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Research Article

Implementation of the Waterfall Method in Mobile Web-Based Outpatient Online Registration Information System

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A B S T R A C T

Our study aims to create, design, and implement a web-based outpatient registration application at Batusangkar Regional Hospital. The research method used is qualitative descriptive research, which involves a series of activities or processes that reveal system processes. This study's system development employs the waterfall method and data collection techniques such as documentation, interviews, and observation. This registration application was designed using the UML (Unified Modeling Language) model, including use case, activity, sequence, and class diagrams. Designing database logic with MySQL. The system was designed and implemented using XAMPP as a web server, PHP MySQL as a database, Visual Studio as a web design editor, and Android Studio as an Android design editor. Hopefully, this application will allow patients to easily register from anywhere and access the most up-to-date information and practice schedules for polyclinic doctors at Batusangkar Regional Hospital.

1. INTRODUCTION

Advances in information technology have undoubtedly resulted in changes in various fields, including health. Information technology support is also required in healthcare activities. [1]. The primary health development program includes creating a health information system, aiming to improve the information system so that its impact can be seen. [2]. Hospitals are affiliated with health and social organizations and offer comprehensive health services, particularly in healing and restoring individual health. [3]. The health information system is required to collect data, organize data, generate periodic reports, and strive to use data and information to provide services to the community. [4].

Batusangkar Regional Hospital, owned by the government of Tanah Datar Regency and located on Jalan Bundo Kandung in Lima Kaum District, recognizes the need to develop a registration information system in response to the community's growing demand for services.

Batusangkar Regional Hospital's outpatient registration process is still manual, which means that patients must wait in line to register at the polyclinic for new and returning patients, which takes time. This method frequently produces errors, such as writing the same patient's name for the umpteenth time, and the difficulty in grouping data takes a long time and does not ensure data security. If we want to find the patient data, we must search the archives individually. Batusangkar Regional Hospital's manual data processing can be replaced with computers and

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existing information technology. The developed information system improves data processing accuracy, speed, and ease. [5].

It is highly appropriate for a community health center to provide comprehensive and efficient information system services. [6]. A Web-Mobile-based health service information system was developed to assist community health centers in processing patient data. This information system will be available online for portions of the Batusangkar Regional Hospital. It is hoped that this information system will overcome all of the issues above and make the tasks of Batusangkar Regional Hospital employees easier.

So, it is hoped that with this technology, patients can register online from anywhere, making it easier for the general public to access information and health services such as outpatient examinations at polyclinics and up-to-date information from the practice schedules of Batusangkar Regional Hospital polyclinic doctors.

This study is consistent with the findings of [7]–[12], who created an application for online outpatient registration using the waterfall method. However, what is unique about the research that will be conducted is that patients can see the doctor's practice schedules at the polyclinic and print their registration results.

2. METHODS

In this study, applications were built using the waterfall method. The waterfall method is a sequential software development process in which progress is seen as flowing downwards through several stages of system development, including analysis, design, coding, and testing. This model takes a systematic, sequential approach. It is called a waterfall because the stages must wait for the previous stage to be completed before proceeding to the next.

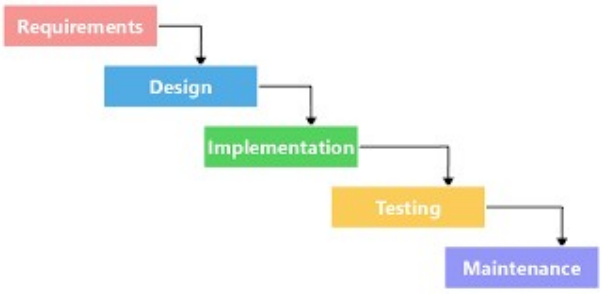

Figure 1. Waterfall method

The waterfall method consists of the following stages:

1. Analysis

The analysis stage involved looking for expected and desired needs in application development and identifying issues with the drug stock control process flow in the Batusangkar Regional Hospital's pharmaceutical facility. This planning stage describes the currently running system, collects information about system requests and needs, and plans the application of the information system being built.

2. Design

The design stage involves planning all the needs identified in the previous stage. The design process included ERD (Entity Relational Diagram) design, software architecture, and interface design with UML tools.

3. Coding

The coding stage involves coding the design from the previous stage to create a single program unit. PHP and MySQL are used in the implementation. The coding stage was used to develop a web-based drug inventory information system.

4. Testing

At this point, testing is performed on the application being built to ensure it meets requirements. The system testing method used in this study is black box testing. The black-box testing method focuses on the software's functional requirements, allowing software engineers to generate a set of input conditions that fully utilize all of a program's functional requirements. At this stage, web-based application testing is performed. Web application testing is done by assessing the existing functional suitability. The results of this stage are in the form of a table that presents test data together with the results of whether the application functionality is available and follows the design that has been carried out.

The flowchart in this study explains the steps involved in developing the application. This research flowchart has several stages, beginning with a review of the literature on problem formulation, followed by data collection through observation, interviews, and the collection of supporting documents. Next, enter the application development stage, which begins with the needs analysis stage and creates a business process model based on the previously collected information. Then, we move on to the design stage, which involves developing the application requirements, including the application display model, based on the system analysis results. The next stage is coding, which involves implementing the system design results into a programming language. Testing is the final stage in the application development process, during which the application is tested to ensure it is running correctly and meets the planned functionality. If it is not completed, it will revert to the coding stage. If it is finished, the next step is to complete the report with the final stage of conclusions and recommendations. Figure 2 shows the research flowchart.

3. RESULT

3.1. System Analysis

3.1.1. Running System

This study focused on the outpatient registration counter staff at Batusangkar Regional Hospital. The Batusangkar Regional Hospital registration counter currently uses a manual registration system. The manual registration flow model can be described using BPMN tools.

Registration Business Model

1. Patients see the schedule
2. Patients register on WA (general, BPJS)
3. Patient wait

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4. Admin validates via WA whether the doctor's schedule is in a branch if available.
5. Admin sends booking number to the patient
6. The patient receives a booking number
7. The patient comes to the hospital and re-registers with the hospital registration admin.
8. Admin: The hospital registration admin records patient reservations
9. The hospital admin gives a reservation to the polyclinic
10. The polyclinic accepts reservations
11. The patient goes to the polyclinic

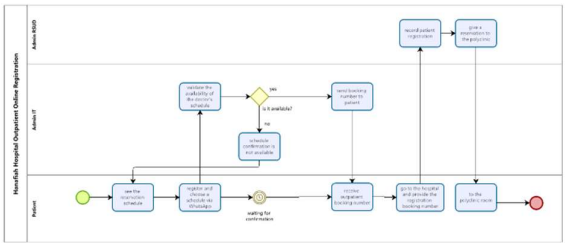

Figure 3. Current Registration Business Model

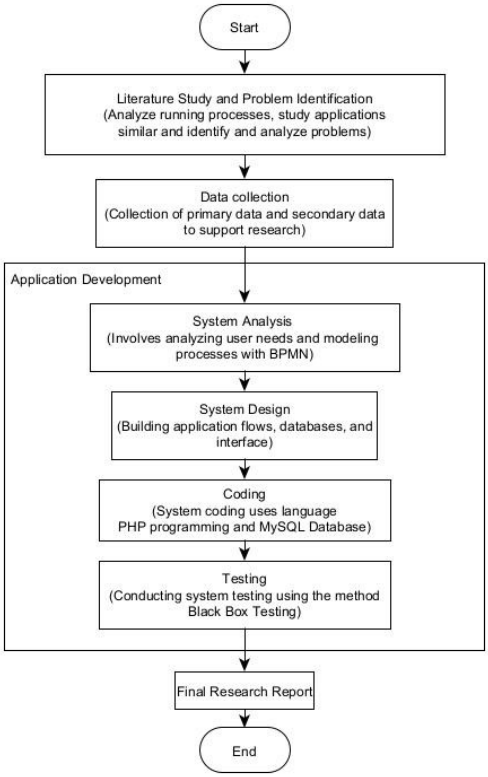

Figure 2. Research Flowchart

3.1.2. Proposed System

Based on observations and discussions with medical records officers at Batusangkar Regional Hospital, the current method is ineffective, particularly with registration counter personnel.

The traditional hospital outpatient registration method demands lengthy wait times and queues, which affects patient satisfaction. The following describes the online registration flow in an information system that will be proposed in Business Process Modeling Notation (BPMN). This area allows users to register for the application, as shown in Figure 4 below.

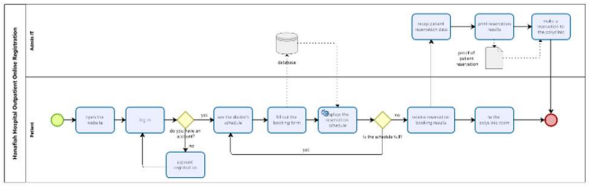

Figure 4. Proposed Online Registration Business Model

3.2. Use Case Diagram

Use case diagrams depict the relationships between the system's functional components and actors. Figure 5 depicts a use case diagram for Batusangkar Regional Hospital's web-based online registration system for outpatient patient registration.

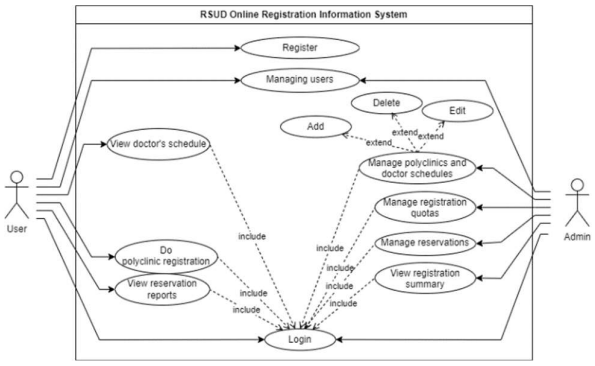

Figure 5. Use Case Diagram

1. Hospital registration admin
- Login
- Managing Users
- Manage polyclinics and doctor schedules
- Manage registration quotas
- Manage Reservations
- Print reservations
- View registration records

2. User
- Carry out user registration
- Login
- Managing Users
- View the doctor's schedule
- Register
- View reservation reports

3.3. Actor Job Description

According to the previous use case diagram, the online registration information system application at Batusangkar Regional Hospital involves two actors: the registration officer and the patient undergoing treatment. Table 1 includes descriptions of the actors' parts.

Table 1. Description of Actor Tasks

No	Actor	Job Description
	Admin	● Log in with an admin account ● Change or delete user data in the system ● Manage polyclinic data and doctor schedules ● Set patient registration quotas for each reservation schedule ● Print proof of patient reservation and give it to the polyclinic ● View a summary of registrations made by users
2	User	● Create an account ● Log in as a user ● Manage user accounts (alter, add, delete data) ● View doctor schedules ● Book reservations as a patient ● View report results or proof of registration

3.4. Database Design

Database design begins with creating a database structure based on the entities used and their relationships with one another. An ERD (Entity Relationship Diagram) describes entities and their relationships. The database in the application for the online registration information system for outpatients at Batusangkar Regional Hospital is designed to work with the registration system. This database may vary as the application is developed in response to user requests. The database is currently constructed with ten tables, which include five master tables and five transaction tables. Figure 6 shows the ERD design for the online registration information system application.

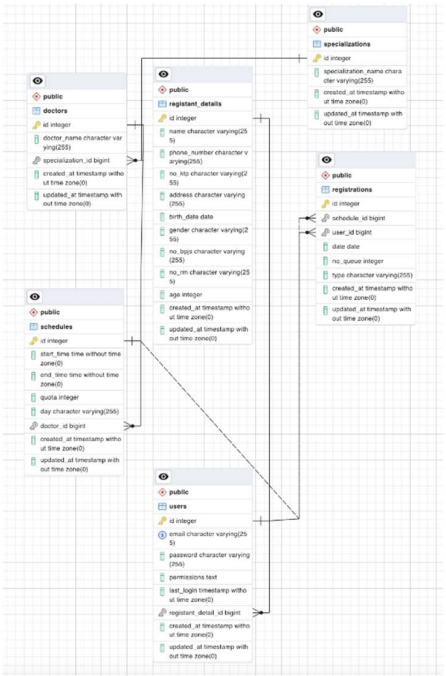

Figure 6. Entity Relationship Diagram

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4. DISCUSSION

4.1. Program Coding

This section describes the computer code developed using the MVC (Model View Controller) application architecture. The display, model, and controller components are each explained separately based on their specific functionalities. This research's code uses the Hypertext Preprocessor (PHP) programming language and the Laravel framework. The database used in this study is MySQL.

4.2. Application Interface Implementation

This section describes the appearance of the application used to establish an online registration information system for outpatient patients at Batusangkar Regional Hospital. This application is available to administrative officers at the registration counter and outpatients seeking treatment. You will see the user login screen when you first enter this application. If the user successfully signs in, the main page will appear. The following describes the system's application display, which was designed following the system implementation.

4.2.1. *Login Page*

The login page is the initial page that appears when a user accesses the application. This page ensures that only those who can enter the system can view this program. Figure 7 shows how the login page is displayed.

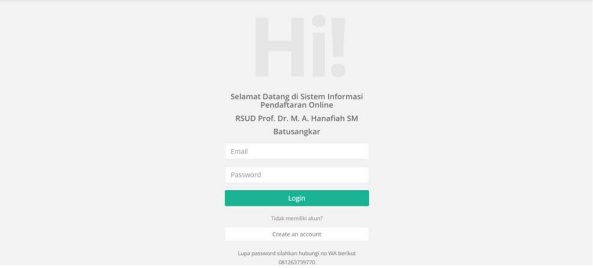

Figure 7. Login Page Display

According to Figure 7, users must log in to access the system by entering the username and password registered in the database and pressing the "login" button. The system will show the main application page if the user logs in successfully.

4.2.2. *Home page for administrative users*

The home page is accessible after the medical records administrator logs in. Medical record officer users can manage medical record officer user data and doctor's practice schedule master data. Figure 8 shows the pharmacist's user page.

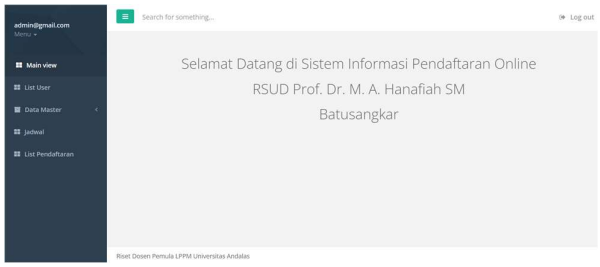

Figure 8. Home Page Display for Admin Users

Figure 8 shows that the pharmacist user page comprises five primary options and submenus, which are described below:

1. Dashboard Menu

The Dashboard menu is the main page that displays information such as whether the user has successfully logged in and is a medical records officer and how to contact the e-mail address specified on the application if a technical problem arises.

2. Master Data Menu

There are three submenus on the Master Data menu: timetable, registration list, and details. This section allows you to arrange doctor's appointments in polyclinics and see outpatients registered for treatment.

3. Schedule the Menu

The schedule menu contains two submenus: doctor list, clinic, and doctor schedule. This section allows users to manage the doctor's name, practice schedule, and polyclinic.

4. Registration Menu

The registration menu lists the names of patients who will seek treatment, as well as their preferred clinic and doctor.

5. Registration Card Printing Menu

The menu includes printed cards for registrants seeking treatment at the polyclinic.

4.3. Application Testing

The system testing stage is the process of determining whether the resulting application is running successfully using the black box testing approach, which is a testing method that focuses on ensuring the availability of functions designed for the application. This black box testing approach is used for applications the author personally tests involving medical records and registration counter officers.

The emphasis of system application testing is built utilizing test data based on previously tested data on the application. This test includes multiple items. Table 2 shows the focus of this test.

Table 2. Testing Focus

No.	Tested Items	Tested Process
1	Manage users	Add
2.	Manage schedule from data.	Add, edit, delete
3.	Manage doctor list data.	Add, edit, delete
4.	Manage registration data	Add, edit, delete

Testing is conducted with a predetermined testing emphasis. Testing is done using black box testing, which is based on system

features and pays close attention to system input and output. The following is a table of tests that have been performed.

The testing phase is conducted on apps built to focus on the system's availability and functional adequacy when evaluated manually. After testing, the results were consistent with the system design and output. Furthermore, there were no failures in any single process or function during testing. Thus, it can be stated that the design of the outpatient online registration information system application performed as anticipated.

Table 3. System Testing

No	Items Tested	Input Data	Observation	Result
1	Manage users	All required data on the "Create User" form	Data is saved, the system displays the user list page, and notification of saved data	in accordance
2	Manage schedule from data	All required data on the "Schedule" form	Data is saved, the system displays the polyclinic schedule page, and notifications of saved data	in accordance
3	Manage doctor list data	All required data on the "Doctor List" form	Data is saved, the system displays the doctor list page and notification of saved data	in accordance
4	Manage registration data	All data required in the "Registration Data" form	Data is saved, the system displays the registration list page and notification of saved data	in accordance

Application testing is performed by pushing the "save" button before filling out the form, after which the system shows an error warning.

Outpatient Registration is the hospital's initial service to patients. [13]. Information technology advances have significantly impacted all disciplines, including the health sector. [14], [15]. Information technology is intended to create rapid, accurate, and accessible information anywhere and at any time. [16], [17]. One approach to meeting needs in the healthcare system is to create a computer-based healthcare information system, particularly for patient registration services. [18]. The implementation of this computer-based information system is projected to increase the quality of patient care.

5. CONCLUSION

Batusangkar Regional Hospital's online outpatient registration information system was successfully constructed using the waterfall method. The waterfall method's analysis, design, coding, and implementation stages can yield the following conclusions: (1) Functional needs that have been examined, articulated, and shown using a use case diagram yielding two actors. The functionalities are then described with use case scenarios, sequence diagrams, and class analysis; (2) During the design phase, the application being constructed employs an Entity Relationship Diagram (ERD). The following design stage describes the Interface (Use Interface) and the application architecture, which explains the system flow and the relationship between application components; (3) The Laravel 5.3 framework was used to develop an online outpatient registration information system application using HTML, PHP, and Javascript programming languages. (4) The black box testing method was used for implementation, with a focus on eight test items; and (5) Based on the test results, it can be concluded that the design of the online outpatient registration information system at Batusangkar Regional Hospital has been successfully developed following the system design that has previously been created and the application that has been built can be applied at the registration counter at Batusangkar District Hospital, making it easier for patients to register for treatment at the polyclinic and find out the doctor.

The design of Batusangkar Regional Hospital's online outpatient registration information system requires additional modification to meet functional requirements. The only example used in developing the program was the registration counter at Batusangkar Regional Hospital. It is intended that this will serve as a model for future study at other Regional Hospitals. Aside from that, it is envisaged that further research would help to develop the features of this program.

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