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Online reservation system development and digital payment integration in car wash business: Case study of car wash sniper

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ABSTRACT

This study aims to develop a website-based online reservation system at Car Wash Sniper with digital payment integration to improve operational efficiency and customer convenience. The system design method uses a waterfall model approach that includes needs analysis, system design, implementation, testing, and maintenance. Black box testing is also carried out to test the suitability of the system with the design that has been developed. To support the payment process, this system is integrated with Midtrans as a payment gateway that provides various payment options such as bank transfers, e-wallets, and credit cards safely and in real-time. The results of the study show that this system is able to optimize the reservation process, reduce queues, and increase customer satisfaction. The novelty of this research by developing a system that is integrated with digital payments, making transactions more practical, efficient, and transparent. This system can be an innovative solution for business actors in the car wash industry to improve efficiency and service quality.

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1. INTRODUCTION

Conventional car wash businesses often face obstacles in service and transaction management, such as time-consuming manual reservation systems and unstructured queue management, leading to customer dissatisfaction. In addition, the cash payment method that is still used is at risk of causing recording errors and slowing down transactions. To overcome this problem, an online reservation system with digital payment integration is an effective solution. Digital payments are a financial transaction process carried out via electronic media without the involvement of physical cash [1]. This technology allows customers to book services online, choose the type of service, and pay via e-wallet or bank transfer, which increases the efficiency and transparency of transactions.

The implementation of a digital reservation system is very important for local Micro, Small, and Medium Enterprises (MSMEs) because it can increase competitiveness through operational efficiency and more professional services. By implementing this technology, businesses such as Car Wash Sniper can expand their market, increase customer satisfaction, and minimize errors in recording and transactions. This is also in

line with the digitalization of the national economy that supports the empowerment of Micro, Small, and Medium Enterprises (MSMEs) through technology.

Developing an e-commerce system requires a systematic and structured software engineering approach. In this case, the System Development Life Cycle (SDLC) is an approach that can be adopted to design a web-based application system. In particular, Waterfall is one of the SDLC models that includes the process of Requirements Analysis, System Design, Implementation, Testing, and Maintenance [2], [3], [4] This method ensures that each step has been completed before proceeding, which allows for complete documentation and reduces development risk [8].

Research conducted by Viky Fithrotul et al. in 2023 designed a website-based booking information system at Aura Salon with the aim of increasing the efficiency and effectiveness of booking services. Previously, the booking process was done manually via WhatsApp, which caused long queues and data irregularities. The results of the study showed that the new system made it easier for customers to make beauty service reservations and helped the salon to summarize booking data more systematically and efficiently [5]. In addition, research conducted by Purwati et al. in 2025 shows that the implementation of a digital reservation system at Sejati Catering has succeeded in increasing operational efficiency and expanding the reach of online promotions. This program involves website management training using a previously built platform, which helps business actors manage reservations and promotions more effectively [6].

Based on previous research, this study focuses on providing flexibility in queue management by giving priority to customers who have made reservations, while customers who come directly can still be served according to time availability. In addition, estimated waiting time information will be displayed in real-time so that customers can estimate their arrival time more accurately and do not have to wait too long at the location. The system is also designed to anticipate customer delays by providing a time tolerance limit before the reservation is automatically canceled. If a customer is unable to attend at the agreed time, they have the option to contact the admin to reschedule the reservation to the next day, as long as there is still a time slot available. If the customer is still absent without confirmation, they can be directed to a new queue without disrupting the order of other customers. On the other hand, business managers also receive direct notifications if there are changes to the schedule or queue conditions, so that operations can continue to run smoothly and orderly. With this system, it is expected that car wash services can run more effectively, reduce queues, and increase customer comfort and operational efficiency for business owners.

2. METHOD

This study proposes to adopt the System Development Life Cycle (SDLC) approach with the waterfall model. The waterfall model is a system development method that is carried out in stages and systematically, which includes the process of needs analysis, design, implementation, testing, and maintenance [7]. In detail, the design stages of the waterfall model can be seen in Figure 1.

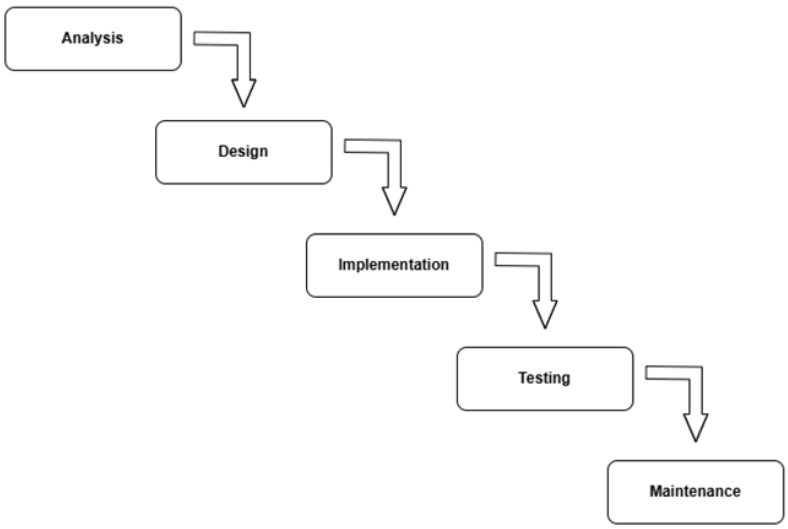

Figure 1. Stages of the waterfall model

Analysis

At this stage, the author collects data through observation and interviews to identify problems that are often experienced by customers and managers of Car Wash Sniper. Some of the problems found include a reservation system that is not functioning optimally, the need to simplify the process of ordering services online, and the need for a more efficient digital payment system integration. In addition, there is also a need for features that can support management in arranging reservation schedules to avoid accumulation or scheduling errors.

Design

Design is the process of creating and planning everything needed so that the product or system we create can work well, be pleasing to the eye, and be efficient. So, it's not just about the visual appearance aspect, but also about how to make everything run smoothly and effectively. At this design stage, one of the aspects designed is the database structure, which is depicted through the Entity Relationship Diagram (ERD) as in Figure 2.

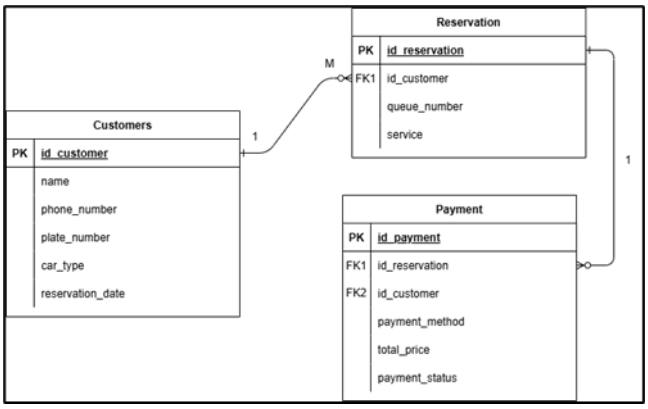

Figure 2. The entity relationship diagram of online reservation systems

The ERD illustrates the relationship between the main entities in the system, namely Customer, Reservation, and Payment. Each Customer can make more than one reservation, which is indicated by the one-to-many (1:M) relationship between Customer and Reservation. Furthermore, each reservation has payment data recorded in the Payment entity. An Entity Relationship Diagram (ERD) is a diagram used to describe the relationships between entities in an information system [8]. This ERD design is important to ensure that the data flow between entities can run logically, neatly, and effectively, interconnected according to system needs.

Implementation

In this section, the coding process or software implementation is carried out based on the previously prepared design. The author uses programming languages and development tools to create software that is in accordance with the specified design specifications.

Testing

Testing is a process to ensure that every feature in the software has been checked and runs according to its function. At this stage, the author conducts testing using the black box method [9]. The black box testing method itself is a testing method that focuses on the system's function from the user's side, without paying attention to the code structure or internal processes in the application.

Maintenance

This maintenance phase includes various maintenance activities to ensure the system continues to run optimally. This maintenance involves performance monitoring, software updates, and system adjustments according to business needs and user input [10].

3. RESULTS AND DISCUSSIONS

Requirement Analysis

At this stage, observations and analysis of interview results with carwash admins have been conducted to determine functional needs. Based on the results of manual activity observations on carwash services, it is known that in one day, during operating hours from 8 a.m. to 4 p.m., there are an average of around 15 to 20 customers who make reservations directly or via text messages to the admin. All processes, such as recording

customer data, determining queues, and payment transactions, are carried out manually, so that there are often irregular queues and data recording errors. With only 1 admin on duty, this manual system is quite burdensome for managing daily services. Therefore, it is necessary to develop a system that can simplify the reservation and payment process to be more efficient and accurate.

This process begins by identifying the actors involved, such as the admin and customer. Actor identification is an essential step in requirements analysis, aiming to determine who will interact directly with the system and understand the goals and roles of each user in the reservation operation (actor) [11]. Identification of these actors (see Table 1) explains the function of the actors who will access and operate the reservation system at the Snapper Carwash. This reservation system has two types of actors. Understanding the role of each user is very important to determine what features are needed in the system, so that the system design is truly in accordance with the workflow and needs.

Table 1. Actor Identification

Actor	Description
Admin	The actor is responsible for managing customer information and verifying payment data, and can add, reduce, edit, and delete service information according to the types of services available.
Customer	Actors who will make reservations and payments through a system that is equipped with digital payments.

Design

Use case diagram

After interviewing the carwash admin, the author created a Use Case diagram based on the approved functional requirements. Figure 3 illustrates that customers can make online reservations and make digital payments, and see proof of payment. Meanwhile, the admin can manage customer data and can change and delete service information according to the type of service available.

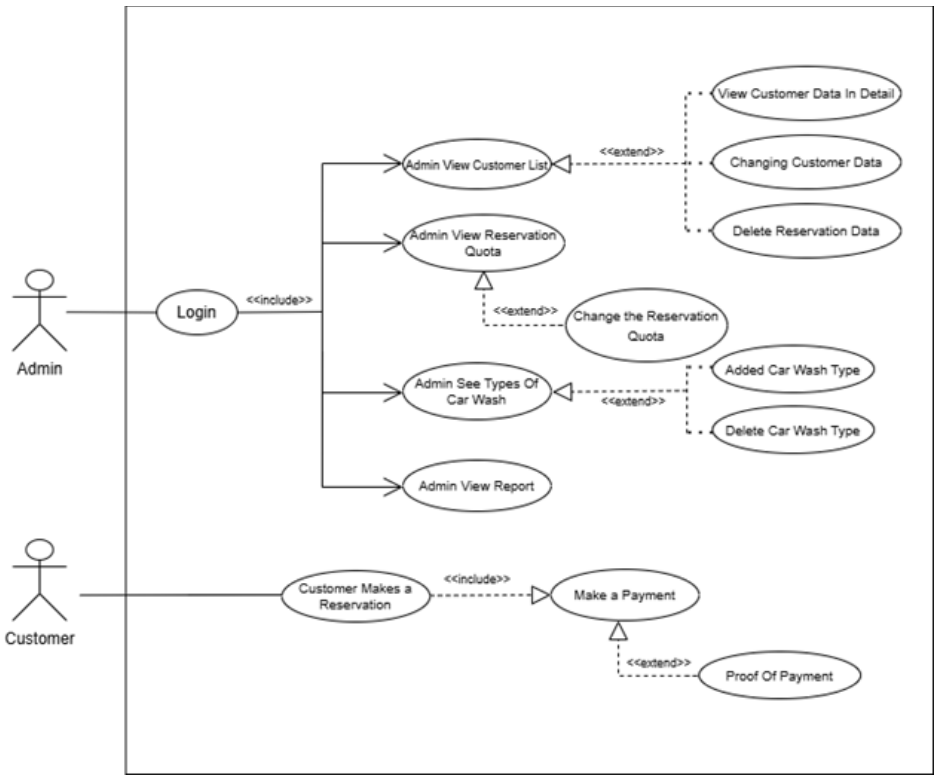

Figure 2. Use case diagram of online reservations

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Activity diagram

After the use case diagram is complete, the next step is to compile an activity diagram. This diagram serves to explain in more detail the activity flow of the features in the system to be developed. One example can be seen in Figure 4, which shows the activity flow of the customer reservation feature to payment.

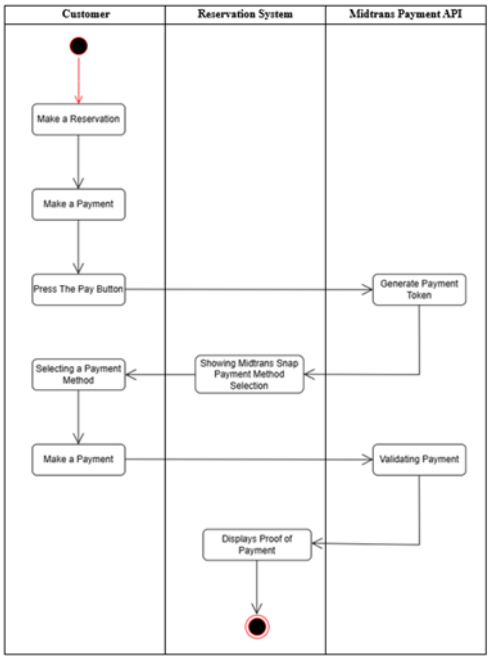

Figure 4. The Activity diagram of online reservations

Sequence diagram

Regarding the use case diagram and activity diagram that have been created previously, the next stage is to compile a sequence diagram. This diagram functions to provide an overview of the interaction between customers, systems, and admins. For example, the sequence of processes in the payment feature can be seen through the sequence diagram shown in Figure 5.

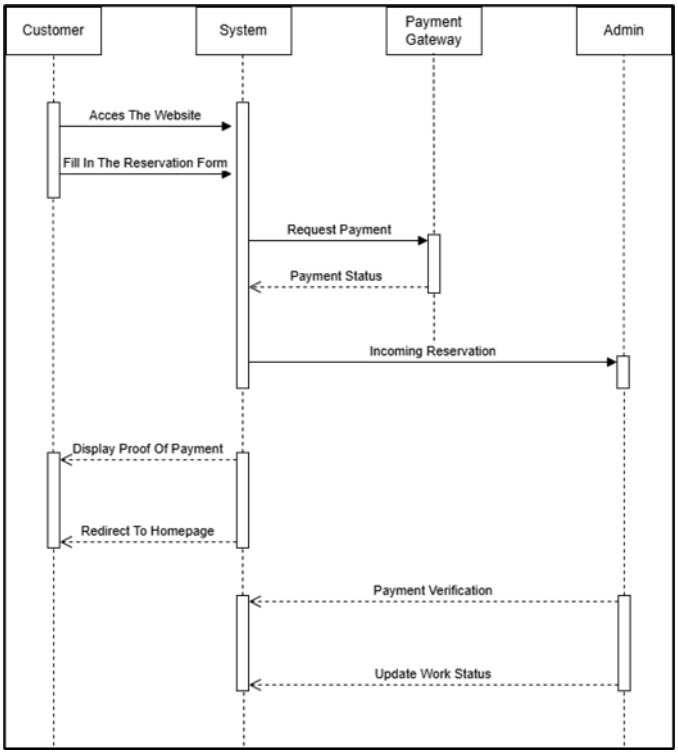

Figure 5. The sequence diagram of online reservation

Implementation

The system implementation stage is a process in which previously created designs begin to be realized into an application that can be run [12]. At this stage, all design results, such as interface displays and system flows, begin to be implemented into program form using the PHP programming language. In the development process, use Visual Studio Code as a text editor, and the Laravel framework. In addition, the system is also equipped with a digital payment feature using the payment gateway service from Midtrans. For data processing using a MySQL database designed according to system needs.

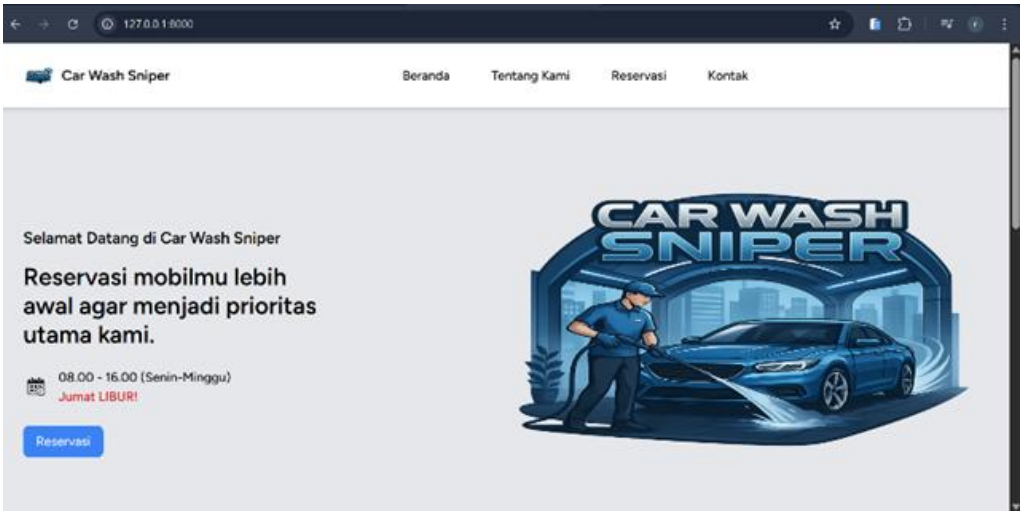

Figure 6. Main page

Figure 6 is the initial display for users when accessing web reservations. The display displays important information about the carwash's operating hours and opening days, and is equipped with contact details, location address, a brief description of the carwash (about us), and a feature for making reservations. This feature is important because it conveys the information that users need most quickly without having to move pages.

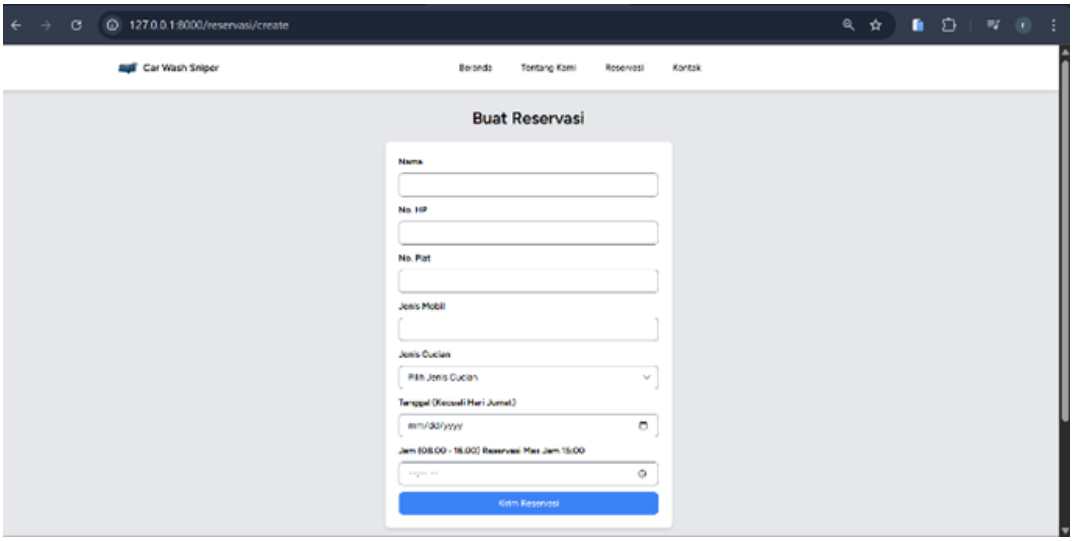

Figure 9. Reservation page

The reservation page in Figure 7 facilitates users in making service reservations independently and efficiently. The form feature, consisting of name, contact, vehicle plate, type of laundry, and date and time, is designed to collect important data systematically. This feature is important so that the carwash can arrange the

service schedule properly, avoid queues, and ensure the type of service is according to demand. In addition, the menu selection feature for the type of laundry and service hours makes it easy for users to choose the available options quickly and accurately.

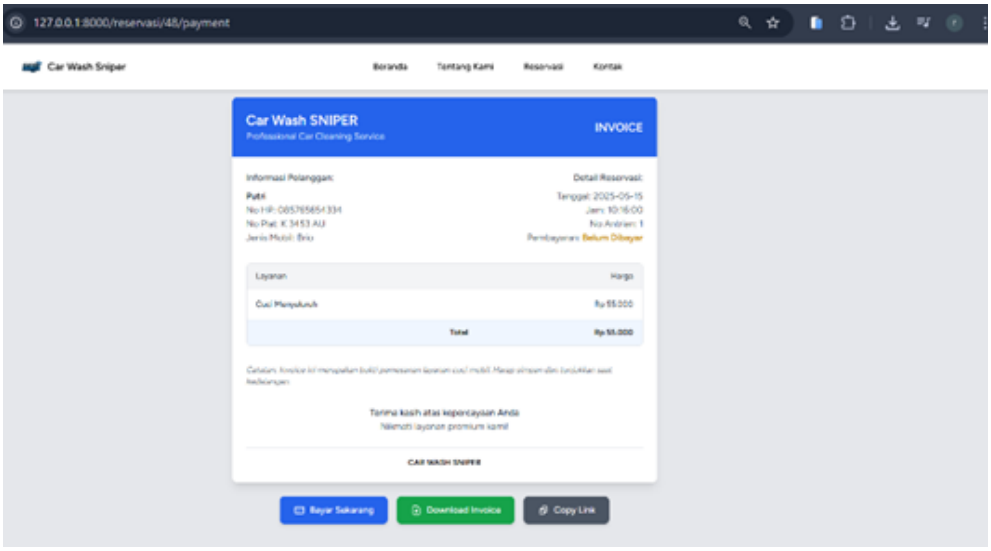

Figure 8. Invoice page

Next, in Figure 8, is a display of the invoice page that functions as proof of reservation, containing important details such as customer name, type of service, total cost, and payment status. This feature is important because it provides transparency to users regarding the transactions made. The “Unpaid” status also provides direct information regarding payment obligations, and action buttons such as “Pay Now” make it easier for users to complete the payment process quickly. Thus, this page is not only a transaction documentation, but also connects the reservation system with the payment process efficiently.

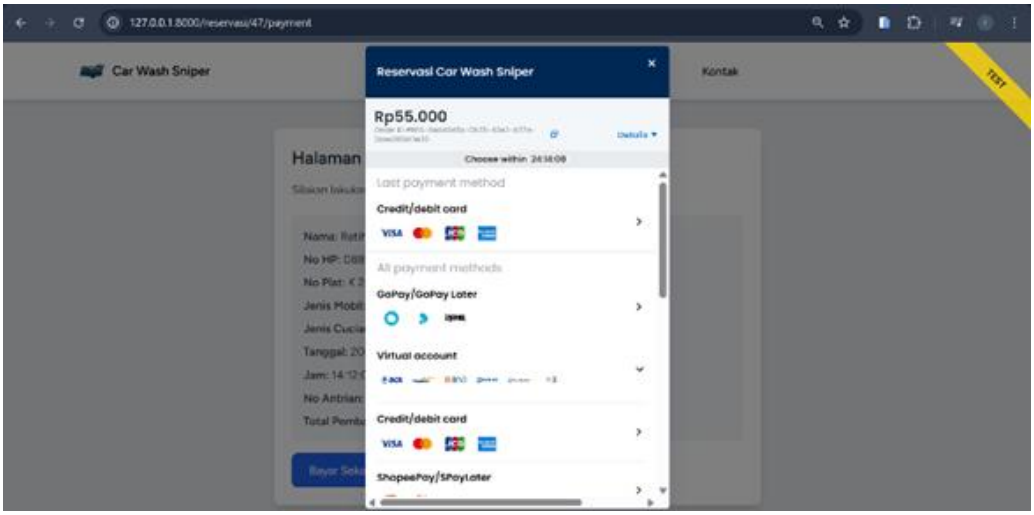

Figure 9. Payment page

Figure 9 shows the integration display with Midtrans, which provides various payment methods such as credit cards, e-wallets, and bank transfers. This feature is very important because it gives users flexibility in choosing the appropriate payment method. In addition, the payment process becomes safer and faster because it is handled by a trusted payment system. With a clear and interactive display, this page supports real-time transaction completion while strengthening user trust in the reservation system used.

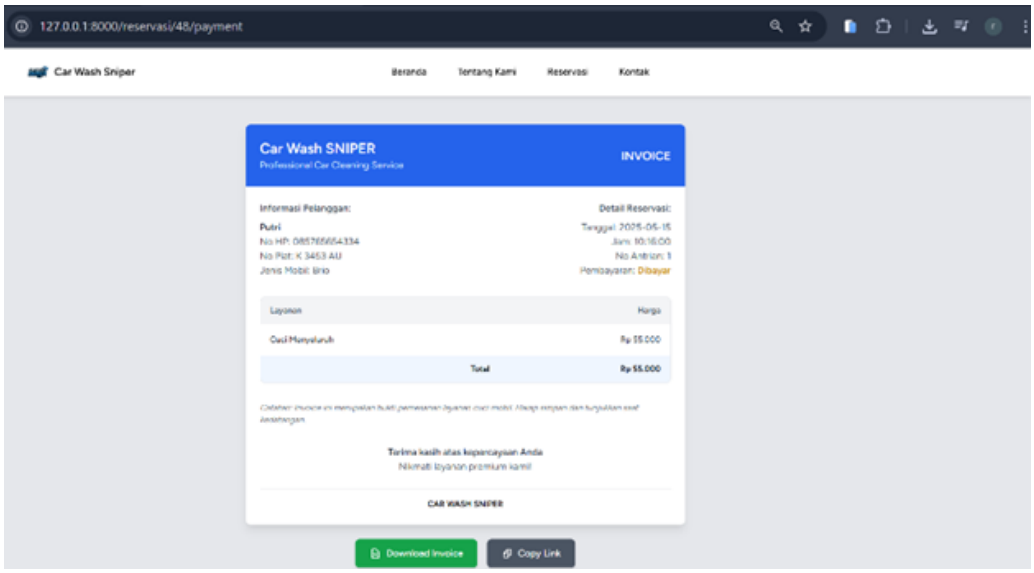

Figure 10. Proof of payment page

The proof of payment page in Figure 10 displays a verified invoice after the user has successfully made a payment. This feature is important because it ensures that users receive official confirmation of the transaction made. With the button to download or copy proof, users can save and show the invoice to the admin if there are any problems. This increases transparency, simplifies verification, and strengthens user trust in the services provided.

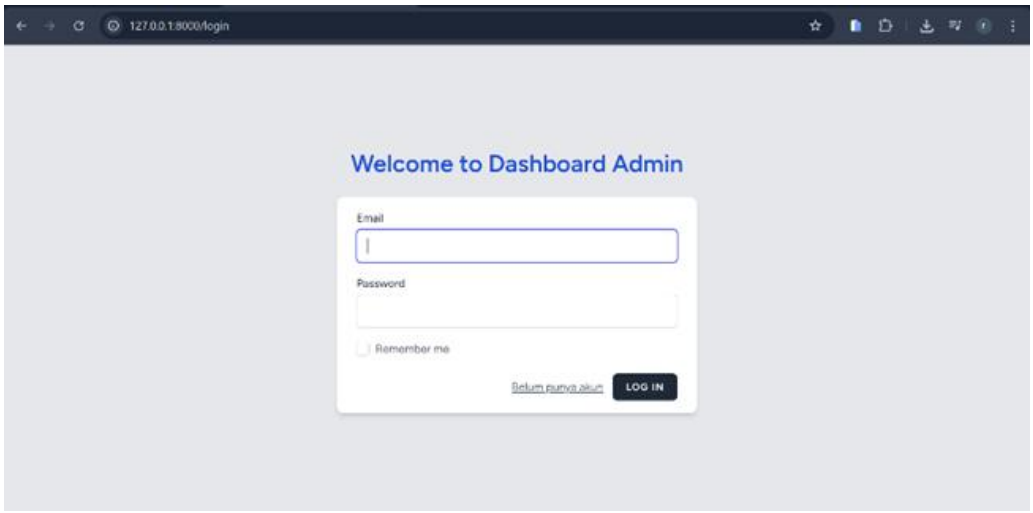

Figure 11. Admin login page

The admin login page in Figure 11 serves as the entrance to the web management system. The admin is asked to enter an email and password as a form of authentication to maintain data security and management features. This feature is important to limit access to authorized users only, thus preventing changes to data or system settings by irresponsible parties.

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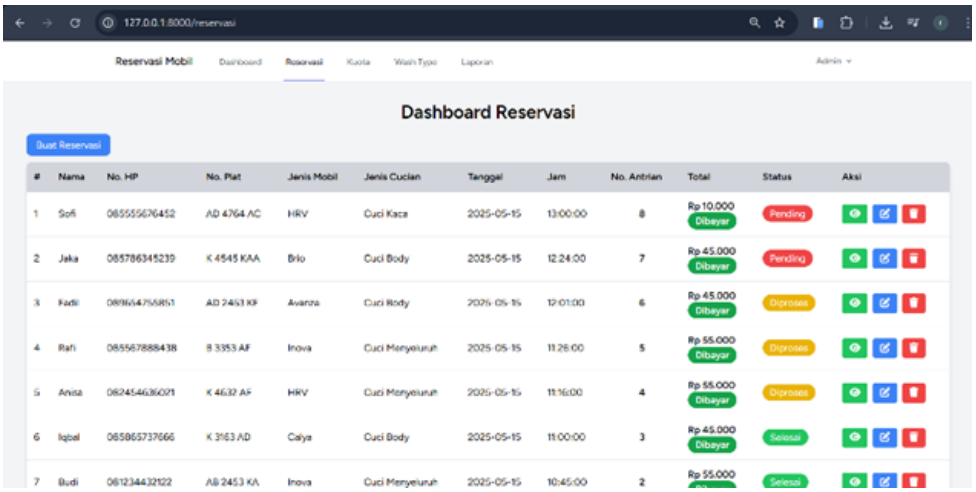

Figure 12. Admin reservation dashboard

Figure 12 is a display of the reservation dashboard page used by the admin to unite and manage car wash service booking data. It contains complete information such as customer name, car type, type of wash, schedule, total cost, payment status, and service process. This feature is important because it allows the admin to take direct action, such as editing, deleting, or viewing reservation details via the action button. With a structured data display, the reservation maintenance process becomes more efficient, accurate, and easy to control.

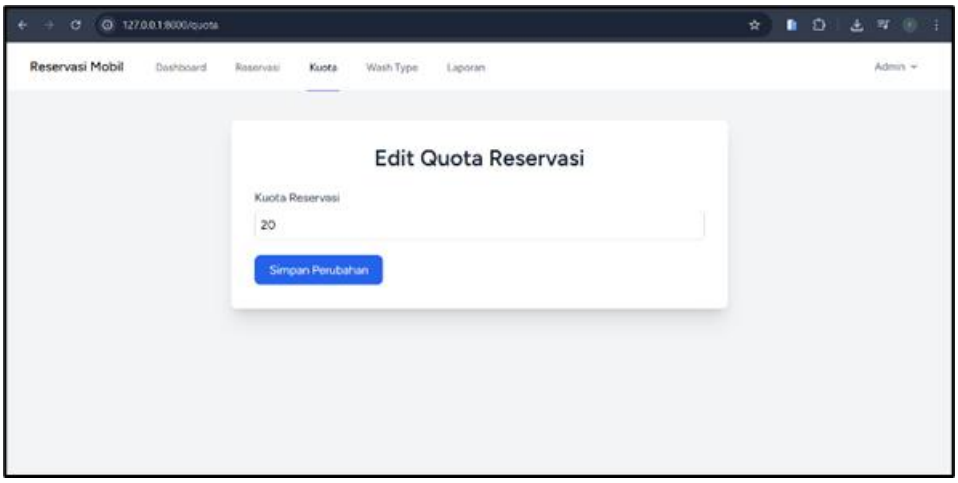

Figure 13. Reservation quota page

Next, in Figure 13, is a display of the reservation quota settings page used by the admin to determine the maximum number of car wash reservations per day. This feature is important because it helps regulate service capacity so as not to exceed operational capabilities. With flexible quota settings, the admin can adjust the number of reservations based on the number of employees, weather conditions, or holidays. This prevents queues from building up, maintains service quality, and ensures that the customer experience remains optimal.

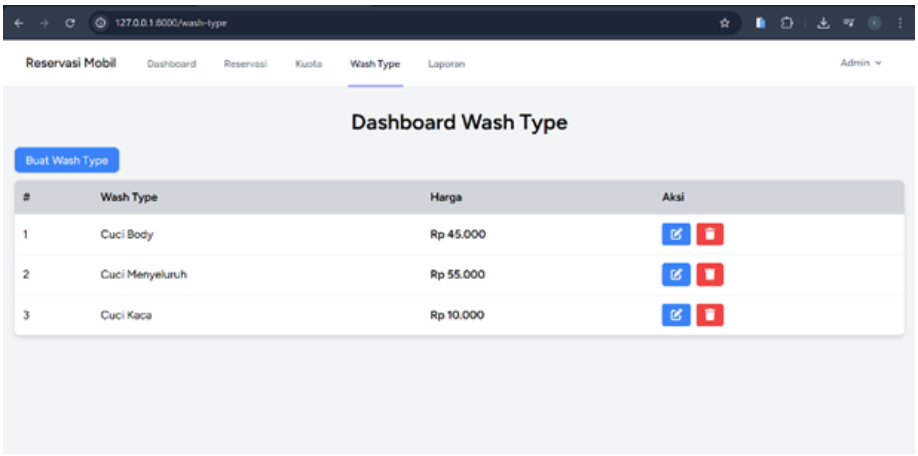

Figure 14. Dashboard wash type

Figure 14 is a display of the Wash Type Dashboard, where the admin can manage the type of car wash service along with the price of each. This feature can provide flexibility for the admin in setting a variety of services available according to business needs. In addition, dynamic price management helps the admin in adjusting rates efficiently without having to manually change the system structure, thus supporting more practical business operations and being responsive to market changes.

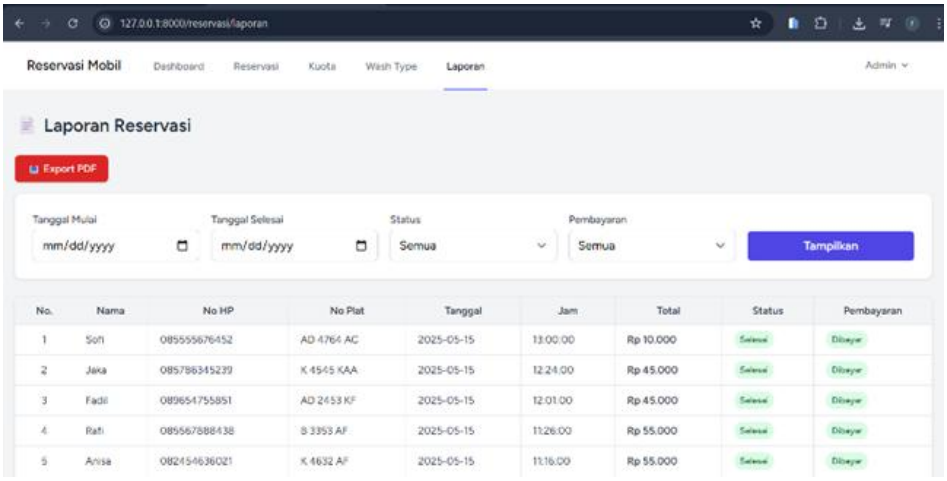

Figure 15. Reservation report page

Figure 15 shows the reservation report page used to summarize car wash service booking data. Admin can filter reports by date, status, and payment to make it easier to search for data. The information displayed includes customer name, license plate number, reservation time, total cost, and service and payment status. This feature is important because it helps admins monitor reservation activities in detail and efficiently. In addition, reports can be downloaded in PDF format via the "Export PDF" button, making it easier to document or report on business.

System Testing

This system testing uses black box testing, where the testing process is adjusted to the design and application that has been developed. Blackbox testing is a software testing method where the tester focuses on the function or output of a system without knowing the details of how it works internally [13], [14]. In this test, the tester only sees what the system should do based on the input given and the expected results, without caring about how the process occurs in the program. The goal is to ensure that the system works according to the specified needs or specifications, so that errors from the functional side can be found without having to

understand the program code [15]. Based on the test results that can be seen in Tables 2 and 3, it can be concluded that the system is running well.

Table 2. Customer system testing

Testing	Input	Expected Output	Results
Customer Home Page	Access the main URL of the Website.	Displays general information: operating hours, address, navigation menu, and reservation button.	V
Reservation Page	Name, Mobile No., Plate Number. Car Type, Washing Type, Date & Time	The reservation's successful invoice displayed.	V
Payment Page	Click the "Pay Now" button	Redirect to Midtrans, transaction successful, status "Paid"	V
Print Invoice/Proof of Payment Page	Click "Download Proof of Payment" after payment	Proof of payment PDF file successfully downloaded	V

Table 3. Admin system testing

Testing	Input	Expected Output	Results
Login Admin	Email & Password Admin	Successfully logged in to the admin dashboard	V
Reservation Dashboard	Click the "Reservation" menu	Order data is displayed in full, and can be edited/deleted	V
Manage Reservation Quota	Enter the quota amount, and click "Save."	Daily reservation quota successfully updated	V
Wash Type Page/Car Wash Type	Add/Edit laundry types and prices	Service data was successfully displayed and saved	V
Reservation Report	Select date & status filter, click "Export PDF"	The report has been successfully filtered and can be downloaded in PDF format.	V

4. CONCLUSION

The implementation of an online reservation system directly addresses the problems of queues and service delays that have often occurred. With the integration of the payment system through Midtrans, transactions become faster, more accurate, and minimize recording errors. This not only makes it easier for customers but also helps business owners manage finances more transparently and professionally. Features such as quota settings, service type management, and reservation reports give admins full control over running daily operations. This system makes the workflow more structured and facilitates decision-making based on real-time data. For further research, it can add service rating and review features, GPS integration so that customers can navigate locations easily, and a loyalty point system to reward customers who frequently use the service. These features can directly increase user engagement and customer loyalty.

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