D Hos App : Digital
Hospital Appointment System

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ABSTRAK

The system aims to address the cumbersome registration and consultation process in traditional hospitals, as well as the long waiting times for patients. It integrates features such as online appointment booking, intelligent scheduling, and waiting reminders. Patients can conveniently book appointments with their preferred departments and doctors through multiple devices. The system intelligently allocates resources based on doctors' schedules and patient demands while providing real-time waiting reminders to reduce patient waiting times and improve consultation efficiency. Through practical application, the system effectively optimizes hospital workflows, enhances patient satisfaction, and improves hospital service quality, providing strong support for the development of smart healthcare.

This system is developed using JDK 8 with the Spring Boot framework. The database engine is MySQL, caching is handled with Redis, and the frontend is built using Vue.js. The project is developed in Java and has strong cross-platform compatibility, allowing deployment on servers running Windows, CentOS, and other operating systems.

PENGENALAN

In today's society, the demand for healthcare services continues to grow, exposing numerous issues in the traditional hospital consultation model. The conventional hospital registration and consultation process is cumbersome, often requiring patients

to spend a significant amount of time waiting in queues for registration and consultation, resulting in a poor medical experience. Moreover, this inefficient model leads to the misallocation of medical resources, making it difficult to meet patients' actual needs. Therefore, the development of a hospital appointment platform has become an urgent necessity.

The hospital appointment platform integrates a series of practical and efficient features. The online appointment booking function eliminates time and location constraints, allowing patients to schedule appointments with their preferred departments and doctors anytime, anywhere via computers, mobile phones, and other devices. The intelligent scheduling feature scientifically and rationally allocates medical resources based on doctors' working hours, specialties, and patient appointment demands, ensuring precise time matching between doctors and patients. The waiting reminder function provides real-time notifications, enabling patients to stay informed about their waiting progress, plan their time effectively, and significantly reduce waiting times.

In practical application, this platform has demonstrated remarkable results. It has successfully optimized hospital consultation workflows, eliminating the need for patients to endure long queues and greatly improving consultation efficiency. Patient satisfaction has significantly increased, and hospital service quality has been notably enhanced. The rational allocation of resources has ensured the optimal utilization of medical resources, providing strong support for the development of smart healthcare and driving the entire medical industry toward greater efficiency and convenience.

METODOLOGI KAJIAN

The hospital appointment platform development project adopts the Agile development methodology, which involves continuous development and testing throughout the software development lifecycle. This approach was chosen because it allows for dynamic adjustments and changes at any stage of the development lifecycle, even in the later phases. It is an ideal, flexible, and user-oriented approach for the development project. By adopting the Agile development methodology, the high quality of the final product can be ensured.

Analysis Phase

The focus of this phase is to analyze system requirements. During this stage, functional and non-functional requirements are identified from project stakeholders. This phase also aims to ensure that the platform under development meets the established objectives. Additionally, a literature review of existing hospital appointment platforms is conducted to enhance understanding and support the development process.

Design Phase

The design phase determines the system architecture. During this stage, the architecture, database, algorithms, and interface design are finalized to streamline the development process and ensure that the research objectives are achieved.

Implementation Phase

This is the most time-consuming phase, as it involves all major development tasks, such as programming. During this stage, all requirements gathered throughout the analysis phase are developed and implemented, integrating them into a complete platform. Additionally, platform defects can be identified and corrected during this process to improve the overall system.

Test Phase

The testing was conducted using the following methods:

Equivalence Partitioning: Input data was categorized into valid and invalid equivalence classes. For example, in the case of appointment scheduling, available time slots were classified as valid equivalence classes, while time slots outside hospital working hours or fully booked slots were classified as invalid equivalence classes. This approach was used to design test cases and ensure coverage of all possible input scenarios.

Boundary Value Analysis: Tests were conducted on boundary values of input data, such as the maximum number of appointments allowed and the minimum appointment interval, to verify the system's ability to handle edge cases.

Scenario-Based Testing: Various real-world user scenarios were simulated, including first-time appointment booking, rebooking after cancellation, and modifying appointment details. This ensured that the system functioned correctly across different business scenarios.

Test Conclusion

After comprehensive and detailed testing, the hospital appointment platform has demonstrated strong performance across key indicators and is ready for deployment.

In terms of functionality, core features such as online appointment booking, intelligent scheduling, and appointment reminders operate stably. The vast majority of test cases have passed successfully, and the system provides effective prompts for

exceptional cases, meeting the design requirements. However, some minor issues remain, such as handling appointment conflicts in extreme scenarios. While these do not affect overall usability, further optimization could enhance the user experience.

Regarding performance, the system maintains stable operation under different levels of concurrent users, with response time and throughput meeting business needs. Even in high-concurrency scenarios, no crashes or severe performance degradation were observed, demonstrating strong resilience under load.

Compatibility testing results show that the platform runs smoothly on major browsers and operating systems, with proper page rendering and seamless functionality, ensuring good compatibility.

Security testing has identified and resolved low-risk vulnerabilities, with no high- or medium-risk vulnerabilities currently present. The system meets expected security standards and effectively protects user data.

Overall, the hospital appointment platform has performed exceptionally well. After deployment, it will provide patients with a more convenient and efficient appointment booking experience. It is recommended to optimize the identified minor issues before going live and continuously monitor system performance to ensure stability and reliability.

Detailed Function Description

User Management Functions

- Registration: Newly registered users are assigned the default role of "patient."
- Login: All platform users can log in. The system supports enabling Single Sign-On (SSO), allowing only one active session per user (logging in from another device will log out the previous session). CAPTCHA verification can be disabled.
- Role Management: Users can be assigned roles, which control menu access permissions.
- User Management: Users can be manually added.
- Menu Management: Works alongside role management to control access permissions.
- Department Management: Configures hospital departments.
- Dictionary Management: Manages system dictionary constants.
- Parameter Settings: Configures system parameters, such as disabling CAPTCHA and changing themes.
- Log Management: Displays logs of user actions.

- Online Users: Displays currently active users and allows forced logouts.
- Data Monitoring: Integrated with Druid to analyze real-time SQL execution performance.
- Service Monitoring: Monitors system resource usage.
- Cache Monitoring: Displays Redis cache status.
- Cache List: Lists stored Redis cache data.

Appointment-Related Functions

1. The admin adds hospital departments through Department Management and assigns doctor schedules via the scheduling feature.
2. Patients log in to the system, select a department, appointment time, and doctor in the appointment system. They can cancel bookings and check estimated waiting times.
3. Doctors log in to the system and view appointment records for their department in Department Management. They can mark patients as Arrived or Not Arrived.
4. After the patient completes their appointment, they can rate the service.
5. The system allows viewing of all appointment records under System Management → Consultation Records.

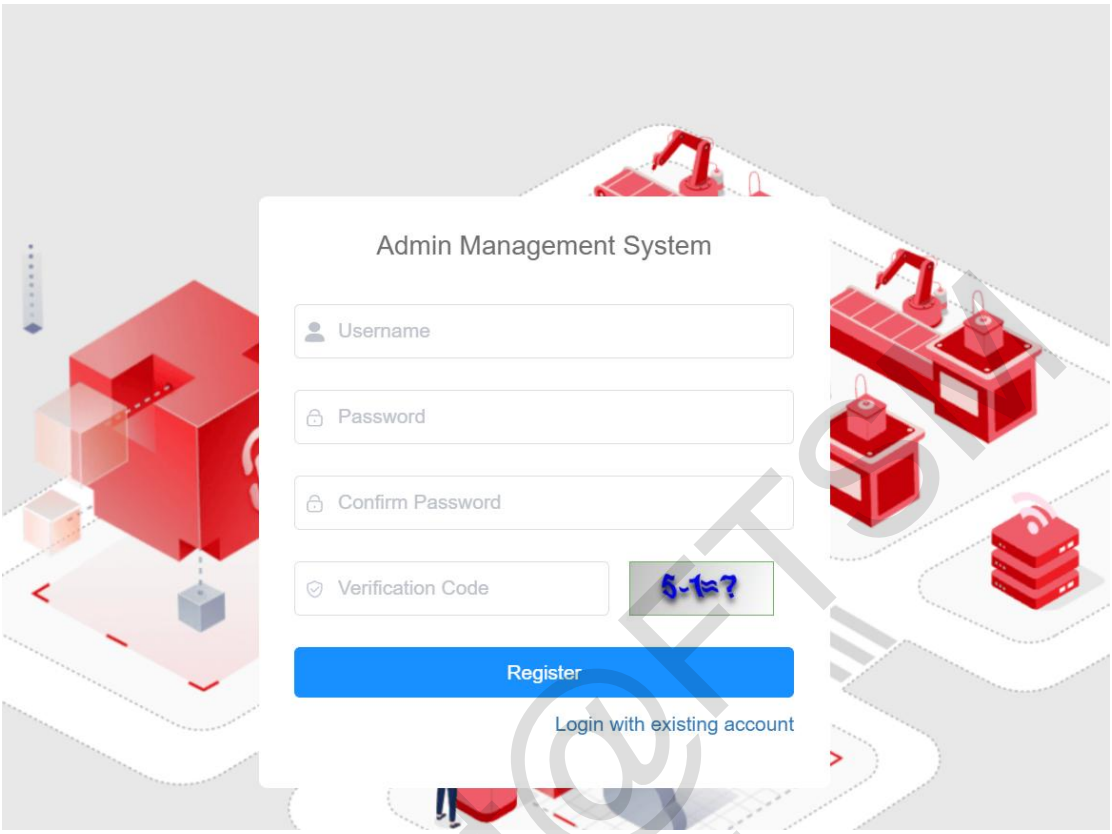

Figure 1 Registration Interface

When entering the platform, the user will see the platform user interface. To start using the platform, users need to register an account first and enter the login interface by clicking the "Login" button, as shown in Figure 1. On the login screen, users can either log in with an existing account or create a new one.

During registration, users need to fill in all required information, including a username, password, and verification code. The system supports enabling or disabling CAPTCHA verification as needed. After successful registration, users can log in and start using the platform.

After the user registers an account, he needs to return to the login page.

The login interface (as shown in Figure 2) allows the user to log in to the platform using the account and password used when registering, and needs to enter the verification code again. At the same time, he can also choose to remember the password.

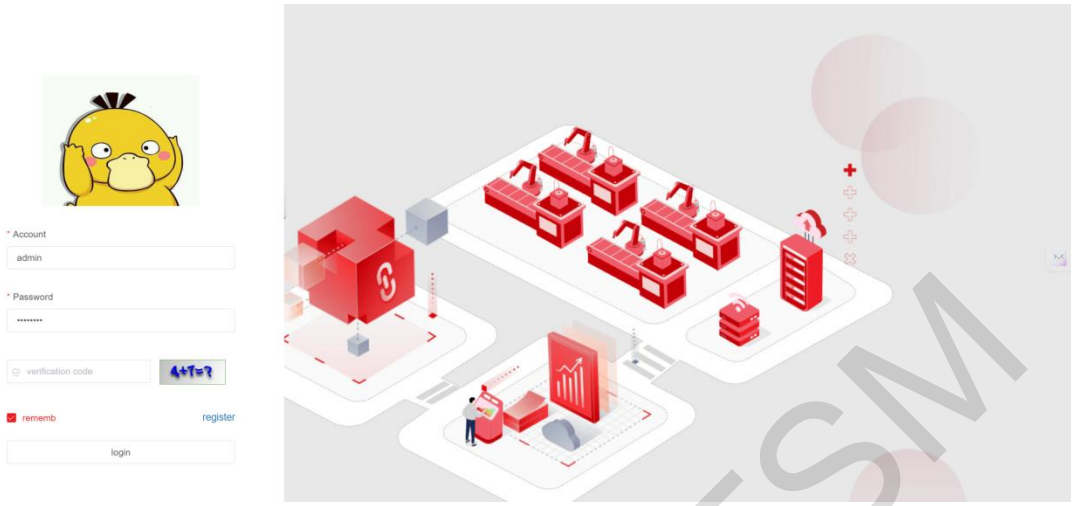

Figure 2 Login Interface

After the user successfully logs in, the platform displays the home page. As shown in Figure 3, the home page consists of a dark blue left sidebar containing several navigation options, including "index" and "appointment system," with a sub-option labeled "make case." The top navigation bar displays the current page path, helping users track their location within the system. The main interface features a large white workspace where dynamic content loads based on user interactions. The top right corner includes a search icon and a user avatar. The layout is designed for easy navigation, allowing users to switch between different features and modules efficiently.

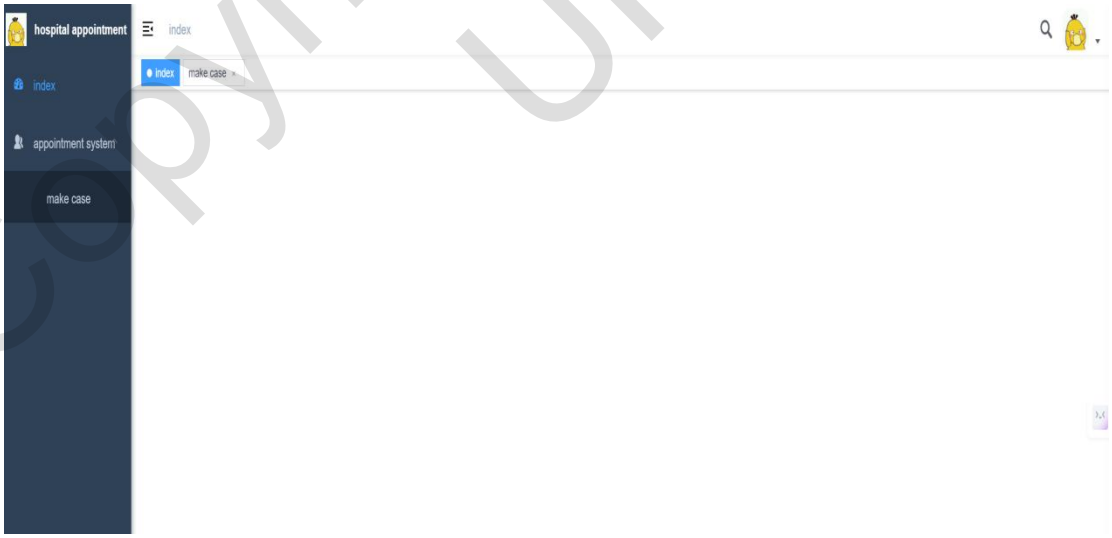

Figure 3 Homepage Interface

This is the patient appointment booking page, where users can select an appointment date, department, and doctor. As shown in Figure 4, the interface includes a pop-up form titled "Add Appointment," allowing users to choose a date and select a doctor from the available options. Each doctor's availability and wait time are displayed in a

dropdown menu. After selecting the desired appointment, users can confirm or cancel the booking. The background shows a table listing existing appointments with details such as customer name, appointment time, status, rating, and assigned doctor.

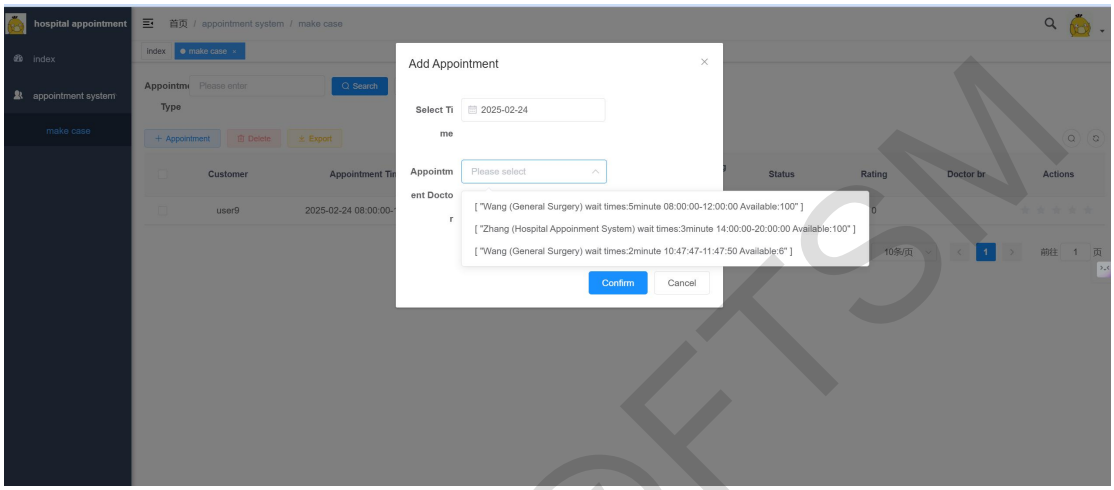

Figure 4 Appointment interface

This is the doctor's dashboard page, displaying both current patient appointments and historical consultation records. As shown in Figure 5, the interface features a table listing details such as patient name, appointment time, assigned doctor, appointment type, status, rating, and available actions. If a patient does not show up, the doctor can click "No Show" to cancel the appointment, while after a successful consultation, they can click "Present" to mark it as completed. Additionally, the doctor can click "br" to send the prepared medical record to the patient. The top section includes search and filtering options, allowing doctors to quickly locate specific appointments, while the left sidebar provides navigation options such as index, system, and departments, helping doctors efficiently manage patient information and daily tasks.

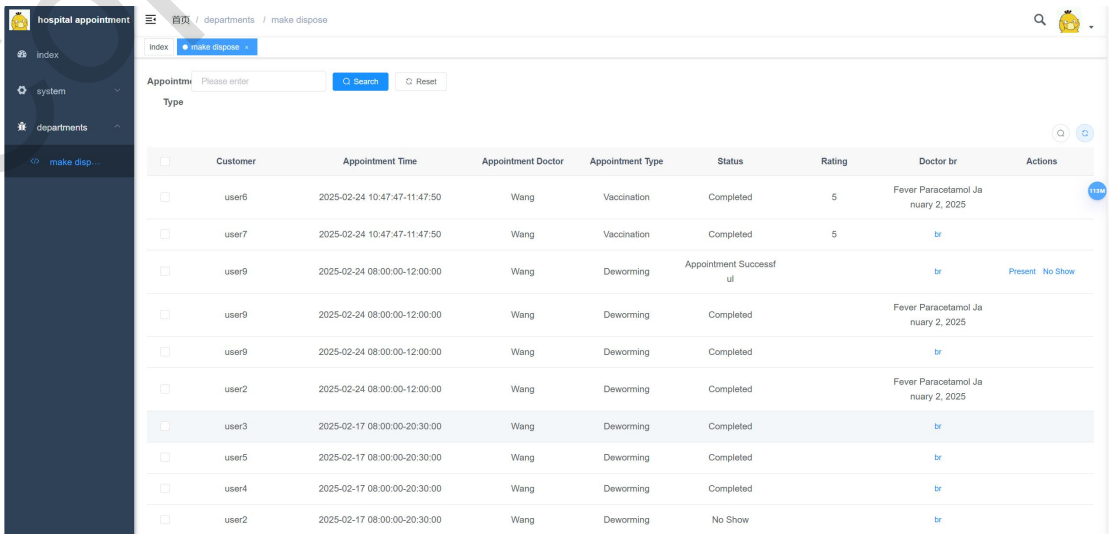

Figure 5 Doctor page interface

After the appointment is successfully made, as shown in Figure 6, the patient can see the estimated waiting time. After the consultation, the patient can give an evaluation of the consultation and will receive a medical record form from the doctor.

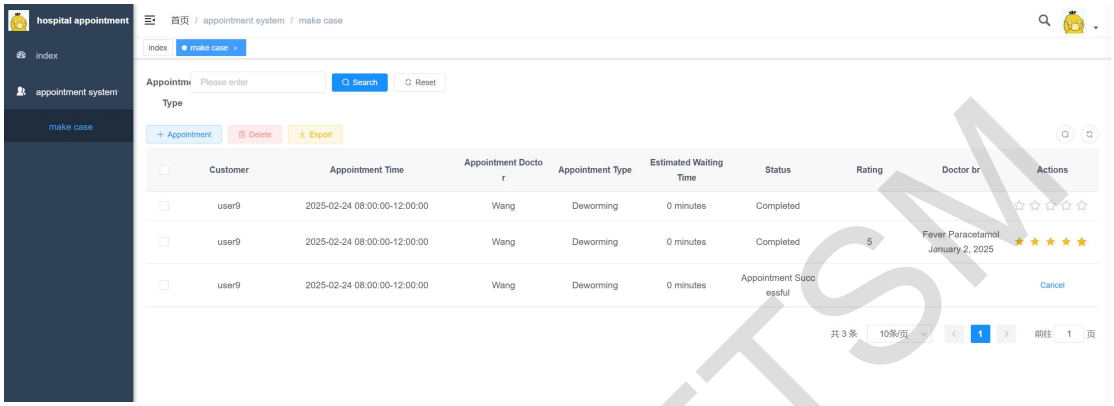

Figure 6 patient page interface

This is the user profile page, displaying personal information and account settings. As shown in Figure 7, on the left side, a profile section shows the user's avatar, username, phone number, email, department, role, and account creation date. The role for this user is labeled as "Normal user." On the right side, there is an editable form under the "Basic Information" tab, where the user can update their nickname, phone number, email, and gender selection. Additionally, there is a "Change Password" tab for security modifications. At the bottom of the form, two buttons, "Save" and "Close," allow users to confirm or discard changes. The sidebar on the left provides navigation options such as "Index," "Appointment System," and "Make Case," facilitating access to other features of the hospital appointment system.

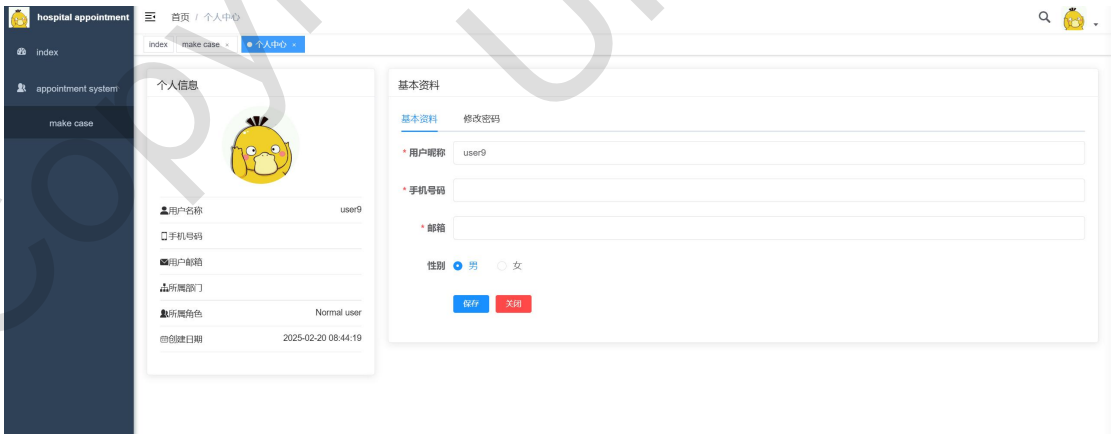

Figure 7 Profile Center

Pengujian Kebolehgunaan

Usability testing is a final testing process conducted by user representatives and stakeholders to ensure that the developed food review platform provides the required functionality before it is released to the public. The purpose of usability testing is to evaluate the usability of the system, collect quantitative data, and assess user satisfaction.

The table shows the average score for each user satisfaction item. The usability testing results indicate that all tested functionalities of the hospital appointment management system performed successfully, with high scores reflecting system reliability and efficiency. The user-related functions, including registration (95/100), login (99/100), and appointment booking (100/100), were all functional, with minor points deducted due to specific validation requirements. The admin functionalities, such as user management, department management, online user tracking, database management, and server management, all achieved perfect scores (100/100), indicating a stable backend system. The doctor-related functionalities, including scheduling, processing appointments, providing feedback, and rating patient visits, also received full marks, demonstrating smooth and efficient workflow support for healthcare providers. Overall, the system exhibits strong usability, with minimal areas for improvement, primarily in refining user validation processes during registration and login.

Test Case ID	Test Case Description	Objective	Result	Score	Comments
User1	register	Register as a patient user. After registration, the dis patient.	successful	95/100	Under the condition that the username is not duplicated and the verification code is not incorrect, both can succeed
User1	Log in	The login function is for all users and is used to log in to the system	successful	99/100	When the verification code matches the account password, the login is successful
User1	appointment	The appointment clinic	successful	100/100	The appointment function

		function is a user function for patients, which allows them to make appointments for outpatient visits			requires selecting outpatient and doctor appointments
Admin	User Management	User Management Tab	successful	100/100	The user management function is only available to administrators and includes functions such as adding users and setting user roles
Admin	Department Management	Department Management Tab	successful	100/100	Department management provides the function of setting up departments, with a tree structure
Admin	Online users	Online user Tab	successful	100/100	View user online status and provide forced offline function
Admin	Data Management	Data Management Tab	successful	100/100	The database management page provided by Druid for user login in the data management tab has been embedded in

					the system
Admin	Server Manager	Server Management Tab	successful	100/100	View system resource status
Wang	Scheduling	Scheduling tab	successful	100/100	Doctor users can schedule their own appointments
Wang	Process appointment forms	Process the appointment form tab	successful	100/100	The doctor processes the appointment form based on the on-site situation
Wang	comment	Process the appointment form tab	successful	100/100	Doctors can leave comments on processed appointment forms to let patients know the specific situation
Wang	Rate	Appointment tab	successful	100/100	Patients can make appointments without being present for scoring purposes

To further enhance the usability of the hospital appointment management system, improvements can be made in several key areas. First, the registration and login processes can be optimized by refining the validation mechanisms to minimize potential input errors and ensure a seamless user experience. Implementing real-time error prompts and suggestions during registration can help users resolve issues more efficiently. Additionally, enhancing the appointment booking process by integrating an intelligent recommendation system for available time slots and doctors based on user preferences and past visits can improve efficiency. For administrative functions, providing a more detailed audit log for user and department management actions would enhance system transparency and security. Moreover, incorporating real-time monitoring and automated alerts for system resources in the server management module can improve maintenance efficiency. Lastly, enabling richer feedback mechanisms for doctors and patients, such as allowing image or document uploads in

appointment reviews, would provide more valuable insights and enhance the overall user experience.

Cadangan Penambahbaikan

After thorough research, a future improvement proposal for this hospital appointment management system is to develop a dedicated mobile application. A mobile app would enhance accessibility, allowing patients to register, book appointments, and receive real-time notifications conveniently. Adding features like AI-powered doctor recommendations, secure in-app payments, and teleconsultation could further improve the user experience. For administrators, a mobile dashboard with real-time monitoring and patient management would boost efficiency. Additionally, multilingual support and voice-assisted navigation would make the system more user-friendly for a diverse audience.

KESIMPULAN

Through a comprehensive and detailed testing process, the hospital appointment system has demonstrated varying levels of performance across key dimensions.

In functional testing, using equivalence class partitioning, boundary value analysis, and scenario-based testing, the system's core functions—such as appointment scheduling, shift management, and information handling—generally meet business requirements. Most normal and exceptional input scenarios are processed correctly. However, in complex business edge cases, some issues persist, such as reduced response speed and accuracy when multiple users attempt to book the same specialist during peak hours.

Performance testing, including load, stress, and capacity tests, shows that the system performs well in low- to mid-concurrency scenarios, with good response times and throughput that meet daily business needs. However, under high concurrency and large data volumes, resource utilization increases significantly, and response times extend. Further optimization of algorithms and server configurations is needed to enhance performance.

Compatibility testing across major browsers, operating systems, and devices confirms that the system runs smoothly in different environments, with no significant issues in layout or functionality, demonstrating strong compatibility.

Security testing, which included vulnerability scanning, penetration testing, and data encryption tests, revealed a few low-risk security vulnerabilities that have been promptly addressed. Encryption measures are well-implemented, effectively safeguarding patient-sensitive information.

In conclusion, the hospital appointment system is ready for deployment, offering reliable compatibility and security while meeting core business needs. However, further improvements are required in optimizing performance under high concurrency and refining functions in complex business scenarios. It is recommended to address these issues before launch and to continuously monitor system performance and security after deployment to ensure stable operation.

PENGHARGAAN

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The authors of the study would also like to thank all those who helped directly or indirectly in the implementation of the project. All the help provided was invaluable, as without their help, the project would not have been able to proceed smoothly. May God bless them and give them the best in return.

RUJUKAN

Scheduling an appointment online at Mayo Clinic
https://www.mayoclinic.org/scheduling-an-appointment-online/vid-20521112

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https://www.qmatic.com/blog/appointment-systems-in-hospitals

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