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Efficient Queue Management System for Rumah Sehat Dokter Zoji Clinic in Cianjur

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Abstract

This charity project aims to implement an efficient queue management system for Rumah Sehat Dokter Zoji Clinic, located in Cianjur, Indonesia. The clinic, known for its alternative and affordable healthcare services using a "pay as you wish" model, experiences high patient volumes—ranging from 300 to 500 daily on weekdays and up to 1,000 on Sundays. To address the growing demand and improve patient care, a mobile application was developed using Flutter with Firebase as the database to organize patient data and manage queue schedules effectively. The system prioritizes patients based on the severity of their conditions, categorizing them into Emergency, Severe, Moderate, and Mild levels. This prioritization ensures that those in urgent need receive prompt care, while others are integrated into the regular queue accordingly. The project also focuses on educating clinic staff and patients about the new system, recognizing varying levels of familiarity with technology. A hybrid approach to the queue system remains in place, accommodating those who prefer traditional methods. The implementation of this system is expected to streamline operations at the clinic, enhancing the overall efficiency and effectiveness of patient care delivery.

Keywords: Queue Management System, Patient Prioritization, Flutter Application, Community Health Clinic, Hybrid Queue System

INTRODUCTION

The development of mobile applications using frameworks like Flutter, paired with cloud technologies like Firebase, has become a key solution in enhancing efficiency and security in various sectors, including parking management, healthcare, and event attendance. Research by (Agarwal et al., 2023) addresses the issue of traffic congestion and long queues in parking areas by implementing a cost-effective mobile application that uses QR-code scanning for vehicle authentication, significantly improving operational efficiency. Similarly, (Button, 2003) highlights the increasing role of private security in 'quasi-public' spaces like shopping malls, underscoring the importance of technological tools for enhancing security in such settings. In the context of server room management, (Özkurt & Cem"ozkurt, 2024) showcase a real-time monitoring system that combines IoT devices with Flutter and Firebase to provide secure and responsive management of digital infrastructures. Other studies, like those by (Hiuredhy & Beeh, 2022) and (Mamoun et al., 2021), demonstrate how similar mobile technologies are used to streamline services such as church seat reservations and telemedicine, further illustrating the versatility of Flutter and Firebase in improving user experience and operational efficiency across different domains. These innovations reflect a broader trend toward integrating mobile applications with real-time data management systems to address various logistical and security challenges.

Community healthcare clinics play a crucial role in providing medical services to underserved populations, particularly in regions where access to conventional healthcare facilities is limited. Rumah Sehat Dokter Zoji Clinic, located in Cianjur, West Java, exemplifies such an institution. Operating on a "pay as you wish" basis, the clinic aims to deliver affordable alternative healthcare to a broad segment of the local community. This unique payment model has made the clinic an attractive option for those who cannot afford standard medical care, leading to a significant increase in patient numbers. As illustrated in Fig. 1, the clinic now faces the challenge of managing daily patient volumes ranging from 300 to 500 on weekdays and up to 1,000 on Sundays. This surge in patient flow has strained the clinic's capacity to provide timely and efficient care, emphasizing the urgent need for improved appointment planning and a more effective

system to manage patient registration and service care delivery.



Fig. 1. The condition of patient queues, both outside and inside the waiting room.

The implementation of a structured queue management system represents a critical intervention to address these challenges. The system is designed to categorize patients based on the urgency of their conditions, ensuring that those with the most critical needs receive immediate attention. By using a mobile application developed with Flutter and supported by Firebase for data management, the system not only streamlines the registration process but also enables the clinic staff to manage patient flow more effectively. This innovation aligns with similar initiatives in other community health settings, where digital solutions have been employed to enhance service delivery in resource-constrained environments. For instance, studies by (Özkurt & Cem"ozkurt, 2024) and (Agarwal et al., 2023) have demonstrated that digital queue management systems significantly reduce patient waiting times and improve satisfaction in high-demand clinics, particularly in underserved regions.

Despite the apparent benefits of digital queue systems, their successful implementation requires careful consideration of the user base, especially in community settings where technological literacy may vary widely. At Rumah Sehat Dokter Zoji Clinic, the introduction of this system must be accompanied by comprehensive training for clinic staff and clear communication with patients. Similar projects, such as the work by (Mamoun et al., 2021) on mobile health interventions in rural clinics, emphasize the importance of integrating educational components to ensure that both staff and patients can effectively use the new technology. In this context, a hybrid approach that combines digital solutions with traditional methods may be necessary to accommodate patients who are less familiar or comfortable with technology.

The literature also highlights the broader impact of queue management systems in improving healthcare equity. By prioritizing care based on medical urgency, these systems ensure that vulnerable patients often those with the least access to alternative care options receive timely and appropriate treatment. This aligns with the goals of community-based healthcare initiatives, which seek to reduce disparities in health outcomes by improving access to essential services. As such, the project at Rumah Sehat Dokter Zoji Clinic is not only about improving operational efficiency but also about enhancing the fairness and quality of care provided to the community.

The objective of this project is to implement an efficient and fair queue management system at Rumah Sehat Dokter Zoji Clinic. By prioritizing patients according to their medical needs and providing thorough training to clinic staff, the project aims to improve the overall efficiency and effectiveness of healthcare delivery. This initiative is expected to ensure that those in greatest need receive timely care while maintaining an organized and equitable process for all patients. Additionally, the project seeks to contribute to the broader understanding of how digital solutions

can be effectively integrated into community healthcare settings, particularly in resource-limited environments.

METHOD

A. The Requirement Process

The requirement process for the queue management system at Klinik Rumah Sehat Dokter Zoji began with a thorough analysis of the clinic's operational challenges. Given the high patient volume, particularly on weekends, the clinic faced difficulties in managing patient flow efficiently. We conducted interviews with clinic staff and observed the daily operations to understand their needs. Key requirements included the ability to prioritize patients based on the severity of their conditions, a seamless integration between patient registration and queue management, and a user-friendly interface for both clinic staff and patients. Additionally, it was essential to ensure that the system could handle high volumes of data securely and provide real-time updates to both users and administrators. These requirements guided the development process, ensuring that the system was tailored to the specific needs of Klinik Rumah Sehat Dokter Zoji.

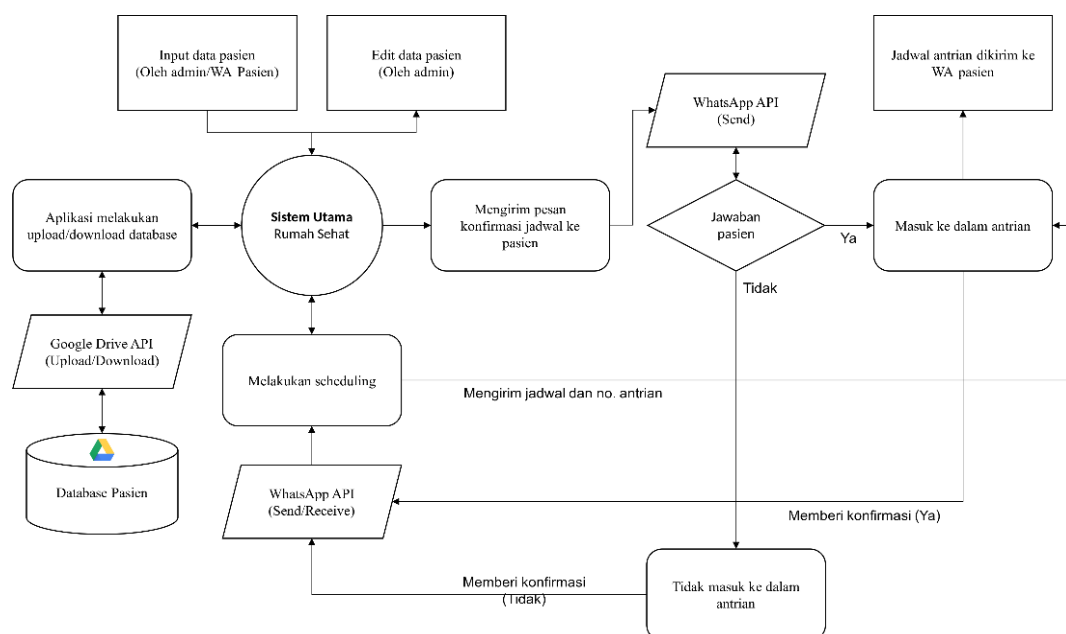


Figure 1. Requirement flowchart from the clinic for the application.

B. Application Design

The design of the queue management system was divided into two main applications: "Rumah Sehat" for clinic administrators and "Pasien Sehat" for patients. The application design focused on creating an efficient workflow for managing patient data and queues. "Rumah Sehat" was designed with features to register patients, assign priority levels, and manage appointment schedules. Meanwhile, "Pasien Sehat" allowed patients to register remotely, check their queue status, and receive notifications about their appointment times. The design aimed to create a cohesive system where both applications could interact seamlessly, ensuring that patient data was consistently updated across the system. We employed modular design principles, enabling future scalability and easy maintenance.

C. Use Case Diagram

The use case diagram was developed to map out the interactions between users and the system, providing a clear visualization of the functional requirements. The diagram included key actors such as clinic administrators, doctors, and patients, highlighting their roles within the system. For example, clinic administrators could register new patients, assign priority levels, and manage daily schedules, while patients could check their queue status, view their appointment times, and update their personal information. The use case diagram served as a blueprint for the system's functionality, ensuring that all critical interactions were accounted for during development. This approach helped in identifying potential user scenarios and edge cases, enabling a more robust application.

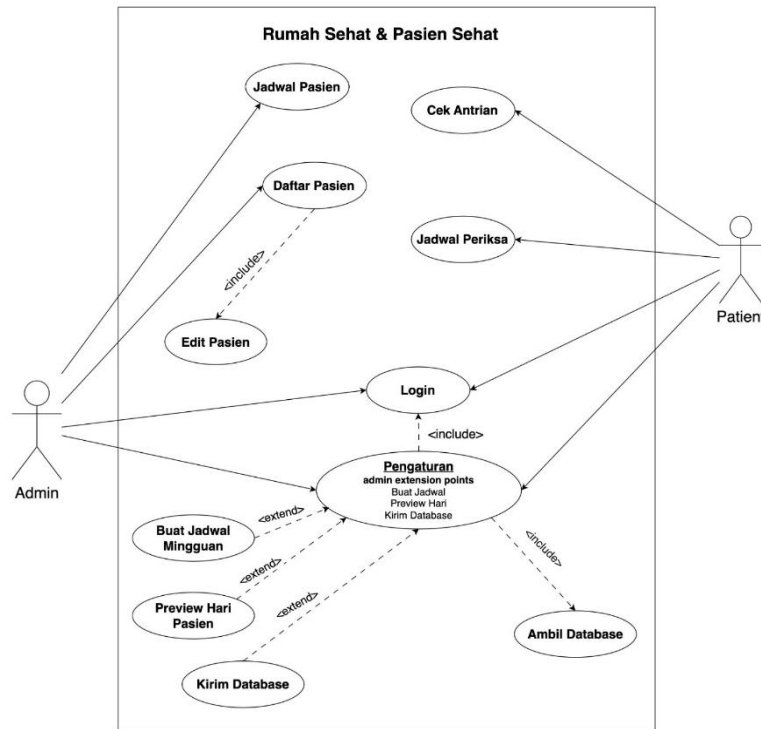


Figure 2. Usecase diagram for application "Pasien Sehat" and "Rumah Sehat".

D. UI/UX Design

The UI/UX design of both "Rumah Sehat" and "Pasien Sehat" was guided by the principles of simplicity, clarity, and user-centered design. For "Rumah Sehat," the focus was on creating an interface that allowed clinic staff to quickly access patient information, schedule appointments, and manage queues with minimal effort. The UI featured clean layouts, intuitive navigation, and clear visual hierarchies to support the clinic's workflow. For "Pasien Sehat," the design prioritized ease of use for patients with varying levels of technological literacy. The interface included straightforward features for checking queue status, scheduling visits, and updating personal information. Both applications were designed to be responsive and accessible on various devices, ensuring a broad reach and usability.

E. Database Design

The database design was critical to ensuring the secure and efficient management of patient data. Firebase was selected as the backend due to its real-time data synchronization, scalability, and robust security features. The database schema was designed to capture essential patient details, including personal information, medical history, appointment records, and queue status. The structure also supported the role-based access control, ensuring that sensitive information was only accessible to authorized personnel. Data integrity and consistency were maintained through the use of validation rules and automated backups. The database design also allowed for seamless data retrieval and updating, which was crucial for both the "Rumah Sehat" and "Pasien Sehat".

F. Application Testing

Testing is a crucial phase in ensuring the reliability and effectiveness of the queue management system. The testing process included unit testing, integration testing, and user acceptance testing (UAT). Unit tests were conducted on individual components to verify their correctness, while integration testing ensured that the various modules of the system worked together seamlessly. User acceptance testing involved clinic staff and patients who provided feedback on the system's usability, functionality, and performance. During UAT, the system was tested in a live environment at Klinik Rumah Sehat Dokter Zoji to identify and resolve any issues before full deployment. The testing process confirmed that the system met all requirements and functioned as intended, ensuring a smooth and efficient queue management experience for both the clinic staff and patients.

G. Community Satisfaction Survey

The survey questionnaire as in Table 1, consisted of four questions, each rated on a 4-point Likert scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (4). The questions focused on assessing the alignment of the community service program with its goals, its effectiveness in addressing community needs, local community support for Telkom University's initiatives, and the adequacy of the

allocated timeframe for the program.

Table 1. List of Survey Questions with Response Scale (1 = Strongly Disagree to 4 = Strongly. Agree)

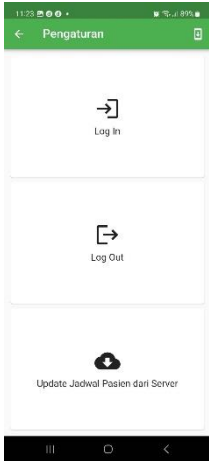
No	Questions
1	The community service program aligns well with its intended goals.
2	This community service program effectively addresses the needs of the target community.
3	The local community supports and anticipates the ongoing and future community service initiatives from Telkom University.
4	The timeframe allocated for this community service program is generally sufficient to meet the needs.

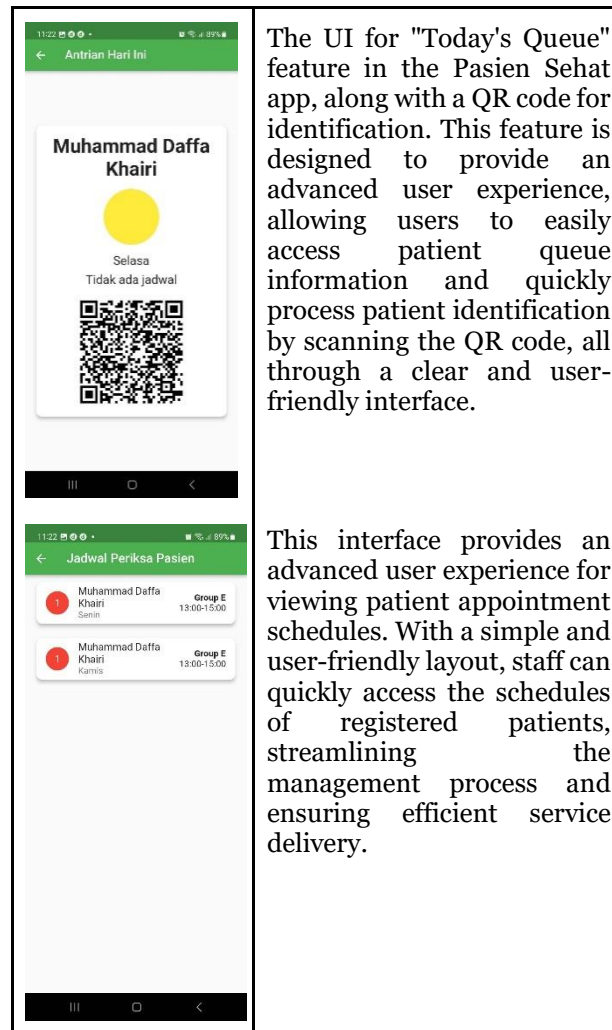
RESULTS AND DISCUSSION

The realization of the interface design for the Rumah Sehat and Pasien Sehat applications has been instrumental in enhancing the queue management system at Klinik Rumah Sehat Dokter Zoji. The interface design ensures both functionality and user-friendliness, aligning with the clinic's operational needs.

"Pasien Sehat" application

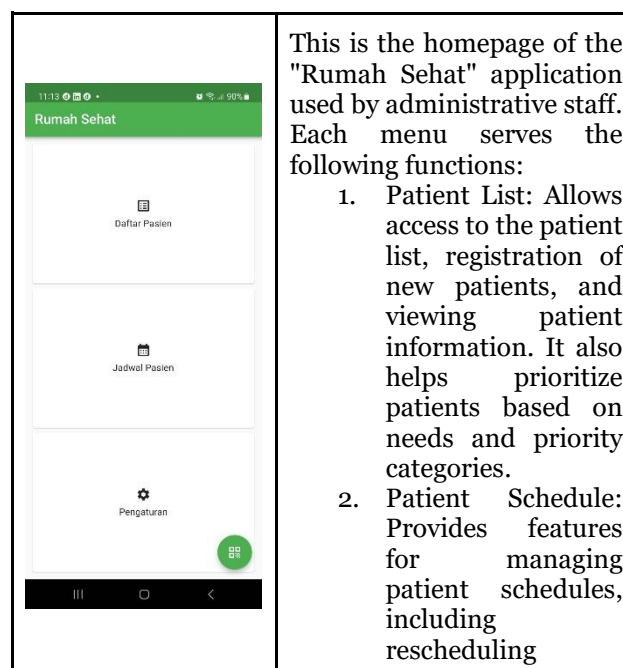
The "Pasien Sehat" application streamlines patient queue management by providing easy access to appointment schedules and real-time updates through a user-friendly interface. It enhances patient care efficiency by enabling quick patient identification and appointment tracking using QR codes and other essential features, ensuring a smooth and organized experience for both patients and clinic staff.

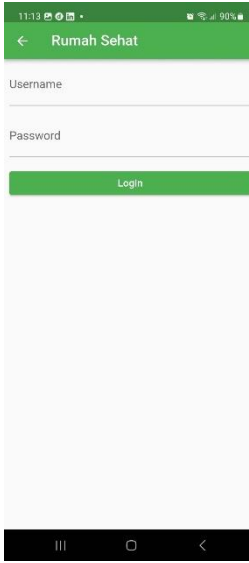
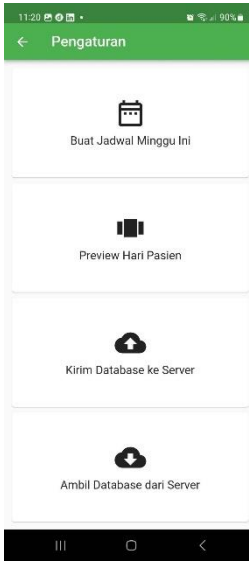
UI display	Description
	<p>The Settings page on the Pasien Sehat app includes several key features:</p> <ol style="list-style-type: none"> 1. Login History: This menu allows users to view their login history, including the date and time of each login, as well as relevant details like the device used or the login location. 2. Logout: Selecting this menu logs the user out of the Rumah Sehat app, redirecting them to the login page, where they can re-enter their credentials if needed. 3. Today's Patient Update: This menu enables users to update patient information for the current day.

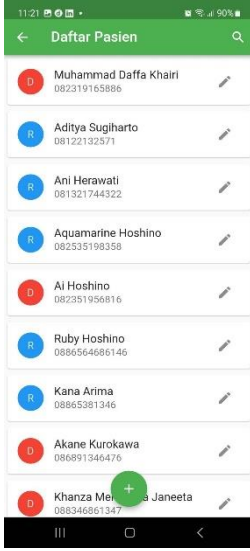
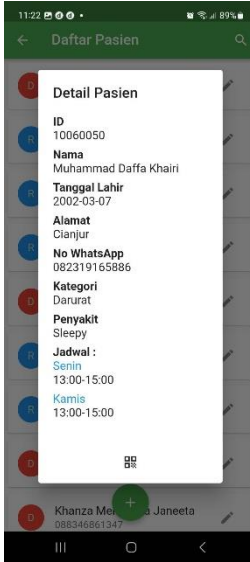


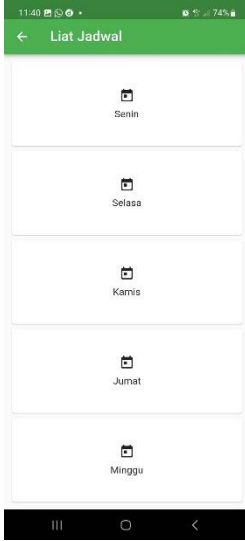
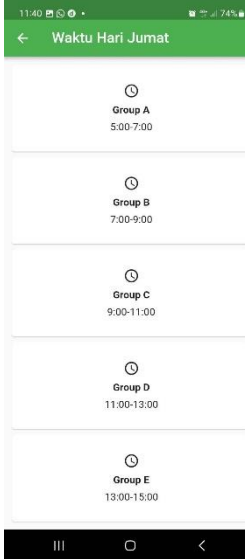
"Rumah Sehat" Application

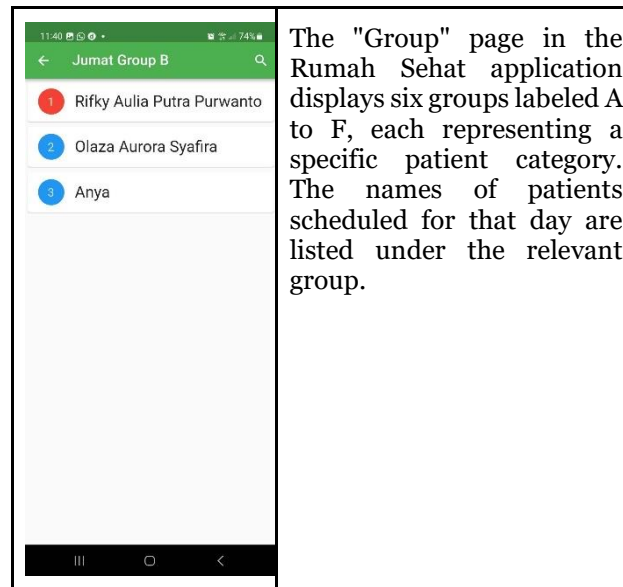
The "Rumah Sehat" application is designed to assist clinic staff with comprehensive patient management, offering features like patient registration, schedule organization, and secure administrative access. By providing an intuitive interface for managing patient data, appointments, and system settings, the application ensures that healthcare services are delivered efficiently and securely.



	<p>appointments, checking doctor availability, and sending notifications or reminders to patients.</p> <p>3. Settings: Enables access to complex application settings, including preferences, notifications, user permissions, and other operational controls.</p>
	<p>The image shows the initial screen of the Rumah Sehat app, where administrators possess extended access to manage and monitor system features and health data. Administrators are required to log in via a designated page, providing a registered username and password. Upon successful verification, they gain access to the main administrator page, which is used to manage the Rumah Sehat system. This login process is designed to safeguard sensitive information, ensuring that only authorized administrators can access and manage the system's features.</p>
	<p>The Settings menu in the Rumah Sehat application provides several useful features. Users can access the "Create Schedule for This Week" option, which facilitates efficient weekly scheduling and helps ensure that healthcare services are well-organized. Additionally, the "Patient Day Preview" feature offers a summary of patients scheduled for the day, aiding in the preparation and planning of medical services. Finally, the "Retrieve Database from Server" feature allows users to recover patient data from the server, proving valuable in case of system errors or</p>

	data loss, thereby preventing the loss of critical information.
	<p>The Rumah Sehat application includes a "Daftar Pasien" (patient list) page, enabling staff to view the registered patients for the clinic. This page displays key information such as name, age, gender, visit date, and reported symptoms. The "Patient List" feature allows staff to quickly access and process patient details, essential for managing medical services, scheduling visits, and ensuring appropriate care. Additionally, a search option can be integrated into this feature to help staff easily locate specific patients.</p>
	<p>The "Patient Details Pop-up" feature in the Rumah Sehat application allows staff to view a pop-up window displaying detailed patient information, including name, date of birth, address, WhatsApp number, disease category, disease type, and visit schedule. This feature provides a convenient and informative overview of patient data. It enables staff to easily access and review essential details, such as the patient's name, date of birth, and unique ID for identification. The address and WhatsApp number aid in communication and coordination with the patient. Additionally, the disease category and type offer insight into the patient's medical condition, assisting staff in developing appropriate care plans and ensuring the patient receives the necessary attention.</p>

	<p>“Lihat Jadwal” is patient schedule feature in the Rumah Sehat application allows staff to view the daily schedule of registered patients. This feature provides an organized and informative display of patient data for a selected day. Staff can choose a specific date to see the list of scheduled patients, including key details such as the patient's name, visit time, and other necessary information for proper care. The "Patient Schedule" feature helps staff manage and prepare for patient visits, enabling effective planning and resource allocation by clearly identifying the patients expected on a given day.</p>
	<p>“Jadwal Pasien” is the patient schedule page that allows staff to view the daily schedule of registered patients. This feature presents organized and clear patient data for a specific day. Staff can select a date to see the scheduled patients, including key details like name, visit time, and other necessary information for appropriate care. The "Patient Schedule" feature helps staff efficiently manage and prepare for patient visits by enabling effective planning and resource allocation based on the expected patients for the day.</p>



User Interface and Experiences



Figure 3. Socialization activity to the users to test their experiences.

The short training session on user interface and experience (UI/UX) was held to provide participants with valuable insights of using the application. A variety of people from different backgrounds and ages contributed to test the experience in using application to book their attendance to the clinic. The training's hands-on approach effectively supported learning, making it both informative and enjoyable for all attendees.

Cost Realization

The spending costs as outlined primarily cover transportation expenses for the Bojongsoang-Cianjur and Cianjur-Bojongsoang routes, totaling Rp. 410,000,000. Despite these significant transportation costs, the development of the mobile application using Flutter with Firebase is notably cost-effective. Both Flutter and Firebase are open-source technologies, minimizing software development expenses. Flutter, a free and open-source UI toolkit, allows for the creation of natively compiled applications across multiple platforms from a single codebase. Firebase, used as the database, is also a cost-efficient option, particularly in its free tier, which is sufficient for small to medium-scale applications. By leveraging these open-source tools, the project ensures efficient use of resources, reducing overall development costs while effectively organizing patient data and managing queue schedules.

Survey Analysis and Feedback

Result analysis from survey data indicates that the applications have been well received but also highlight areas for improvement. On October 15, 2024, during a demonstration at the clinic, patients and staff provided feedback on the system. Some patients suggested that those traveling long distances should

be informed about queue availability through the application.

The survey results on Figure. 4, illustrated in bar charts, reflect the community's response to the project's objectives, needs, and implementation timing. The feedback underscores the importance of ongoing socialization and education about the new queue management system. Given the initial unfamiliarity with the system, a hybrid approach combining manual and digital processes will be maintained to accommodate all patients. The gradual introduction of the applications, along with comprehensive training for both staff and patients, will help maximize the benefits of the queue management system. The survey results show that more than 92% of respondents expressed overall satisfaction, as depicted in the accompanying bar chart. This demonstrates a strong positive response, with most participants indicating that their expectations were met or exceeded. The chart clearly highlights the high level of approval and reinforces the widespread contentment among the survey participants.

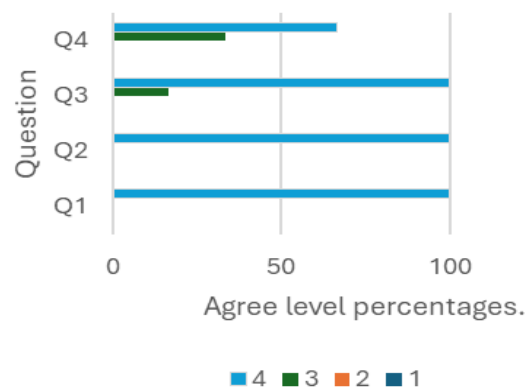


Figure 4. The community service satisfaction survey.

CONCLUSION

The queue management system at Klinik Rumah Sehat Dokter Zoji was developed to streamline operations and ensure patients are prioritized based on the severity of their conditions. It consists of two main applications: "Rumah Sehat" for clinic administrators and "Pasien Sehat" for patients. The system was designed to enhance the workflow of managing patient data and queues, with features for registration, priority levels, and appointment schedules. Its user interface and experience were crafted to ensure simplicity, clarity, and intuitive navigation. Firebase was chosen for the database due to its real-time synchronization, scalability, and robust security, ensuring secure patient data management with role-based access control.

The system underwent comprehensive testing, including unit testing, integration testing, and user acceptance testing (UAT), and met all functional requirements. The result was a smooth, efficient experience for both staff and patients. A community satisfaction survey was also conducted to assess the program's alignment with its goals, its effectiveness in addressing community needs, and local support for Telkom University's initiatives. The design of the applications, especially Pasien Sehat, greatly improved queue management by providing real-time updates and easy appointment tracking. Rumah Sehat, on the other hand, enabled clinic staff to efficiently manage patient registrations, schedules, and administrative access.

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