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Design and Development of a Mobile Based Reservation System for Muslims in Medan

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ABSTRACT

Salon Muslimah Dina is a privately owned business offering a variety of beauty treatments specifically for women. Operationally, the salon still uses a manual system, requiring customers to visit in person or contact them via WhatsApp to make reservations or inquire about services. The high volume of inquiries slows down the service process, as the salon must respond to messages individually. Furthermore, the lack of transaction data records often results in long wait times for walk-in customers and inconsistencies in service delivery. Important information such as operating hours, service types, prices, and locations are also not communicated effectively to potential customers. To address these issues, an online reservation system was developed to disseminate information and facilitate service bookings. This system utilizes the FCFS (First Come, First Served) scheduling method, where services are processed in the order of arrival and completed one by one. This method is considered fair because the entire process is handled in the order in which they arrived. The development results demonstrate that the reservation system has been successfully developed, with features that simplify customer bookings without having to visit in person, saving time and money. This system also helps salons manage service data, schedules, and reservation information more optimally and efficiently in the future.

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1. Introduction

The beauty industry is one of many industries experiencing rapid development and significant change in line with technological advancements in the current era of globalization [1]. The utilization of information technology has become a crucial component in business operations to achieve service efficiency, speed, and accuracy. The availability of mobile-based devices offers an effective alternative solution for connecting service providers with customers, enabling easy access to services anytime and anywhere. Given this trend, implementing a computer-based information system is essential for maintaining the overall effectiveness of business operations [2].

Dina Muslimah Salon in Medan, as a private beauty salon business, currently still operates using a manual system. Based on observation, the customer reservation process relies on unstructured communication such as WhatsApp or direct visits [3]. The high volume of inquiries often slows down the service response because staff must reply to messages individually, leading to service inefficiency. Furthermore, the lack of a computerized system for recording transaction data and service history results in

long waiting times and queue uncertainty for walk-in customers. The inadequate dissemination of important information, such as location, service types, fees, and operating hours, also hinders potential customers. This fundamental issue indicates a significant gap between the need for efficient queue management and the currently conventional operational system. Therefore, the development of a system capable of managing the booking process digitally and systematically is necessary [4].

A reservation system plays a vital role in managing scheduled services, particularly those involving queues and limited resources [5]. To ensure that services are provided fairly and orderly, this research applies the First Come First Served (FCFS) scheduling method. FCFS is chosen because it is a simple and effective non-preemptive algorithm where services will be processed and completed based on the order of reservation arrival (*First In, First Out*), thereby being formally considered fair. Based on the identified problems, the primary aim of this study is to design and develop a mobile-based online reservation system for Dina Muslimah Salon, implementing the FCFS scheduling method to systematically manage queues, provide comprehensive information, and simplify the booking process [6]. This development of a mobile-based application also serves as the key distinction from previous studies that generally focused on website-based systems, aiming to provide wider and more flexible accessibility for users [7].

2. Research Method

2.1 Research Methods Research and Development (R&D)

This research employs the Research and Development (R&D) method to create a mobile-based reservation system. The R&D process is utilized to produce a specific product in a particular field of expertise, which also generates certain by-products and helps determine the product's effectiveness [8].

The specific R&D procedure utilized in this study follows an adaptation of the ten-step model originally developed by Borg and Gall. This model was selected because the research aims to develop and validate a functional system product capable of solving the defined problems. As illustrated in Figure 1, the process involves ten systematic stages: Research and Information Collecting, Planning, Develop Preliminary Form of Product, Preliminary Field Testing, Main Product Revision, Main Field Testing, Operational Product Revision, Operational Field Testing, Final Product Revision, and concluding with Dissemination and Implementation. This methodical approach ensures that the resulting system is thoroughly tested, revised based on field results, and ultimately validated to meet the specified operational requirements [9], [10].

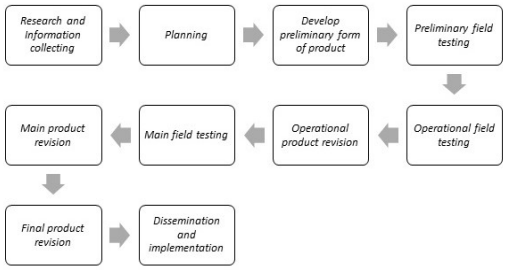

Figure 1. Research & Development (R&D) Method

2.2 System Development Method

The system development method used in this research is the Waterfall model. The Waterfall model was chosen because it provides a systematic and structured workflow, progressing sequentially from one phase to the next, starting from requirements analysis, design, implementation, testing, and concluding with maintenance. The selection of this model is based on the nature of the project, which focuses on developing a mobile-based reservation application with requirements that are relatively stable and well-defined at the project's inception. The Waterfall model ensures that each phase is completed thoroughly before moving to the next, thereby mitigating the risk of major changes during the development process. The stages of the Waterfall method applied are as follows [11], [12]:

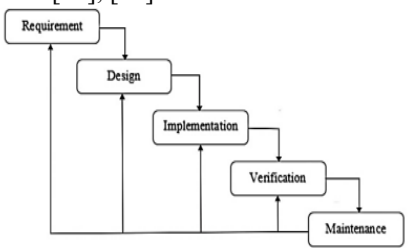

Figure 2. Waterfall Method

1. Requirement
   This phase aims to gather all necessary information and requirements for building the reservation system. Data collection was performed through observation and interviews at Dina Muslimah Salon.
   - Observation: This was conducted to gain a direct overview of the salon's daily operations. The data collected includes detailed information regarding the salon's location, the types of beauty services and offerings available, operating hours, and the specific cost of treatments that need to be integrated into the system.
   - Interviews: Structured interviews were conducted with Mrs. Dina Meilita, the owner of Dina Muslimah Salon, as the main respondent. The purpose of these interviews was to gain an in-depth understanding of the challenges faced with manual reservation processes, queue management, and customer data recording, as well as the users' specific expectations for the features required in the mobile application to be developed.
2. System Design
   Based on the analyzed data and requirements, this phase involves designing the system architecture, the User Interface (UI) design, and the database structure. The design is executed in detail, including the determination of data structures, flowcharts, and interface mockups, to ensure all system functionalities (including the implementation of the FCFS algorithm) can run as planned.
3. Implementation
   This stage is the process of writing the program code (coding) using the appropriate programming language for the mobile platform. The output of this stage is a prototype of the mobile reservation system ready for testing [13].
4. Verification
   If bugs or defects are found in the system during this stage, changes will be made.
5. Maintenance
   After the system is successfully implemented, this phase involves ongoing maintenance to address bugs, perform updates, and adjust the system to future changes in the salon's operational needs [14].

2.3 *First Come First Serve (FCFS)*

The First Come First Serve (FCFS) scheduling algorithm is implemented in this mobile reservation system to manage customer queues. FCFS is a simple, non-preemptive scheduling strategy where those who arrive first will be served first. In the context of the salon, service requests are assigned processing time and arranged strictly according to the chronological order in which they are received by the system [15]. This mechanism ensures fairness in the formal sense, as a process begins and continues until completion before the next service request is addressed. The utilization of FCFS, implemented using a FIFO (First In, First Out) queue, directly addresses the previous problem of long, uncertain waiting times and inefficient queue management experienced by the salon [16].

System Evaluation and Testing Methods

To validate the functionality and quality of the developed mobile-based system, several evaluation methods were employed:

1. Black Box Testing: This method was conducted to verify that all functional requirements of the application, such as registration, login, order management, and queue display, operate strictly according to the predetermined design specifications. This testing focused primarily on the external behavior and accuracy of the system’s output.
2. Usability and User Acceptance Testing (UAT): This evaluation assessed the system's ease of use, practicality, and user satisfaction level. The application was tested by system experts and personnel of Salon Muslimah Dina to ensure practical suitability and effectiveness in solving the manual booking problems.
3. FCFS Scheduling Verification: Specific testing was performed to verify the accurate implementation of the FCFS algorithm, ensuring that service start times, completion times, and wait times are calculated and displayed correctly based on the exact chronological order of customer bookings, as detailed in the calculation results.

3. Result and Discussion

This section presents the results of the system development, validates the functionality, and analyzes the performance of the implemented FCFS scheduling algorithm. Descriptive operational data, such as detailed service price lists (Tables 1-4), have been excluded from this section as they are not core analytical components and are relocated to the Appendices. Based on observations conducted at the Dina Muslimah

Salon located on Jl. Perhubungan, Tembung, Percut Sei Tuan District, Deli Serdang Regency, North Sumatra 20371, the following data was obtained:

Table 1. Facial Treatment Data

No	Facial Treatment	Price
1	Facial Microdermabrasi	Rp 120.000
2	Facial Whitening (Thibbun Nabawi)	Rp 100.000
3	Facial Chemical Peeling	Rp 140.000
…	…	…
9	Acupressure + Facial Mask	Rp 50.000

Table 2. Body Care Data

No	Body Care	Price
1	Body Massage	Rp 80.000
2	Body Scrub	Rp 90.000
3	Massage + Body Scrub	Rp 170.000
…	…	…
9	Spa (Milk Bath/Spice Bath)	Rp 50.000

Table 3. Facial and Body Care Data

No	Facial, Hair, and Body Treatment Packages	Price
1	Facial Dermabrasi + Body Scrub + Massage	Rp 290.000
2	Facial Whitening + Creambath + Body Scrub + Massage	Rp 310.000
3	Facial Dermabrasi + Mask + Body Scrub + Massage	Rp 365.000
…	…	…
10	Facial Dherma PDT + Hair SPA + Massage + Body Scrub	Rp 425.000

Table 4. Hair Care Data

No	Hair Care	Price
1	Hair Clippers	Rp 15.000
2	Babyliss Regular	Rp 30.000
3	Babyliss Creative	Rp 50.000
…	…	…
14	Hair SPA Premium	Rp 150.000

3.1 System Design

The mobile-based reservation system was successfully implemented using Android Studio and Firebase. The final product's design directly addresses the research objectives by offering key features to manage the booking process centrally. The Use Case Diagram (Figure 3) validates the system's ability to facilitate interactions between two primary actors Customer and Admin through core functionalities such as online reservation, queue viewing, and service management. Functional integrity was confirmed through Black Box Testing, which verified that all features, including the secure *login* (Figure 4) and the Admin's ability to dynamically set service availability and duration (Figure 6), operated fully according to the design specifications. This ensures the required information is readily available and resolves the initial problem of poor information dissemination.

Figure 3. Use Case Diagram

Implementation

1. User Login Page

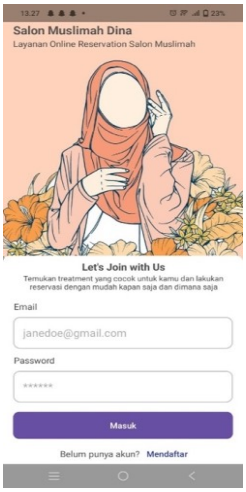

Figure 4. User Login Page

This page allows admins and customers to log in using the password and username they created during registration.

2. Admin Order Management Page

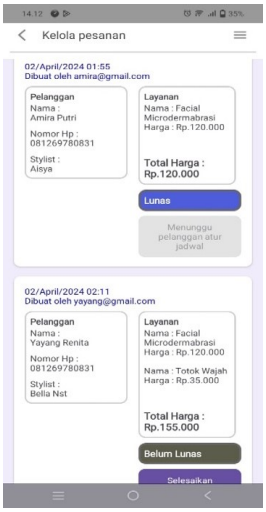

Figure 5. Admin Manage Orders Page

This page contains a list of customers who have made reservations, and the admin can manage the status of customer orders.

3. Manage Admin Catalog Page

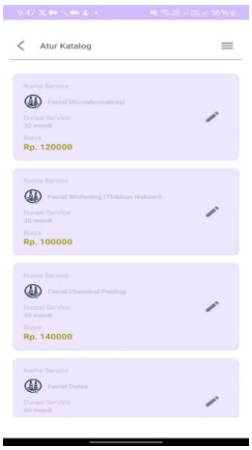

Figure 6. Admin Catalog Setup Page

Admins can add, edit, and delete catalogs on this page according to the salon's needs.

4. Your Customer Orders Page

Figure 7. Your Customer Order Page

This page allows customers to view details of previously placed orders. If an error occurs during the order, customers can cancel the order and create a new one.

5. Admin and Customer Queue Page

Figure 8. User Queue Page

This page allows users to check the queue list for their desired or selected date.

3.2 FCFS Scheduling Algorithm and Performance Analysis

The core solution for the previous problem of queue uncertainty is the implementation of the First Come First Served (FCFS) scheduling algorithm. This algorithm ensures that service execution adheres strictly to the chronological order of booking arrival. To analyze the system's performance logic, a simulation using three sequential service requests was conducted. The raw input data used for the FCFS calculation is presented in Table 6, while the analytical output is shown in Table 7.

Table 6. Reservation Table

Queue Number	Customer Name	Order Time	Service Type	Service Duration
1	Feny Andriani	09.00	Facial Microdermabrasi	20 minute
2	Delvira Anjani	09.00	Facial Chemical Peeling	30 minute
3	Mia Lustree	09.00	Facial Microdermabrasi	20 minute

Table 7. FCFS Scheduling Calculation Results

Customer Name	Arrival Time	Execution Duration	Execution Start	Execution Complete	Wait Time	TA
Feny Andriani	09.00	20	09.00	09.20	0	20
Delvira Anjani	09.00	30	09.20	09.50	20	50
Mia Lustree	09.00	20	09.50	10.10	50	70

The results in Table 7 demonstrate that the FCFS logic functions accurately. The Average Wait Time (AWT) calculated from this sample is AWT = (0 + 20 + 50) / 3 = 23.33 minutes. This analytical data is crucial, as the system provides customers with a transparent and precise predicted wait time through the User Queue Page (Figure 8), a capability completely absent in the previous manual system.

3.3 Discussion: Impact and Efficiency Improvement

The implementation of the mobile-based reservation system marks a significant shift from reactive to proactive service management, leading to measurable improvements in efficiency and transparency.

Performance Comparison (Manual vs. Online): In the previous manual system, customer waiting times were unpredictable, often exceeding 60 minutes for *walk-in* customers due to high inquiry volumes and a lack of systematic scheduling. Furthermore, the administrative speed was hampered by staff spending excessive time responding individually via social media. The new system, by centralizing scheduling and automating the queue sequence with FCFS, significantly reduces the uncertainty and administrative overhead. The calculated average wait time of 23.33 minutes for simultaneous bookings shows a quantifiable benchmark for queue performance, a vast improvement over the chaotic manual process.

Efficiency Improvement: The system enhances overall efficiency and data accuracy. By forcing a systematic sequence, the mobile application eliminates human error in scheduling and provides instant queue transparency. This aligns with findings from other studies (e.g., in healthcare information systems) which consistently show that digital system implementation improves efficiency by structuring workflow and reducing administrative time overhead. The systematic queue data generated is now accessible for management, allowing for better resource allocation and future service planning, a functionality that was impossible under the manual operation.

In conclusion, the developed system successfully addresses the research aims by providing a robust, mobile-based solution that leverages the FCFS algorithm to impose systematic order on the previously inefficient reservation process.

4. Conclusion

This research successfully achieved its primary objective by designing and developing a mobile-based online reservation system for Dina Muslimah Salon, effectively transforming the manual reservation process into an efficient and structured digital system. The system's functional integrity was validated through Black Box Testing, confirming its adherence to all defined design specifications. The successful implementation of the First Come First Served (FCFS) scheduling algorithm directly addressed the core operational challenge of queue uncertainty. The key measurable outcome demonstrating this is the system's ability to provide a transparent and predictable Average Wait Time (AWT), calculated at 23.33 minutes for the simultaneous bookings in the test sample, offering a vast improvement over the chaotic and unpredictable wait times experienced under the manual system. Furthermore, by centralizing scheduling and eliminating the need for staff to individually respond to inquiries via social media, the system enhances administrative efficiency and ensures greater data accuracy and accessibility for management. The primary strength of the system lies in its mobile-based design, which provides customers with enhanced accessibility and differentiates this study from prior research focused on website-based systems. However, the current study is limited by the small sample size used for the FCFS performance analysis (three data points), which, while proving logical functionality, prevents a statistically robust comparison with the previous manual system. Looking ahead, the successful digital transition offers a model for other small businesses struggling with manual scheduling. Therefore, future research is highly recommended to focus on scaling and performance benchmarking through large-scale User Acceptance Testing (UAT) and conducting a comprehensive comparative study to quantify the exact reduction in administrative workload. Additionally, exploring more advanced scheduling algorithms could further optimize resource utilization for varied service durations.

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