation, and testing, is completed sequentially to ensure consistency and proper documentation during the system development process.

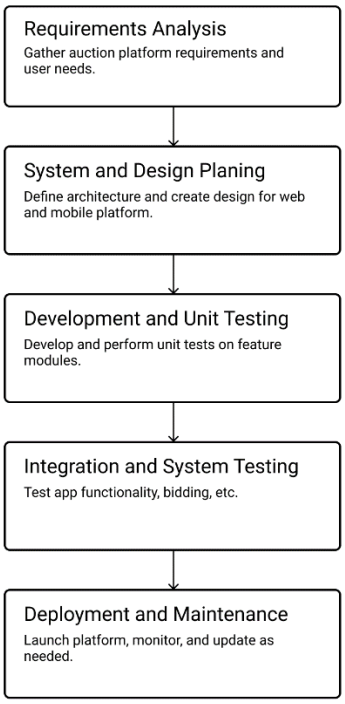

Figure 1. Waterfall Method

During the analysis phase, functional requirements for the system were identified, such as user registration and authentication, watch data management, bidding mechanisms, and determining auction winners based on time and highest price. In addition, non-functional requirements such as system performance, user data security, and usability were also identified to support the overall quality of the application.

The design stage focused on developing the system architecture, database design, and Flutter-based application interface design. This design is important to ensure that the auction process flows in a structured manner, from product publication and user bidding to auction closing and result determination. With a clear design from the outset, each system module can be developed according to the specified requirements.

Next, the coding stage is carried out based on the results of the design that has been compiled, so that feature implementation can run consistently and in a focused manner. In the testing stage, the system functionality was evaluated using the black-box testing method. This testing focuses on validating whether each system function operates according to the specified requirements without examining the internal code structure. Several test scenarios were designed for both the web admin system and the mobile application, including authentication, auction data management, bidding processes, notification delivery, and payment processing.

The success criteria for each test case were determined based on whether the system produced the expected output for a given input. If the output matched the expected result and the feature operated without errors, the test case was categorized as Passed.

With a phased and documented development model, the waterfall method supports the creation of an online watch auction application that has a clear system structure, a systematic process flow, and consistency between planning and implementation.

Data Collection

This study used several data collection methods to support the development of an online watch auction application, namely:

1. A literature review was conducted by examining journals, books, articles, and previous studies related to online auction systems, e-commerce, and mobile application development as a theoretical basis for system design.
2. Interviews were conducted with Rangga Muslim, one of the owners and managers of the watch auction through the Upbid.id Instagram account, to obtain information about the business flow, auction mechanisms, user needs, and the processes involved in practice.
3. Observations were made by directly monitoring auction activities through Instagram to understand the interactions between organizers and participants, as well as the bidding process flow during the auction session.

Architecture Model

The model architecture used in this study consists of five components. These components are shown in the figure below:

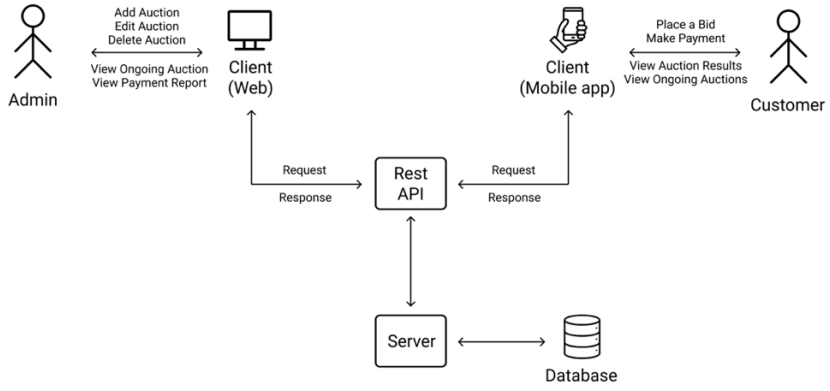

Figure 2. Architecture Model

The system architecture consists of a mobile application, a web-based admin interface, a backend server, and a database that are interconnected through a RESTful service. The mobile application was developed using the Flutter framework, while the web-based admin interface was built using HTML. Both client applications communicate with the backend through a REST API.

The backend is implemented using Node.js, which functions as the server responsible for processing requests from both the mobile and web applications. The server

handles business logic such as managing auction data, processing bids, and handling transaction information. All data is stored and managed in a PostgreSQL database. Through this architecture, the REST API enables data exchange and synchronization between the mobile and web systems, allowing features such as bid updates, auction status changes, and transaction data to be processed consistently.

Design System

The system design stage is carried out to visually model system requirements in the software development process. In this study, modeling uses Unified Modeling Language (UML), which includes use case diagrams and Entity Relationship Diagrams (ERD).

Use case diagrams serve to describe system functionality and requirements that must be met from the user's perspective. Actors are entities, both human and machine, that play a role in performing certain tasks or activities through the system (Fajarwati, 2023).

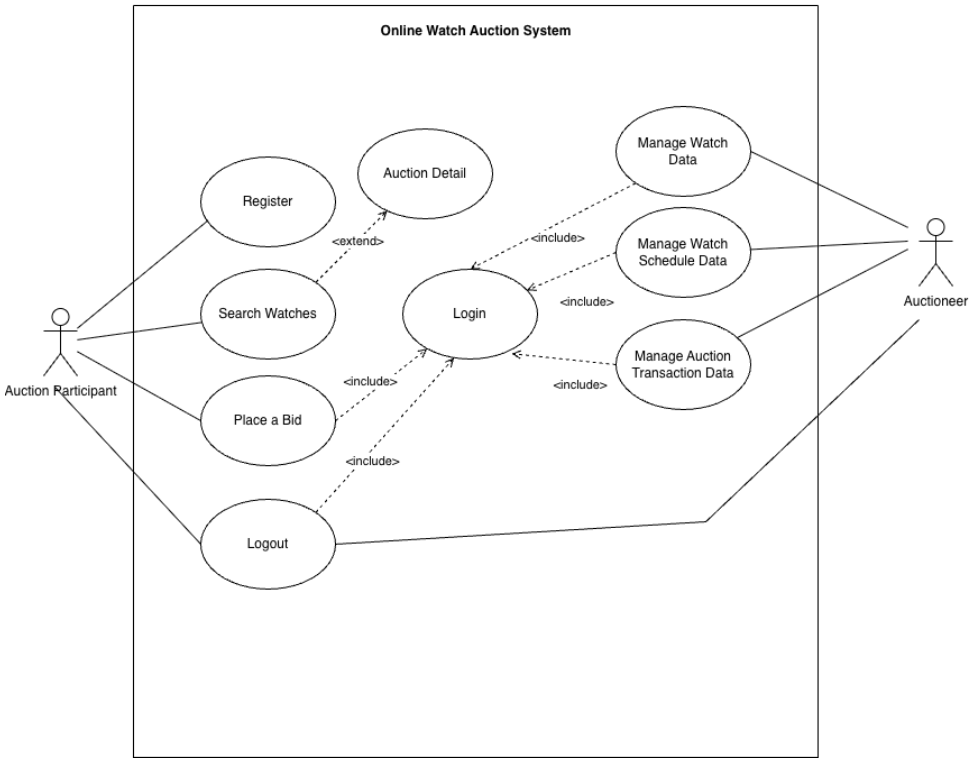

Figure 3. Use Case Diagram

An Entity Relationship Diagram (ERD) is a conceptual data model used in database design. Its main components include a set of entities, relationships between entities, and integrity rules. A set of entities represents objects in the real world that have unique identities and are distinct from one another (Ridwan et al., 2022).

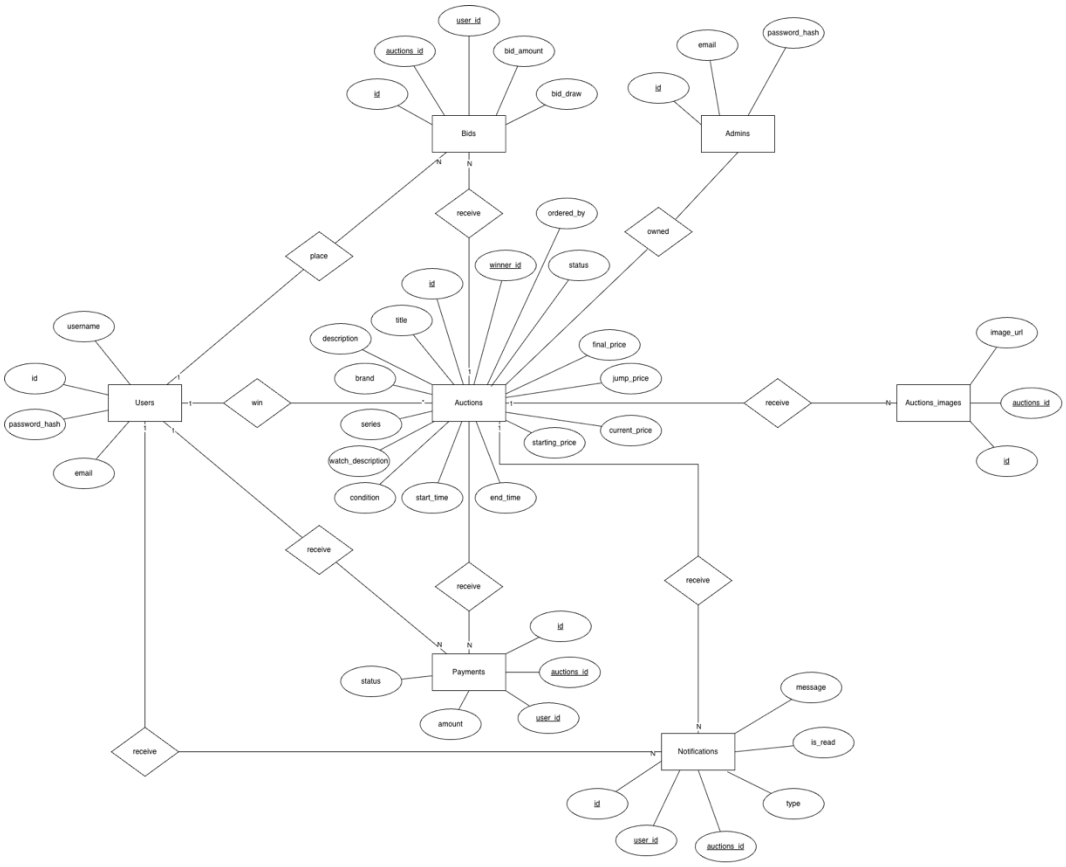

Figure 4. Entity Relationship Diagrams (ERD)

FINDING AND DISCUSSION

RESEARCH RESULT

The online watch auction system consists of two main components, namely a web-based application used by administrators to manage data and auction processes, and a mobile application used by auction participants to place bids and monitor the auction process.

A. Web Admin System

1. Web Admin Login Page

   Displaying the login page for administrators. Administrators enter valid usernames and passwords into the system.

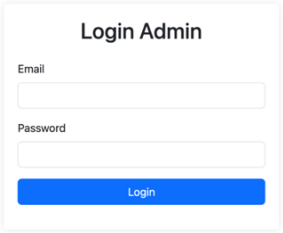

Figure 5. Admin Login Page

2. Web Admin Auction Dasboard

Display Auction List, Create New Auction, and download payment summary. As well as Actions to Edit and Delete Auctions.

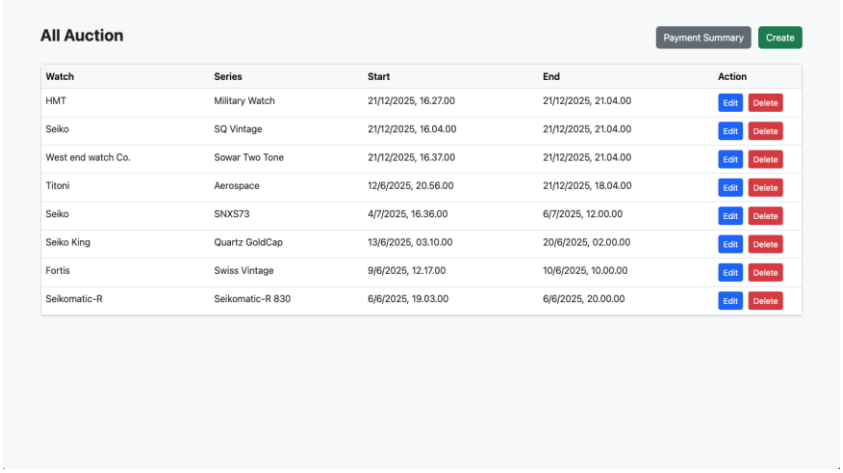

Figure 6. Admin Dasboard

3. Auction Creation Web Page

Displaying inputs to create an auction for administrators, including Title, Auction description, Brand, Series, Watch description, Condition, Start time, End Time, Starting price, Jump price, and images.

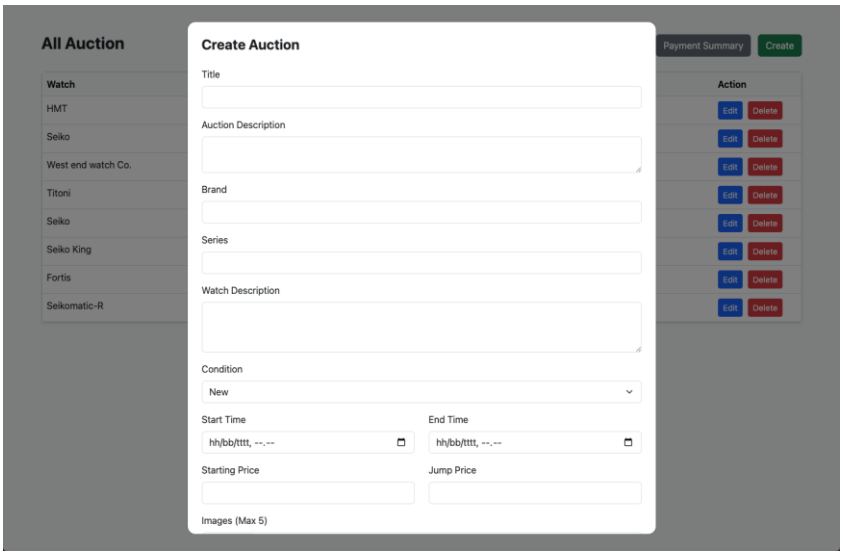

Figure 7. Create Auction

4. Auction Recap Results

Displaying the recap of successful auction payments downloaded in PDF format.

Rekap Pembayaran Lelang

No	Nama User	Judul Lelang	Jumlah	Status	Tanggal
1	pipi	Fortis	Rp 1000000.00	pending	10/6/2025
2	egi	Seikomatic-R	Rp 2300000.00	completed	8/6/2025

Figure 8. Auction Recap Results

B. Mobile Auction Participants

1. Mobile App Splash Screen

Splash screen is displayed when the application is first opened and automatically closes when the display time is complete, after which it will redirect to another page. The splash screen is set to display for three seconds, after which it will redirect to the login page.

Figure 9. Mobile Splash Screen

2. Mobile App user Registration Page

The registration page for users to create an account so they can participate in the auction. Users enter their name, email address, password, and repeat the password to verify it matches.

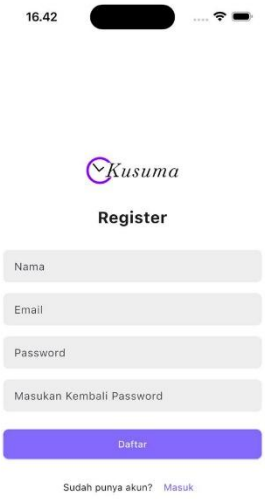

Figure 10. Mobile Registration

3. Mobile App User Login Page

Users need to enter their email and password that match the data registered in the users table. The system will then verify the validity of the data. If the data is correct, users will be redirected to the home page.

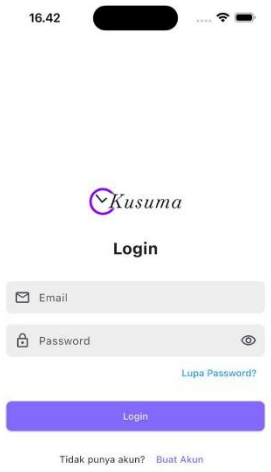

Figure 11. Mobile Login

4. Mobile App Homepage

Users can view the latest auctions and bids made by other users.

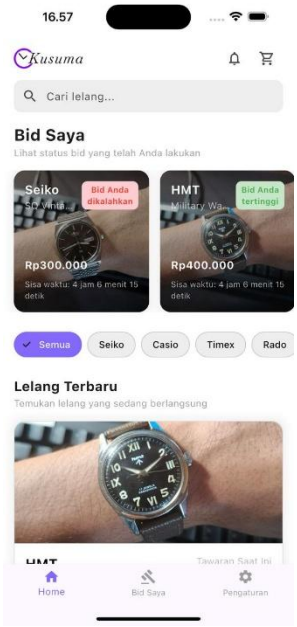

Figure 12. Mobile Homepage

5. Mobile App Auction Detail Page

Displays information about the auctioned watch, including the title, series, description, condition, starting bid, bid increments, auction end time, and list of bidders. Users can place a bid by tapping the “Place a Bid” button.

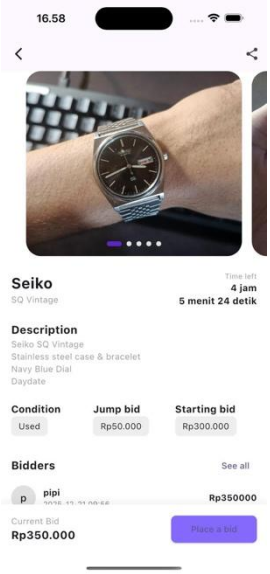

Figure 13. Auction Detail Page

After pressing the Place Bid button, the system displays the minimum bid value allowed. Users can adjust the bid amount using the plus (+) and minus (−) buttons according to the bid increment rules set by the system.

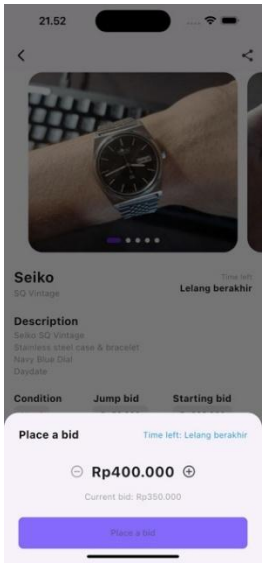

Figure 14. Place a Bid

6. Mobile App Bidder Page

Displays auction information for users who have placed bids, including their bid amount, countdown time, and bid status (highest or outbid).

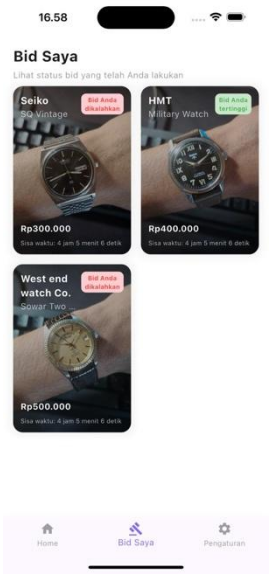

Figure 15. Bidder Page

7. Mobile App Notification Page

Page for viewing notifications. If a user participates in an auction, they will receive a notification informing them whether they have won or lost the auction.

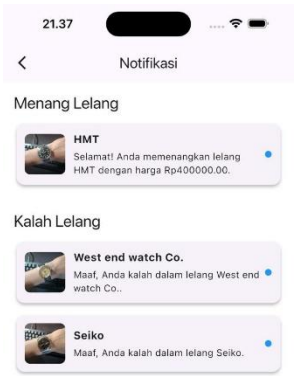

Figure 16. Notification Page

8. Mobile App Payment Page
   The payment page is used to process payments for auction winners and provides information such as the subtotal and the total amount to be paid.

Figure 17. Payment Page

9. Mobile App Setting Page
   For users to log out of their accounts.

Figure 18. Setting Page

C. Black Box Testing

Black Box Testing is a software testing method that focuses on testing system functions based on requirements and specifications without looking at or knowing the structure of the program code inside. This testing is carried out by providing certain inputs into the system, then observing the output produced to ensure that it is as expected.

The main purpose of black box testing is to verify that every feature or function of the application works correctly according to user requirements, detect functional errors, and ensure that there are no bugs in the system's input and output processes.

Table 1. Results of Black-Box Testing on the Web Admin System

No	Test Case	Test Scenario	Expected Result	Status
1	Admin Login	Admin enters valid username and password, then clicks login	System successfully authenticates and redirects to admin dashboard	Passed
2	Admin Login (Invalid)	Admin enters incorrect username or password	System displays error message and denies access	Passed
3	Add Watch	Admin inputs valid watch data and submits the form	Watch data is successfully saved and displayed in the watch list	Passed
4	Add Watch (Invalid)	Admin submits the form with incomplete or invalid data	System displays validation error and prevents submission	Passed
5	Edit Watch	Admin updates existing watch data with valid information	System successfully updates and saves the modified watch data	Passed
6	Delete Watch	Admin deletes selected watch data	System successfully removes watch data from the database and watch list	Passed
7	Download Recap	Admin clicks download recap/report button	System generates and downloads the recap/report file successfully	Passed

Table 2. Results of Black-Box Testing on the Mobile Application

No	Test Case	Test Scenario	Expected Result	Status
1	Customer Register	User enters valid registration data and submits the form	System successfully creates a new account and redirects to login or home page	Passed
2	Register (Duplicate Email)	User registers using an email that is already registered	System displays error message indicating email	Passed

			already exists and prevents registration	
3	Customer Login	User enters valid email and password	System successfully authenticates and redirects to home page	Passed
4	Login (Invalid)	User enters incorrect email or password	System displays error message and denies access	Passed
5	View Watches Catalog	User accesses the watch catalog page	System displays list of available watches with correct details	Passed
6	Place a Bid	User enters a valid bid amount higher than current highest bid and submits	System successfully records the bid and updates the highest bid in real-time	Passed
7	My Bids Page	User opens “My Bids” page	System displays list of auctions the user has participated in with current status	Passed
8	Notification (Win)	User wins an auction	System sends and displays winning notification to the user	Passed
9	Notification (Lose)	User loses an auction	System sends and displays losing notification to the user	Passed
10	Payment	User completes payment for a won auction	System successfully processes payment and updates auction status to paid	Passed
11	Logout	User clicks logout button	System successfully logs out user and redirects to login page	Passed

Based on the black-box testing results in Tables 1 and 2, all main system functionalities operate according to the specified requirements. The web admin system and mobile application successfully perform key functions such as authentication, auction management, bidding, notifications, and payment processing. These results indicate that the system is functionally stable and capable of supporting the online watch auction process.

DISCUSSION

On the web section, the system can only be accessed by administrators after logging in. Administrators are required to enter their registered email and password into the system. Once authentication is successful, administrators will be directed to the main

page (admin home), which is the control center for managing auction data. On this page, administrators can view a list of all ongoing and completed auctions. This information is presented in a concise and structured manner, making it easy for administrators to monitor the auction process.

In addition, administrators have full access to create, modify, and delete auction data. On the auction creation page, administrators are asked to fill out a form containing detailed information about the watch to be auctioned, such as the auction title, description, starting price, bid increments, start and end times, and upload product images. All data entered will be stored in the database through the backend and automatically displayed in the mobile application.

If changes are needed, the admin can access the auction edit page to update previously created auction product information, including replacing product images. All changes are immediately updated in the system and accessible to mobile users in real time. The admin can also delete invalid or canceled auctions using the provided delete function, with a confirmation displayed before the deletion process to prevent errors.

An additional feature available on the web page is the ability to download a summary of the auction results in PDF file format. This feature makes it easy for administrators to save or print auction result reports, such as participant lists, highest bids, and auction winners. This function is very useful for documentation and administrative reporting purposes.

The mobile application is specifically designed for users (bidders) who want to participate in the watch auction process directly through Android or iOS devices. When opening the application for the first time, users will be greeted by a splash screen for a few seconds before being directed to the login page. For new users, there is a registration feature that allows them to create an account by filling in their name, email, and password. After successfully registering, users can log in using the data they have registered. The system will verify the login data via API, and if valid, users will be directed to the application's home page.

The home page is the center of user activity, displaying various auction products that are currently ongoing. On this page, users can also see navigation buttons to access the “My Bids” page, which contains a list of auction products they have participated in. On the “My Bids” page, users can monitor the status of their bids whether they are currently the highest bidder or have been overtaken by other users. This information is accompanied by a countdown to the end of the auction, providing a real-time experience of following the auction process.

Another important feature is the notification page. If users have participated in an auction, once the auction time has ended, the system will send a notification informing them whether they have won or lost the auction. If users are declared the winners, they will be directed to the payment page. On this page, users can see payment details, including the subtotal and total amount to be paid. This payment process is connected to the backend to record the user's payment status.

The bottom navigation bar also provides quick access to two important features, namely “My Bids” and “Settings”. The “My Bids” page serves as a hub for monitoring all of the user's bidding activities. Meanwhile, on the “Settings” page, users can log out of the application when they have finished using the service. All of these features are designed to provide convenience, transparency, and ease of access in participating in the digital watch auction process.

Compared to auction transactions conducted through social media, the developed system offers several advantages. The application provides a structured auction environment, transparent bidding processes, and centralized data management through the admin dashboard. Users can also monitor their bidding status in real time through the mobile application, improving convenience and user experience.

Despite its advantages, the system still has several limitations. The current version does not yet integrate an automated payment gateway and still relies on manual payment confirmation. In addition, system scalability and security mechanisms can be further improved to support larger numbers of users and more complex auction transactions.

CONCLUSION

This research successfully designed and implemented a web-based and mobile online watch auction application using the Waterfall development method. The system was built with a REST API architecture that integrates the web platform as an admin panel and a mobile application as the main medium for users to participate in the auction process. The backend was developed using Node.js with PostgreSQL database management, while the mobile application was built using Flutter so that it can run on Android and iOS platforms.

The application of the Waterfall method allows each stage of development from requirements analysis, system design, implementation, to testing to be carried out in a structured and systematic manner. Based on the results of black box testing, all main features such as user registration and authentication, auction data management, real-time bidding mechanisms, notifications, and payment processes have been running in accordance with the functional requirements of the system.

Overall, the developed application provides a more transparent, secure, and efficient auction solution compared to auctions still conducted via social media. This research contributes to the development of an integrated web and mobile-based digital auction system that can be adapted for various other auction business needs.

For future development, the system can be improved by integrating secure payment gateways, enhancing security mechanisms, and implementing real-time auction technologies such as WebSocket-based bid synchronization to improve responsiveness during the bidding process.

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