

Design and Implementation of Electronic Queue System at Walenrang Health Center for Service Optimization

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ABSTRACT

This study aims to design, develop, and implement an Android-based electronic queuing system to enhance the effectiveness, efficiency, and overall quality of healthcare services at Walenrang Community Health Center. The manual queuing system previously applied often caused patient congestion, long waiting times, service delays, and discomfort for both patients and staff. To overcome these problems, an electronic queuing system was created, allowing patients to take queue numbers online, monitor the real-time status of the queue, access detailed service information, and view their visit history conveniently. This system was developed using a Research and Development (R&D) approach, following the waterfall model as the software development method. Evaluation of the system involved three expert validators, resulting in a validation score of 95.17%, which classifies the system as highly feasible for implementation. Furthermore, usability testing with 12 user respondents revealed an average satisfaction score of 94 out of 100, indicating a very high level of user satisfaction regarding ease of use, speed of access, and accuracy of queue information. Based on these results, the implemented system has proven effective in improving the efficiency of healthcare service delivery while providing greater convenience, comfort, and accessibility for the community, thereby supporting a more organized and patient-friendly healthcare environment.

INTRODUCTION

Queue management in public health services is one of the crucial aspects that determine patient satisfaction and service efficiency. At Walenrang Community Health Center, the manual queuing system that has been used so far often causes long waiting times, patient congestion, and discomfort in accessing services. This condition not only reduces the effectiveness of service delivery but also creates dissatisfaction among patients. According to data from the Ministry of Health (2022), long queues and waiting times remain a common complaint in community health centers, indicating the need for effective innovations in service management. Observations at Walenrang Community Health Center show that manual queuing often leads to crowded waiting rooms and decreased quality of health services.

The rapid development of information and communication technology has enabled the emergence of digital solutions in healthcare, one of which is the implementation of electronic queuing systems. Electronic queuing applications, especially those based on Android, provide practical, real-time, and accessible features for patients to take queue numbers online, monitor queue status, and access service information. To ensure accurate and efficient service management, this study uses a systematic software development approach suitable for mobile-based applications. In this context, the Waterfall model is applied as it provides a structured sequence from requirement analysis, system design, implementation, to testing, as implemented in the development of the Walenrang Community Health Center electronic queuing system.

Previous studies have shown the effectiveness of electronic queuing systems in improving health service management. Gunawan et al. (2020) demonstrated that electronic queuing reduces waiting times significantly, while Agustina (2022) highlighted the benefits of digital queuing in minimizing patient density in waiting rooms. However, most studies still focus on general queuing mechanisms and have not been specifically implemented in community health centers in rural areas, where patient density is relatively high and service access is limited.

Therefore, this study aims to design and implement an Android-based electronic queuing system at Walenrang Community Health Center using the Research and Development (R&D) approach with the Waterfall model. The system is expected to increase the effectiveness and efficiency of health services, reduce waiting times, and provide convenience for patients in accessing health services.

LITERATURE REVIEW

This literature review examines previous studies related to the development and implementation of electronic queue systems in healthcare services. It aims to compare the methods used, highlight their strengths and limitations, and



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establish the foundation for the system developed in this study.

A study by Zakaria and Saifudin (2023) developed a real-time queue application with push notification features to reduce patient waiting time caused by lack of updated queue information. The system successfully improved efficiency and user convenience by ensuring patients were notified promptly about their service turn.

A comparative study conducted by Gunawan, et al. (2020) implemented real-time queue monitoring for patient registration at Puskesmas Tinewati, Tasikmalaya during the COVID-19 pandemic. The Android-based system helped minimize physical contact and crowding by enabling online registration and appointment management. Feedback from both patients and staff demonstrated that the system effectively reduced congestion and improved safety protocols during the pandemic.

Meanwhile, Agustina (2022) developed an Android-based queue number system at Puskesmas Sawahan. The system enabled patients to secure queue numbers remotely, thereby reducing overcrowding in waiting rooms. Functional testing confirmed that all features worked as expected, although the study recommended further optimization with advanced technologies for long-term improvements.

Additionally, Fitrianto, et al. (2022) designed a mobile-based patient queue application at Klinik Pratama MTA Surakarta. The prototype facilitated online registration for polyclinic services, replacing the inefficient manual queue process. The study confirmed that mobile queue systems can streamline patient flow and reduce waiting times.

Pitaloka et.al. (2022) developed an Android-based online queuing system at Bua Community Health Center, Luwu Regency. The system facilitated patients in taking queue numbers efficiently and reduced crowding in waiting areas, thereby improving overall healthcare service effectiveness.

Hardianti et al. (2023) developed a patient queue application for general practitioners using the FIFO (First In, First Out) method based on Android. The application provides an estimated waiting time based on the average service duration, helping patients plan their arrival time. The research employed a qualitative method with data collection techniques including observation, interviews, and literature review. The results indicated that the application is effective in managing patient queues and improving service efficiency.

Across these studies, the use of mobile technology for healthcare queue management has consistently demonstrated improvements in efficiency, patient satisfaction, and service quality. However, limitations such as reliance on internet connectivity, the need for broader system integration, and dependency on mobile devices remain challenges for widespread adoption. These findings provide a strong rationale for the development of an Android-based electronic queue system at Puskesmas Walenrang, aimed at optimizing public health services by combining real-time monitoring, usability, and security.

METHOD

Research Design

This study employed a Research and Development (R&D) approach using the Waterfall model as the development methodology. The research was conducted at Walenrang Public Health Center, Luwu Regency, from December 2024 to June 2025.

In the Analysis stage, observations and interviews were carried out with health workers and patients to identify the main issues in the existing manual queuing system. The analysis revealed that manual registration led to long waiting times, overcrowding in waiting areas, and decreased patient satisfaction. To overcome these issues, a solution was proposed in the form of a mobile-based electronic queuing system application developed using the Flutter framework with Dart programming language and MySQL database.

The Design stage included planning the system architecture, database design, and user interface mockups. UML diagrams such as use case, activity, sequence, and class diagrams were used to model system processes and interactions.

In the Implementation stage, the application was developed according to the design specifications. The admin module was designed to manage queues, daily reports, and health center information, while the patient module allowed users to register, take queue numbers, view queue status, check visit history, and access information about the health center.

The Testing stage involved evaluating the system functionality using black-box testing to ensure all features operated according to requirements. In addition, expert validation was conducted with three validators using a Likert scale, producing a score of 95.17% (very feasible). Furthermore, user testing with the System Usability Scale (SUS) method involving 12 respondents yielded an average satisfaction score of 94/100, indicating that the application was easy to use, efficient, and well-accepted by users.

Finally, the Deployment stage included the implementation of the application at Walenrang Health Center, along with recommendations for periodic maintenance and potential system enhancements in the future. The visual representation of the Waterfall development model is shown in Fig. 1 (Agung & Muslih, 2021).

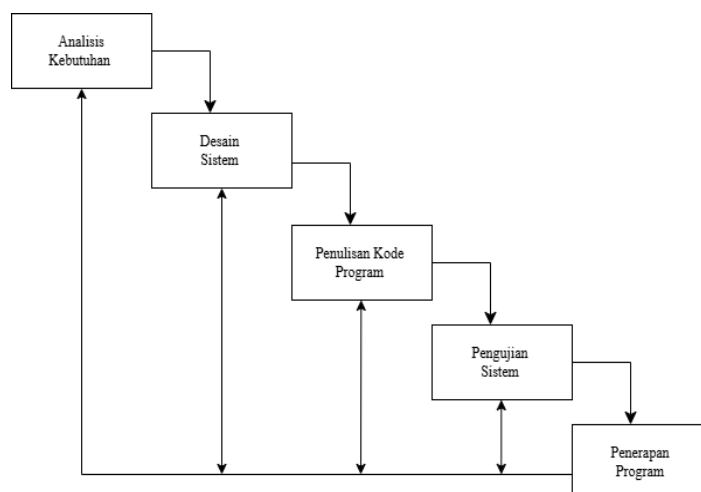


Figure 1. Waterfall Model

Black-Box Testing Method

Black-box testing is a method used to evaluate the functionality of an application by focusing on inputs and outputs without examining the internal structure of the code (Setiyadi & Kurniawan, 2020). In this study, black-box testing was applied to ensure that all features of the electronic queuing system worked according to requirements. Each function, including login, queue registration, queue monitoring, visit history, and report generation, was tested with different input conditions. The outputs were then verified against the expected results to confirm system accuracy and reliability.

System Usability Scale (SUS) Method

The System Usability Scale (SUS) was used to measure the application's ease of use and acceptance based on user perceptions. This method consists of ten statements rated on a five-point Likert scale, from strongly disagree to strongly agree. SUS provides a quantitative overview of how easy, efficient, and satisfying the system is to use. The SUS score was calculated using the following formula (Kurniawan et al., 2022):

$$\text{SUSScore} = \{(S1-1)+(5-S2)+(S3-1)+(5-S4)+(S5-1)+(5-S6)+(S7-1)+(5-S8)+(S9-1)+(5-S10)\} \times 2.5$$

In this study, SUS testing with 12 respondents resulted in an average score of 94/100, which indicates that the application is very feasible, efficient, and user-friendly.

Validation by Subject-Matter Experts

Expert validation was conducted to ensure the feasibility and accuracy of the electronic queuing system. Three expert validators assessed the application using an evaluation instrument based on a five-point Likert scale, covering aspects of design, functionality, and usability. The validation process produced a score of 95.17%, categorized as very feasible. This confirmed that the system met technical and functional standards before being deployed in real operational settings at Walenrang Public Health Center.

RESULT

Functional Requirements

This research aims to develop an Android-based electronic queuing system application to improve the efficiency of health services at Walenrang Public Health Center. The application is developed using the Flutter framework with the Dart programming language, and MySQL serves as the database platform. The system is designed with two main user roles: admin and patient, each with specific functional requirements to ensure effective system usability.

For patients, the application provides features to register a new account, log in to the system, and access the homepage or dashboard. Patients can take queue numbers online by filling out a registration form that includes personal and medical information. Additional features allow patients to view their current queue status, check their visit history, access health center information, and securely log out.

For admins, the system provides access to manage queues, monitor patient registrations, update health center information, generate daily reports, and manage logout sessions. These interconnected features support smooth interaction between patients and healthcare staff, while reducing waiting times and overcrowding in the health center.

Application Interface Visualization

The user interface of the electronic queuing system application includes key components designed for both patients and administrators. For patients, the main menus include Register, Login, Dashboard, Take Queue, View



Queue, Visit History, Health Center Information, and Logout. These menus are designed to be user-friendly, allowing patients to independently register and monitor their queue status in real-time.

The next is the user or patient interface, which consists of patient registration, patient login, take queue number, view my queue, visit history, patient information, and patient logout. The next section is the user or patient application interface, which consists of patient registration, patient login, take queue number, view my queue, visit history, patient information, and patient logout

After completing the registration, patients are directed to the login page as the main page of the application. From this page, patients can access various features designed to simplify and speed up the queuing process.



Fig 2. Patient Login Page Interface

On the dashboard page, patients are directed after logging in. This page serves as the main navigation hub, providing access to features such as take queue number, view my queue, visit history, health center information, and logout.

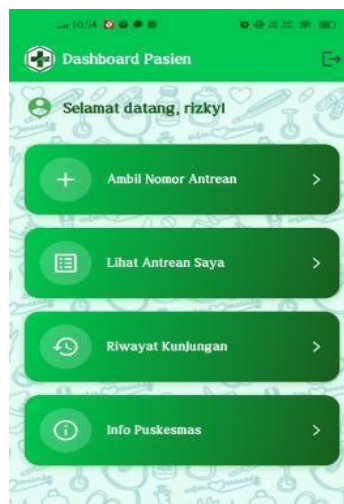


Fig 3. Patient Dashboard Page Interface

Through the take queue number page, patients can register and obtain their queue number online without having to come early to the health center. The view my queue page displays the current status of their queue in real-time, so patients can monitor their position.



Fig 4. Patient Take Queue Number Page Interface

On the View My Queue page, patients can monitor their current queue status in real time, allowing them to know their position and estimated service order.



Fig 5. View My Queue Page Interface

On the Visit History page, patients can view a record of their previous visits, including queue numbers and service dates, which helps them track their healthcare history.



Fig 6. Patient Visit History Page Interface

On the Patient Information page, users can access important details about the health center, including available

services, operating hours, and contact information.



Fig 7. Patient Information Page Interface

On the Patient Logout page, users can securely end their session. After confirmation, the system redirects them to the login page to ensure account safety.



Figure 8. Patient Logout Page Interface

System Usability Scale

The electronic queuing system application was implemented at the research site, specifically at Walenrang Public Health Center, Luwu Regency. An evaluation was conducted involving 12 respondents, consisting of patients and general users, to assess how well the application meets user needs in accessing and managing health service queues. Respondent data is presented in Table 1.

Table 1 shows an average SUS score of 94

No	Respondent	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Total	×2.5
1	Respondent 1	4	4	4	4	4	3	4	4	3	4	38	95
2	Respondent 2	4	4	4	4	4	4	4	4	3	4	39	98
3	Respondent 3	4	4	4	4	4	3	4	4	3	4	38	95
4	Respondent 4	4	4	4	4	3	4	3	4	3	4	37	93
5	Respondent 5	4	4	4	4	3	4	3	4	3	4	37	93
6	Respondent 6	4	4	4	4	4	3	4	4	3	4	38	95
7	Respondent 7	4	4	4	4	4	4	4	4	3	4	39	98
8	Respondent 8	4	4	4	4	4	4	4	4	3	4	39	98
9	Respondent 9	3	3	3	3	4	4	4	3	4	3	34	85

10	Respondent 10	4	4	3	4	4	3	3	2	4	3	34	85
11	Respondent 11	4	4	4	4	4	4	4	4	3	4	39	98
12	Respondent 12	4	4	4	4	4	4	4	4	3	4	39	98
Average Score												94	

Table 1 shows an average SUS score of 94, placing the application in the “Excellent” category, with a Grade A and an “Acceptable” rating. These results indicate high usability, convenience, and user satisfaction, confirming the system’s readiness for broader use.

Expert Validation

The validation of the electronic queuing system application was carried out by three validators using an instrument based on a 4-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, 4 = Strongly Agree). The evaluation covered five aspects: user interface (UI/UX), functionality, content and information, usability, and user data security.

The results of the assessment are presented in Table 2.

Table 2. assessment are presented

		Validator		
		v1	v2	v3
No	Indicator			
Aspect of UI/UX Interface				
1	The application display is attractive and consistent	4	4	4
2	Application navigation is easy to understand and use	4	4	4
3	The visual design supports user comfort	4	4	4
4	The size of text, icons, and buttons is appropriate for users	4	4	3
Total		16	16	15
Aspect of Functionality				
1	The application runs smoothly without bugs or errors during testing	4	4	4
2	The queue number retrieval feature works properly	4	4	4
3	Notifications or information related to queue numbers are displayed clearly	4	4	4
4	The queue number retrieval process is fast and not confusing	4	4	3
Total		16	16	15
Aspect of Content and Information				
1	The information displayed (service name, schedule, etc.) is clear and accurate	4	4	4
2	The language used is easy to understand for general users	4	4	4
3	The application provides usage instructions or help when needed	4	2	3
Total		12	10	11
Aspect of Usability				
1	The application simplifies the queuing process compared to the manual method	4	3	4
2	New users can quickly understand how the application works	4	3	4
3	The application is suitable for patients of various age groups	4	3	3
Total		12	9	11
Aspect of User Data Security				
1	The application requests relevant and non-excessive permissions	4	4	4
2	User data (e.g., ID number, name, phone number) is stored securely	4	4	4
3	Personal information is not displayed publicly	4	4	4
4	The application provides a logout/account exit feature to maintain privacy	4	4	4
5	Users feel confident that their data will not be misused	4	3	3
Total		20	19	19
Total		76	70	71
Total Respondents' Score			217	

The total score obtained from the three validators was 217. With 19 indicators and a maximum score of 4 per item, the maximum possible score was:

$$19 \times 3 \times 4 = 228$$

The expert validation percentage was calculated as:

$$\text{Expert Validation} = \frac{217}{228} \times 100\% = 95,17\%$$

The validation result of 95.17% places the application in the “Highly Feasible” category. This indicates that the electronic queuing system meets technical and functional standards in terms of interface design, functionality, content, usability, and data security, making it suitable for implementation in healthcare services at Walenrang Public Health Center.

DISCUSSION

The electronic queuing system application developed in this study has proven to be effective and user-friendly for both patients and staff at Walenrang Public Health Center. Based on testing using the System Usability Scale (SUS), the application received an average score of 94, which falls into the Excellent (Grade A, Acceptable) category. Furthermore, expert validation results showed a percentage of 95.17%, classified as Highly Feasible. These results indicate that the electronic queuing system meets the required technical and functional standards and is ready for real-world healthcare service implementation. This demonstrates that implementing an electronic queuing system not only improves user experience but also provides a solution to the manual queuing problems that often cause patient discomfort.

One of the main advantages of this application is its ability to digitalize the queuing process. Patients can register and take queue numbers online through the application, monitor the queue in real-time, and review their previous visit history. With these features, patients no longer need to wait long at the health center, as they can estimate waiting times and plan their arrival according to their queue. Additionally, the application provides convenience for administrators or health center staff in managing queues, organizing service queues, and generating daily reports automatically. Therefore, this system can significantly improve healthcare service efficiency, reduce congestion at registration counters, and optimize staff workflow.

Nevertheless, the electronic queuing system still has some limitations. One of them is its dependence on an internet connection, which may pose challenges for patients without internet access. In addition, the current features are still limited to basic queue management, such as patient registration and queue monitoring, and do not yet integrate with other systems that the health center may have, such as electronic medical records. This indicates that while the system is effective, there is still room for further development to maximize its benefits.

For future development, several improvements can be made, including adding offline support, allowing patients to register even without internet access. Additionally, a notification feature could be implemented to remind patients of their queue or changes in service schedules. Integration with electronic medical records is also a strategic step to enhance coordination and service efficiency, making the queuing system not only a queue management tool but also part of an integrated digital healthcare ecosystem. With these improvements, the electronic queuing system can provide broader benefits for both patients and healthcare workers and support the enhancement of overall healthcare service quality.

Overall, this study demonstrates that the implementation of an Android-based electronic queuing system at Walenrang Public Health Center provides a practical, efficient, and easily accessible solution for users. The system's advantage lies in its ability to improve patient experience and support staff performance in queue management, while also creating opportunities for future development so that the system becomes more advanced and integrated with other healthcare services. Therefore, the implementation of this electronic queuing system is expected to be a strategic step in optimizing public healthcare services in the digital era.

CONCLUSION

Based on the design, implementation, and testing phases, this study successfully developed a mobile-based electronic queuing system application for Walenrang Public Health Center. The application was built using the Flutter framework with Dart programming language and MySQL as the database. Black-box testing confirmed that all features functioned properly, while expert validation achieved a score of 95.17% (Highly Feasible) and user evaluation through the System Usability Scale (SUS) produced an average score of 94/100 (Excellent). Key features—such as online queue registration, real-time queue monitoring, visit history, daily reports, and health center information—enable patients to access services more efficiently and support administrators in managing queues effectively.

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