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IMPLEMENTATION OF SYSTEM USABILITY SCALE IN THE DOCTOR APPOINTMENT APPLICATION DEVELOPMENT USING THE SCRUM METHOD

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ABSTRACT

Healthcare facilities often face long queues and extended waiting times, disrupting the service process and increasing the risk of spreading infectious diseases. To address these challenges, this study utilized Scrum methodology to develop a Doctor Appointment application based on the Progressive Web Application (PWA). System usability testing uses the System Usability Scale (SUS) to ensure user-friendliness. The application includes doctor schedules, appointment booking, service status checking, and a visit history review. It is integrated with the Emesys system from PT Bigs Integrasi Teknologi, which serves as the case study location. The implementation of Scrum involved various stakeholders, including end-users, leading to improved team coordination and accountability through five planned sprints. The SUS testing results showed an average score of 78.58 from 30 respondents, indicating a high level of usability approaching the excellent category. This suggests that users are satisfied with the ease of use and overall application experience. However, further evaluation revealed that users may require some time to adapt to the application.

Keywords: *Doctor Appointment, Healthcare Facilities, Scrum, System Usability Scale.*

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1. INTRODUCTION

Healthcare facilities are crucial in maintaining public health through diagnosis, treatment, and promoting healthy lifestyles. Types of healthcare facilities include independent medical practices, pharmacies, community health centers, telemedicine facilities, clinics, and hospitals. One of the main issues healthcare facilities face is long waiting times for outpatient services, which ideally should be less than or equal to 60 [1]. However, in practice, long queues often occur due to surges in patient visits, unprepared staff, and inefficient registration processes, including short message-based registrations not integrated with existing systems [2]. This issue affects patient comfort and increases the risk of spreading infectious diseases in healthcare facilities.

Various studies have been conducted to address this issue through the development of information systems and registration applications. One such system is an Android-based online queue system that uses an SMS gateway as a communication medium [3]. Additionally, another study integrates a booking system with a doctor search and location service using Google Maps [4]. Research also focuses on developing a mobile booking application for dental care [5]. Furthermore, a web-based application for scheduling doctor appointments has been designed to save time for both doctors and patients [6]. This indicates that information technology approaches are a viable alternative for addressing queue problems.

With the rapid advancement of technology, information technology, such as online doctor appointment applications, is an effective solution to tackle queue problems at healthcare facilities. These applications allow patients to register for outpatient care, select doctors, and obtain queue numbers online, thereby reducing waiting times and crowding. The Doctor Appointment application will be integrated with the Emesys application from PT Bigs Integrasi Teknologi to assist staff in managing patient registration.

This application will be developed using the Scrum methodology to ensure efficiency, adaptability, and

team collaboration throughout the development process. Scrum allows the development team to adapt to changing requirements and ensures that the product produced is of high quality [7]. Once the application is developed, usability testing will be conducted to ensure that the application is easy to use and meets users' needs. Applying the System Usability Scale (SUS) in usability testing will help measure the effectiveness, efficiency, and user satisfaction with the Doctor Appointment application.

This research aims to conduct testing using the SUS method in the application of Scrum to develop a Progressive Web Application-based Doctor Appointment application. By doing so, it is expected that the system developed will improve the quality of services in healthcare facilities, as it will have been validated and tested using the SUS method. The writing structure will include an introduction to provide a clear overview of the research flow. This methodology section discusses the theoretical and practical steps of the research conducted, results and discussions, and conclusions.

2. METHOD

2.1 SCRUM METHODOLOGY

The Scrum methodology is one of the most popular agile methodologies, characterized by its adaptability, iterative process, speed, flexibility, and efficiency [8]. In every project, three core roles are emphasized: the Scrum Master, the Product Owner, and the development team, each with distinct responsibilities [9]. This method is designed to deliver significant value quickly through team collaboration, active user involvement, and the ability to respond swiftly to changes. According to [10], the stages in application development using Scrum include:

i) Initiate. At the project initiation stage using Scrum, the critical early steps include defining the project vision, identifying the Product Owner and Scrum Master, forming the Scrum team, developing epics, and creating a prioritized product backlog. The project vision is determined through communication and understanding the needs and desires of the end users. The CTO of PT Bigs Integrasi Teknologi acts as the Product Owner, with a vision of providing a healthcare service transformation solution through the Doctor Appointment application based on a Progressive Web App. This application aims to allow patients to receive medical care without long queues, ensuring patient safety and comfort while reducing the risk of disease transmission at healthcare facilities. The COO of PT Bigs Integrasi Teknologi has been appointed as the Scrum Master. The Scrum team consists of two members: a front-end developer responsible for developing the application interface and a back-end developer focused on server-side development. The epic development includes features for efficient online registration and booking, allowing patients to create accounts, select a clinic and doctor, and schedule appointments through the application. Project personas were also developed to describe the primary users and their needs, ensuring the design and development are aligned with the target audience's requirements.

ii) Plan and Estimate. At the **Plan and Estimate** stage, the focus is on developing user stories, identifying tasks, and estimating the effort required to complete those tasks.

Table 1. Backlog Task and Estimate

Backlog Item	***Tasks***	***Estimate* (day/s)**
System Architecture Creation	Create system architecture	3
UML Design Creation	Create site map	1
	Create use case diagram for the application	2
	Create activity diagram	1
Doctor Appointment Application Wireframe Design	Create wireframe for homepage	1
	Create wireframe for clinic list	1
	Create wireframe for doctor list	1
	Create wireframe for appointment booking	1
	Create wireframe for doctor's schedule	1
	Create wireframe for feedback and	1

Backlog Item	***Tasks***	***Estimate* (day/s)**
	suggestions	
	Create wireframe for clinic services	1
	Create wireframe for BMI	1
	Create wireframe for booking status	1
	Create wireframe for appointment history	1
	Create wireframe for medical history	1
	Create wireframe for profile	1
	Create wireframe for adding participant profiles	1
	Create wireframe for editing participant profiles	1
	Create wireframe for login	1
	Create wireframe for registration	1
Application Testing Form Creation	Create application testing form	1
	Create homepage interface	1
	Create clinic interface and clinic list	1
	Create doctor interface and doctor list	1
	Create clinic services info interface	1
	Create BMI interface	1
Homepage Feature Creation	Create feedback and suggestions interface	1
	Create doctor's schedule interface	1
	Create doctor's appointment booking interface	1
	Fetch clinic data from API	1
	Fetch doctor and schedule data from API	1
	Send doctor appointment data	1
Service Status Feature Creation	Create service status interface	2
	Fetch active service data from API	2
Visit History Feature Creation	Create visit history interface	1
	Create interface to view patient's medical history	1
	Fetch visit history data from API	2
	Fetch medical history data from API	2
Patient Profile Feature Creation	Create patient profile interface	1
	Create add participant profile interface	1
	Create patient details interface	1
	Create profile edit form interface	1
	Fetch patient profile data from API	2
	Send add patient profile data	2
Authentication Feature Creation	Create login interface	1
	Send login user data	1
	Create registration interface	1
	Send registration user data	2
PWA Emesys Settings Creation	Create interface for managing clinics	1
	Create CRUD for clinics	3
	Create interface for managing doctors	1
	Create CRUD for doctors	3
	Create interface for managing clinic service info	1
	Create CRUD for clinic service information	3

iii) Create Sprint Backlog. In the Create Sprint Backlog phase, each task is given priority using the MoSCoW method. The MoSCoW method divides the product development's priority of features, requirements, and user stories [11]. This method categorizes priorities into four groups: Must Have, which includes the most important requirements that must be met for the product to function; Should Have, which are important requirements that support the product's success but are not critical; Could Have, which are desired requirements but are not as essential as "Should Have"; and Won't Have, which are low-value requirements that can be deferred. The MoSCoW method can be applied to prioritize backlog items and tasks in Scrum.

Table 2. Sprint Backlog

Sprint Backlog	**Total *Task***	***Tasks Priority***	***Responsible***	***Duration***
1	24	*Must Have:* 23 *Should Have:* 0 *Could Have:* 0 *Won't Have:* 1	*Front-end:* 22 *Back-end:* 5	1 Month
2	18	*Must Have:* 13 *Should Have:* 3 *Could Have:* 1 *Won't Have:* 1	*Front-end:* 22 *Back-end:* 5	1 Month
3	12	*Must Have:* 13 *Should Have:* 3 *Could Have:* 1 *Won't Have:* 1	*Front-end:* 8 *Back-end:* 5	1 Month
4	15	*Must Have:* 13 *Should Have:* 3 *Could Have:* 1 *Won't Have:* 1	*Front-end:* 8 *Back-end:* 8	1 Month
5	12	*Must Have:* 13 *Should Have:* 3 *Could Have:* 1 *Won't Have:* 1	*Front-end:* 7 *Back-end:* 6	1 Month

2.2 USABILITY TESTING

Usability is an important quality parameter that assesses the ease of use of an interface, system, or website based on specific standards **[12]**. Usability testing is a research method that directly observes users interacting with a product to gather empirical data **[13]**. One widely recognized method is the SUS, a standard questionnaire for evaluating user experience **[14]**. SUS consists of 10 questions with a scale of 1 to 5. The score for odd-numbered questions is reduced by 1, while the score for even-numbered questions is subtracted from 5. The final score is obtained by multiplying the adjusted score by 2.5, yielding a value between 0 and 100 **[15]**. Odd-numbered questions assess positive aspects like ease of use, while even-numbered questions evaluate difficulties encountered by users **[16]**. This approach reduces bias in user responses and ensures careful consideration of each question.

This study involved 30 respondents aged 17-64, who were assumed to be outpatient service users at a clinic. The respondents were selected with diversity in mind to ensure a wide range of user perspectives, providing a comprehensive view of the user experience across different ages and backgrounds. Data was collected via Google Forms to facilitate efficient data gathering and reduce recording errors, resulting in more accurate and reliable outcomes. This method helps identify areas for improvement relevant to user needs, thus enhancing the usability of the application being tested.

3. RESULT

3.1 IMPLEMENTATION

The Scrum method in the implementation phase includes creating deliverables and conducting daily standups.

i) *Create* Deliverables. Deliverables in Scrum refer to the outputs produced by the Scrum team

during the development process. Therefore, the application interfaces developed include the login page, registration, forgot password, homepage, clinics, doctors, clinic service information, BMI, feedback and suggestions, appointment status, appointment history, medical history, patient profile, patient profile details, and add a patient profile. An example of an interface that has been developed is the homepage, which is the initial screen that appears when the user opens the application. This page displays menus for clinics, service information, BMI, and feedback & suggestions. The homepage interface can be seen in Figure 1. a) Homepage. Next, the clinic's page appears when the user selects the clinic's menu, showing a list of clinics within the facility. The clinic page interface can be seen in Figure 1. b) Clinic List Page. The doctor's page appears when the user selects a clinic, displaying a list of doctors in the clinic chosen. The doctor's page interface can be seen in Figure 1. c) Doctor List Page.

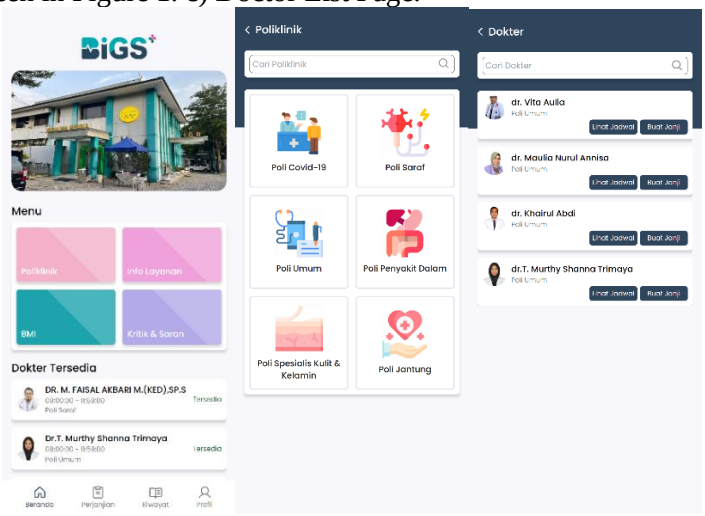

Figure 1. a) Homepage, b) Clinic List Page, c) Doctor List Page

ii) Conduct Daily Standup. Conduct Daily Standup. This phase is a process in the Scrum methodology aimed at maintaining effective communication and ensuring that all team members are aligned. The Daily Standup Meeting, often called the "Daily Scrum," is a brief meeting usually held at the same time each day, lasting about 15 minutes. In this project, the Conduct Daily Standup activity is carried out daily at 09:00 AM.

iii) Review and Retrospect. Review and Retrospect involves two key activities: Demonstrate and Validate and Sprint Retrospective. The development team presents the completed deliverables to the stakeholders in the Demonstrate and Validate phase. The goal is to showcase the sprint results, gather feedback, and obtain approval from the Product Owner that the deliverables meet the established criteria. The Sprint Retrospective is an evaluation of the recently completed sprint. This process typically occurs after the Demonstrate and Validate phase and before the start of the next sprint. The Sprint Retrospective focuses on the team's performance, work processes, and the outcomes achieved during the sprint.

3.2 USABILITY TESTING RESULT

In the usability testing, data was collected by providing a demo link and a usage video of the application to 30 users. Afterward, users were asked to fill out a prepared questionnaire. Usability testing was conducted using the SUS to evaluate the user experience. Below is the table showing the scores provided by the respondents.

Table 3. Usability Testing Result

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
R1	3	4	4	4	4	4	3	3	3	3
R2	4	4	4	3	4	4	4	4	4	4
R3	2	3	3	3	2	2	3	3	2	1
R4	4	2	4	3	5	1	3	2	4	4
R5	5	2	4	2	4	2	3	2	5	3
R6	4	1	5	2	5	1	4	1	5	3
R7	5	2	5	2	4	2	5	2	4	3

Respondent	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
R8	4	1	5	1	5	1	4	1	5	2
R9	2	2	4	2	4	2	4	2	4	4
R10	4	2	3	4	3	2	4	2	4	4
R11	4	2	4	2	5	2	4	2	4	3
R12	4	2	5	2	4	2	4	1	4	5
R13	4	1	5	2	4	2	4	2	4	3
R14	3	4	4	2	4	2	2	2	3	2
R15	5	2	5	1	5	1	4	1	5	1
R16	5	1	5	1	5	1	5	1	5	3
R17	5	2	5	1	5	2	4	2	4	3
R18	1	1	5	2	5	1	5	1	5	2
R19	1	2	4	2	4	1	4	2	5	3
R20	4	2	4	3	4	1	4	1	4	3
R21	5	1	4	2	4	1	4	2	4	3
R22	5	1	5	1	5	1	5	1	5	1
R23	5	1	5	2	5	1	4	1	5	2
R24	5	1	5	1	5	1	5	1	5	2
R25	4	1	5	1	4	2	5	2	4	2
R26	4	3	4	3	4	2	4	2	4	3
R27	4	2	4	3	4	2	4	2	4	2
R28	4	3	4	3	4	3	4	2	4	4
R29	4	3	4	3	5	2	3	2	4	3
R30	4	2	4	3	5	2	4	3	4	3

The usability testing using the SUS to evaluate the user experience can be seen in Table 4. SUS Calculation.

Table 4. SUS Calculation

Res-ponden	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Jml	Nilai (x2.5)
R1	3	4	4	4	4	4	3	3	3	3	35	87,50
R2	4	4	4	3	4	4	4	4	4	4	39	97,50
R3	2	3	3	3	2	2	3	3	2	1	24	60,00
R4	3	3	3	2	4	4	2	3	3	1	28	70,00
R5	4	3	3	3	3	3	2	3	4	2	30	75,00
R6	3	4	4	3	4	4	3	4	4	2	35	87,50
R7	4	3	4	3	3	3	4	3	3	2	32	80,00
R8	3	4	4	4	4	4	3	4	4	3	37	92,50
R9	1	3	3	3	3	3	3	3	3	1	26	65,00
R10	3	3	2	1	2	3	3	3	3	1	24	60,00
R11	3	3	3	3	4	3	3	3	3	2	30	75,00
R12	3	3	4	3	3	3	3	4	3	0	29	72,50
R13	3	4	4	3	3	3	3	3	3	2	31	77,50
R14	2	1	3	3	3	3	1	3	2	3	24	60,00
R15	4	3	4	4	4	4	3	4	4	4	38	95,00
R16	4	4	4	4	4	4	4	4	4	2	38	95,00
R17	4	3	4	4	4	3	3	3	3	2	33	82,50
R18	0	4	4	3	4	4	4	4	4	3	34	85,00
R19	0	3	3	3	3	4	3	3	4	2	28	70,00
R20	3	3	3	2	3	4	3	4	3	2	30	75,00
R21	4	4	3	3	3	4	3	3	3	2	32	80,00
R22	4	4	4	4	4	4	4	4	4	4	40	100,00
R23	4	4	4	3	4	4	3	4	4	3	37	92,50
R24	4	4	4	4	4	4	4	4	4	3	39	97,50
R25	3	4	4	4	3	3	4	3	3	3	34	85,00
R26	3	2	3	2	3	3	3	3	3	2	27	67,50
R27	3	3	3	2	3	3	3	3	3	3	29	72,50
R28	3	2	3	2	3	2	3	3	3	1	25	62,50
R29	3	2	3	2	4	3	2	3	3	2	27	67,50

Res-ponden	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Jml	Nilai (x2.5)
R30	3	3	3	2	4	3	3	2	3	2	28	70,00
Total Jawaban	90	97	104	89	103	102	92	100	99	67		
					Rata-rata							78,58

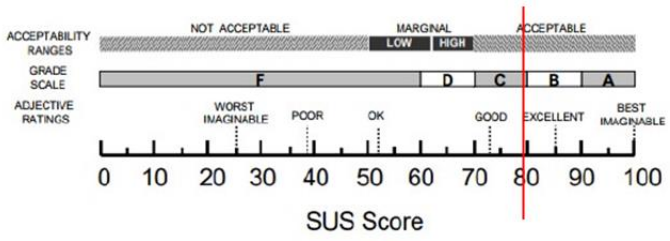

Figure 2. SUS Parameter [17]

Usability testing using the SUS was conducted to assess the user experience. The SUS calculation reduces the scores for odd-numbered questions by 1. In contrast, the scores for even-numbered questions are subtracted from 5 to normalize the scores, balancing both positive and negative aspects of the user experience. Odd-numbered questions evaluate positive aspects, while even-numbered questions assess negative aspects. The total score for each respondent is then multiplied by 2.5 to obtain the final SUS score.

The results in Table 4 show that the average score from 30 respondents is 78.58. This score indicates that the application has a good level of usability, approaching the "excellent" category according to the SUS interpretation standards [17]. This suggests that most users are satisfied with the ease of use and overall experience when using the Doctor Appointment application. Therefore, it can be concluded that the application has a high usability quality and meets user expectations regarding functionality and efficiency.

However, as seen in Table 4, in the total responses section, the lowest score was given for the last question, "I needed to familiarize myself with the system before I could use it." This indicates that, on average, respondents felt they needed time to adapt or repeat use before feeling comfortable and accustomed to using the application. While most usability aspects were rated highly, this area highlights room for improvement in making it easier for new users to adapt quickly. It is essential to address this to ensure the application is more intuitive and user-friendly for those unfamiliar with technology or using it for the first time.

4. CONCLUSION

The development of the Doctor Appointment application, based on Progressive Web Application (PWA) and using the Scrum methodology, has been completed. This application helps address the issue of long queues at healthcare facilities by allowing patients to view doctors' schedules, make appointments, check service status, and view visit history. Integration with the Emesys system further enhances the efficiency of managing patient registrations.

Usability testing was conducted using the SUS with 30 respondents, resulting in an average score of 78.58. This score indicates that the application has good usability and is close to the "excellent" category. The score reflects that users are satisfied with the ease of use and overall experience when using the Doctor Appointment application. The Scrum methodology used in the application's development successfully improved team coordination and accountability through the five planned sprints. However, ongoing monitoring and improvement are needed to ensure a better user experience in the future.

The SUS results showed that the lowest score was given for the final question. Therefore, it is recommended that future research focus on improving the application's intuitive aspects and ease of use for new users. A more user-friendly interface would help users unfamiliar with technology or using the application for the first time. It is also suggested that a comparative study be conducted with similar applications available in the market. This way, the application can continue to evolve and provide more significant benefits to healthcare facilities and users.

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