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Web-Based Online Reservation System With The Implementation Of The First Come First Served (FCFS) Algorithm To Overcome Customer Queues At A Barber Shop In Bandung

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Abstract

With the rising demand for digital services, industries such as barbershops must utilize technology to improve service efficiency, especially in controlling customer lineups. Kabarbershop currently uses a manual queueing system, resulting in unpredictable wait times, potential customer attrition, and inaccuracies in documentation. This study creates a web-based Online Reservation System that uses the First Come First Served (FCFS) algorithm to efficiently and equitably manage queues.

The study employs the Research and Development (R&D) methodology, using a Waterfall development strategy. The system is architected with Unified Modeling Language (UML) and developed using Next.js for the frontend, Tailwind CSS for a responsive UI, ExpressJS for the backend, and MongoDB as the database. Essential features include online bookings, wait-time assessment, WhatsApp alerts, and an administrative dashboard.

Findings from black box testing demonstrate that all functionalities perform as anticipated. This system aims to improve operational efficiency, minimize customer attrition, and offer a more convenient and transparent reservation experience.

Keywords : *Online Reservation, FCFS, Queue Management, Web*

INTRODUCTION

The progression of digital technology has profoundly influenced the service sector, particularly barbershops. Kabarbershop continues to use a manual queuing system, resulting in issues such as ambiguous wait times, potential customer attrition, and inaccuracies in record-keeping. This circumstance results in diminished consumer satisfaction and impacts corporate revenue.

These issues underscore the disparity between the demand for more efficient services and the traditional wait structure currently in place. Prior studies demonstrate that adopting a web-based reservation system, coupled with the First Come, First Served (FCFS) algorithm, can significantly improve efficiency, equity, and transparency in the management of customer lines.

A. Digital Booking Platform

The online reservation system is a web-based program that enables users to reserve services digitally without being physically present at the location. This system enables users to schedule services, verify availability, and mitigate queue unpredictability (Yandi, M., & Rosita, 2023). In barbershops, the online reservation system reduces wait times and improves client comfort, while also helping managers systematically capture reservation data.

B. First-Come, First-Served (FCFS) Algorithm

The First Come First Served (FCFS) algorithm is the most basic queue management method, functioning on the idea of "first to arrive, first to be served." This procedure is carried out through an equitable and transparent queuing

system (Ardiansyah, M. R., Kusuma, J. F., Gumelar, I. S., & Mentari, 2021). This research demonstrates that the FCFS algorithm arranges customer bookings to minimize conflicts, elucidate predicted wait times, and enhance the objectivity of the service experience.

C. Website and Ancillary Technologies

A website is a digital platform used to distribute information or services on the internet. A web-based reservation system offers clients the benefit of accessibility at any time and from any location (Atencia-Mckillop, I., Sánchez-Merino, S., Fortes-Ruiz, I., & Galán-García, 2024). This study uses Next.js as the frontend framework for developing an interactive interface, Tailwind CSS for responsive design, ExpressJS for the backend, and MongoDB for storing customer and reservation data.

D. Waterfall Development Methodology

The Waterfall model is a software development framework that follows a series of phases: requirements analysis, system design, implementation, testing, and maintenance (Sasmito, G. W., Wiyono, S., Irwansyah, E., & Suhartono, 2023). This paradigm is appropriate for creating reservation systems as the system requirements are explicitly delineated from the outset, facilitating a systematic development process that corresponds with the planned objectives.

E. WhatsApp Notifications as an Auxiliary Function

Notifications are real-time short message services dispatched to users' devices to convey specific information (Budiawan, N. K., & Hantoro, 2024). This study uses WhatsApp alerts to notify clients about their service appointments. This feature enables consumers to wait in a more comfortable setting, minimizing the likelihood of delays or missed queue opportunities.

F. Prior Investigations

Numerous prior studies have examined queue management and online reservation systems. Ramadhan, M. R. M., Sarwido, S., & Tamrin, (2025) examined the implementation of the FCFS algorithm in car rental systems, whilst Prayitno, M. H., & Nurmalisa (2024) developed a QR code-based attendance system with notification functionality. Chodijah, S., Hami, A., & Ramdhani, (2024) examined the prerequisites for web-based barbershop reservation systems, while (Abdurohim, U., Versanika, D. V., & Dirgantara, 2022) developed a barbershop reservation system utilizing the Laravel framework. Nonetheless, studies that particularly incorporate a web-based reservation system with the FCFS algorithm for queue management in barbershops remain few. This gap in the literature is the focal point of this thesis.

This research aims to design and develop a web-based reservation system that uses the FCFS algorithm to manage client wait times at Kabarbershop. This system includes functionality for service reservations, wait-time assessment, and WhatsApp notifications, enabling clients to wait more comfortably without being physically present at the venue. The installation of this system aims to enhance operational efficiency, minimize customer attrition, and deliver a more transparent and gratifying service experience.

METHOD

This study uses the Research and Development (R&D) methodology to develop a web-based reservation system that incorporates the First Come, First Served (FCFS) algorithm to manage customer lines at Kabarbershop. The R&D technique is selected for its appropriateness to research aimed at creating new goods, including need analysis, design, implementation, and system evaluation. The employed system development methodology is Waterfall, which adheres to a linear progression through stages of requirements analysis, design, implementation, testing, and maintenance.

This research employs several data-collection strategies. The initial strategy is observation, in which the researcher conducts direct observations at Kabarbershop to gain insights into the current manual queuing process. This enables the researcher to collect empirical data on concerns such as ambiguous wait-time projections, potential client attrition, and inaccuracies in manual record-keeping. The second strategy entails conducting interviews with the owner and personnel, especially the cashier and barbers, to elicit comprehensive information on issues related to the queuing system, expectations for the online reservation system, and the specific features required by both customers and managers. Finally, a literature review is performed by analyzing pertinent books, journals, and previous research. This literature encompasses research on the FCFS algorithm, online reservation systems, and the application of digital queue management.

The system development employs the Waterfall technique, which is organized into several sequential phases. The initial phase involves a needs analysis, during which the researcher identifies the challenges encountered by consumers and managers, culminating in the establishment of critical system requirements, including login functionality, online reservations, wait-time projections, WhatsApp notifications, and an administrative dashboard. The subsequent stage of system design entails developing user interface (UI) designs, database architectures, and UML models, including use case, activity, and sequence diagrams. In the development phase, the system employs Next.js for the frontend, Tailwind CSS for the user interface, ExpressJS for the backend, and MongoDB for data storage. Testing will be conducted using the Black-Box Testing methodology to verify that each function performs in accordance with user requirements, including validating queue order using the FCFS algorithm. The maintenance phase occurs post-deployment at Kabarbershop. This phase includes bug rectification, enhancements to functionality in accordance with new specifications, and performance optimizations informed by user feedback.

The installation of this system aims to enhance operational efficiency, minimize customer attrition, and deliver a more transparent and gratifying service experience.

RESULTS AND DISCUSSION

This research presents the development of a web-based reservation system utilizing the First Come First Served (FCFS) algorithm to manage client

lines at Kabarbershop, along with system testing to evaluate the application's functionality. The system implementation is illustrated via the website's user interface, encompassing essential functionality such as account registration, login, service booking, barber selection, schedule management, order confirmation, and payment tracking. The system also offers notification tools to keep consumers informed about their reservation status, along with an admin portal for overseeing data on barbers, services, and queues.

Subsequently, testing is performed to verify that all functions operate as specified and to assess the precision of the FCFS algorithm in arranging the queue order. Testing uses the Black-Box Testing methodology for each primary feature, including the reservation process, queue management, payment confirmation, and data management. The test results demonstrate that all system functions operate as intended, and the FCFS algorithm efficiently handles client queues equitably according to reservation time order.

The subsequent outcomes pertain to the study execution of a web-based online reservation system for a barbershop in Bandung:

Collection Database Implementation:

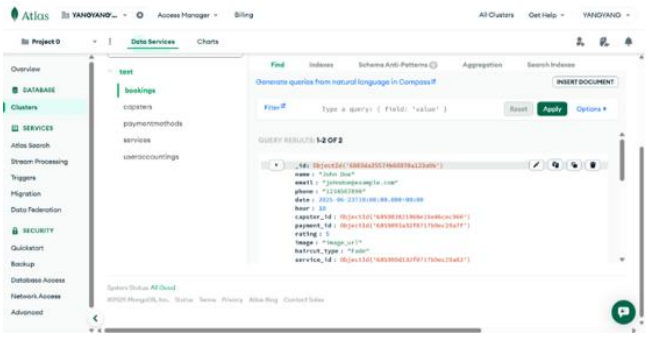

Figure 1. Implementation of Collection Database bookings

Figure 1 depicts the database installation in the bookings collection, which retains customer reservation data within the system. This collection includes essential attributes: name for the customer's name, email for the email address, phone for the telephone number, date for the reservation date, and hour for the service time. Furthermore, there is a capster_id that associates the reservation with a specific barber, a service_id that links it to the selected service, and a payment_id that corresponds to the applied payment method.

Supplementary features, including ratings, are incorporated to reflect clients' opinions on the service; image_url provides a reference for associated service photographs, and haircut_type delineates the selected haircut style. Every document in this collection contains a distinct _id that serves as the identifier for each reservation. This database architecture underpins the system for managing reservations at Kabarbershop. The saved data enables the system to document comprehensive customer reservations, associate them with barbers, services, and payment methods, and facilitate the application of the First Come First Served (FCFS) algorithm for queue management. As a result, the system can deliver

more efficient, transparent, and organized services.

Use of the First Come First Served (FCFS) Algorithm

The FCFS algorithm will be used to determine the service sequence for consumers based on their reservation times. This algorithm prioritizes consumers based on the order of their reservations. FCFS offers numerous benefits that enhance the queuing system at a barbershop in Bandung:

1. Simplicity: FCFS is straightforward to construct as it organizes the queue just based on the sequence of arrival or reservation, without prioritizing or additional factors.
2. Fairness: This approach guarantees that every consumer is attended to in an impartial sequence, devoid of discrimination or mismanagement of the queue.
3. Efficiency: Automating the queuing system accelerates the service process, streamlining operations, diminishing customer wait times, and enhancing customer satisfaction.

Implementation of admin dashboard interface design

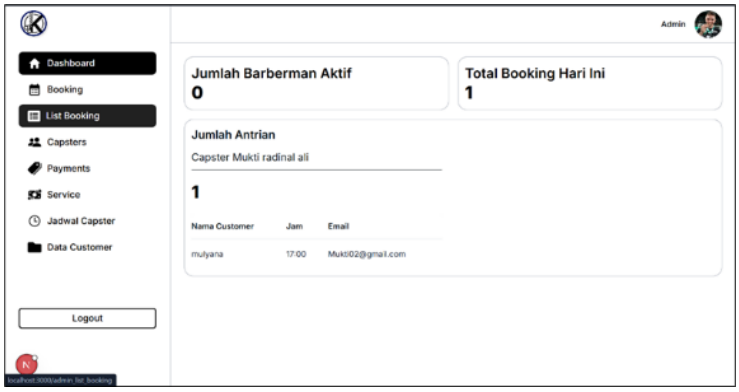

Figure 8 Implementation of the Question Test Website

Figure 2 depicts the website's execution on the Admin Dashboard page, intended to oversee reservation and queue operations at Kabarbershop. This interface presents concise information, such as the number of active barbers and the total number of appointments for the day. This information helps the administrator understand the availability of barbers and the number of customers who have made reservations.

The primary component of the page displays the current line, including the customer's name, reservation time, email address, and the designated barber. This implementation indicates that a customer called Mulyana has a reservation planned for 17:00 with barber Mukti Radinal Ali.

The dashboard framework includes a navigation panel on the left with primary options such as Booking, List Booking, Capsters, Payments, Service, Schedule Capsters, and Customer Data. These menus assist the administrator in overseeing all system data, encompassing schedule configurations, payment validation, service monitoring, and customer information.

This implementation enables the administrator to oversee and regulate reservation activities in real time, enhancing the efficiency, organization, and transparency of the service process while adhering to the First Come First Served (FCFS) algorithm.

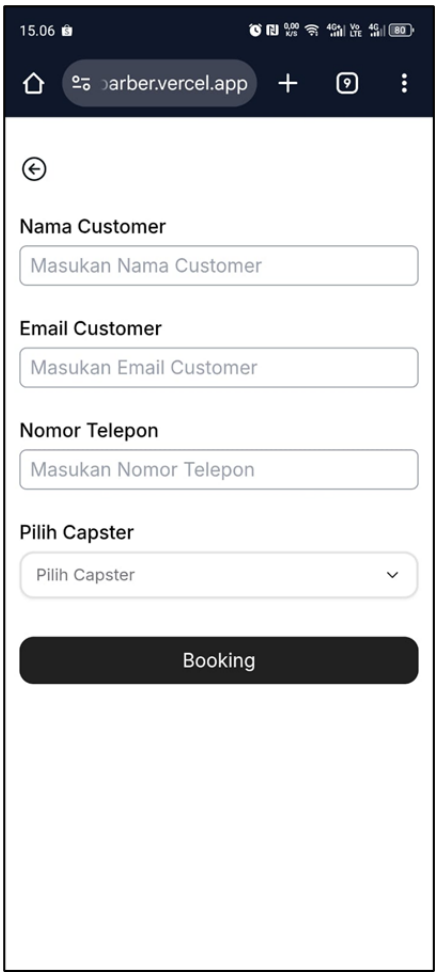

Figure 3. Implementation of customer booking interface design

Figure 3 depicts the website's execution on the Customer Booking page, intended to facilitate service reservations at Kabarbershop. This interface features an input form that consumers must complete before making a booking.

The form comprises numerous critical fields, including Customer Name for identifying the customer, Customer Email for documenting the customer's contact email address, and Phone Number for supplementary communication information. Furthermore, a dropdown menu titled Choose BarberBarber enables consumers to select their desired BarberBarber.

Upon completion of data entry, consumers may select the Booking button to transmit their reservation information to the system. The incoming data is processed and stored in the database, then scheduled in accordance with the queue order using the First Come First Served (FCFS) algorithm.

This interface's structure guarantees that every customer reservation is thoroughly documented, including identifying details,

contact information, and the selected BarberBarber. This booking website features a straightforward, intuitive design that allows consumers to make appointments swiftly and conveniently, seamlessly integrated with the automated queue management system.

System Testing

Table 3 System Testing

No	Feature Name	Testing Scenario	Input	Expected Output	Test Results	Status
1	Login Successful	Enter the correct email and password	Valid email and password	Go to the main page	Succeed	In accordance
2	Login Failed	Enter an empty email or password	Email and password cannot be empty	The message "Incorrect email or password" appears.	A message appears	In accordance
3	Add Capster Successfully	Fill in the complete and valid capster data	Name, contact, etc. are valid.	Capster data saved	Succeed	In accordance
4	Add Capster Not Successful	Not filling in the capster data	Empty form	The message "Form data cannot be empty" appears.	A message appears	In accordance
5	Add Payment Successfully	Fill in the complete payment data	Valid payment method name	Payment data saved	Succeed	In accordance
6	Add Payment Failed	Did not fill in payment data	Empty form	The message "Data cannot be empty" appears.	A message appears	In accordance
7	Add Service Successfully	Fill in complete and valid service data	Service name, price, validity duration	Service data saved	Succeed	In accordance
8	Add Service Failed	Not filling in service data	Empty form	The message "Data cannot be empty" appears.	A message appears	In accordance

No	Feature Name	Testing Scenario	Input	Expected Output	Test Results	Status
9	Print Customer Data Successfully	Click the print customer data button	Stored customer data	Printed customer data PDF file	Succeed	In accordance
10	Booking Successful	Fill in the booking data completely and validly	Customer name, service, valid schedule	Booking data saved	Succeed	In accordance
11	Booking Failed	Did not fill in booking data	Empty form	The message "Data cannot be empty" appears.	A message appears	In accordance

CONCLUSION

The research and development findings indicate that the web-based online reservation system has been effectively built and deployed to resolve client queue problems at a barbershop in Bandung. This system employs the First Come First Served (FCFS) algorithm, which efficiently organizes customer lines in an equitable, transparent manner based on reservation times.

The application implementation demonstrates that the online reservation function enables customers to book services without prolonged wait times at the venue effortlessly. Simultaneously, the queue and barber scheduling management module enables the administrator to organize services efficiently. System testing using the Black-Box Testing methodology demonstrates that all primary functionalities meet user requirements, including registration, booking, barber management, and payment recording. Consequently, the system facilitates a more organized, efficient, and contemporary enhancement in service quality.

Periodic usability testing is advised, involving both customers and Kabarbershop personnel, to ensure the interface design remains intuitive, user-friendly, and responsive to users' changing requirements. This technology is anticipated to evolve into a progressively superior digital solution for facilitating reservation services and queue management in barbershops.

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