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Utilizing Requirement Testing Methods on Web-Based Swab Data Information System

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ABSTRACT

The spread of the virus caused by SARS-CoV-2 has been designated as an extraordinary event so that the government to speed up the collection and management of this disease then appoints several hospitals that serve as referral hospitals for people who want to check themselves. One of the hospitals used as a reference by the government in West Sumatra is Andalas University hospital. In just one day, the hospital received thousands of samples for examination. The number of samples to be examined and the limited number of administrations that conduct data collection results in the length of the sample collection process. This article aims to design and implement an information system in the data collection of Swab Covid-19 using waterfall model system development methods. The requirement testing model is used for testing a web-based Covid 19 swab data information system whether it is in accordance with system users' needs analysis and design.

1. Introduction

Corona Virus Disease-19 (COVID-19) is a respiratory tract infection caused by a type of coronavirus [1]. This disease becomes a trend of conversation, debate, discussion, and news material in medical print or electronics. Currently, the Covid-19 trend has always been the number one trend and trending topic on all social media, without exception. The virus has spread to 199 countries. Deaths from the virus have reached 26,494 cases. The death rate from this disease reaches 4-5%, with the most deaths occurring in the age group over 65 years [1].

The rapid spread of the virus in the community will require a lot of sample testing so that the government then forms laboratory centers that serve as test sites for Covid-19 samples. Establishing this sample test site can make it easier for the community to conduct tests if they get themselves infected from the Covid-19 virus.

West Sumatra appointed the Integrated Diagnostic and Research Center Laboratory of Infectious Diseases, Faculty of Medicine, Andalas University (LAB PDRPI FK UNAND) as one of the laboratories used to examine suspected samples of suspected samples Covid-19. LAB PDRPI FK UNAND is located in Padang City, where the average number of samples examined per day is 2000 samples. Recording and recording samples in the PDRPI Lab FK UNAND is still done manually, namely by using notebooks and using excel applications to facilitate computer-based recording. Recording using this method has the disadvantage of easy data manipulation because there is no aspect of data security so that there will be a lot of redundant data. In addition to the large amount of

data that is easing, another weakness of using this manual sample examination data processing method is that it will spend a lot of time and the error rate is very high, especially in the input and processing process samples.

To avoid errors caused by manual input and the length of processing time due to so much data to be processed, then with the advancement of information technology, the time used to process these data can be accelerated. The advancement of information technology has been almost entirely in all areas of life and has been utilized in all areas. The advancement of information technology is very supportive and can facilitate all human work, for example, in education, health, government, and everyday work in the household is also inseparable from the advancement of information technology.

For the processing of Covid-19 sample data in the Lab PDRPI FK UNAND quickly, precisely, and accurately, information technology is utilized to create an information system that uses databases for data processing. In addition to using the database for covid-19 sample data storage, creating a system for processing sample data also uses the laravel framework for creating the system.

The information system for the processing of Covid-19 sample data at the the Lab PDRPI FK UNAND is a request from the head of the Lab PDRPI FK UNAND laboratory to facilitate the processing of covid-19 sample data. This system is expected to facilitate and speed up the processing of sample data at the Lab PDRPI FK UNAND so that the public can easily know the examination results.

The purpose of this article is to test whether the design and implementation of the creation of an information system used to process covid-19 sample data in the Lab PDRPI FK UNAND are under the needs analysis and design by using the requirement testing model in black-box testing.

2. Theoretical Foundation

With the advancement of information technology and telecommunications, new, more efficient ways of being implemented for the production, distribution, and consumption of goods and services are possible. It is this process that brings humans to the information economy society. Similarly, a shift is taking place in education from conventional face-to-face education towards more open education, such as through web networks or the use of software programs. A system can be defined as a unit consisting of components or subsystems that are orderly, inter-interaction, interdependence with each other, and cannot be separated (integrative) to realize a goal.

An information system can be used for recording data of people in monitoring (ODP), patients in surveillance (PDP), positive and dead so that it will make it easier for those who conduct data collection such as a village, subdistrict, health, and hospital in conducting follow-up on the person [2]. Because the faster the information generated, especially for the amount of data distribution such as data on the spread of covid, especially for areas with a high spread, the faster the area takes action.

The use of information systems can also reduce data duplication (data redundancy), resulting in information available inaccurate information. The use of information systems for distribution, systematic and efficiency is very important to facilitate the accessibility of information and with the rapid changes where the processing of information has changed from conventional changes to digital information so that information easily, accurately, and quickly exchanges the flow of any information so that it can be accessed by everyone anywhere and anytime.

2.1 System Development life cycle model waterfall

In this article, the method of extinguishing the system used is the waterfall model with the stages of the waterfall model is as follows [6]:

a. Requirement's definition, the stage of system design by analyzing the needs of the system then defining in detail and the function of system specifications.

b. System and software design, the stages of system design by allocating the needs of the hardware and software system by creating an overall system architecture. Such design involves identifying and depicting abstractions of the basic system of software and its relationships.
c. Implementation and unit testing, at this stage, the system's design will be realized in the form of programming. At this stage, testing will also involve verifying each unit whether it meets the desired criteria or not.
d. Integration and system testing are the integration into the system at this stage. Once the process is complete, it will be tested as a system to ascertain whether it suits the software needs or not.
e. Operation and maintenance, this stage involves correcting errors that were not found in previous stages, increased implementation of system units, and improving system services as new needs.

2.2 Requirement testing model

System testing aims to see if the system that has been created is under the original purpose of manufacture and is suitable for use. Testing the system using the Black Box method is to find out that the parts in the application system have correctly displayed an error message if there is an error in the input of data. Black Box Testing itself is a test that is done only by observing the execution results through test data and checking the software's functionality. This black box test focuses on system functions [7]

Here are ten types of testing of the Black Box method according to [8]:

a. Equivalence Partitioning: Divides inputs into data classes that can be used to generalize test cases.
b. Boundary Value Analysis / Limit Testing: This allows for a selection of test cases that test the input value limit, complementing Equivalence Partitioning.
c. Comparison Testing: Test each version with the same data to ensure all versions produce the same output.
d. Sample Testing: Involves several selected grades from an equivalent class.
e. Robustness Testing: Input data is selected outside the defined specification; The purpose of this test is to prove that there is no error if the input is invalid
f. Behavior Testing: Test results cannot be evaluated if they only do the test once but can be evaluated if the test is done several times, for example, on the test of the data stack structure.
g. Performance Testing: Evaluating the ability of programs to operate properly is viewed in terms of reference needs such as data flow, memory usage measures, execution speed.
h. Requirement Testing: The specifications of the software's needs are identified at the requirements and design specification stage.
i. Endurance testing involves repeated test cases by a certain amount.
j. Cause-Effect Relationship Testing: Divide the specification of needs to be the part that has the possibility of work

3. Result and Discussion

The stages in the waterfall model are as follows:

3.1 Requirements

At the requirement stage, the analysis of the current system is:

a. The process of inputting and preparing data is still manual, such as preparing sample data from agency A, preparing data for the creation of examination lists, preparing data for the creation of sample code, etc.
b. Data storage and archiving is still a file that has been stored and computerized using Microsoft Excel.
c. The redundancy rate is still high by using manual data processing.

3.1.1 Functional needs analysis

Functional needs analysis is done to explain the current problems and procedures. Examples of functional needs in this system:

a. The system can input many sample data in a short period.
b. The system can create a list of sample data used in the sample examination process.
c. The system can display sample data that is or has not come out.
d. The system provides a feature to print lists of inspection data in pdf and excel forms.
e. In carrying out a data process, input, process, and output analysis, if needed. This is to find out what data is needed for ice damage later.

3.1.2 Input analysis

Input from the system running on this system is swab sample data using a manual system where all the data is compiled using the Microsoft Word and Excel bag facilities to take sufficient time and allow for errors in the data processing.

Table 1. System Needs Input Analysis

No	Input	Current needs	Needs to be made	Actor
1.	Data Sample	Input Using Ms. Word/Excel	Input in the form of NIK, Patient Name, Address, Sender, Status, Symptoms, Comorbid, Contact History, Supporting History, etc.	Admin and Officer
2.	CT Value	Input Using Ms. Word/Excel	Input in the form of CT Value results from the PCR machine.	Officer

3.1.3 Process Analysis

The work process is still being computerized using Microsoft Word and Excel. This takes a long time in the preparation and processing of sample data. The computerized storage process also results in redundancy and data loss. There are often delays in searching for data; this is because the database system for storing data is still in separate files.

Table 2. System Requirements Process Analysis

Input	Current Needs	Needs to be made	Actor
Sample Data Processing	The current sample data processing process is processed with Ms. Word/Excel and also generate sample code manually	A page is provided for processing sample data and also generating sample code automatically by the system	Admin and Officer

3.1.4 Output Analysis

In producing reports or information, many work procedures are passed. The administrative officer section will separate the sample data that the analyst officer has completed then the data will be validated whether the results are negative, positive, iconic, or invalid. Samples other than positive and negative will be reprocessed.

Table 3. System Requirements Output Analysis

Input	Current needs	Needs to be made	Actor
List Sample	The list of samples that have been checked must go through several checks using Ms. Word and Excel before the results are made a letter for the sample sender	Provided a page that displays results in real-time	Officer and User

3.2 Design

At the design stage, the things to do are:

3.2.1 Entity Relationship Diagram

ERD is used to determine the existing process rules for the information system used. The following ERD is used in this information system.

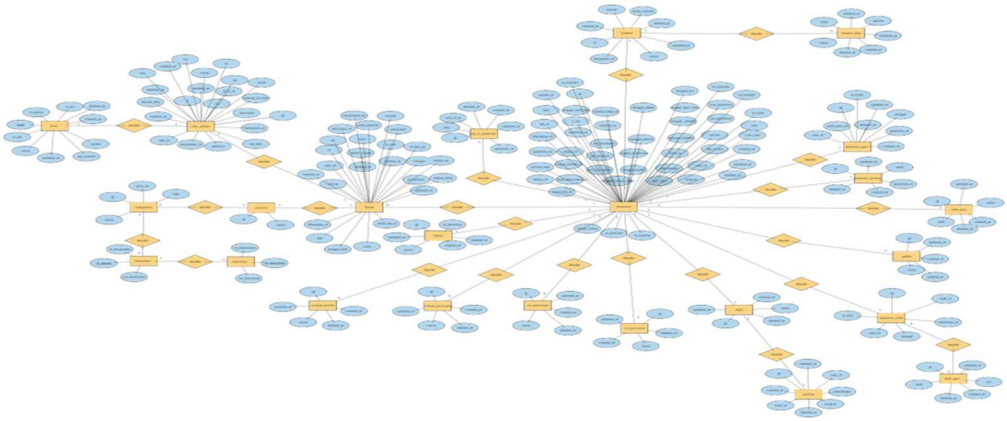

Figure 1. The Design of ERD 1

3.2.2 Use case diagram design

Use case diagrams to describe the processes that actors can perform on the designed system. The following is a Use case scenario on the system being built:

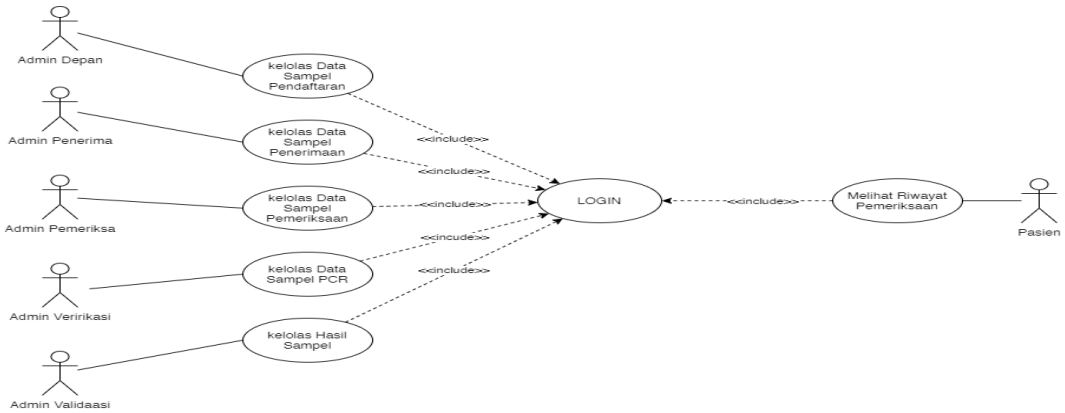

Figure 2. The design of the use case diagram

The description of the use case diagram is mentioned in Table 4 below.

Table 4. Actor System

Actor	Description
Home Admin	Actors have access rights to manage the entire information system built and are responsible for managing registration sample data.
Recipient Admin	Actors have access rights to manage sample data after being verified by the front admin.
Examiner Admin	An actor who has access rights to manage sample data that has been received by the recipient admin.
Verification Admin	Actors who have access rights to manage sample data will have been examined.
Validation Admin	Actors who have access rights to manage sample data to be issued results.
Patient	Actors who have access rights only see the history of examination results

Identification of use case diagrams for information systems can be seen in Table 5 below.

Table 5. Use Case

Use Case	Description	Actor
Register	The process for registering into the system	Patient
Login	Each user logs in by entering the username and password that have been registered in the system.	Patient, admin/officer
Manage Registration Sample data	The process where the admin can manage the sample data that has been registered.	admin/officer
Manage Admission Sample data	The process by which officers can manage verified sample data.	admin/officer
Manage Inspection	The process by which officers can manage sample data that	admin/officer
Managing PCR Sample data	The process by which officers can manage sample data that has been checked will be subject to further examination.	admin/officer
Manage Result data	The process by which officers can manage sample data to be validated based on the results of the PCR examination.	admin/officer

3.2.3. The scenario of Use Case Register

The following is a scenario of each defined use case diagram:

Table 6. Use Case Register

Name *use case*	Register
Actor	Patient
Pre-condition	Actor accesses the register page
Post-condition	Actor successfully registered
Normal Scenario	
Action Actor	**Action System**
1. Enter complete patient data such as name, NIK, domicile address, address, province, district, etc. 2. Pressing the Register button	1. Checking whether the data filled in is valid or not by checking the patient input and checking the patient-user table. 2. Go to the login page

Table 7. Use Case Login

Name *use case*	Login
Actor	Patient
Pre-condition	Actor access login page
Post-condition	Actor successfully logged in
Normal Scenario	
Action Actor	**Action System**
1. Enter your NIK and password. 2. Press the login button	
	3. Checking whether the data filled in is valid or not by checking the patient input and checking the patient-user table
	4. Enter the main menu view
Normal Scenario	
Action Actor	**Action System**
5. Enter your NIK and password. 6. Pressing the login	
	7. Checking whether the data entered is valid or not by checking the patient input and checking the patient-user table
	8. Displays a failed login message

3.2.4 Activity Diagram

Activity Diagram is modeling user and system workflow by describing various activity flows in the designed system. Activity Diagram explains each flow starts, decisions taken, and the flow ends. The following is an activity diagram scenario for the system that is being built.

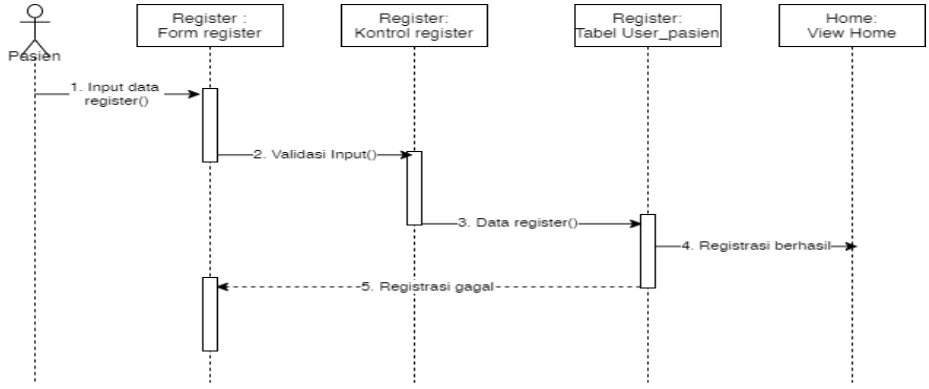

Figure. 3 Activity Diagram

3.3 Implementation

The following picture is an implementation of the information system design made.

3.3.1 Dashboard display

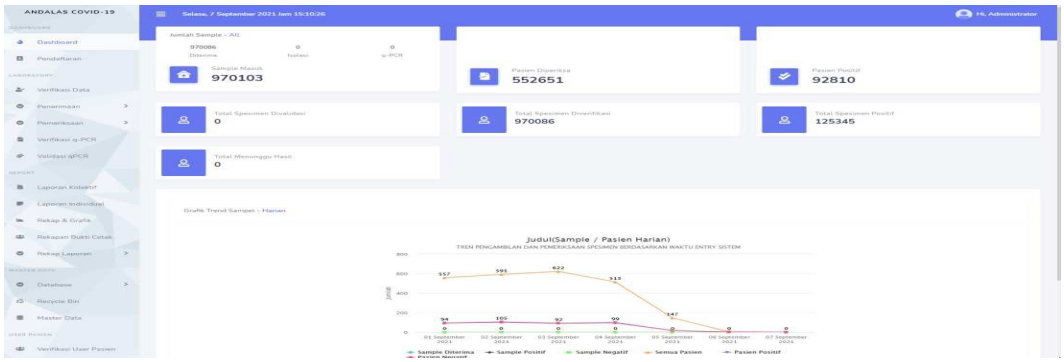

Figure 4. Dashboard display

3.3.2. Positioning sample display

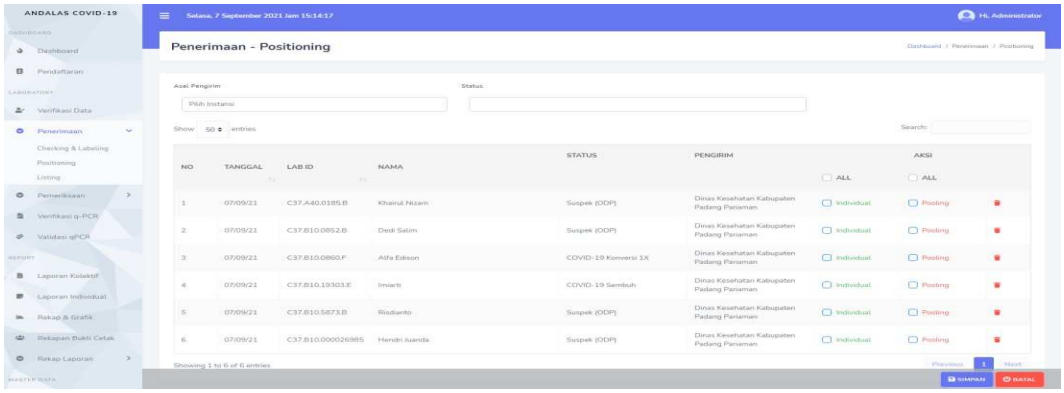

Figure 4. Positioning sample display

3.4 Operation and maintenance

The following table is a table of test results using the Black box method on the system's functionality for data collection of sample data using the Requirement Testing model, which emphasizes the specification of requirements associated with the software identified at the requirements specification and design stage.

From the results of the implementation and testing of the information system for the COVID-19 swab sample data, as shown in the following table, table 8.

Table 8. Requirements testing results

No	Tested interface	Expected results	Results obtained	Results
1.	Register	Entering complete user data	Complete user data entered into the database	Succeed
2.	Login	Login using a user account	Successfully logged into the system	Succeed
3.	Dashboard	Display totals and sample graphs	Successfully display sample total and graph	Succeed
4.	Registration	Registering patient samples	Successfully entered sample data into the database	Succeed

5.	Sample Verification	Can verify registered samples	Successfully verified registered sample	Succeed
6.	Checking and labeling	Can create sample lists and labels	Successfully created a sample list and label	Succeed
7.	Positioning	Can group samples for inspection	Successfully grouped samples	Succeed
8.	Individual list	Can make a list of individual samples	Successfully made a list of individual samples	Succeed
9.	List pooling	Can make a sample pooling list	Successfully Created a sample pooling list	Succeed
10.	Re-isolation list	Can make a sample re-isolation list	Successfully made a sample re-isolation list	Succeed
11.	List of qPCR	Can make a sample qPCR list	Successfully created a sample qPCR list	Succeed
12.	Confirm PCR	Can confirm PCR sample	Successfully confirm PCR sample sample	Succeed
13.	PCR validation	Can validate	Successfully validate sample PCR	Succeed
14.	Status management	sample PCR	Successfully manage status	Succeed
15.	Results Management	Can manage status	Successfully managing Results	Succeed
16.	Contact History Management	Can manage results	Successfully managing Contact History	Succeed
17.	Supporting History Management	Can manage Contact History	Successfully managed Support History	Succeed
18.	Pregnancy Management	Can manage Supporting History	Successfully manage Pregnancy	Succeed
19.	Comorbid Management	Can manage Pregnancy	Successful management of Comorbid	Succeed
20.	Agency Management	Can manage comorbid	Successfully manage the agency	Succeed
21.	FKTP Agency Management	Can manage FKTP Agencies	Successfully managed the FKTP Agency	Succeed
22.	Agency Letter Management	Can manage agency letters	Successfully managing agency letters	Succeed
23.	Lab sequence management	Can manage Lab order	Successfully managed Lab sequences	Succeed
24.	User management	Can manage users	Successfully manage user	Succeed
25.	Access Rights Management	Can manage Access Rights	Successfully managed Access Rights	Succeed
26.	Creating Labels	Can Make Labels	Successfully Created a Label	Succeed
27.	Manage Troubled Data	Can Manage Troubled Data	Successfully Manage Troubled Data	Succeed
28.	Creating a Collective Report	Can Make Collective Reports	Successfully Created a Collective Report	Succeed
29.	Making Individual Reports	Can Make Individual Reports	Successfully Create Individual Report	Succeed
30.	Making Checklist	Can Make a Checklist	Successfully Create Checklist	Succeed

4. Conclusion

Design and manufacture of information systems at the PDRPI Lab, Faculty of Medicine, Andalas University using the PHP programming language with the Laravel framework in creating program code and using MySQL as a database. The design and manufacture of this information system can assist the PDRPI Lab in processing swab sample data received in conducting the examination. There are two access rights in this system, namely admin and officers. Admin rights have access to manage sample data, instance, status, etc. Meanwhile, the officer's right to have access is only to manage the sample as long as the sample does not have results. This information system can display sample data starting from registered samples until the sample results come out in real-time. The system that has been built still has some shortcomings and limitations. Therefore, several things need to be developed by further researchers to make it better. This information system needs further development for tracking positive confirmed patients. It is necessary to add an email verification feature for registering an account. Mobile platforms such as Android and iOS can be used for future development.

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