



FACULTY OF COMPUTING AND INFORMATION TECHNOLOGY

Bachelor of Software Engineering (Honours)
Programme: RSW (Group: 6)

ASSIGNMENT

BACS2073 SOFTWARE DESIGN AND ARCHITECTURE

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Plagiarism Statement and Guideline for Late Submission of Coursework

Read, complete, and sign this statement to be submitted with the written report.

We confirm that the submitted work are all our own work and are in our own words.

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SOFTWARE DESIGN DOCUMENT

PROJECT TITLE : Covid Vaccination System (CVS)

PRACTICAL GROUP : RSW06

NAME	MODULE
1. HING ZI HUI	PATIENT MODULE
2. HO WEN TING	VACCINATION MODULE
3. JOSHUA CHONG ZHIGUANG	INVENTORY MODULE
4. LEE WEE HARN	USER MODULE
5. LEE CHEN HONG	APPOINTMENT MODULE

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1. Introduction

1.1 Document Purposes

This document shall serve as :

- a. a baseline or main reference for the stakeholders and development team
- b. delineates the purpose of the SRS and gives a clear navigation of reference points for the developers
- c. a contract agreed technical requirement vendor customer for clearly defines all the requirements will be included in the enhanced system

1.2 Product Scope

Covid Vaccination System (CVS) project is part of the initiative to enhance the efficiency of the existing processing currently implemented in We-Care Clinic. CVS is an online system which includes the following modules and scope :

No	Module	Purpose
1	Vaccination	<ul style="list-style-type: none"> - Manage each vaccination records - Manage vaccines
2	User	<ul style="list-style-type: none"> - Manage system users
3	Patient	<ul style="list-style-type: none"> - Track patients' health conditions - Manage patients' details
4	Inventory	<ul style="list-style-type: none"> - Manage medical supply - Track usage of the inventory
5	Appointment	<ul style="list-style-type: none"> - Manage vaccination appointment for patient - Allow patient to make appointment online

1.3 Intended Audience and Document Overview

1.3.1 Intended Audience

No	Audience	Role
1	Customer – End User	Nurse, Doctors, Pharmacist
2	Customer – Management Team	Clinic Manager, Head Nurse
3	Dev Team - Project Management	Project Manager
4	Dev Team - Requirement Analysis	Quality Assurance (QA) Analyst
5	Dev Team - Architecture & Design	Software Developer, Software Designer
6	Dev Team - Testing & Integration	Tester, Programmer
7	Dev Team - Maintenance	Programmer

1.3.2 Document Overview

Chapter	Contents Summary
Chapter 1	Introductory to the project to be developed
Chapter 2	System Overview and system functionalities
Chapter 3	Initial Design choose an architectural design for the CVS
Chapter 4	Detailed Design for each module, how the module work
Chapter 5	Human Interface Design which is the UI design each of the module

1.4 Definitions, Acronyms and Abbreviation

Terms / Acronyms / Abbreviation	Definitions / Descriptions
SRS	Software Requirements Specification (SRS) document
MHPCMS	Mental Health Patients Clinic Management System
NA	Not applicable
TBD	To be defined
CVS	Covid Vaccination System
AD	Activity Diagram

1.5 References and Acknowledgements

1.5.1 References

Artefacts / Template / User Forms / Etc	
1	Software Requirements Specification (SRS) template
2	End-User Interview Kit (MHPCMS-IVKit-2034v2)
3	End-User Questionnaire Kit (MHPCMS-QKit-2034v2)
4	Form P-2: Patient Information Record

2. SYSTEM OVERVIEW

2.1 Modules and Key Functionalities

Module Name	Key Function	Module Description
Vaccination	<ol style="list-style-type: none"> 1. Record Vaccination 2. Distribute vaccine 3. Order Vaccine 	This module mainly handles all the processes related with the vaccine and vaccination.
Patient	<ol style="list-style-type: none"> 1. Add patient 2. Record post-vaccine 3. Record on-the-spot checking 4. Register 	This module manages all the patient details and keeps track of the patient's status for the vaccinations.
User	<ol style="list-style-type: none"> 1. Edit Profile 2. Reset Password 3. Create New User 4. Assign Roles 	This module is to manage the information and details of the user when signing in the account.
Inventory	<ol style="list-style-type: none"> 1. View total items 2. Record medical supplies 3. Record vaccine supplies 4. Manage inventory 	This module is to view the vaccine details, history and also the summary of the inventory usage.
Appointment	<ol style="list-style-type: none"> 1. Make Appointment 2. Manage patient appointment 3. View Appointment Detail 4. Apply Changes on Appointment 5. Provide Solution for Enquiry 6. Enquire about appointment 	This module is to manage online and physical appointments in the clinic. Besides, it also provides a platform for patients to enquire about appointments and Nurses to provide solutions.

2.2 Design & Implementation Constraints

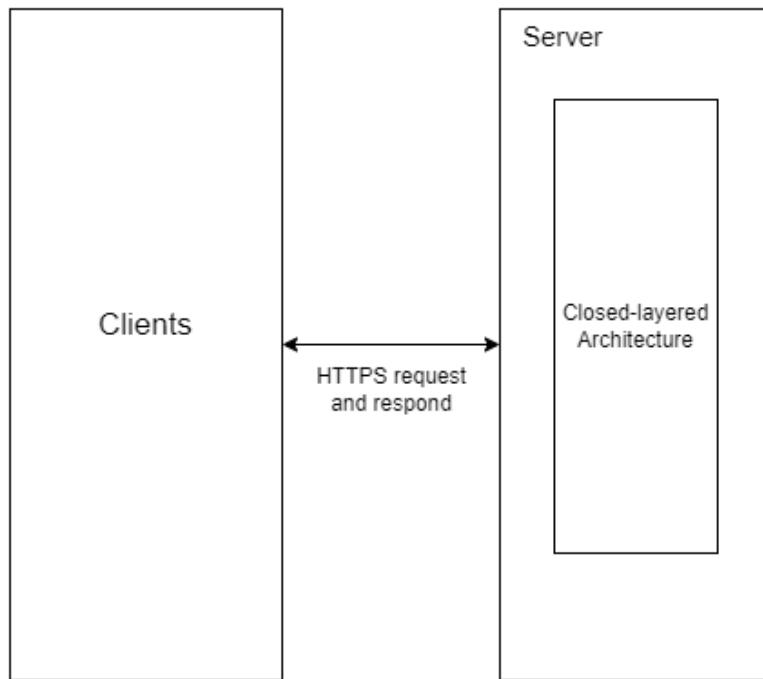
Terms / Acronyms / Abbreviation	Definitions / Descriptions
Design	<ol style="list-style-type: none"> 1. The project shall apply Object Oriented Analysis and Design techniques in all its processes starting from Requirement Specification. 2. The information of all users, vaccination details and inventory details shall be stored in a database that is accessible by the website. 3. The product shall be accessible from any computer that has Internet browsing capabilities and an Internet connection. 4. The product shall run 24 hours a day.
Implementation	<ol style="list-style-type: none"> 1. The project shall be implemented using Object Oriented programming paradigm, framework and tools. 2. All data transferred within the system or to external entities shall be encrypted using Advanced Encryption Standard (AES) algorithm.

SOFTWARE DESIGN DOCUMENT (SDD)

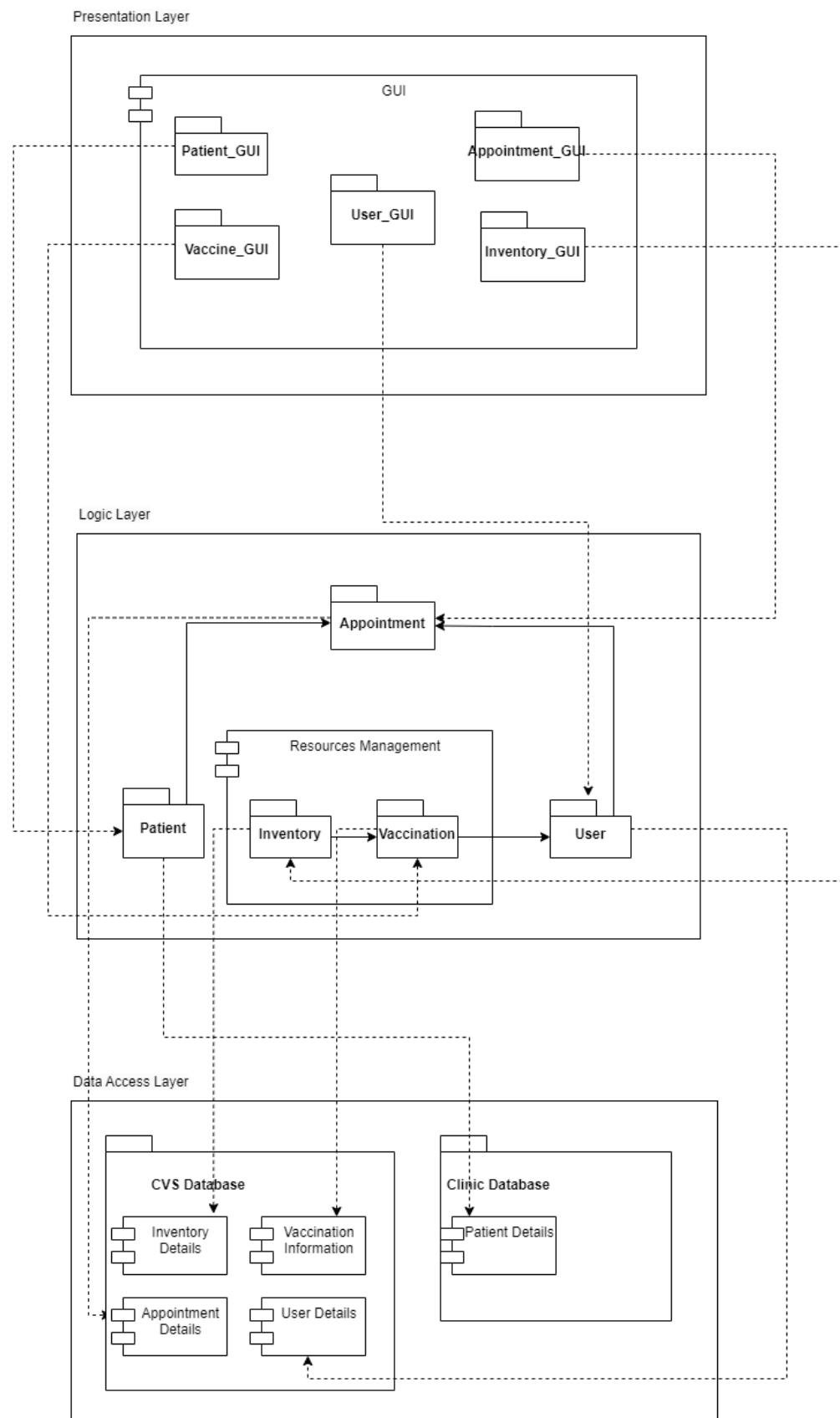
	<ul style="list-style-type: none">3. The project shall apply Structured Query Language (SQL) for database implementation.4. The project shall implement Firewall Security Management for data protection.
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3. INITIAL DESIGN

3.1 Architectural Design

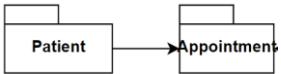
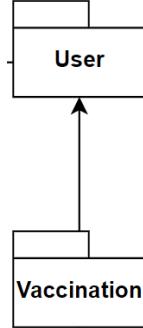
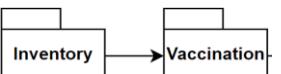


The CVS will implement Client-Server architecture which involves 2 tiers of different machines which are client and server. The clients will request the service through the internet while the server will respond with the requested service. For further improvement on security, scalability and other quality, a closed-layered architecture will be implemented inside the server tier.



In the client tier, Closed-layered architecture will be implemented to separate the system structure into the three layers which are presentation, logic and data access.

Example of communication between each module in the layer:

	<p>When a patient asks for a vaccination appointment, the appointment module first checks the patient module to make sure the patient is ready for the shot, considering things like age, medical history, and any recent vaccinations they may have had. In order to send appointment reminders and other relevant messages, the appointment module will also use the patient module to confirm the patient's identification and contact information.</p> <p>When a vaccination appointment is made, the appointment module updates the patient module with the date and time of the appointment as well as any other necessary details. The patient module will be used by the appointment module to record the patient's history of vaccinations and, if required, to set up follow-up appointments.</p>
	<p>The user module verifies a user's account details and permissions when they log into the appointment module. Based on their authorization, the appointment module then allows them access to the related features. An administrator might be able to control the amount of inventory and generate reports, but a nurse might be able to arrange and give vaccinations.</p> <p>The user module is also used by the appointment module to control user availability for booking appointments. The appointment module allows users to declare their availability for appointments, and the appointment module will use this information to book appointments with patients.</p>
	<p>The user module verifies a user's account information and authorization when they log into the vaccination module. Based on their permissions, the vaccine module then allows them to access the relevant features and functions. For example, an administrator may be authorised to maintain vaccine inventory while a nurse may be authorised to deliver vaccines.</p> <p>The vaccination module allows users who have been granted permission to give vaccines to track the delivery of each injection, update patient vaccination records and generate reports on the effectiveness and side effects of the vaccines. The user module is used by the vaccination module to make sure that only authorised users can carry out these tasks and that the delivery of the vaccines is accurately and securely recorded.</p>
	<p>When a user is permitted to give vaccinations, they can use the vaccination module to check the available vaccine inventory, pick the right vaccine for the patient, and record the administration of each vaccine dose. The vaccination module relies on the inventory module to ensure that there is sufficient vaccine supply for each appointment and that the inventory is properly managed and replenished as needed.</p> <p>The inventory module can also provide reports on vaccine supply and usage, which can be used to inform decision-making regarding vaccine procurement and distribution. These reports can be used by the vaccination module to keep track of vaccine usage and make future appointment plans.</p>

3.2 Design Rationale

3.2.1 Quality Concern

When selecting architecture patterns for the Covid Vaccination System (CVS), there are several critical concerns that need to be addressed:

1. Platform

As an online web-based application, the architecture design must focus on meeting the requirements of a web-based system, ensuring scalability, performance, and availability. The selected pattern should be able to identify the different machines from the user and the system as this system provides the functionality online which through the internet for the patients. Besides, it also should be able to handle the anticipated traffic and data flow, as well as be easily scalable in case of increased demand.

2. Database

The data involved in the system is distributed and stored in a specific database, and integration with an existing clinic database must be considered during the architecture design process to ensure seamless data communication and consistency. The architecture pattern should support effective data storage, retrieval, and management, including data migration and backup.

3. Security

The CVS contains sensitive personal data, such as patients' privacy information, and requires a high level of security to prevent unauthorised access, data breaches, and cyber-attacks. The pattern should allow the features such as secure login and authentication, access control, encryption, and data monitoring to ensure the data privacy and security standards are met.

Considering these concerns, the selected architecture pattern should ensure efficient and effective functioning of the CVS while safeguarding sensitive data.

3.2.2 Architecture Pattern Consideration

After evaluating various architecture patterns, three potential candidates have been identified for consideration in the design of CVS:

1. Client-server architecture

Client-server architecture plays an important role for a web application in dividing the system into two parts, which is the client to send requests and the server to provide services. As our CVS is an online website, the client-server architecture allows the two components to run on different machines in order to provide services to the client through a network. This pattern allows for better scalability, as the server can be easily upgraded to handle more requests without affecting the clients.

2. Closed layered architecture

The pattern provides enhanced security through multiple layers, with access and authentication limited only to relevant layers. Furthermore, the integration of data can be used for the existing data to ensure the consistency and security of the data such that the data collected from the patients and stakeholders will be consistent and always accurate to prevent any error from happening. Additionally, the pattern allows for better security as each layer can have its own set of security rules.

3. Service-oriented Architecture (SOA)

SOA offers unique security features, including encryption techniques for confidentiality and integrity of patient and user information. Additionally, it can employ monitoring methods to detect and thwart threats or ransomware attacks. SOA can provide reusable services that can be easily implemented into other applications without requiring extensive testing phases. As a result, it is a suitable architecture for applications that can be independently deployed as services and undergo frequent changes.

3.2.3 Final Selection

Based on the considerations of the architecture design pattern of CVS system, the client-server architecture is a necessary choice to provide services to clients through the network. To address concerns related to security, a server-side architecture must be implemented. After comparing Service-Oriented Architecture (SOA) and closed layered architecture, we have decided that closed layered architecture is the best choice for our system.

Service-Oriented Architecture (SOA) can be more vulnerable to security attacks compared to closed layered architecture since the services of the architecture will rely on each other to perform a proper work which means services can be accessed from different locations. Whenever one of the services is attacked by attackers, the security of the entire system may be threatened, and it will be difficult to regulate and safeguard the flow of data from one service to another. Besides that, the changes in security of Service-Oriented Architecture include a reliance on third parties which might have some risk exposure at the third party side. This will attract more attackers from the vulnerability exposed by the third party service and cause serious damage to the CVS.

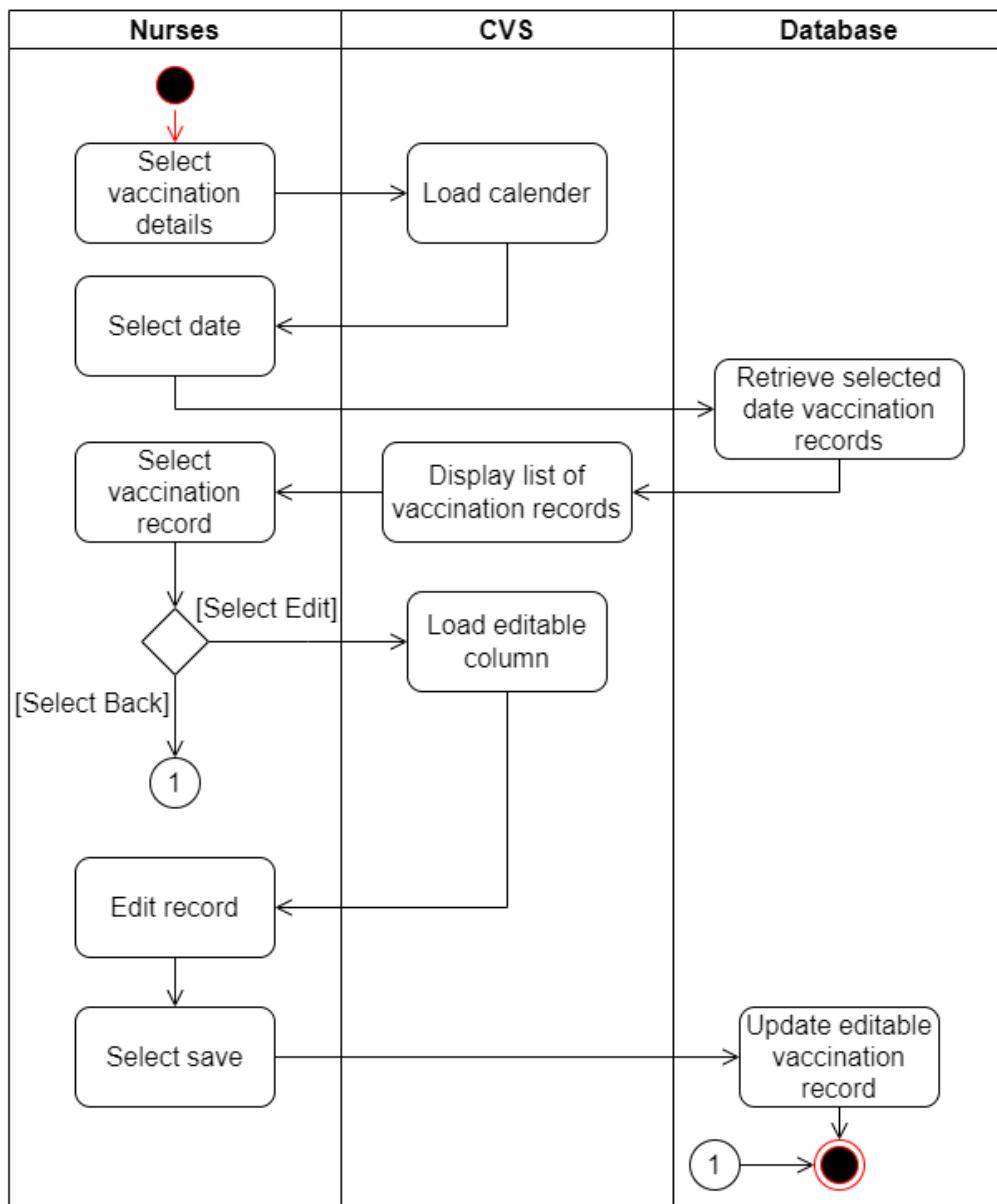
For closed layered architecture, it is designed to define different layers of the security requirement and provides a more intense and structured approach based on security for those layers. For example, since CVS has a well-defined authentication and authorization control that limits database access to only nurses, the closed layered architecture will be the most suitable choice for the server-side of the client-server based architecture to ensure that data is protected from a wide range of threats.

4. DETAILED DESIGN

4.1 Module 1 : Vaccination

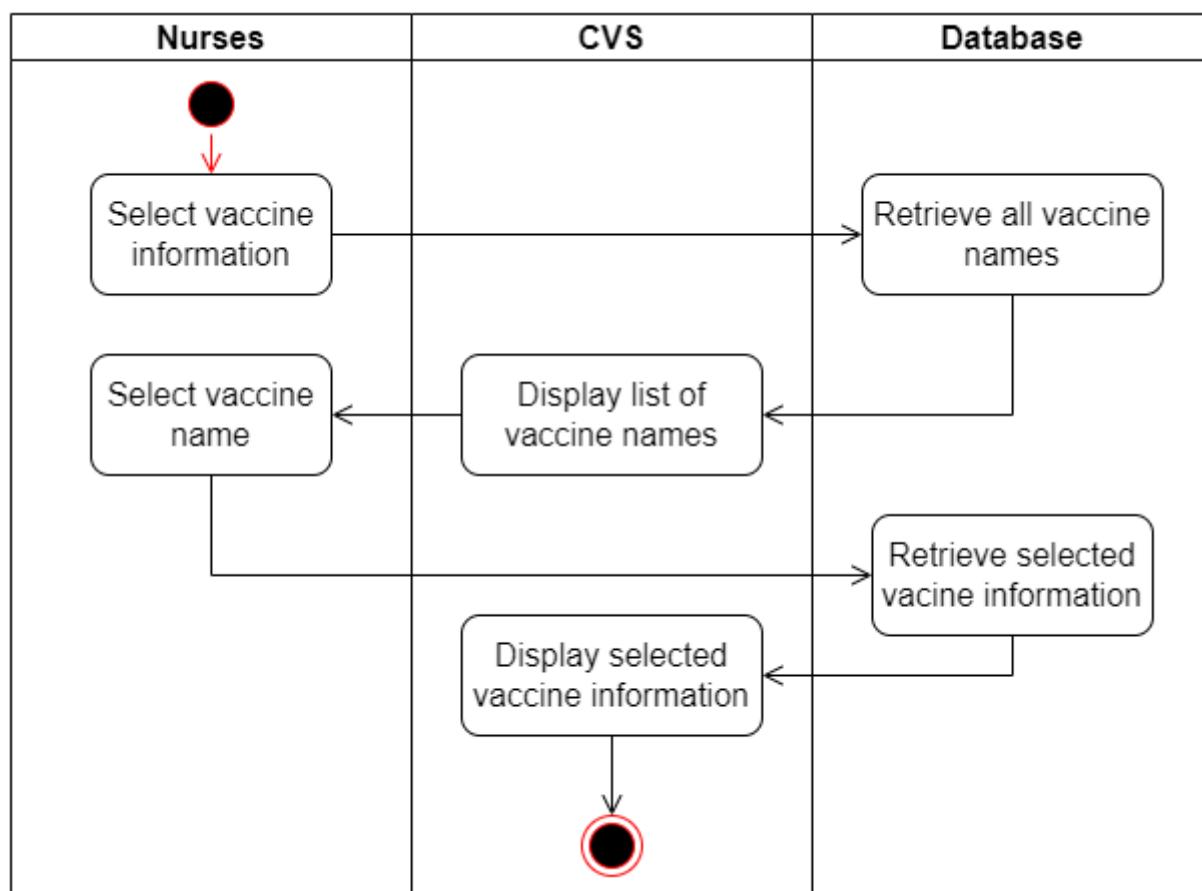
4.1.1 Activity Diagram

4.1.1.1 Activity Diagram for Use Case: AD01_1 - View Vaccination Details



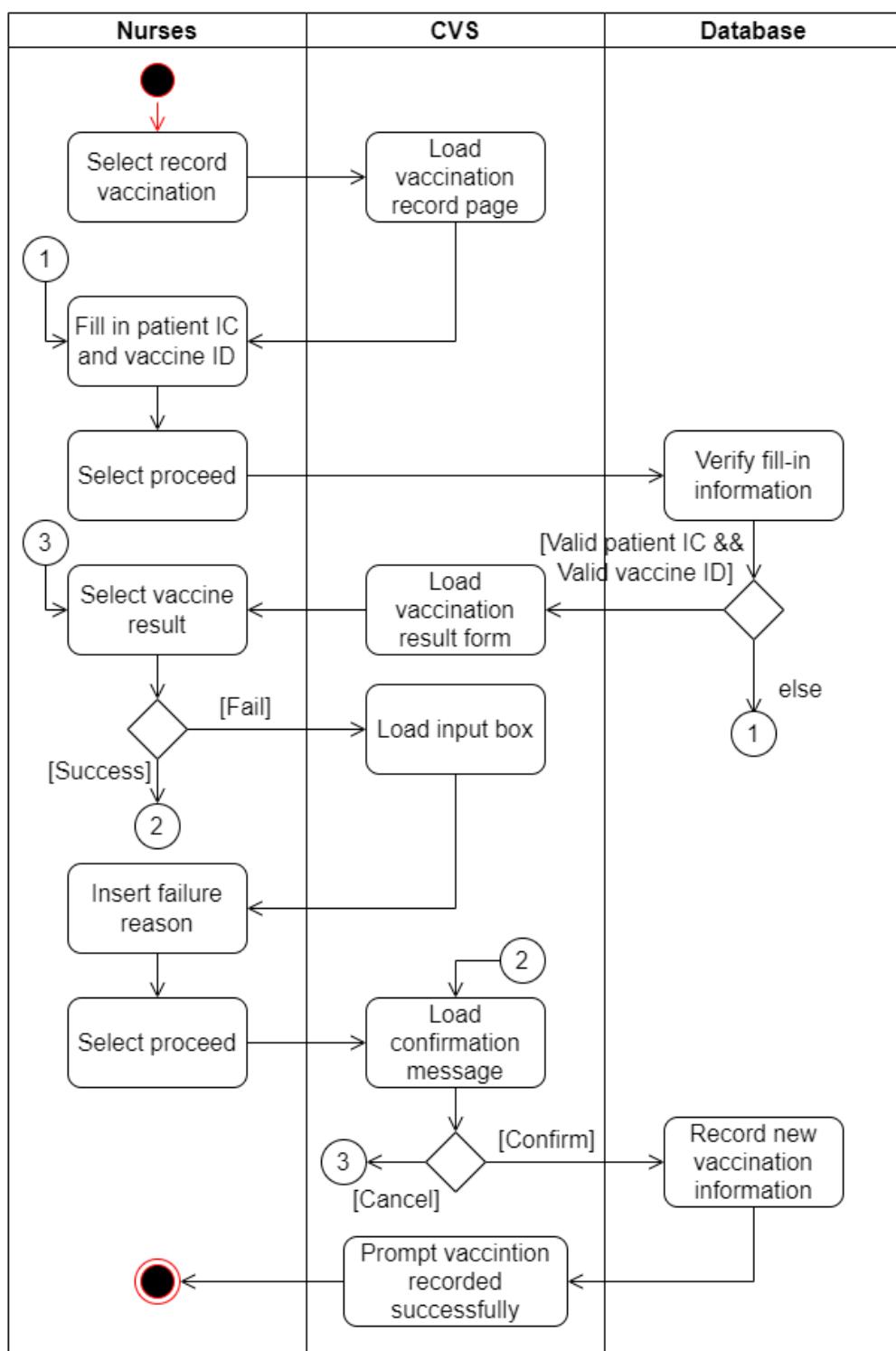
The following activity diagram outlines the steps that a nurse must take to view vaccination details. Firstly, the nurse selects a specific date, and the system generates a list of all the vaccination records for that date. Next, the nurse selects a particular record from the list, and the system retrieves all the corresponding details for that record. The nurse then has the option to edit the information if necessary.

4.1.1.2 Activity Diagram for Use Case: AD01_2 - Obtain Vaccine Information



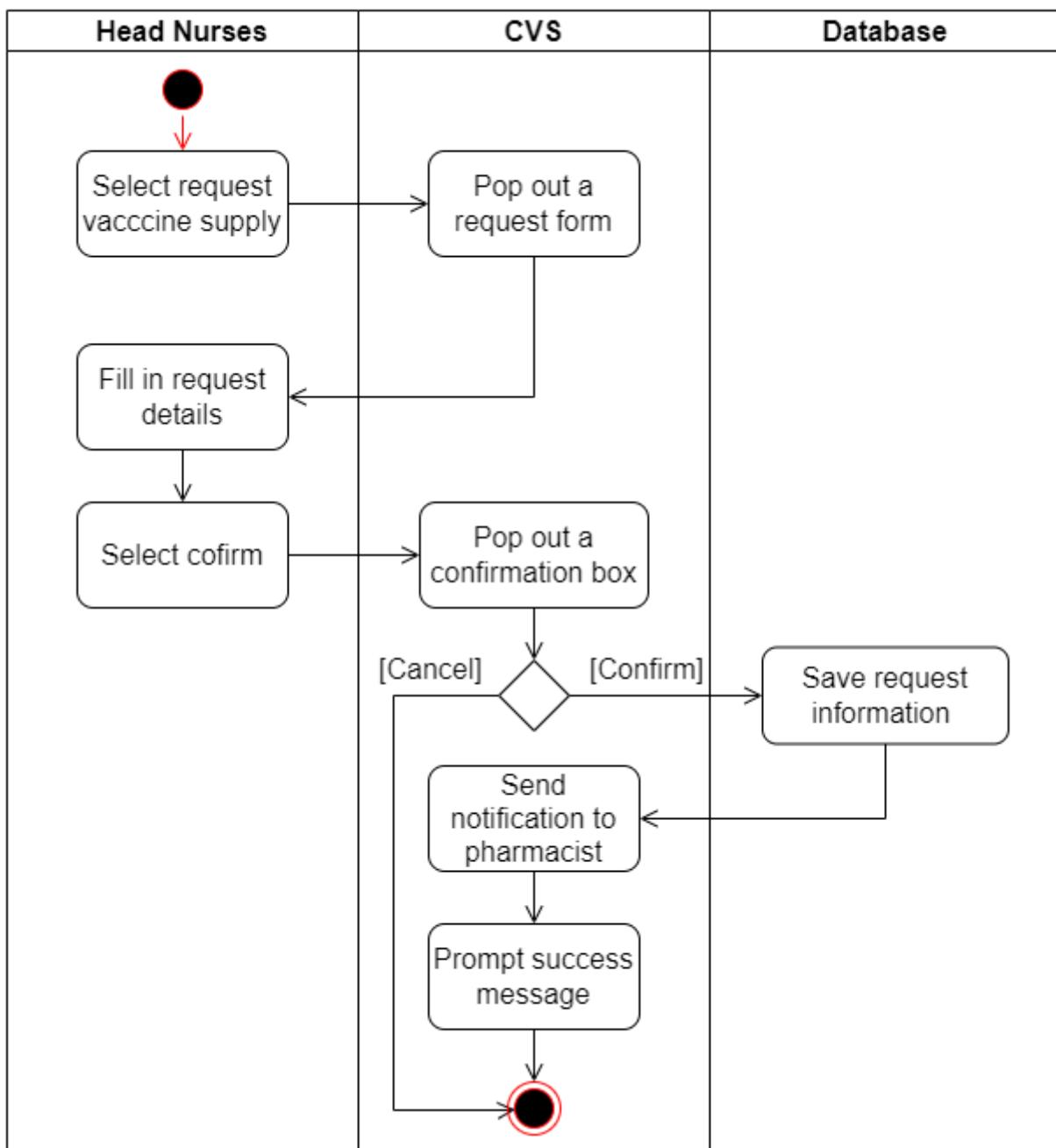
The following activity diagram outlines the steps that a nurse must take to obtain vaccine information. Once nurses access the vaccine information page, the system will present a list of vaccine names. The nurse will then select a vaccine from the list, and the system will retrieve all relevant information about that specific vaccine based on the selection made by the nurse.

4.1.1.3 Activity Diagram for Use Case: AD01_3 - Record Vaccination



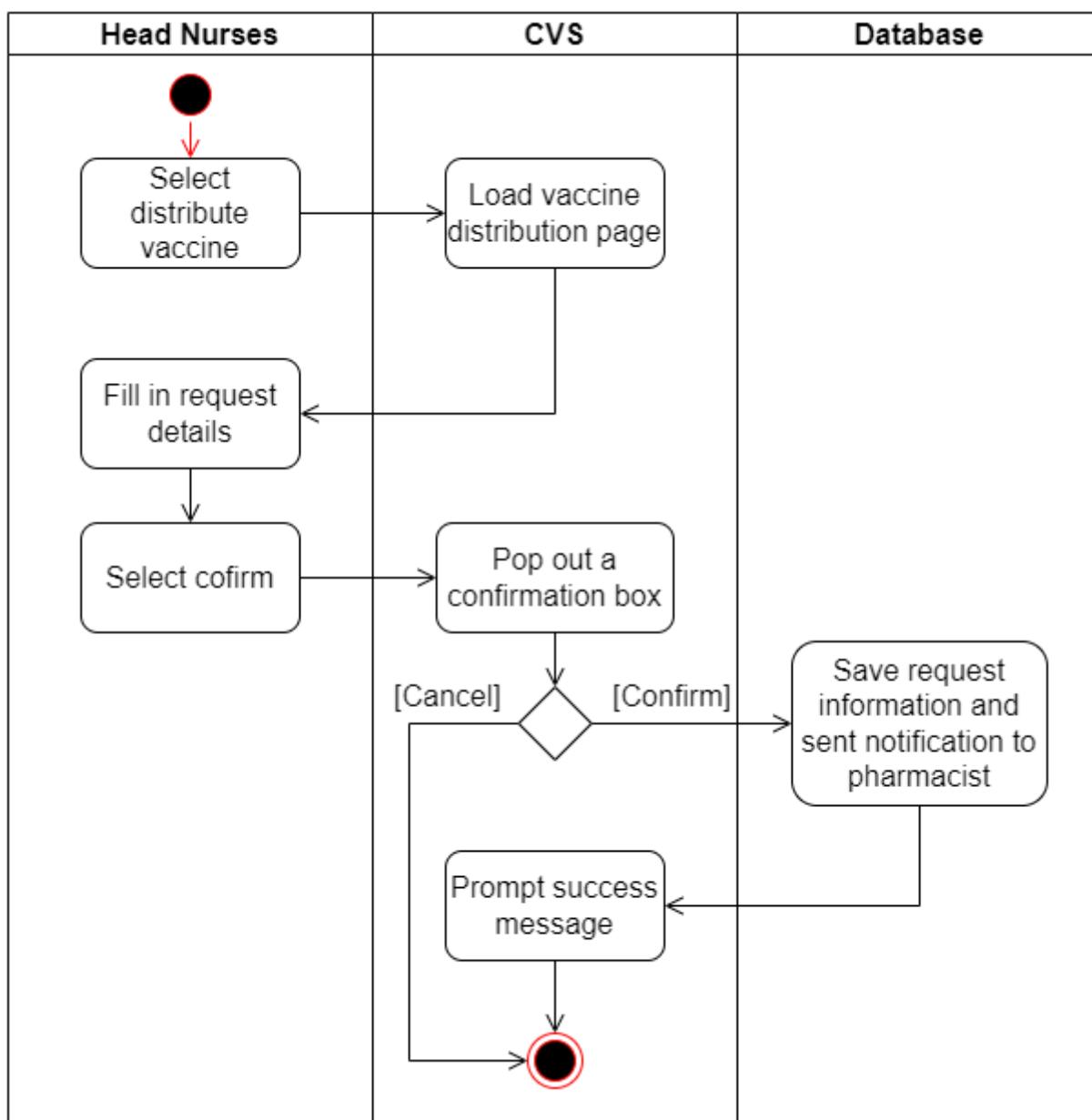
The following activity diagram outlines the steps that a head nurse must take to record vaccination. First, nurses are required to fill in IC and vaccine ID to proceed. The fill-in information will be verified. If the information is valid, a result form will be loaded for nurses to select the vaccination result, else it will ask the nurses to fill-in the information again. If the selected result is successful, a double confirmation will be requested and saved to the database, else a failure reason is requested before being added into the database.

4.1.1.4 Activity Diagram for Use Case: AD01_4 - Request Vaccine Supply



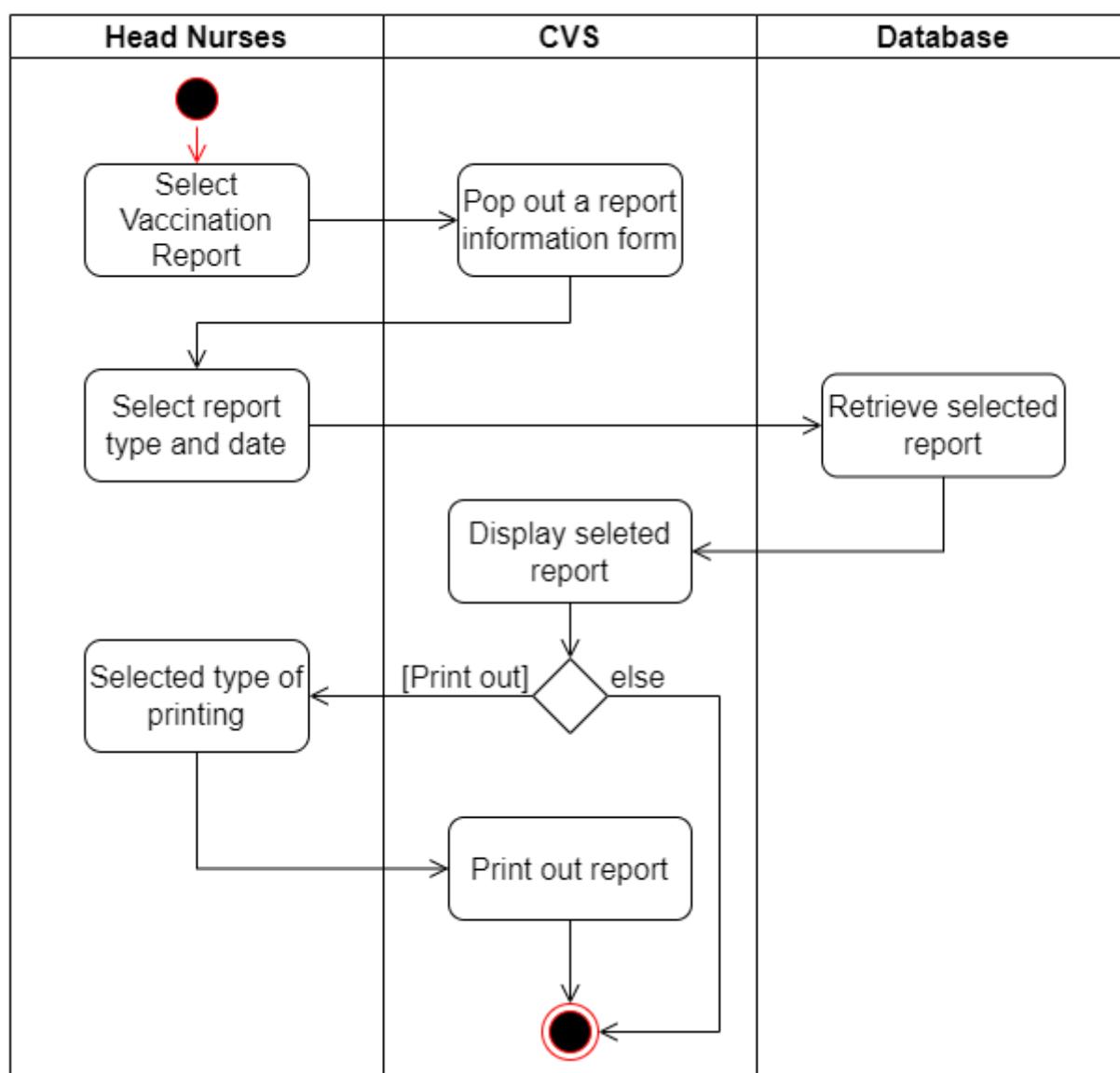
The following activity diagram outlines the steps that a head nurse must take to request vaccine supply. Once head nurse access to the request vaccine supply page, a request details form is provided from the head nurses to input all necessary information. Once the form is complete, the head nurse will be required to confirm their request. Once the form is complete, the head nurse will be required to confirm their request. After the double confirmation process, the request information will be saved, and a notification will be sent to the pharmacist. However, if the head nurse selects "cancel," the process will terminate.

4.1.1.5 Activity Diagram for Use Case: AD01_5 - Distribute Vaccine



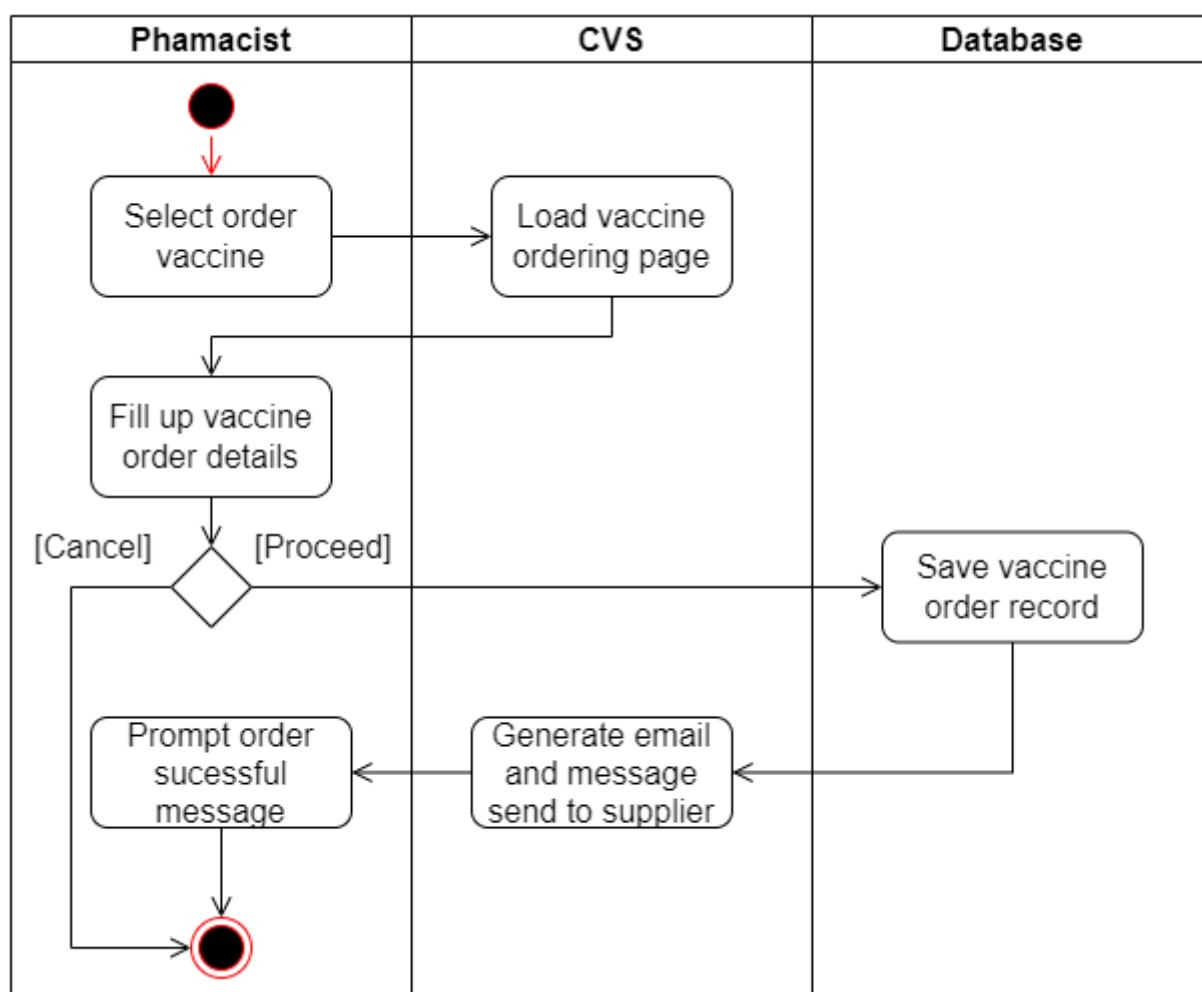
The following activity diagram outlines the steps that a head nurse must take to distribute vaccines. A form is provided for the head nurse to fill in necessary information. After head nurses complete and select "confirm", a double confirmation process will occur. After the confirmation, the request will be saved and sent to the pharmacist for future distribution process. However, if the head nurse selects "cancel," the process will terminate while no information will be saved and notified.

4.1.1.6 Activity Diagram for Use Case: AD01_6 - View Vaccination Report



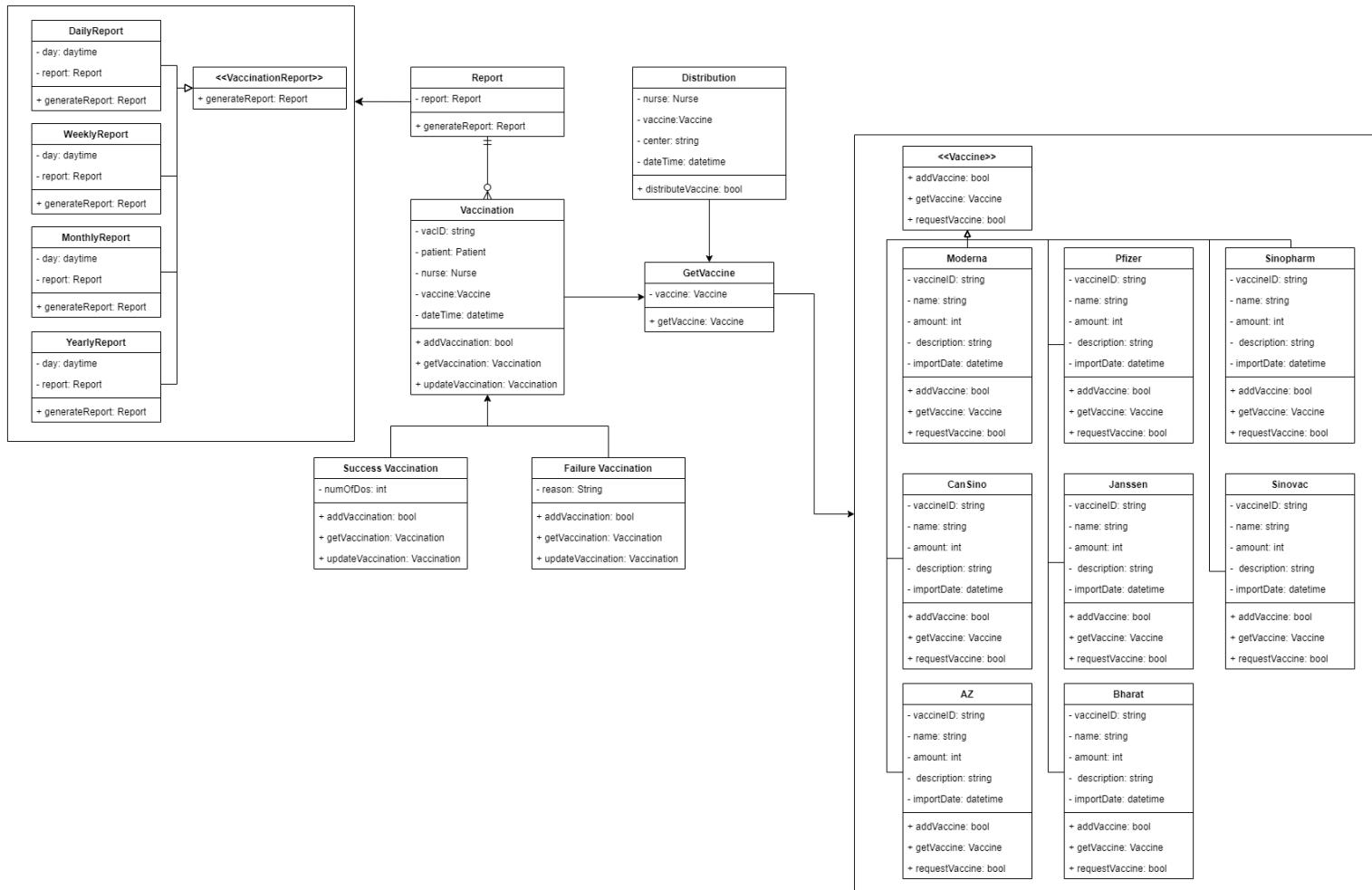
This activity diagram shows the procedure of the vaccination report viewing process. The head nurse is required to select the type of report and provide a date. The system will retrieve the report based on information provided. Besides, the head nurse is able to print out the report.

4.1.1.7 Activity Diagram for Use Case: AD01_7 - Order Vaccine



This activity diagram shows the procedure of the pharmacist to order a vaccine. A form is necessary to be filled up by the pharmacist for order details. If pharmacists proceed with the process, the record will be saved in the database and generate an email and message to the supplier. After the notification is successfully sent, a success message will be prompted.

4.1.2 Design Class Diagram



4.1.2.1 Rationale for Selected Design Pattern

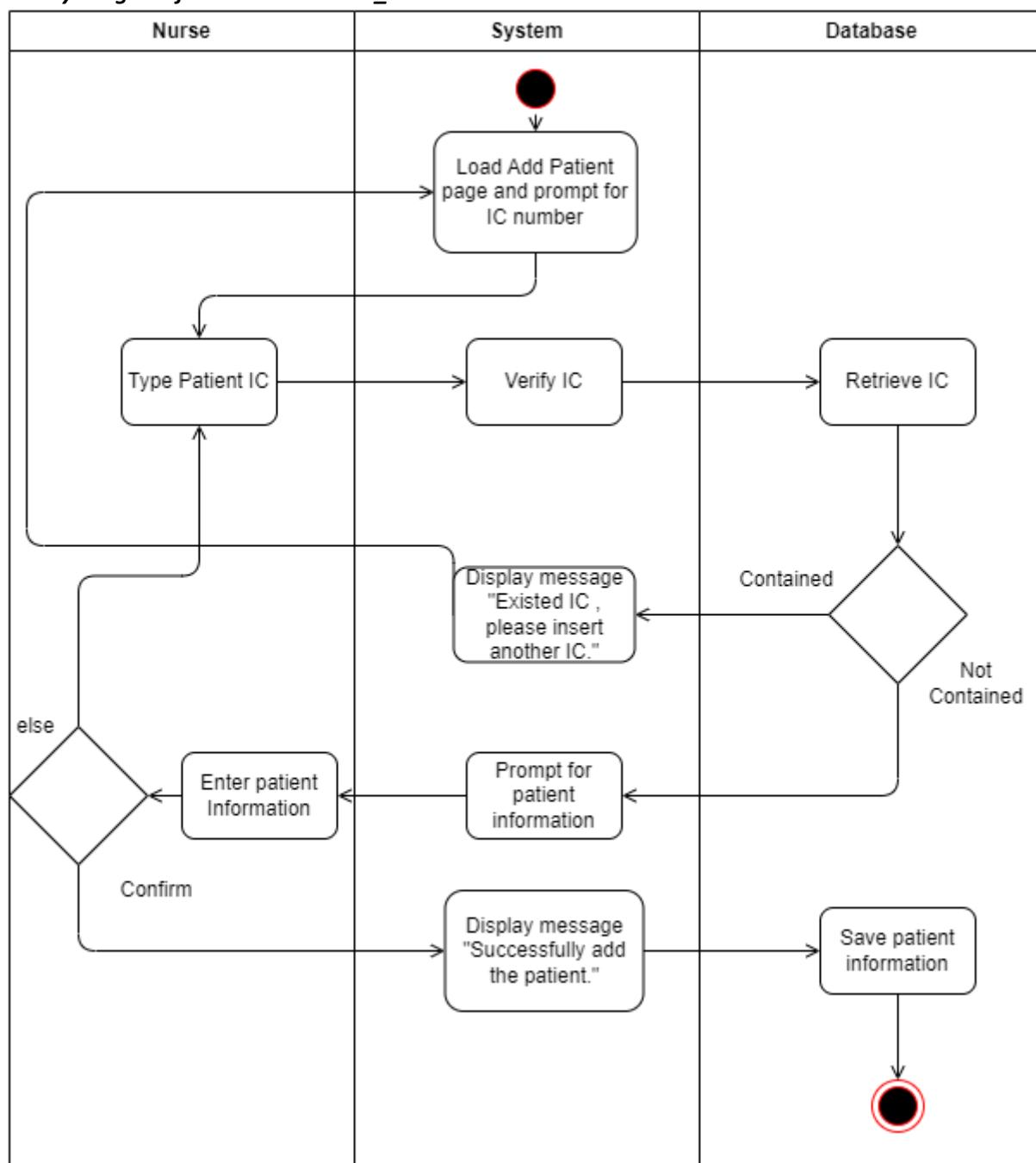
The Vaccination Module class diagram is implemented using the Factory design pattern. This pattern provides flexibility and efficiency in object creation by allowing subclasses to alter the type of objects that will be created through a common interface. In the context of the vaccination class diagram, this can be useful for creating instances of different types of vaccinations based on specific criteria or parameters. For example, a factory class could take in a specific type of vaccine and instantiate the appropriate subclass based on that input, providing greater flexibility in adding new types of vaccinations in the future without changing the existing codebase. The Factory pattern can also be used for the report class as different types of reports require generation with different methods.

Another consideration for design patterns in the vaccination class diagram is the Singleton design pattern. This pattern ensures that only one instance of a class is created and provides global access to it. For the vaccination class diagram, this pattern could be useful for managing the storage and retrieval of data. However, it may lead to scalability and maintainability issues as there would be only one instance of the vaccination class throughout the entire application. This could cause problems with concurrent access, performance, and testing. Therefore, the Factory pattern is a better choice for the vaccination class diagram, as it provides more flexibility and scalability in object creation.

4.2 Module 2 : Patient

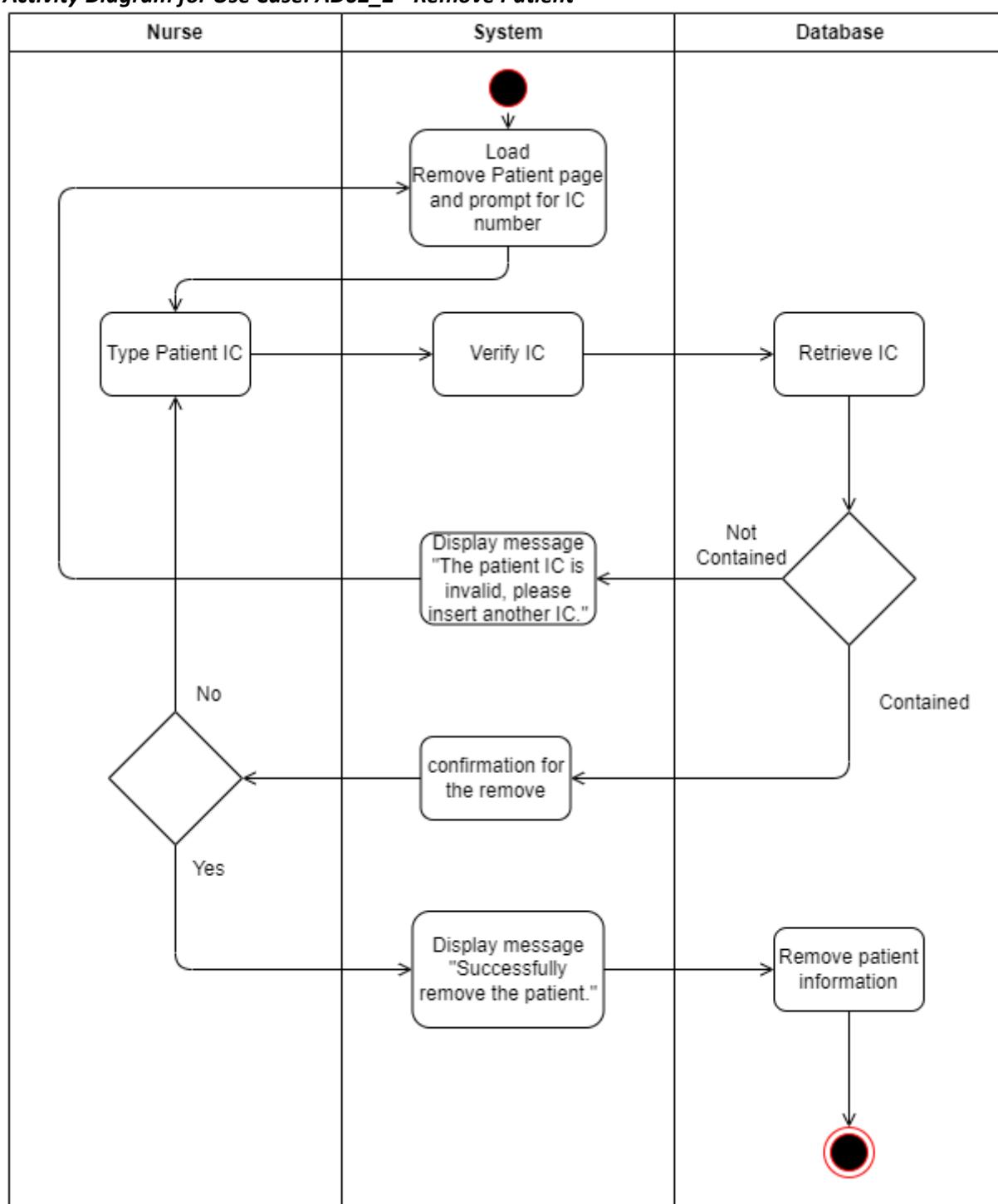
4.2.1 Activity Diagram

4.2.1.1 Activity Diagram for Use Case: AD02_1 - Add Patient



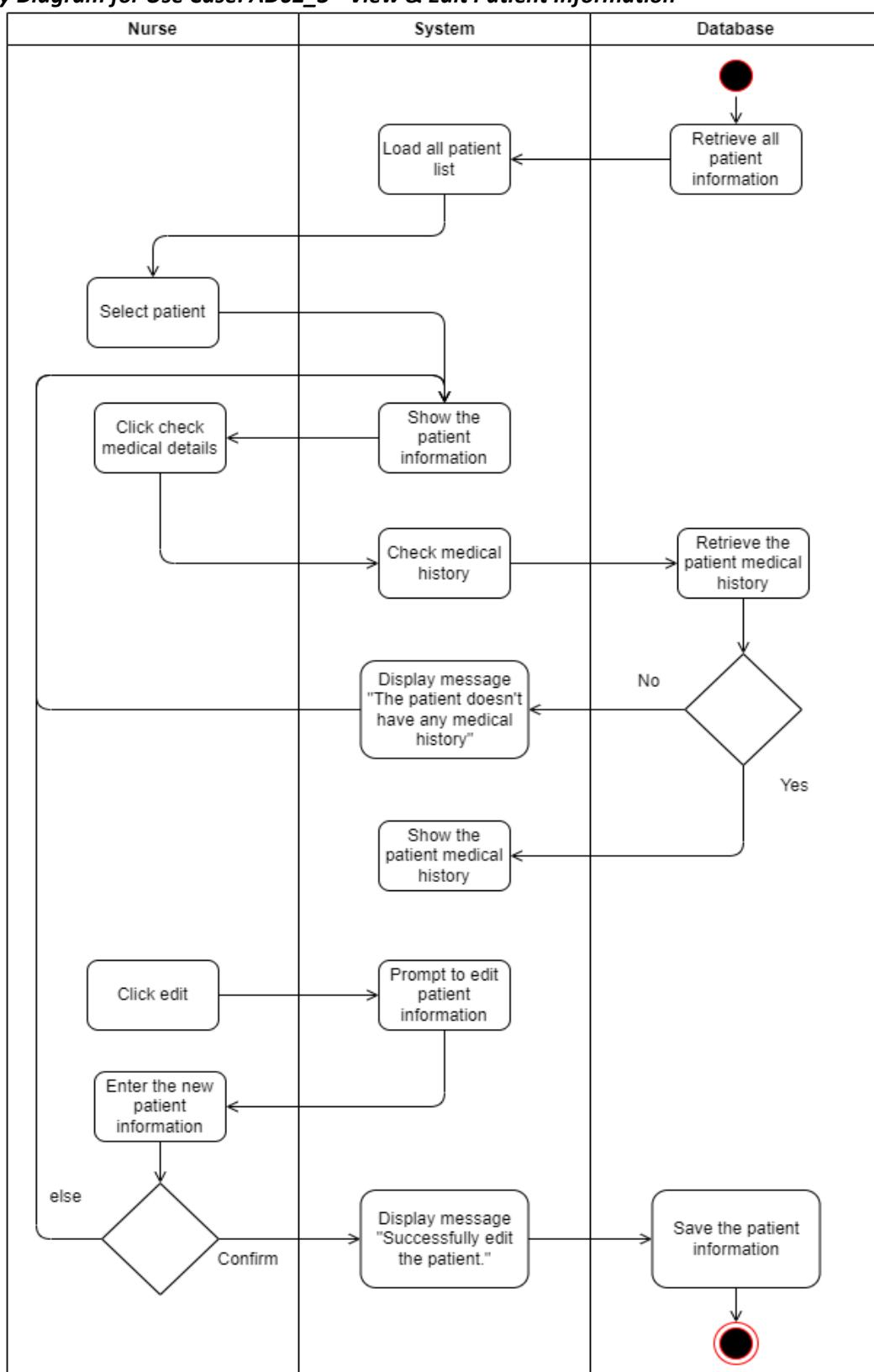
This activity diagram explains about the step for nurses to add the new patient into the CVS database by ensuring the Patient IC given is valid and does not exist in the database before. After verification, the patient information is required to enter such as phone number.

4.2.1.2 Activity Diagram for Use Case: AD02_2 - Remove Patient



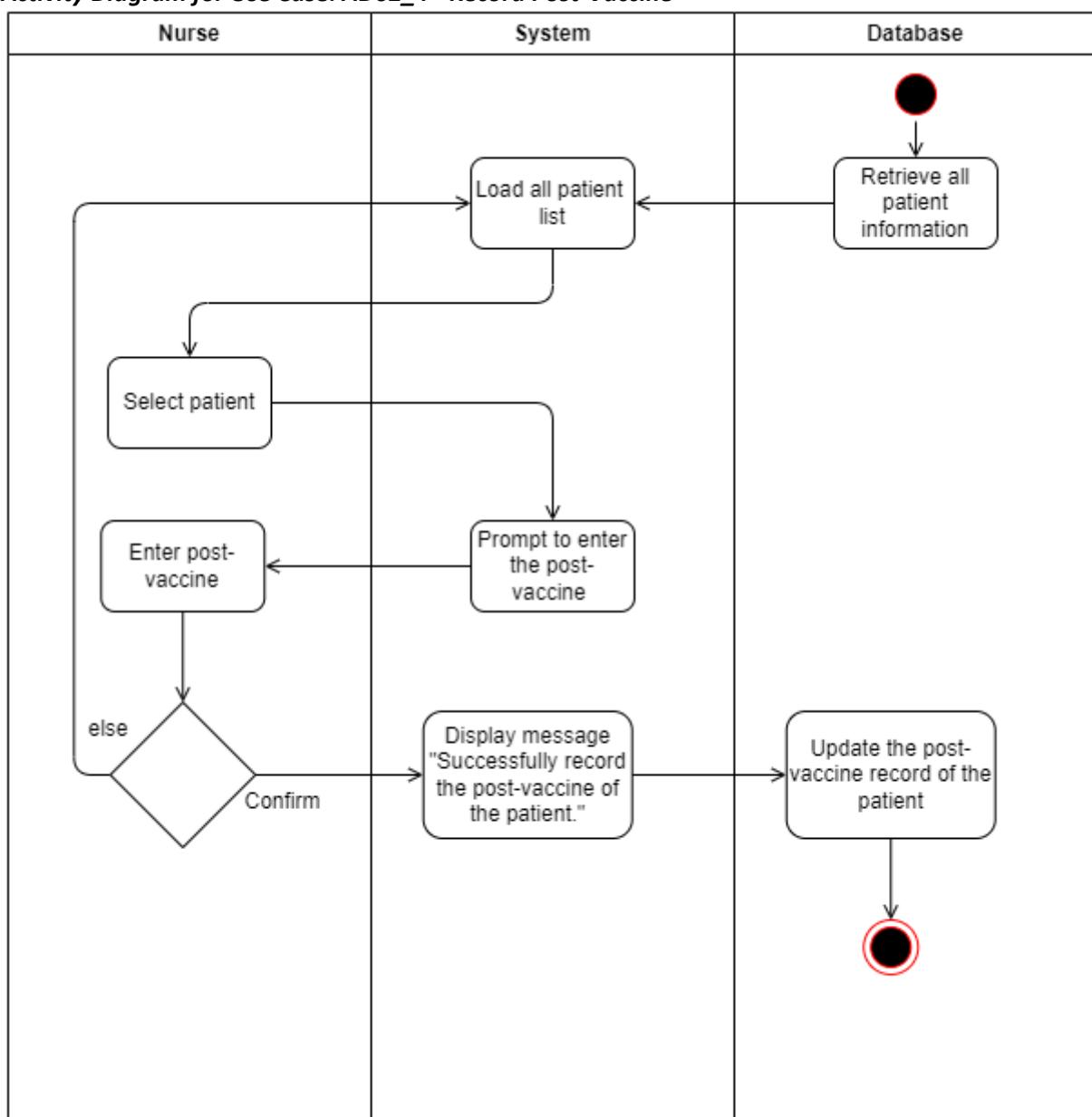
This activity diagram explains about the step for nurses to remove the patient from the CVS database by ensuring the Patient IC given is valid and exists in the database.

4.2.1.3 Activity Diagram for Use Case: AD02_3 - View & Edit Patient Information



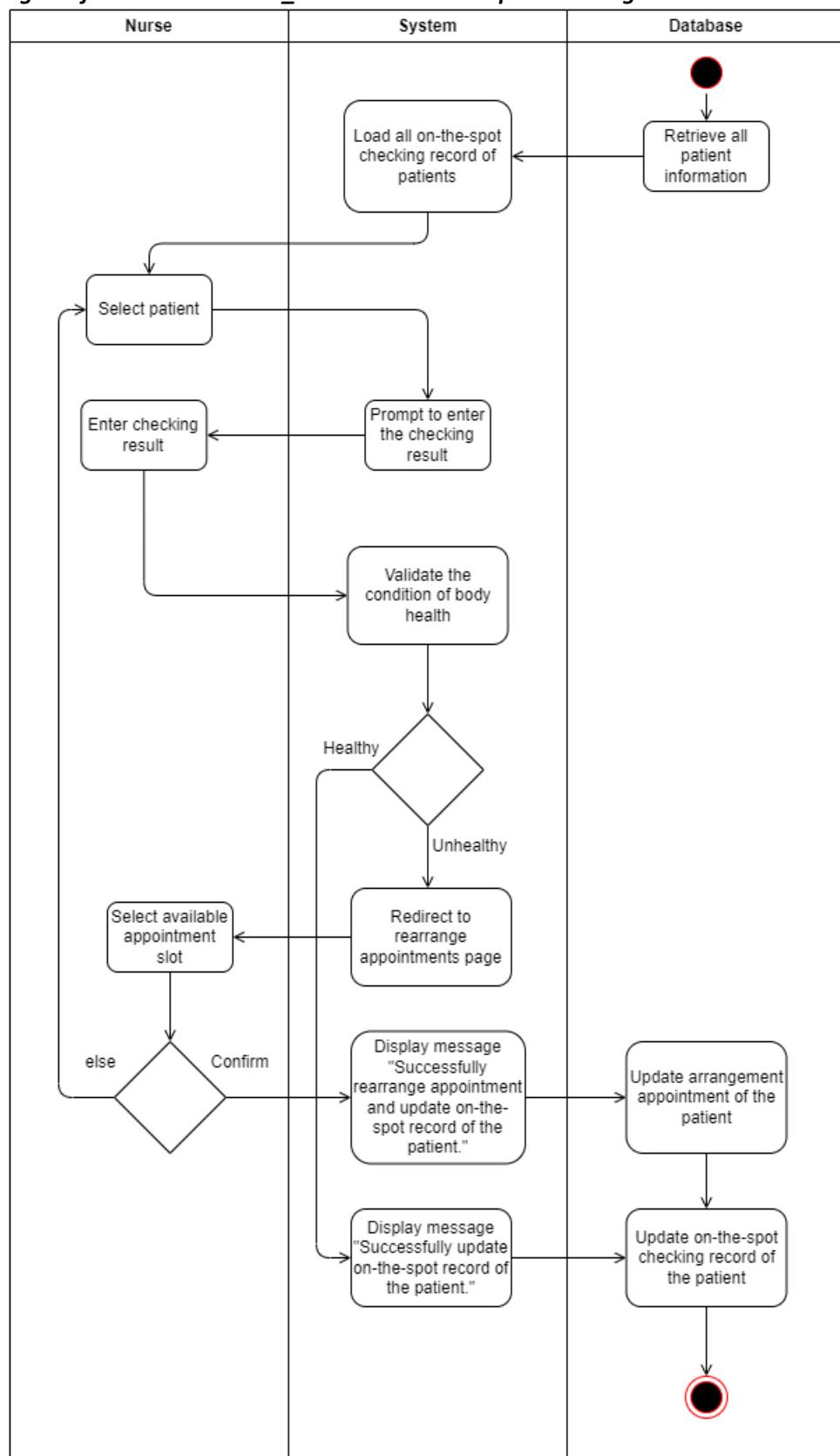
This activity diagram explains about the steps for nurses to view and edit the patient information from the CVS database.

4.2.1.4 Activity Diagram for Use Case: AD02_4 - Record Post-Vaccine



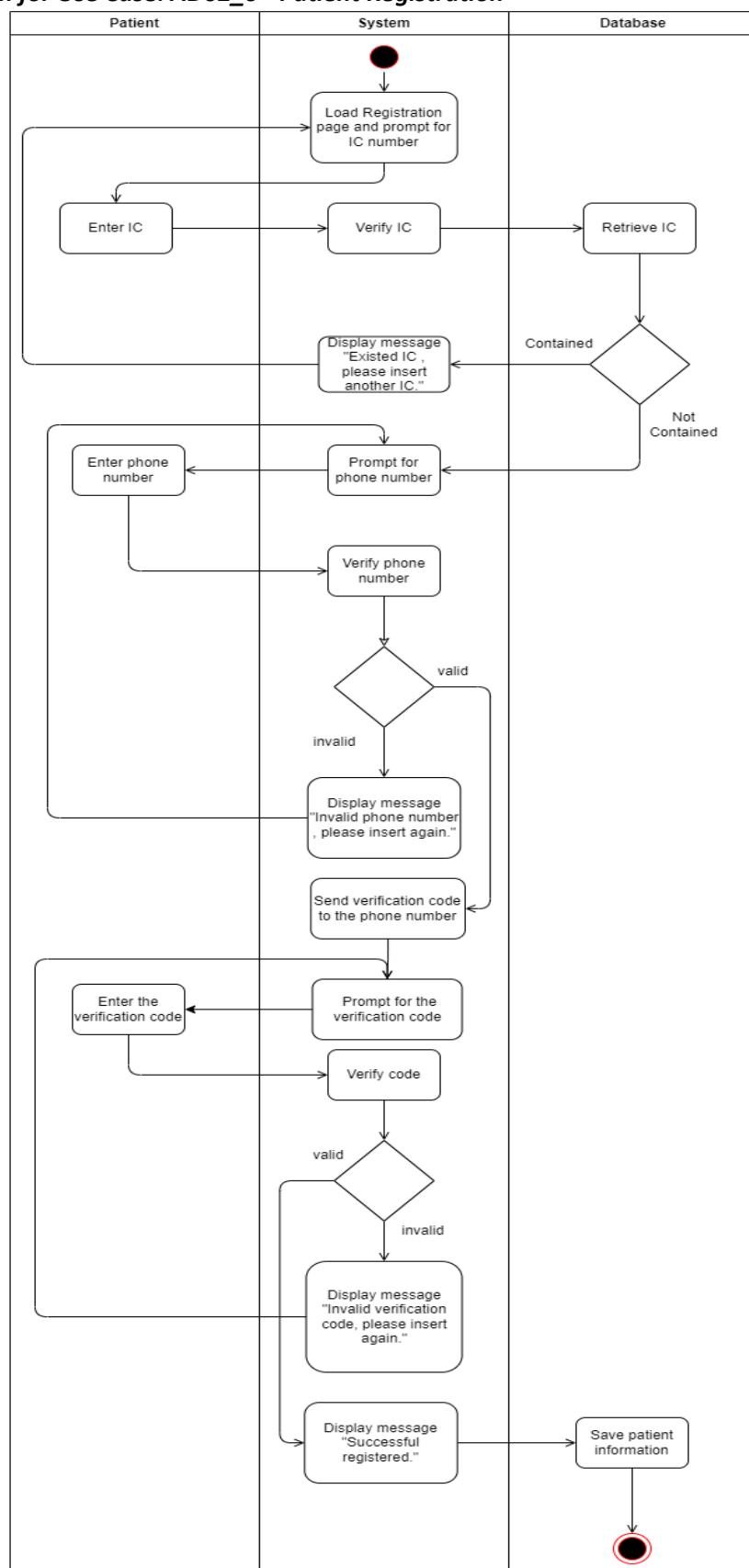
This activity diagram explains about the step for nurses to record post-vaccine of the patient from the CVS database and update the record into the CVS database.

4.2.1.5 Activity Diagram for Use Case: AD02_5 - Record On-the-spot Checking



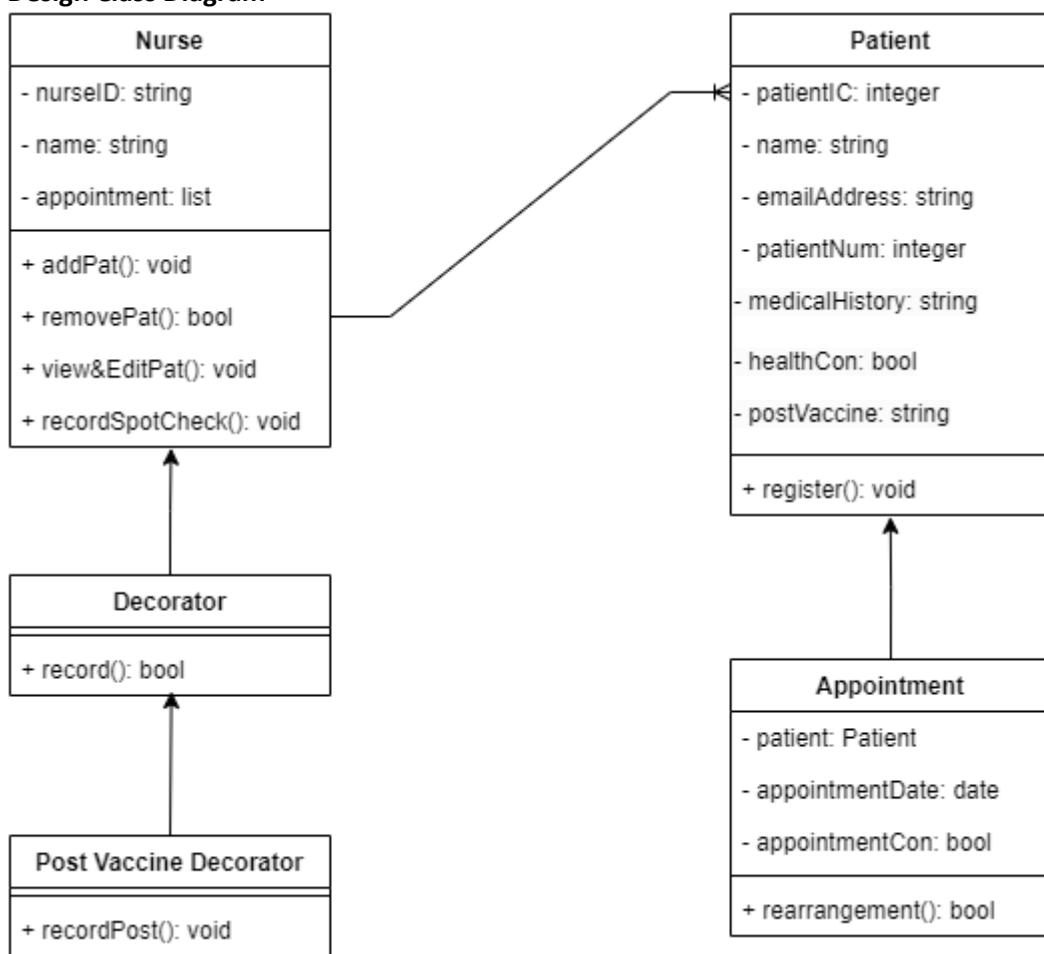
This activity diagram explains about the step for nurses to record On-the-Spot checking for health of the patient and based on the health condition to decide whether need to rearrange the vaccine appointment.

4.2.1.6 Activity Diagram for Use Case: AD02_6 - Patient Registration



This activity diagram explains about the step for patients to register themselves into the CVS database by ensuring the Patient IC and phone number given are valid and does not exist in the database before.

4.2.2 Design Class Diagram



4.2.2.1 Rationale for Selected Design Pattern

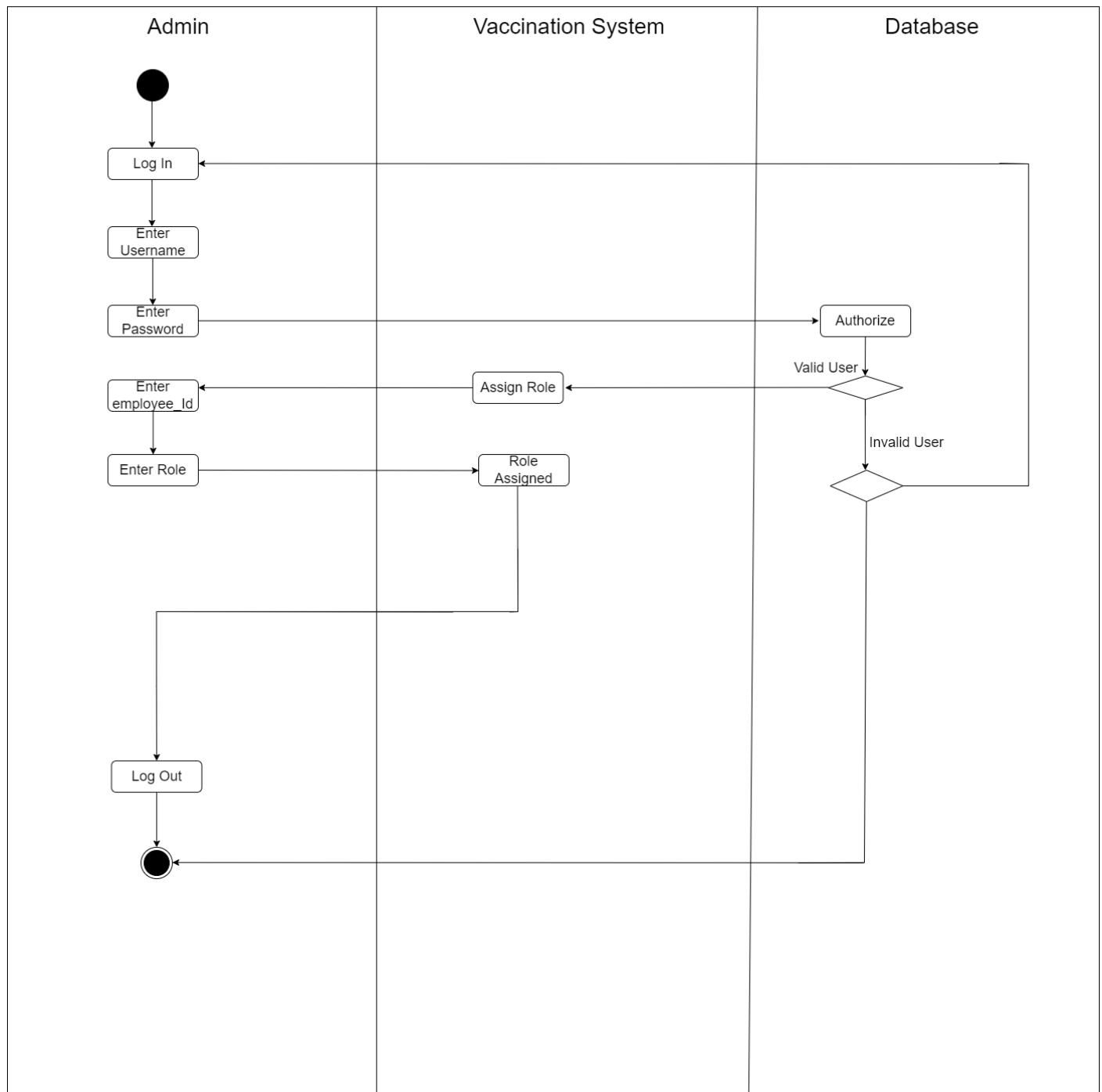
The design pattern of the patient module's class diagram will be the Decorator pattern among the structural patterns. The crucial points of selecting this design pattern are that the nurse enables the ability to record the post vaccine symptom of the patient without modifying the existing codebase of the covid vaccination system. By implementing the Decorator design pattern, there will be a Post Vaccine Decorator that has a function of recording the information such as recordPost(). Besides, the Decorator class is the base class for all decorators which adds additional functionality to the core Nurse class.

The Decorator pattern design would be more suitable than the Factory Pattern design for this scenario. While the Factory Pattern did provide an interface for creating objects in a superclass by allowing the subclasses to alter it. Since nurses have their own access and ability to view and edit the patient information including medical history. The factory pattern will be a not suitable design because it will duplicate the same functionality such as when a new patient was registered for appointment vaccine, the factory pattern will create a new patient record.

4.3 Module 3 : User Module

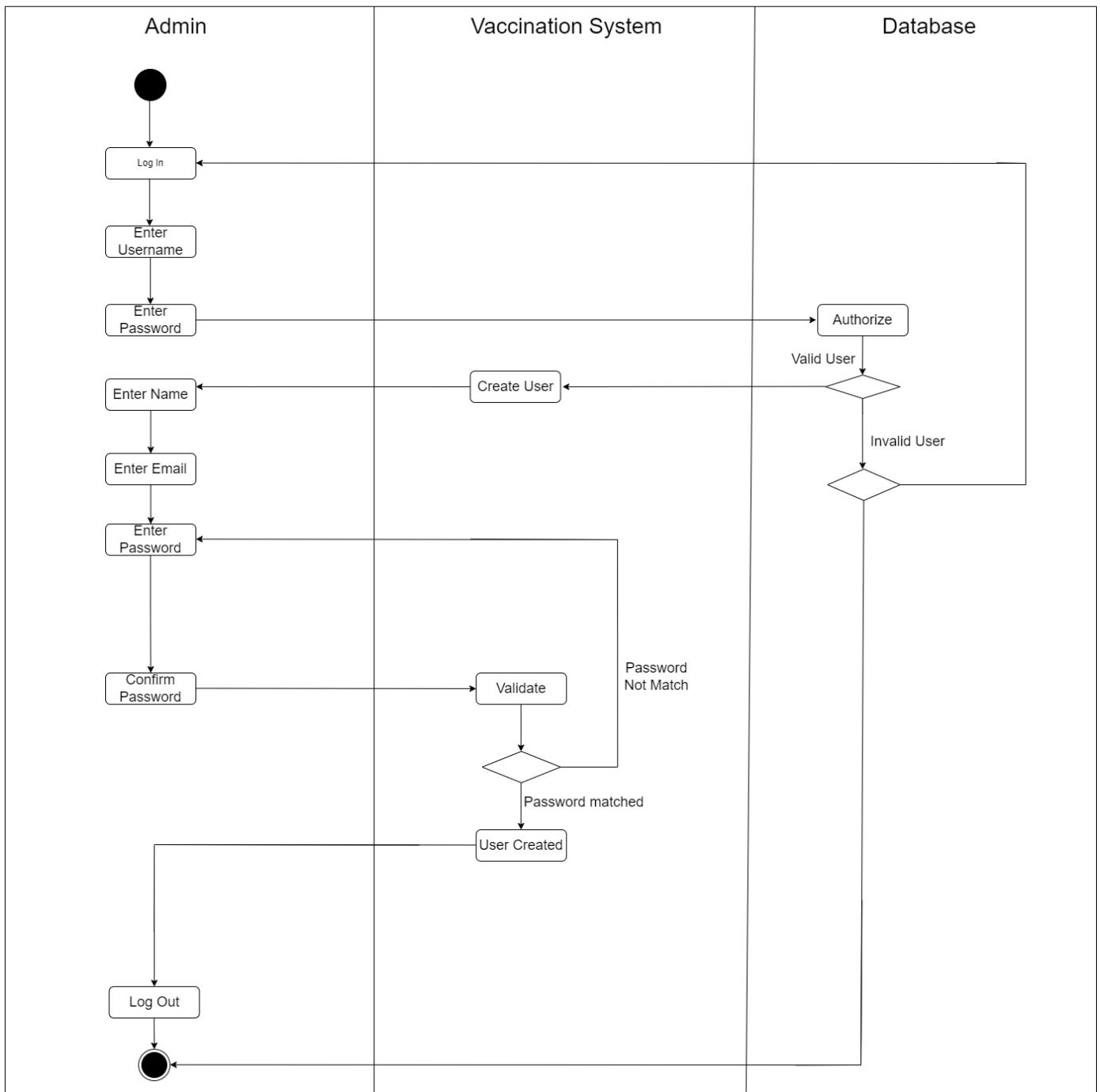
4.3.1 Activity Diagram

4.3.1.1 Activity Diagram for Use Case: AD03_1 - Assign Role



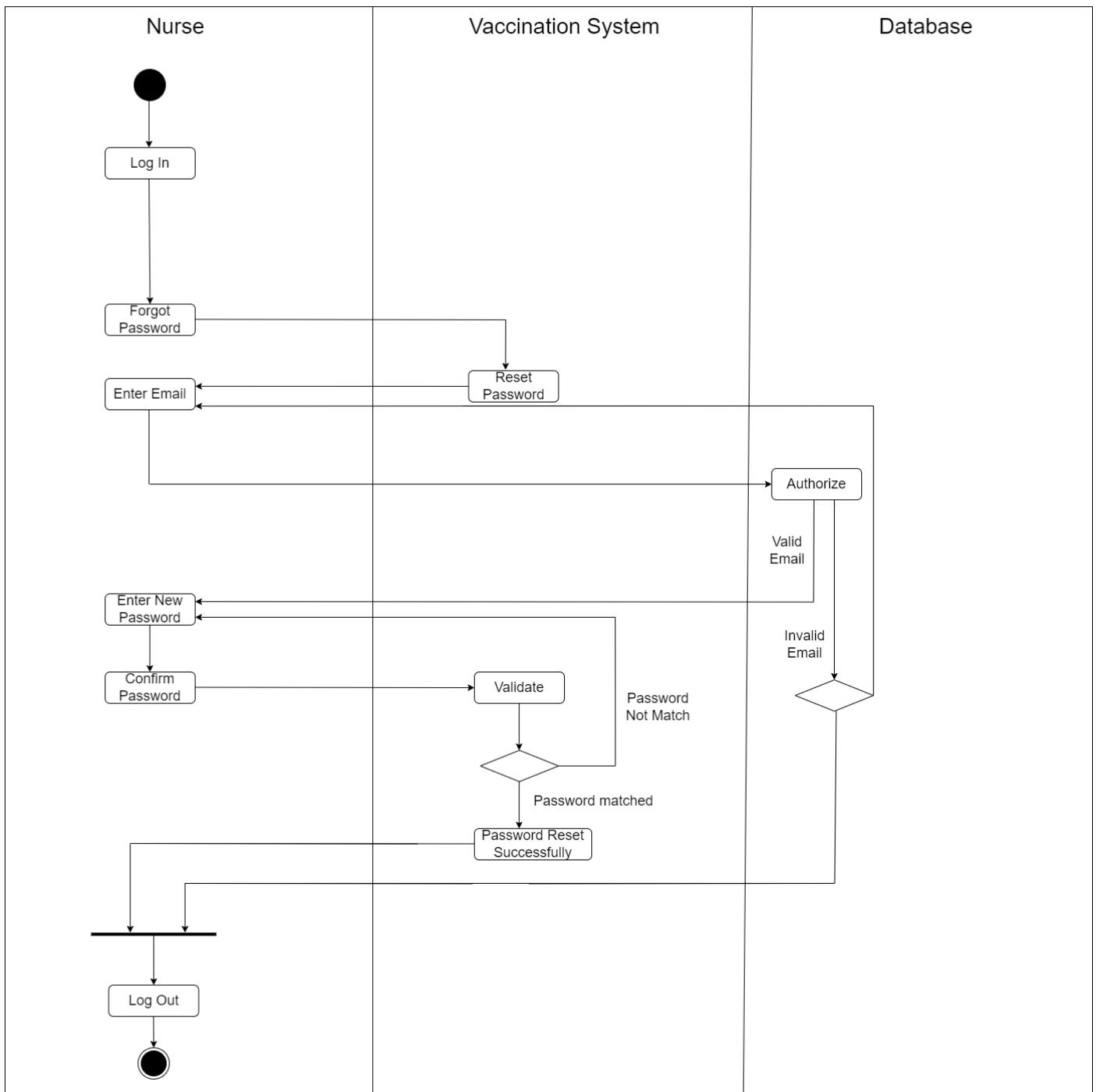
This activity diagram explains the flow of assigning roles. Only admin is allowed to assign roles, therefore admin must first log in to the system with valid username and password only. After logging in, the admin needs to enter the employee id that they wish to assign. After entering employee id they need to enter what role that they wish to assign to that employee. After that, the system will inform them that their role has been assigned successfully.

4.3.1.2 Activity Diagram for Use Case: AD03_2 - Create User



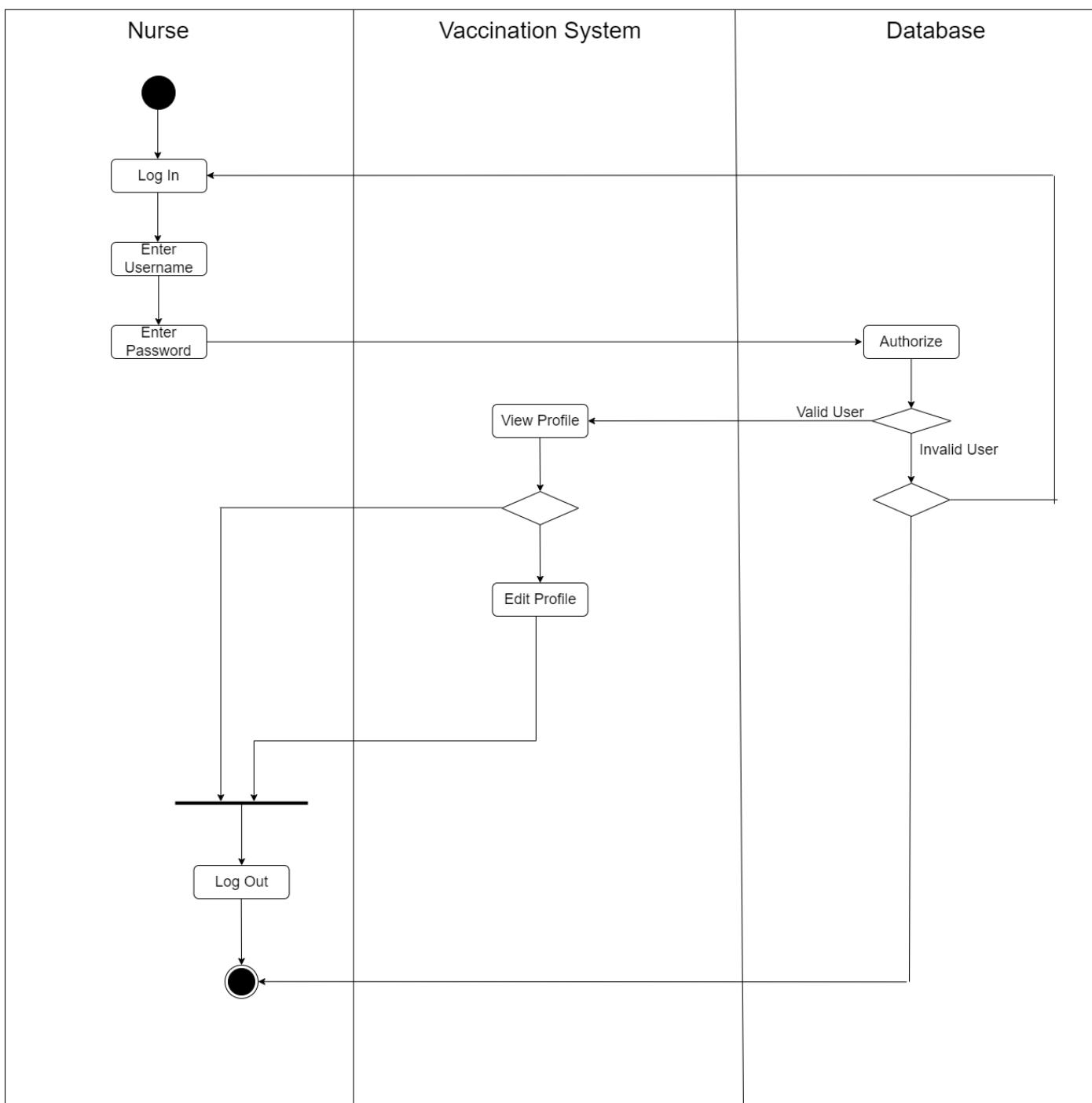
The activity diagram explains the flow of how admin creates users. Only admin is allowed to create a user, therefore admin must first log in to the system with valid username and password only. After logging in, the admin will need to enter the information of the user that he wishes to create such as their name,email,password and password confirmation. The system will require the admin to enter the password again if the password is not matched. If the information entered is valid the system will display user created successfully.

4.3.1.3 Activity Diagram for Use Case: AD03_3 - Reset Password



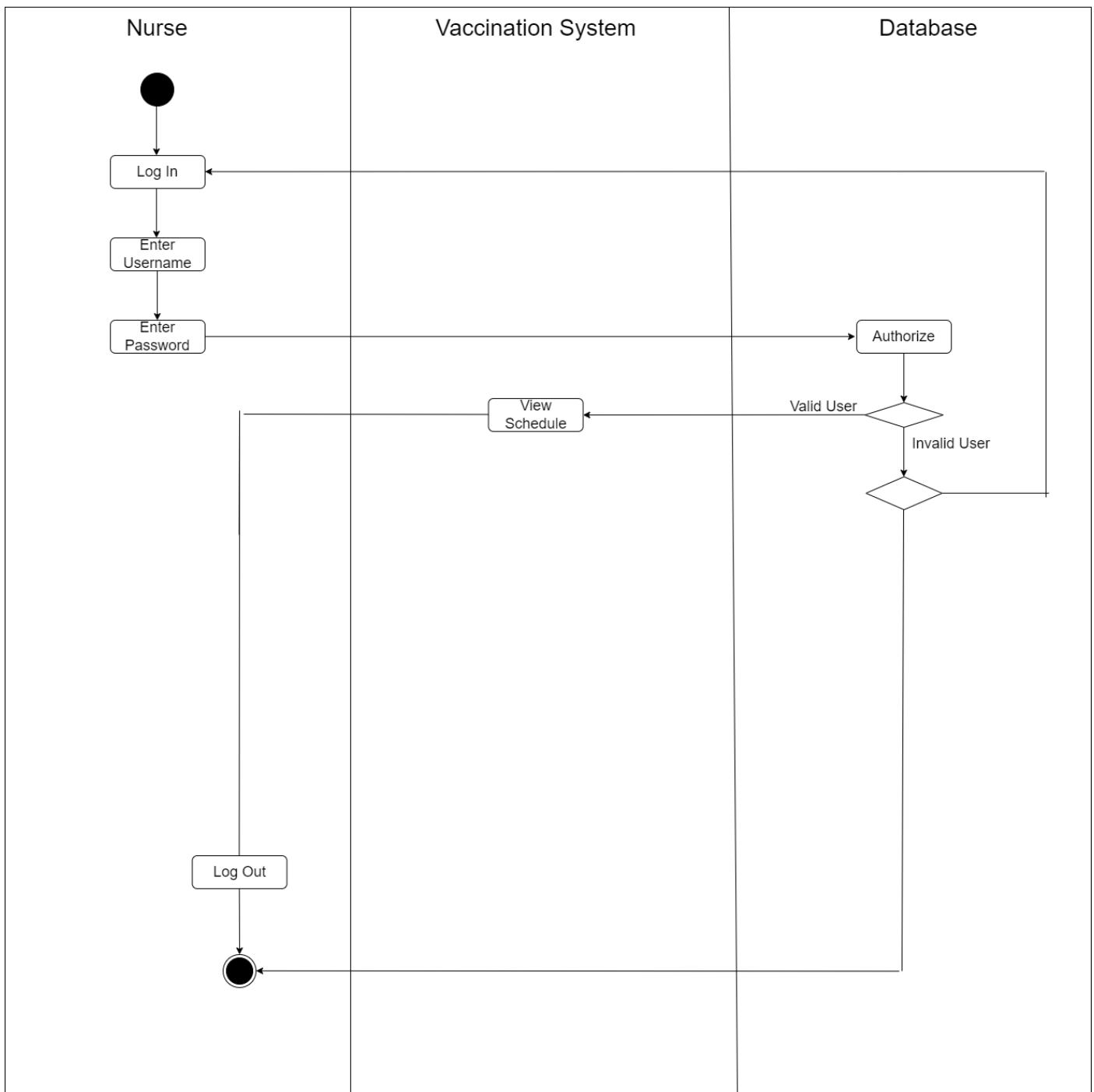
The activity diagram explains how users can reset their password. Users can reset their password by pressing the forgot password on the login page. After that, the system will require users to enter their email for validation purposes. Users are allowed to reset their password only if they entered a valid email. On the other hand, if users entered an invalid email they will ask to re-enter again so they can choose to quit.

4.3.1.4 Activity Diagram for Use Case: AD03_4 - Edit Profile



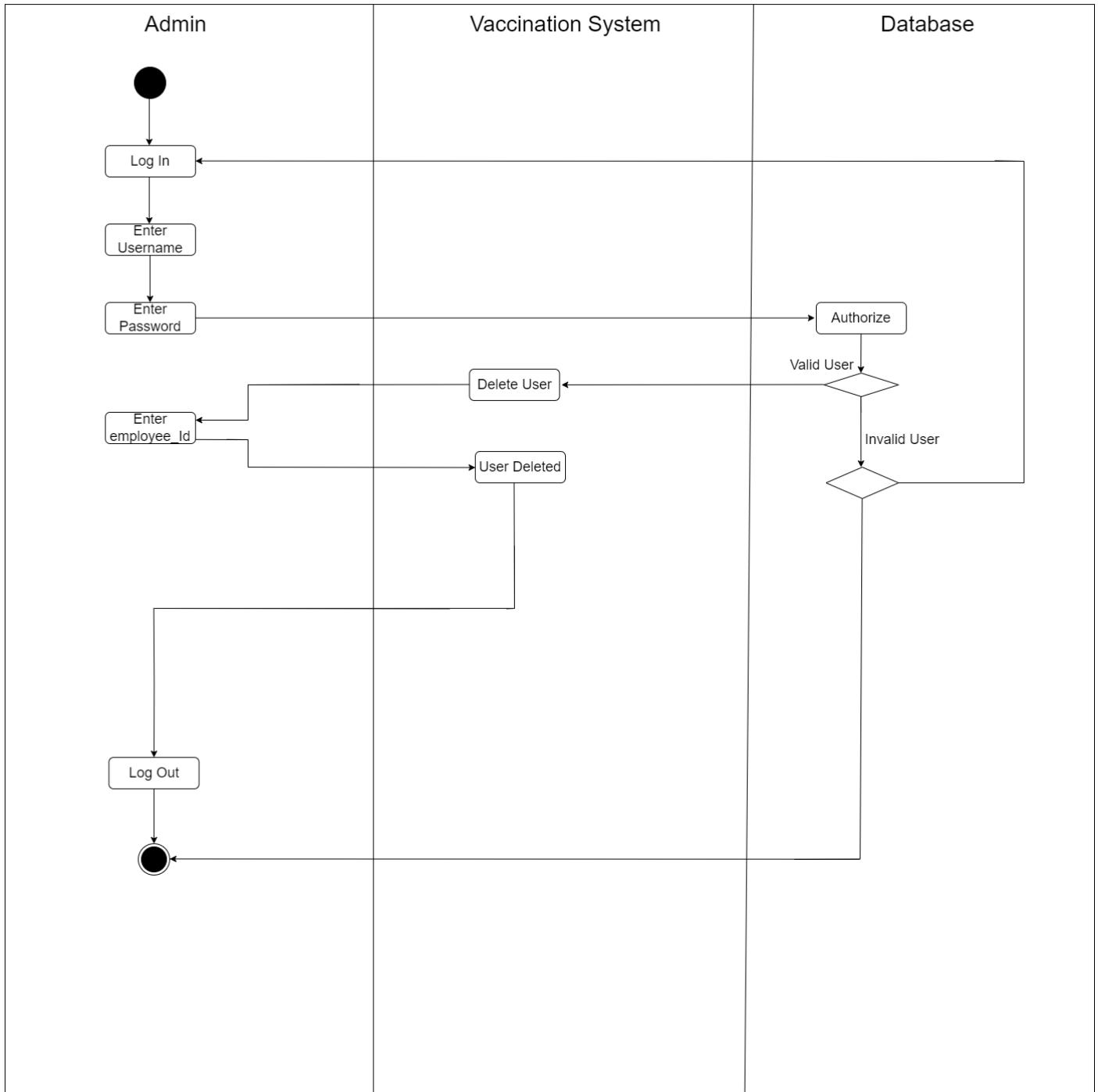
The activity diagram explains the flow and how users can edit their profile. Only valid users are allowed to edit their profile, therefore admin must first log in to the system with valid username and password. Users can edit their profile after they log in.

4.3.1.5 Activity Diagram for Use Case: AD03_5 - View Schedule



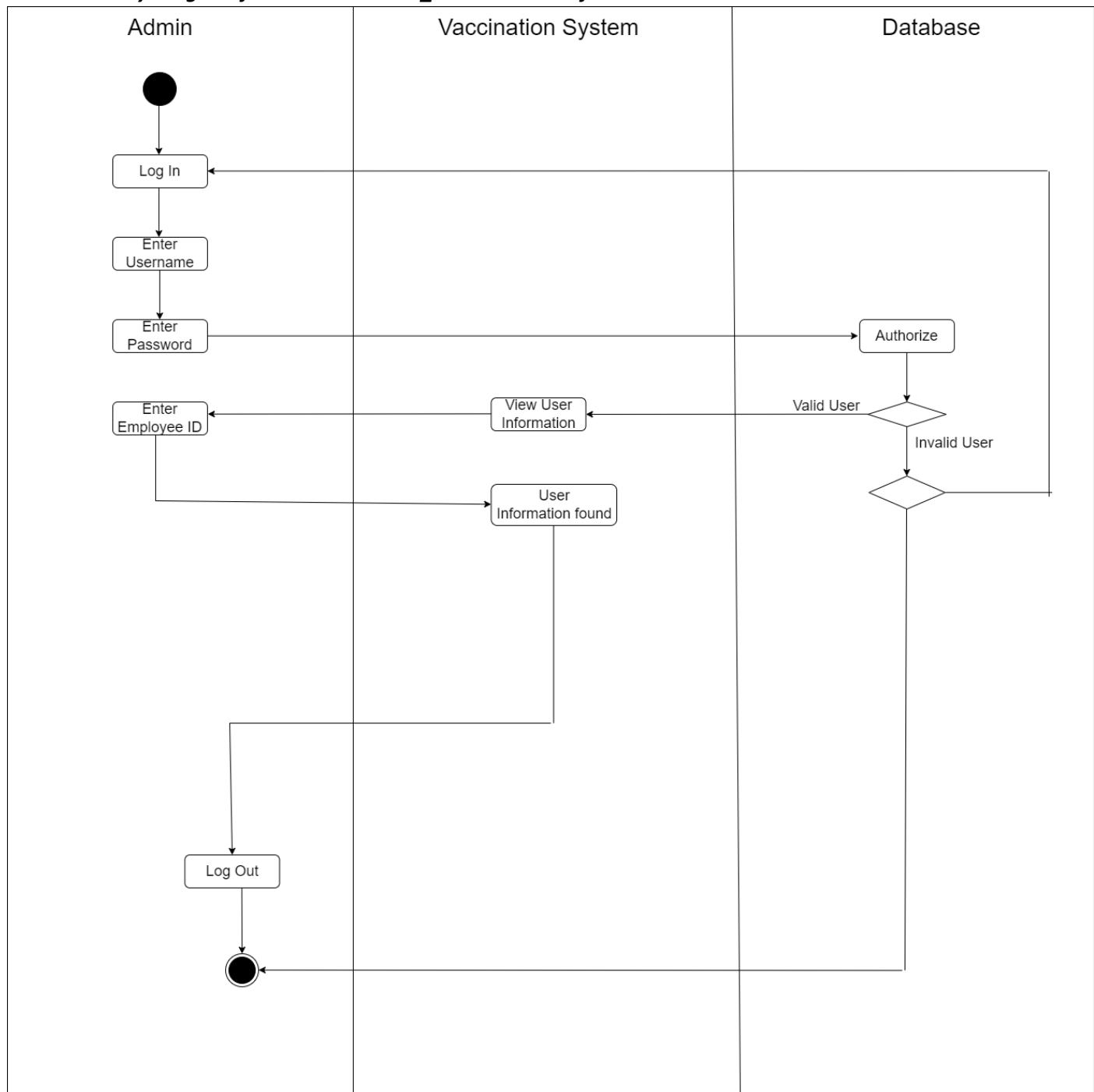
The activity diagram explains the flow and how users can view their schedule. Only valid users are allowed to edit their profile, therefore nurses must first log in to the system with a valid username and password. Nurses can view their schedule after they log in.

4.3.1.6 Activity Diagram for Use Case: AD03_6 - Delete User



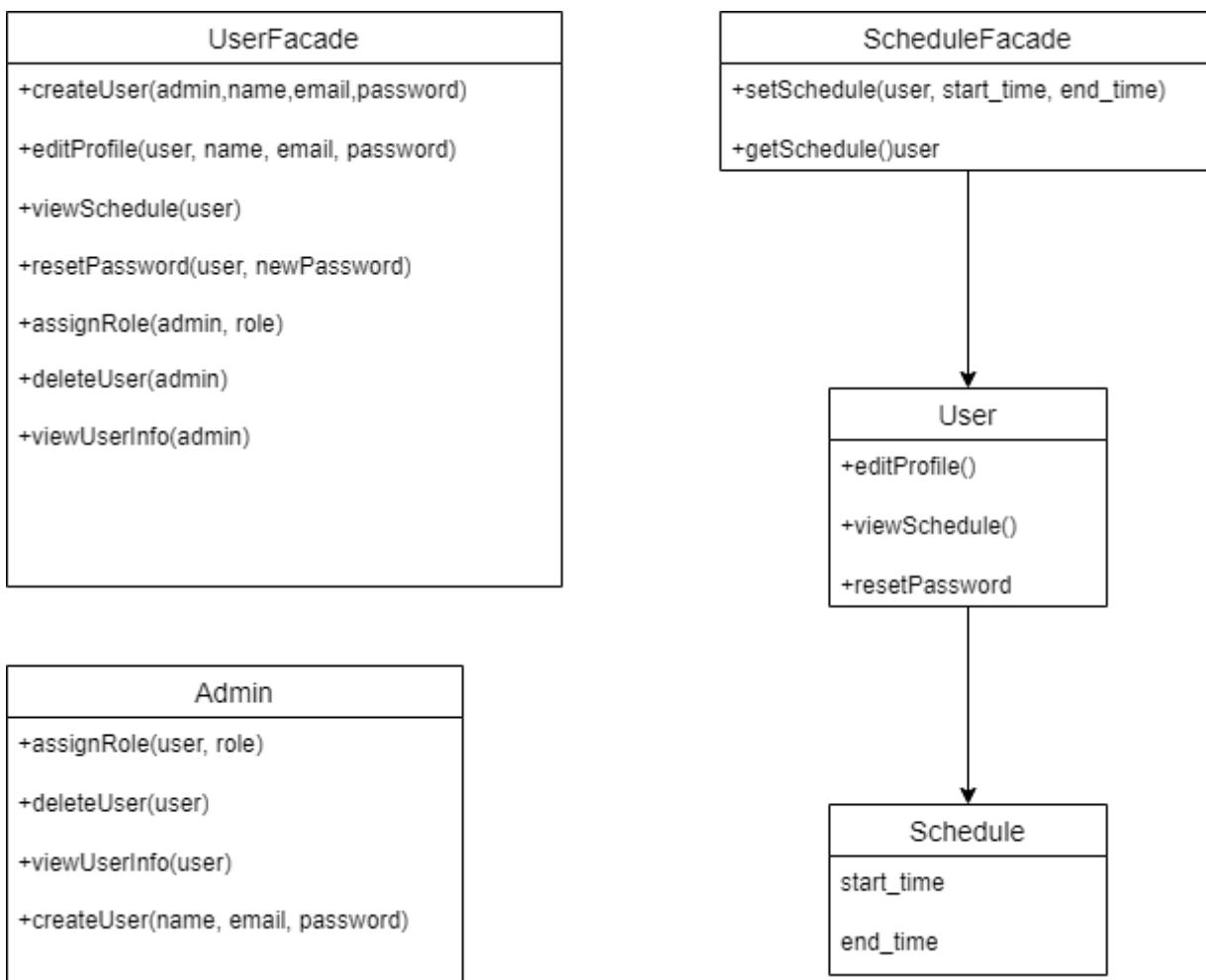
The activity diagram explains the flow of how admin delete users. Only admin is allowed to delete a user, therefore admin must first log in to the system with valid username and password only. After logging in, the admin will need to enter the employee id of the user that he wishes to delete after he presses the delete user button. If the employee id entered is valid the system will display the user is deleted successfully.

4.3.1.7 Activity Diagram for Use Case: AD03_7 - View User Information



The activity diagram explains the flow of how admin delete users. Only admin is allowed to delete a user, therefore admin must first log in to the system with valid username and password only. After logging in, the admin will need to enter the employee id of the user that he wishes to view after he presses the view user information button. If the employee id entered is valid the system will display the user information found.

4.3.2 Design Class Diagram



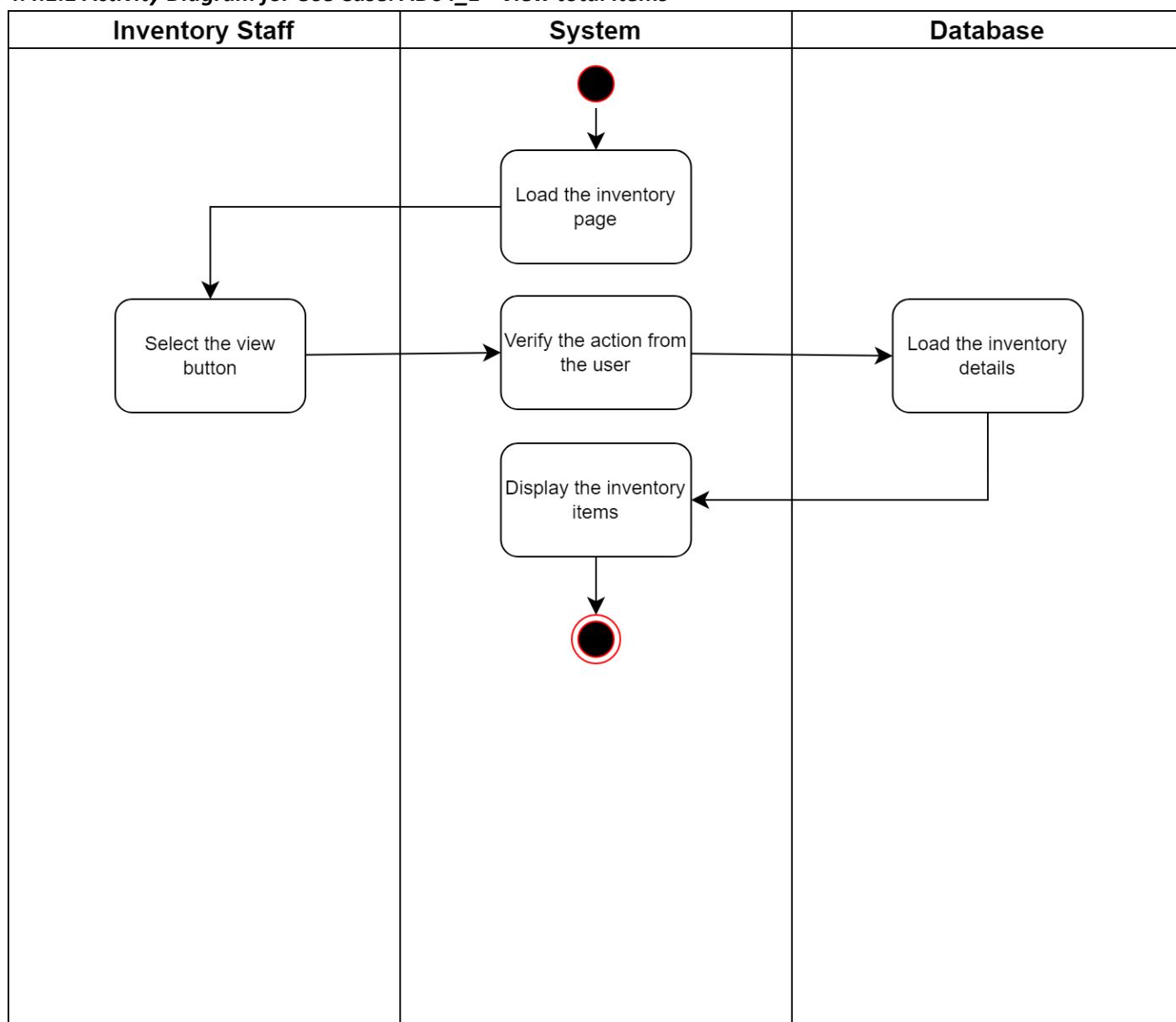
4.3.2.1 Rationale for Selected Design Pattern

The UserFacade and ScheduleFacade classes serve as simplified interfaces for clients to communicate with the User module in this facade style. While the ScheduleFacade offers ways to set and obtain users' schedules, the UserFacade offers ways to create, edit, delete, and view users and their information. The Admin class may assign roles, delete users, and access user information, whereas the User class can modify a user's profile, view their schedule, and reset their password. With properties like `start_time` and `end_time` to represent the user's working hours, the Schedule class in the system represents a user's working schedule. By dividing related functionality into two different classes, this Facade pattern simplifies the User module's interface, making it simpler for users to engage with the system. Clients are able to perform routine operations on users without having to be familiar with the specifics of the various classes that make up the User module due to the UserFacade and ScheduleFacade classes, which serve as an abstraction layer between the clients and the User module.

4.4 Module 4: Inventory

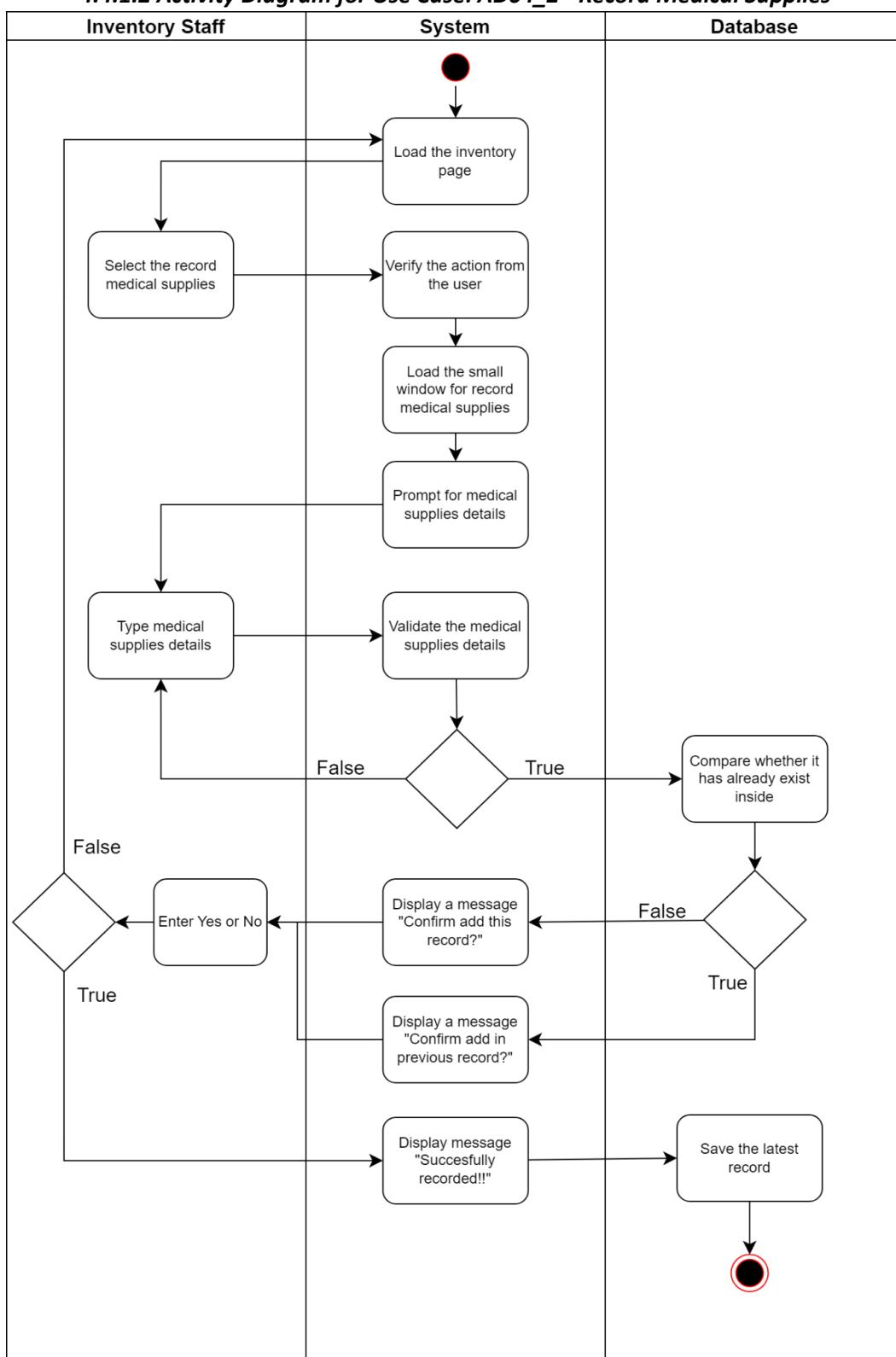
4.4.1 Activity Diagram

4.4.1.1 Activity Diagram for Use Case: AD04_1 - View total items



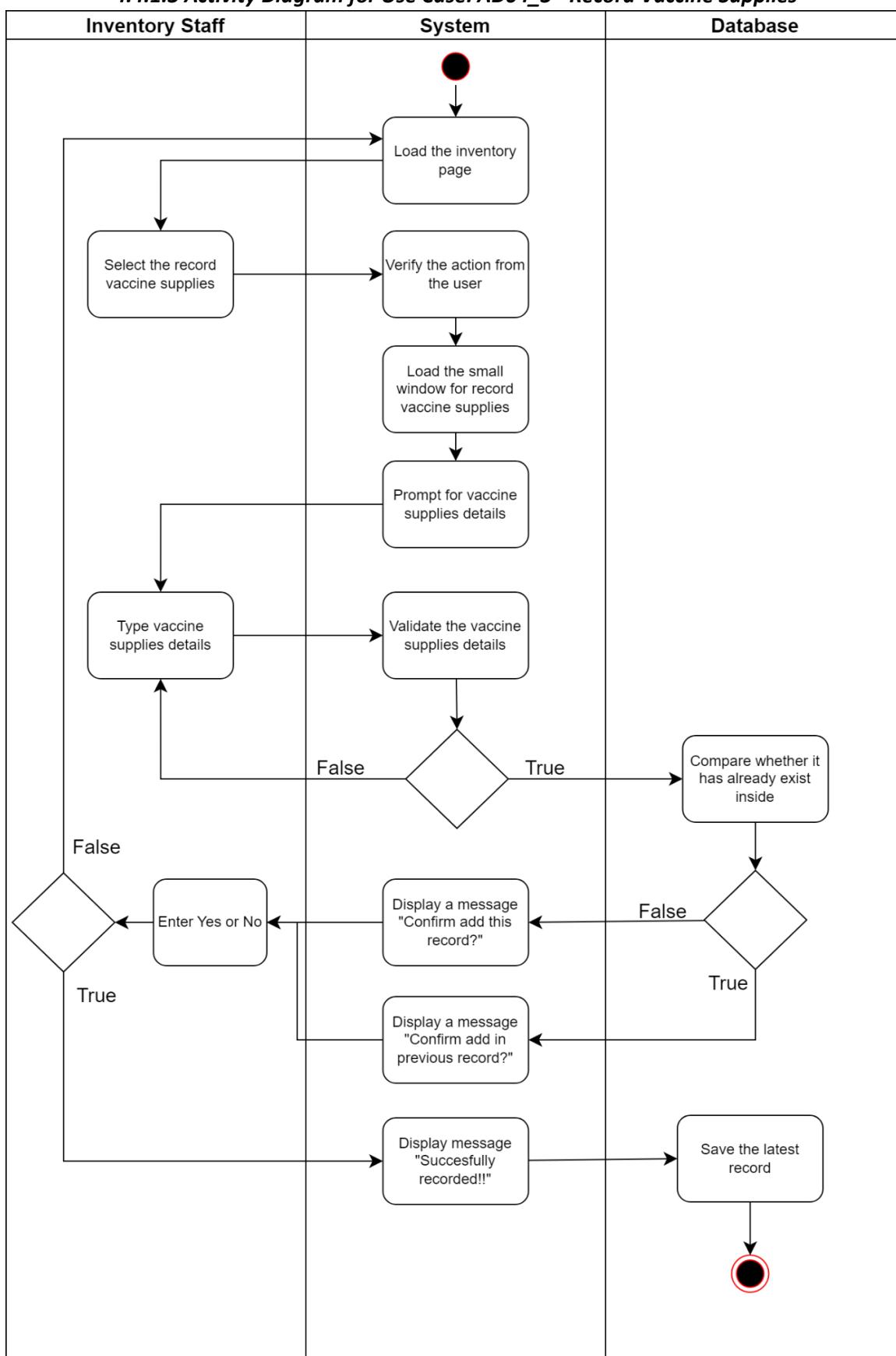
This activity diagram explains the flow of viewing the total items in the inventory items and verifies the actions from the user do, and also retrieves the data from the database for displaying.

4.4.1.2 Activity Diagram for Use Case: AD04_2 - Record Medical Supplies



This activity diagram is showing the record medical supplies steps and the action validation shown at above. Will also compare the data to add on the items or add new items. The last step is saving the record.

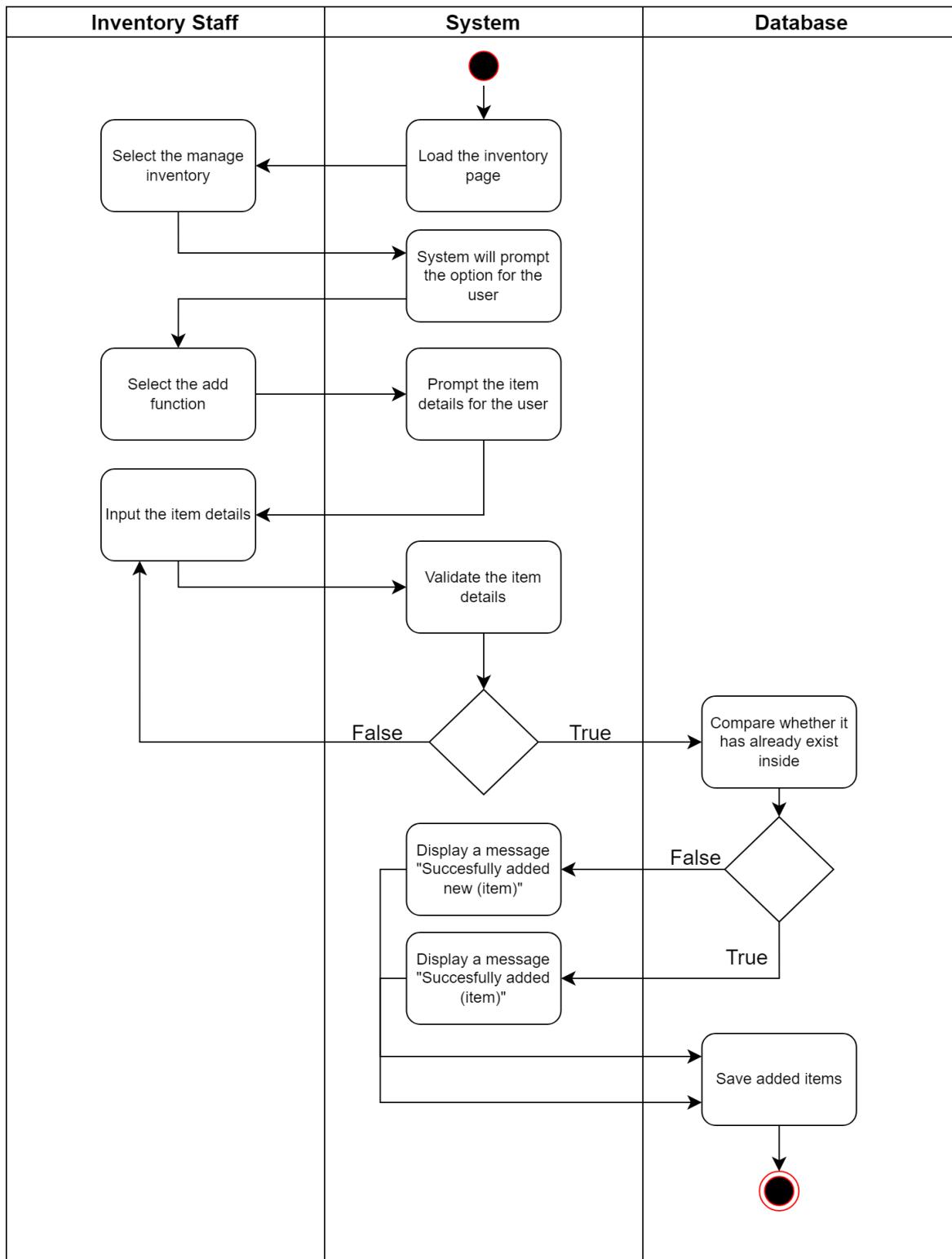
4.4.1.3 Activity Diagram for Use Case: AD04_3 - Record Vaccine Supplies



This activity diagram is showing the record vaccine supplies steps.

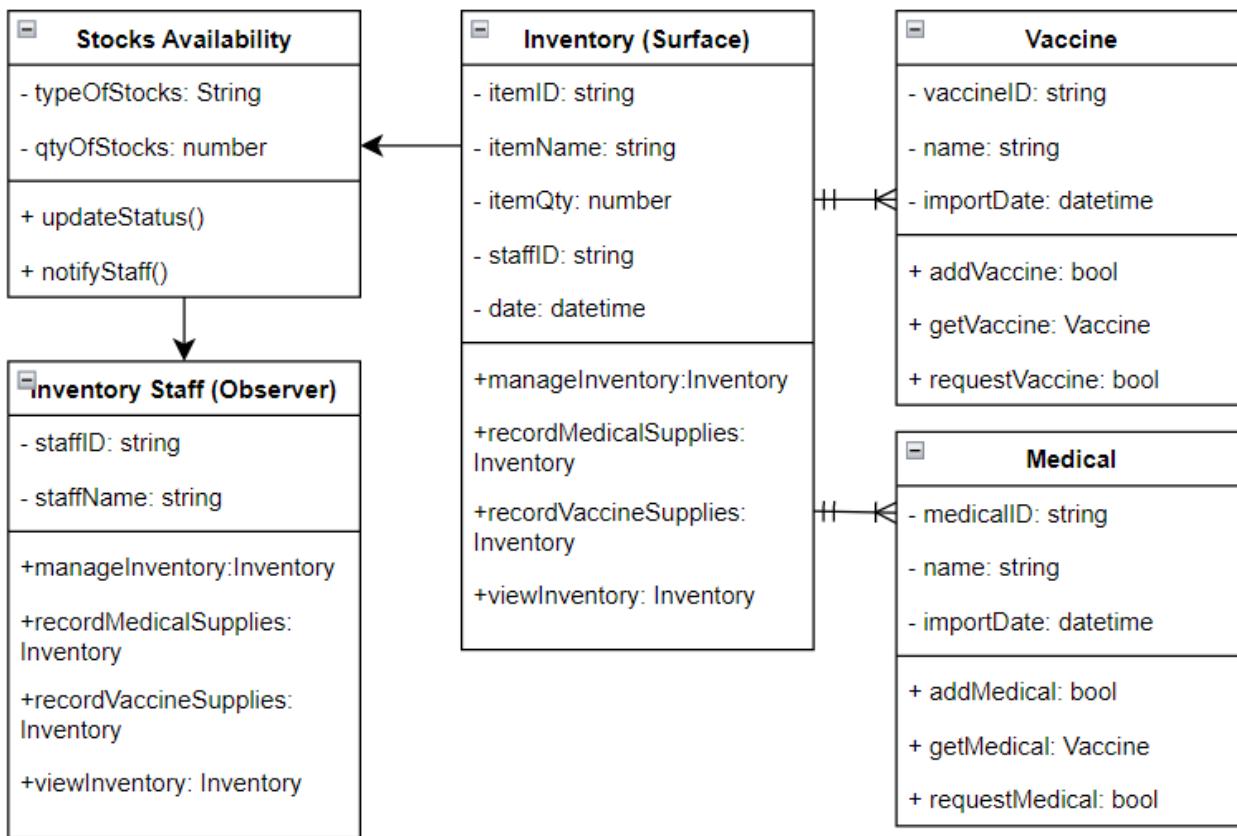
4.4.1.4 Activity Diagram for Use Case: AD04_4 - Manage Inventory

4 option of manage inventory: add, remove, sort, request stock



This activity diagram is showing the managed inventory steps from the start of the page to the last steps, save added items.

4.4.2 Design Class Diagram



4.2.2.1 Rationale for Selected Design Pattern

Design Pattern will be selected as the Observer Pattern under the Behavioral Pattern. With the crucial point of choosing this, it can notify the inventory staff while the stock threshold is going low. Then, inventory staff is able to request for more stocks depending on which stocks are low and also prevent the stock being used being finished then only notice about the stocks.

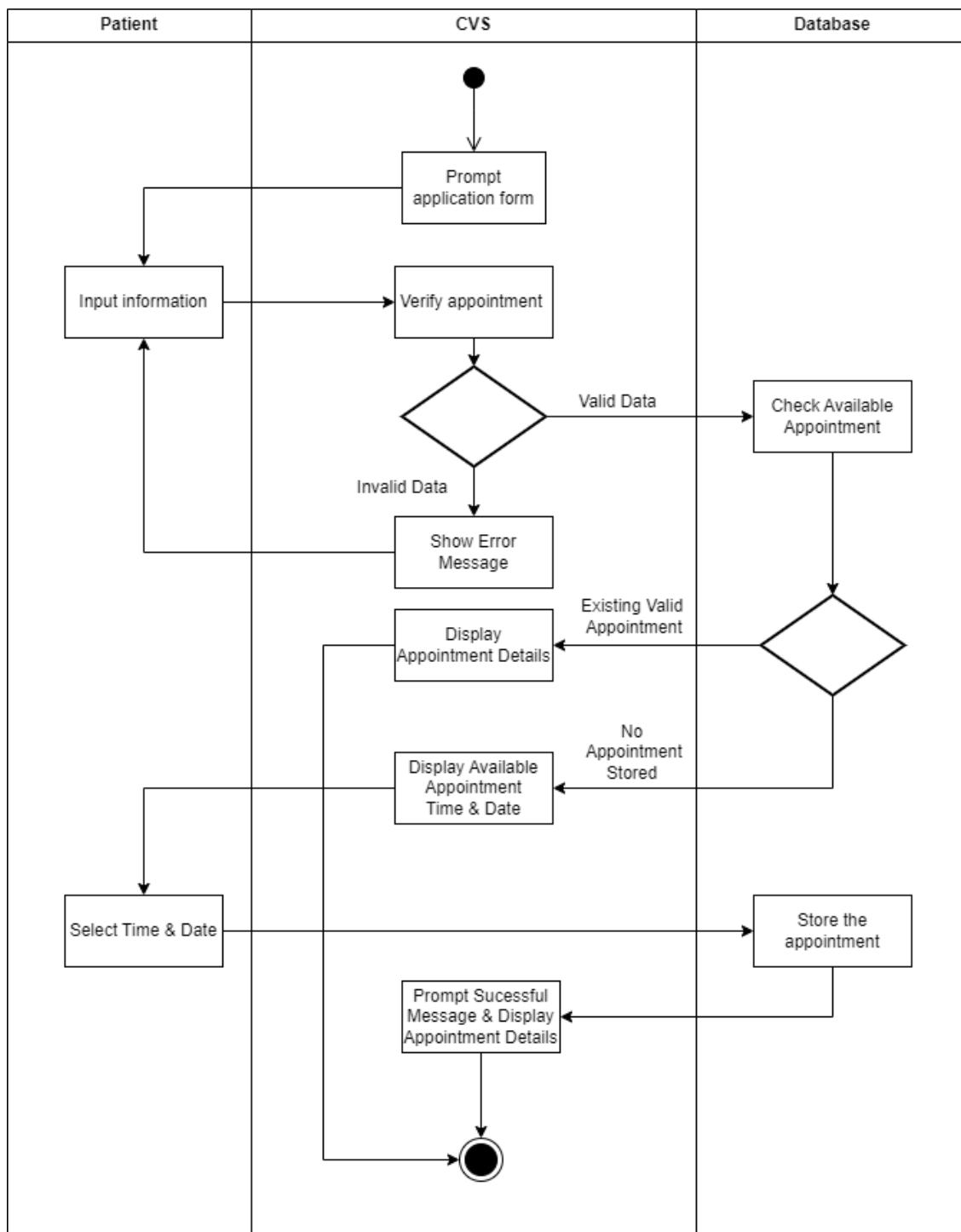
By implementing the Observer Pattern, we will have the surface (Inventory) and observer (Inventory Staff). Between surface and observer will have a class that represents the update of the status of stock and if the stock is low it will send the notification to the inventory staff for requesting the order stock of that item.

Besides the Observer pattern that I choose, is the factory method, strategy but it doesn't suit the inventory of CVS. Because the factory method is for categorising the raw material and other items that can more easily manage well but for me the Inventory module requires more crucial features such as notifying the user the stocks are going low. If the stocks are very few and lately to be realised it will cause a big effect to our CVS such as the health of patients as doesn't not have the medical for injecting the vaccine to them. For the strategy pattern, I don't think that is suitable for the inventory modules as our inventory doesn't need to be separated to different levels for managing the inventory. Even the just-in-time(JIT) are well received from suppliers only as they are needed, but the inventory is not that many items category and just have a few types of vaccines and some medical items.

4.5 Module 5 : Appointment

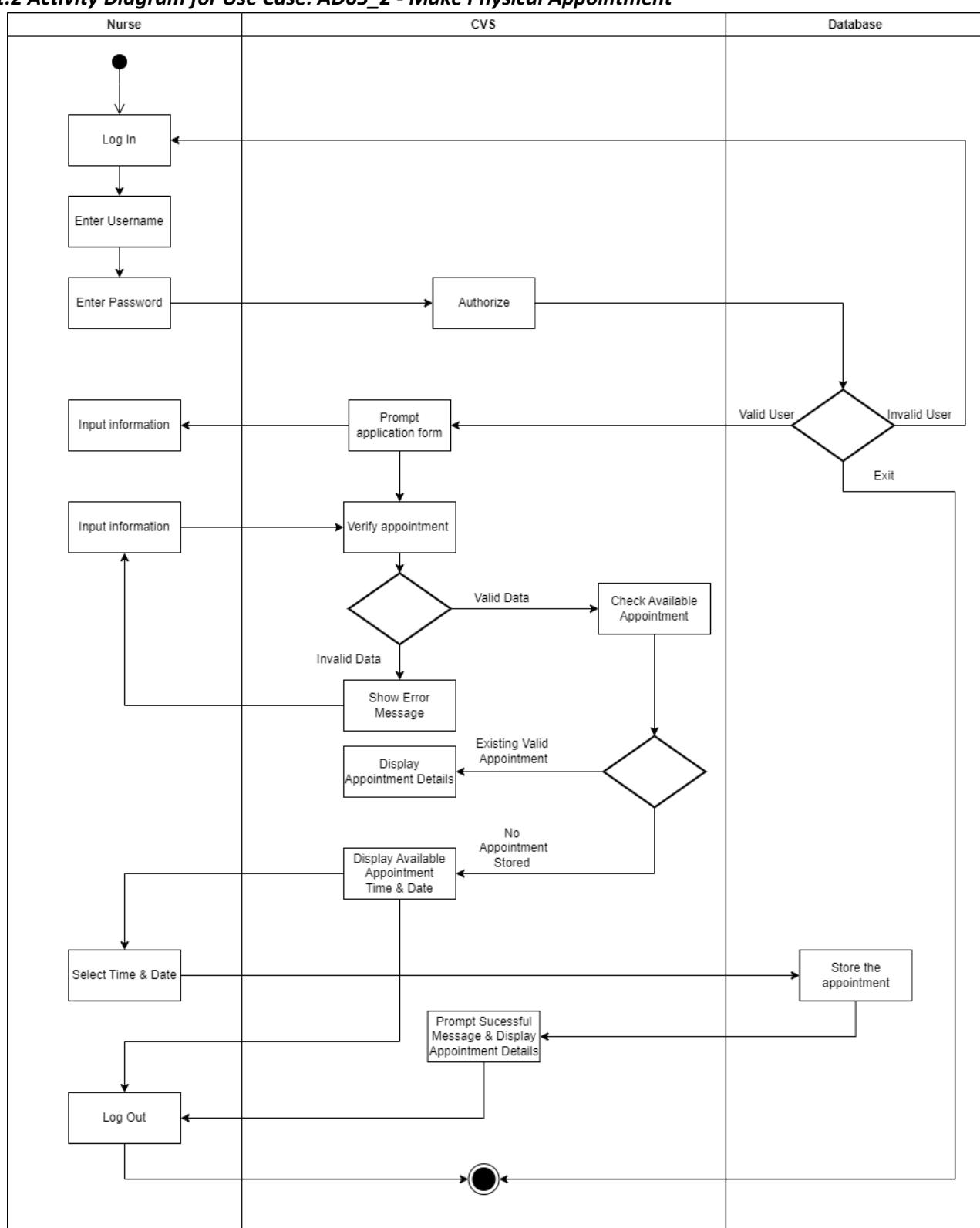
4.5.1 Activity Diagram

4.5.1.1 Activity Diagram for Use Case: AD05_1 - Make Online Appointment



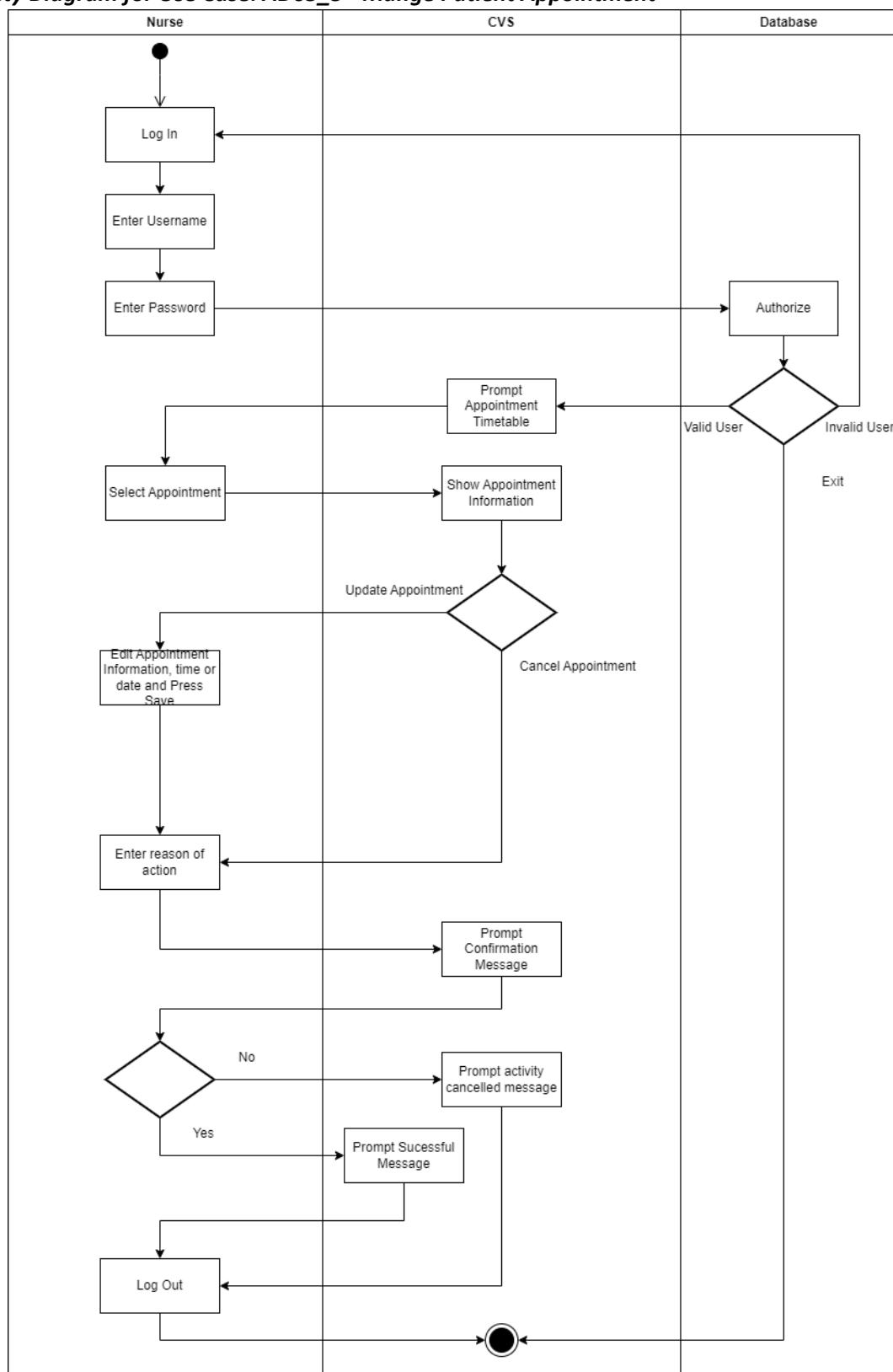
This activity diagram is showing the progress of making online appointments from the patient side with their own devices.

4.5.1.2 Activity Diagram for Use Case: AD05_2 - Make Physical Appointment



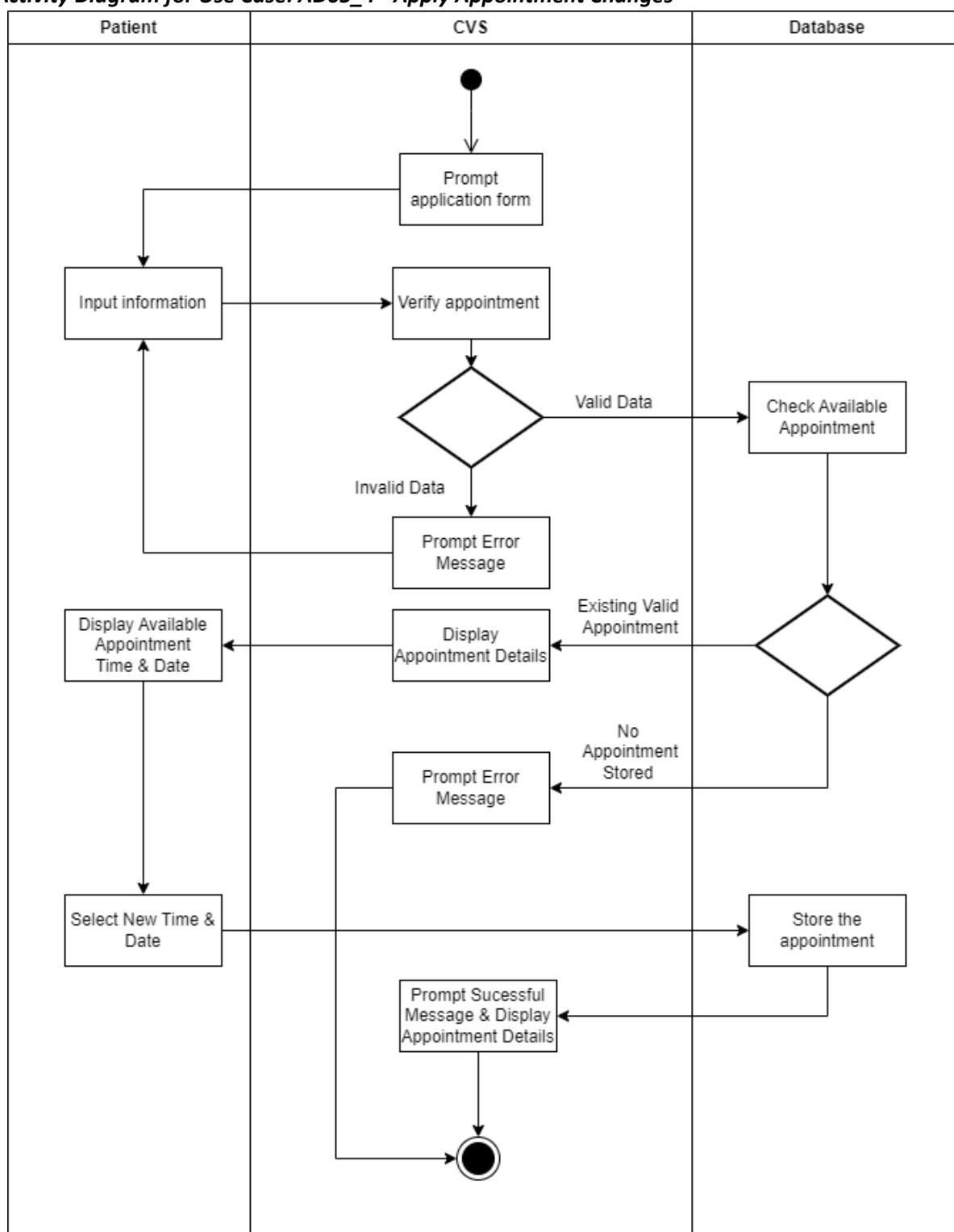
This activity diagram is showing the progress of making physical appointments by nurse with the device provided in the clinic.

4.5.1.3 Activity Diagram for Use Case: AD05_3 - Mange Patient Appointment



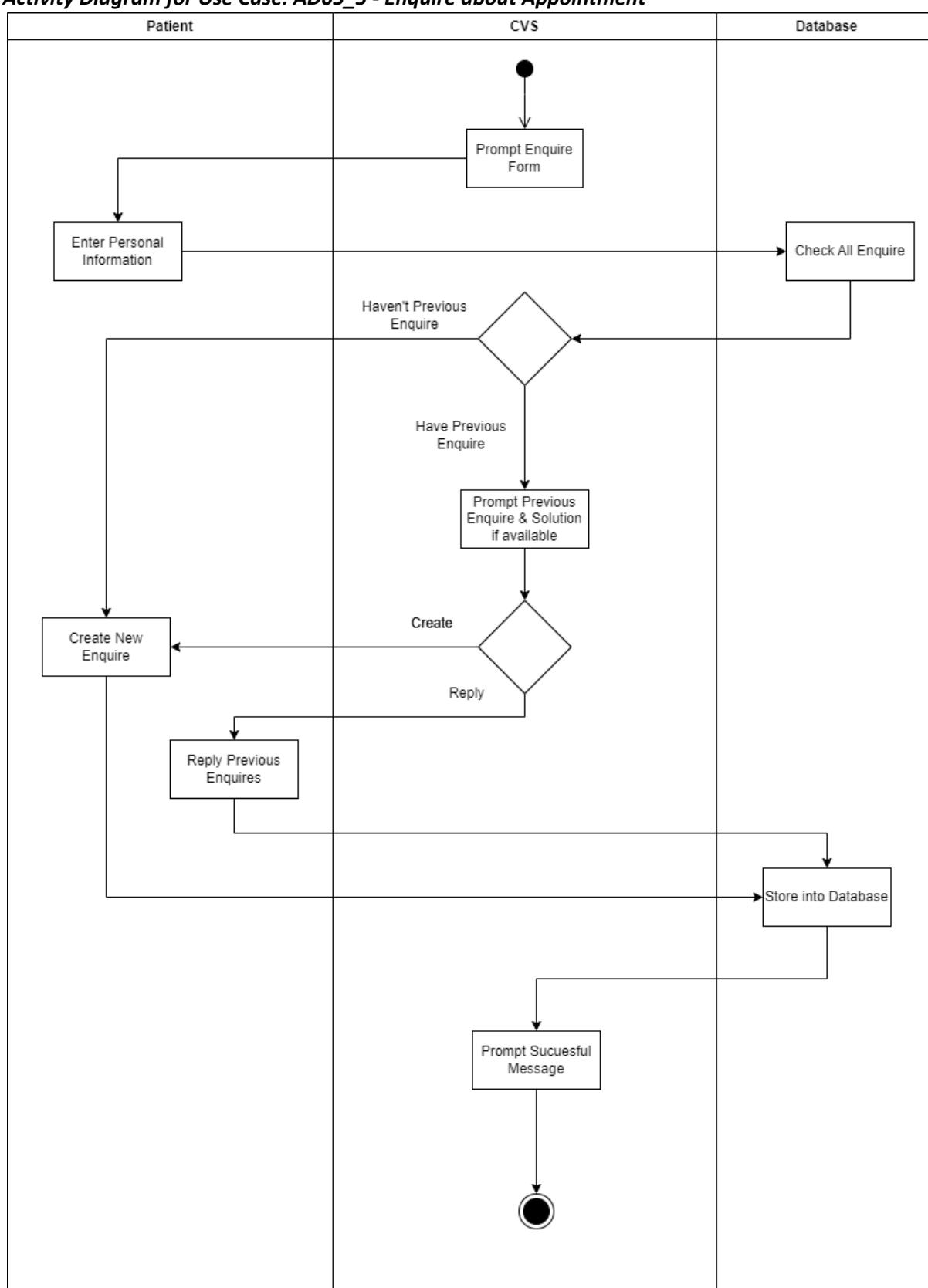
This activity diagram is showing the management of patient appointments by nurses with devices provided. The appointment date is able to be changed by a nurse with a valid reason.

4.5.1.4 Activity Diagram for Use Case: AD05_4 - Apply Appointment Changes



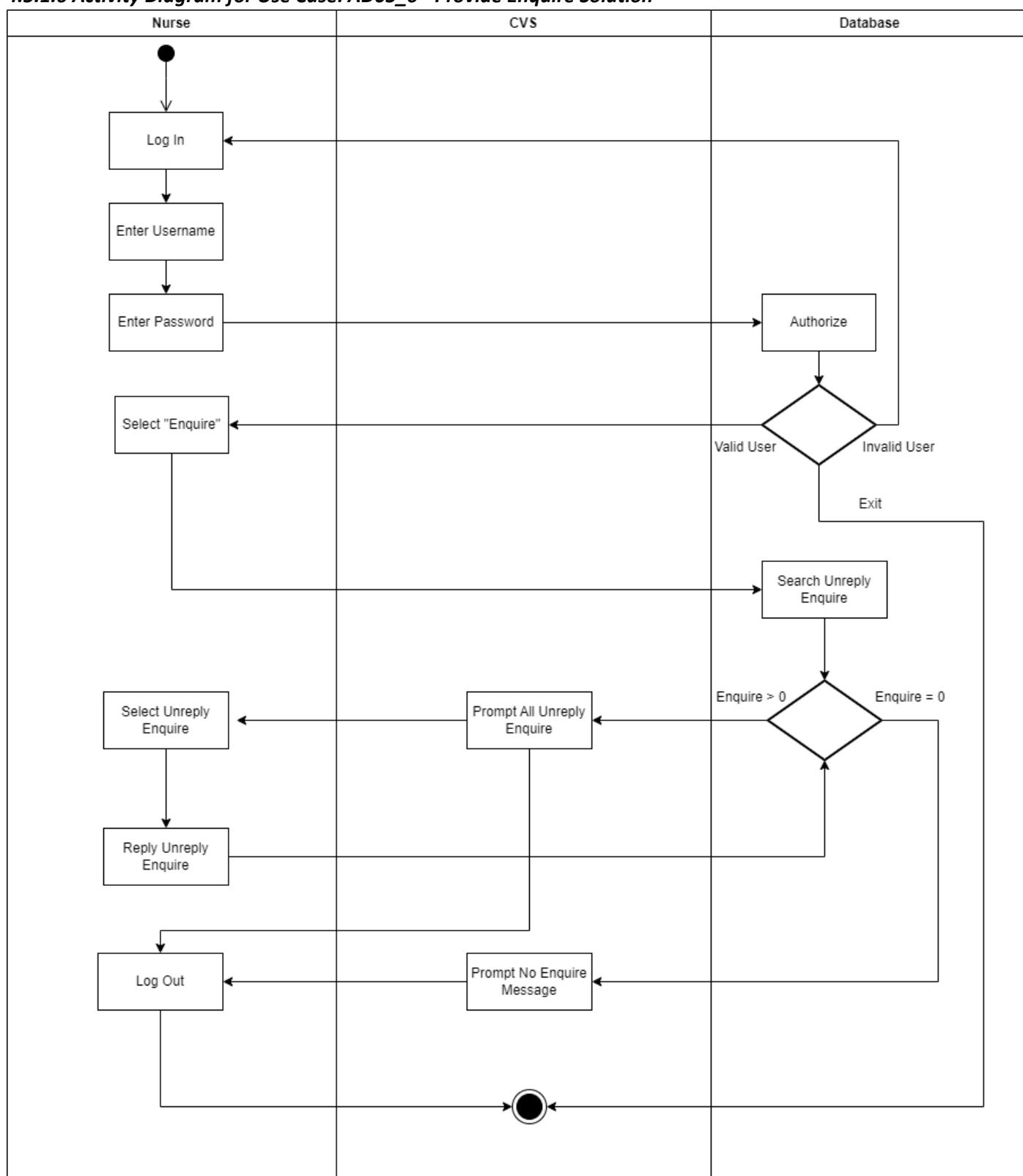
This activity diagram is showing the applying changes on appointment date by patients with their own devices. The patient is able to change their appointment date.

4.5.1.5 Activity Diagram for Use Case: AD05_5 - Enquire about Appointment



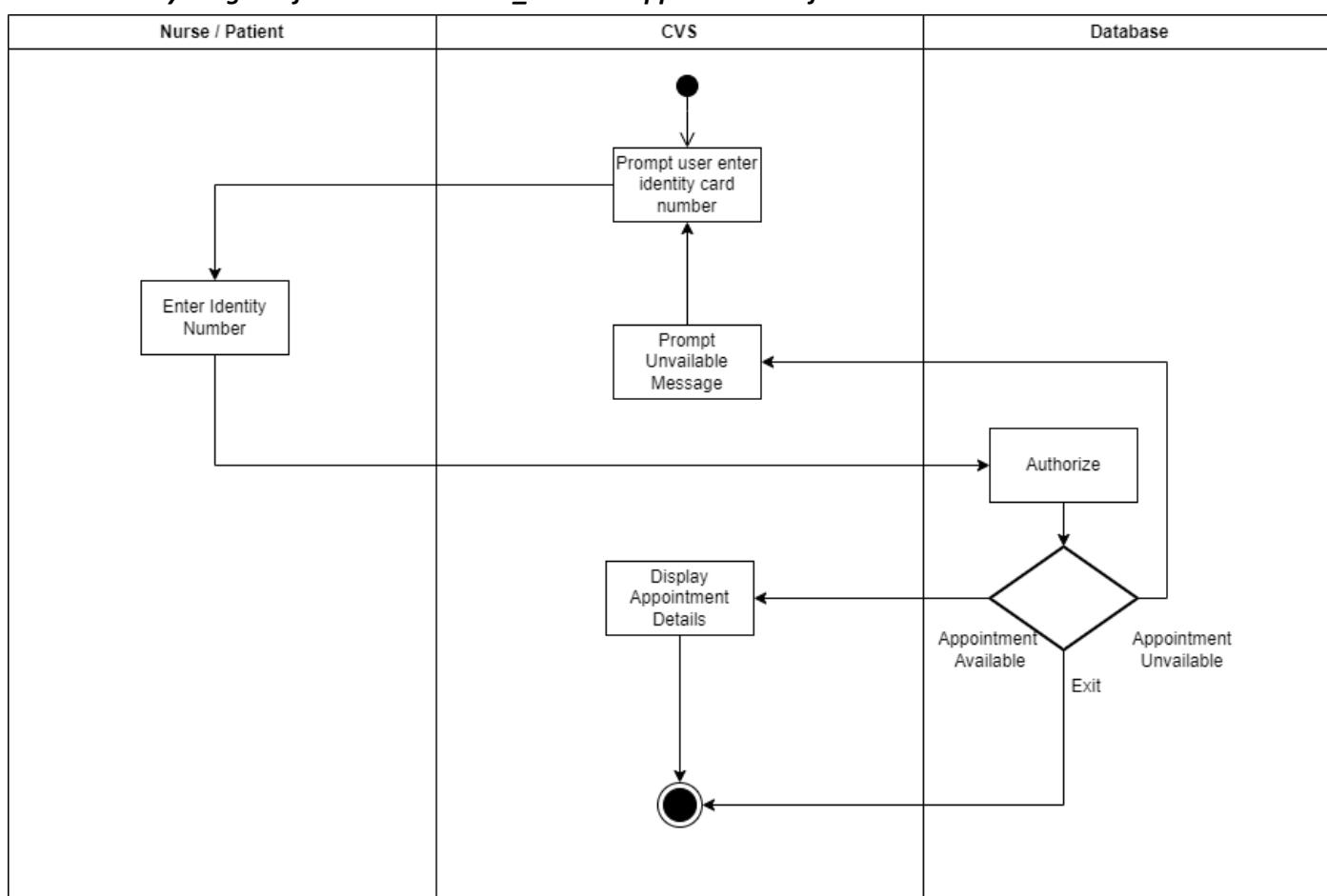
This activity diagram is showing the enquire platform for patient to require enquire to appointment before or after visit to the Clinic.

4.5.1.6 Activity Diagram for Use Case: AD05_6 - Provide Enquiry Solution



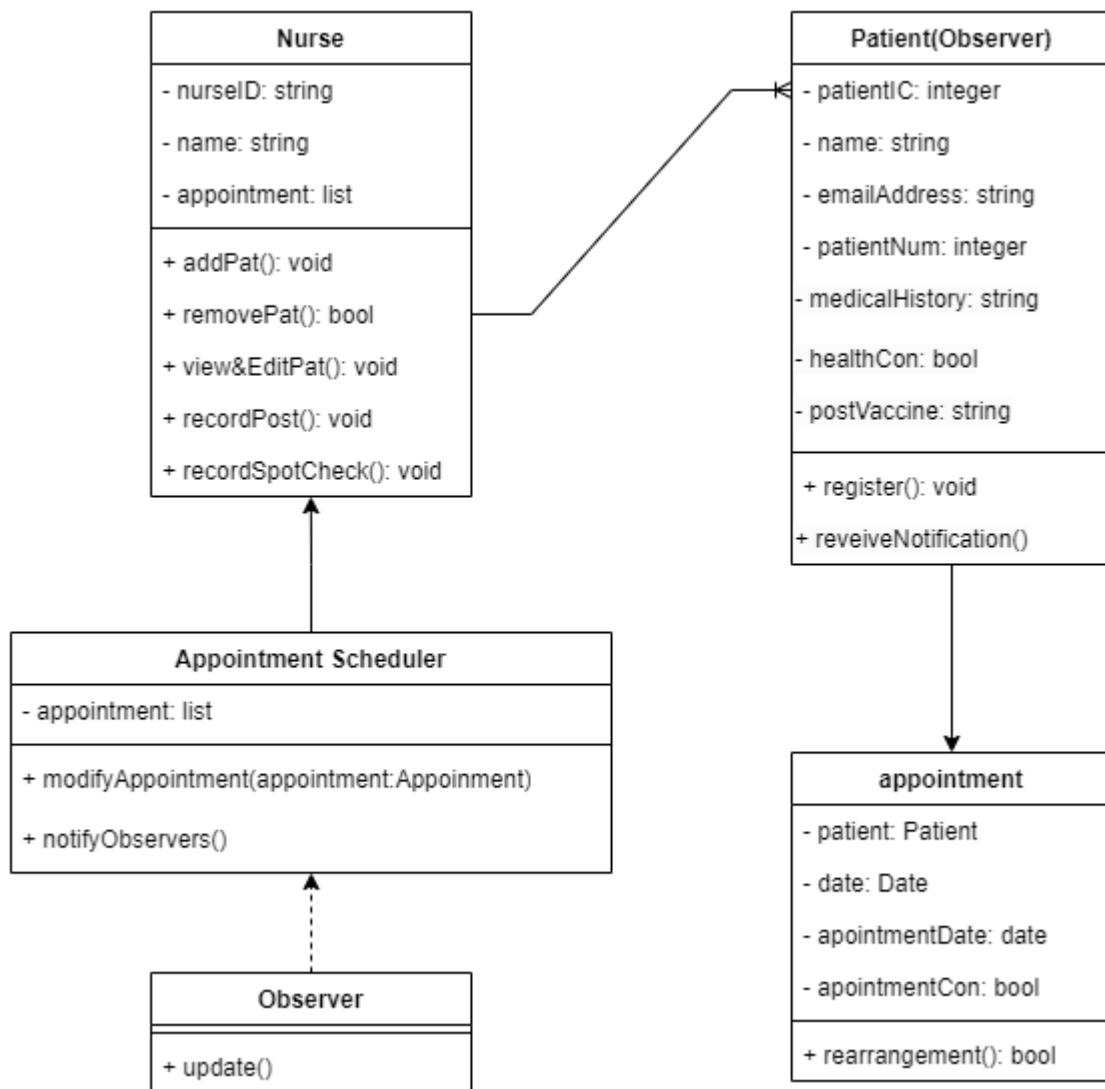
This activity diagram is showing the platform for nurses to reply to the enquiry from patients.

4.5.1.7 Activity Diagram for Use Case: AD05_7 - View Appointment Information



This activity diagram is showing the process of how a nurse and patient are able to view the appointment date of a patient.

4.5.2 Design Class Diagram



4.5.2.1 Rationale for Selected Design Pattern

The design pattern selected for the appointment module is Observer. By implementing the Observer design pattern, the patient will be the observer with `receivedNotification()` method. The method will be called when the nurse updates the appointment date if any changes. When the nurse modifies the Appointment list, the `notifyObservers()` method will call and notify the update to the observer. The patient will receive the new appointment scheduler for them to apply changes on their appointment.

The Observer pattern design is able to solve the problem of patients needing to contact or visit the clinic to ask for an empty slot every time before booking. Besides, nurses also need to check with the slot every time a patient asks about the scheduler. The design pattern will help to notify the patient that the appointment was changed and notify other patients that the schedule of appointment was updated after the nurse modified a patient appointment date and time. Instead of wasting time on checking the availability of time slot or the clinic waste resources notifying the wrong patient of the appointment, the observer can update the correct patient new appointment date and time and others patient new schedule of appointment for applying new appointment or changes on existing valid appointment.

5. HUMAN INTERFACE DESIGN

5.1 Module 1 : Vaccination

5.1.1 Record Vaccination

This page allows the nurses to record the vaccination process for each patient. Patient IC and vaccine ID are required which provide two text fields for nurses to input the required data. After verifying the data, nurses can select the injection result which two buttons provided for success or failure result.

If a failure injection result is chosen, a pop out window is provided for the user to insert the failure reason.

5.1.2 Request Vaccine

The screenshot shows the 'Covid Vaccination System' interface. At the top, there is a header with the Malaysian coat of arms, the text 'KEMENTERIAN KESIHATAN MALAYSIA', and the system name 'Covid Vaccination System'. On the right side of the header are language selection buttons ('BM', 'EN') and a user profile icon. Below the header, a navigation bar has links for 'HOME', 'PROFILE ▾', 'PATIENT ▾', 'VACCINE ▾' (which is currently selected), and 'APPOINTMENT ▾'. The main content area is titled 'REQUEST VACCINE SUPPLY'. It contains two input fields: 'Vaccine Type:' with a dropdown menu showing 'Sinovac' and a warning message below it stating '**The amount shall more than 0'; and 'Amount:' with a numeric input field containing '0' and a spin control. A red warning message '**The amount shall more than 0' is displayed below the amount input field. At the bottom is a large blue button labeled 'Proceed'.

This request vaccine supply page allows users to input the necessary information to request the vaccine supply. The user can select the vaccine type from the list of available vaccine names. The user also requires to provide the amount while an informative warning letter is displayed below the input field to remind the user to input a valid amount.

5.2 Module 2 : Patient

5.4.1 Add Patient

The diagram illustrates that if the user enters a valid patient IC number and clicks the NEXT button, the system will check if the IC number exists in the database. If it is not found, the system will redirect the user to a page to enter the patient's information, such as name, phone number, and address.

5.4.2 Record On-The-Spot Check

This page shows the system will prompt users to enter the checking result of the patient such as temperature, Oxygen saturation (SpO2), Pulse Rate and beats per minute (PR bpm) and blood pressure. After the user has entered all the checking results, the health condition will be determined by the system and show whether the patient is healthy or unhealthy.

5.4.3 Record Post-Vaccine

RECORD POST-VACCINE

Please select the following symptom that match to the patient's symptom after vaccination.

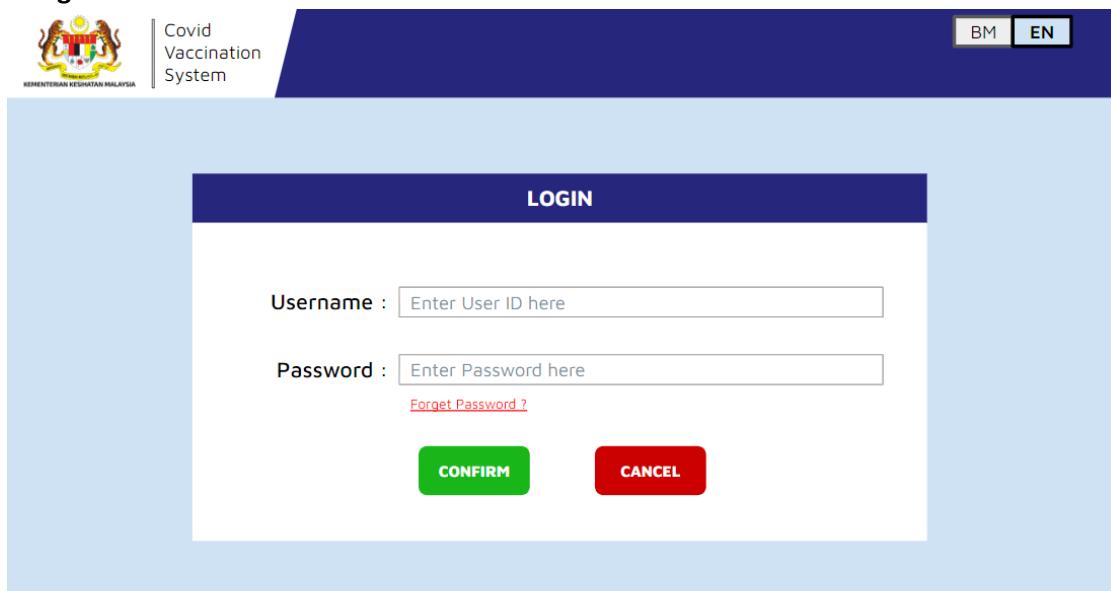
Fever	<input type="checkbox"/>	Nausea	<input type="checkbox"/>	No Symptom	<input type="checkbox"/>
Headache	<input type="checkbox"/>	Tiredness	<input type="checkbox"/>	Other Symptoms	
Muscle Pain	<input type="checkbox"/>	Arm Swelling	<input type="checkbox"/>	Enter Other Symptoms here	

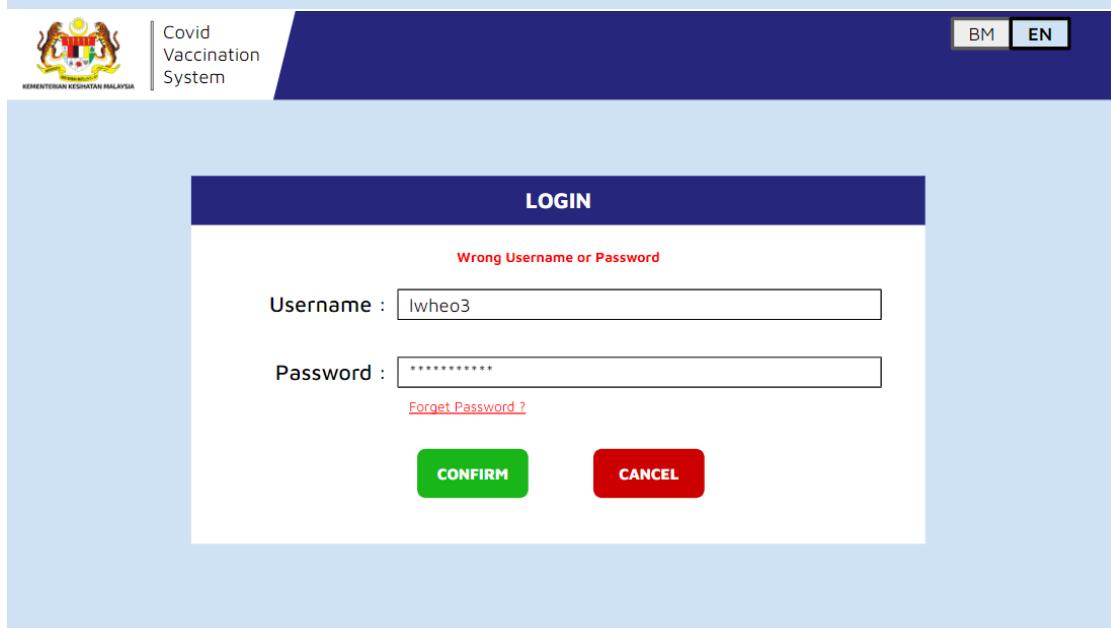
CONFIRM **CANCEL**

This Record Post-Vaccine page shows the user will select or enter the post-vaccine symptom that matches with the current symptom of the patient. After the user selected or entered the post-vaccine symptom, the user may click confirm to update the post-vaccine of the patient into the database.

5.3 Module 3: User

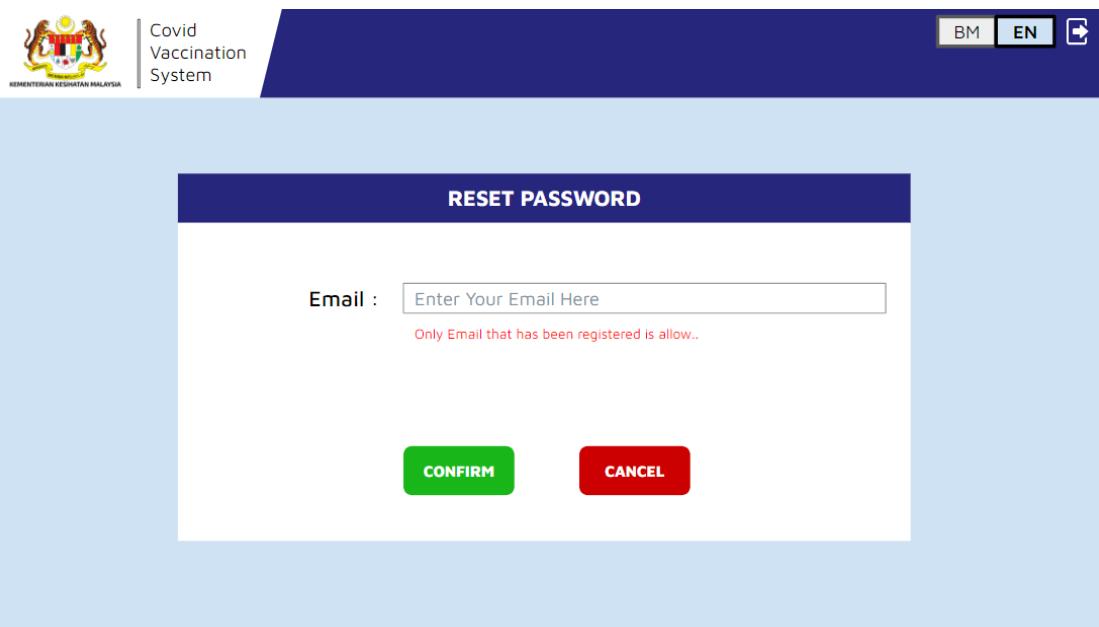
5.3.1 Log In



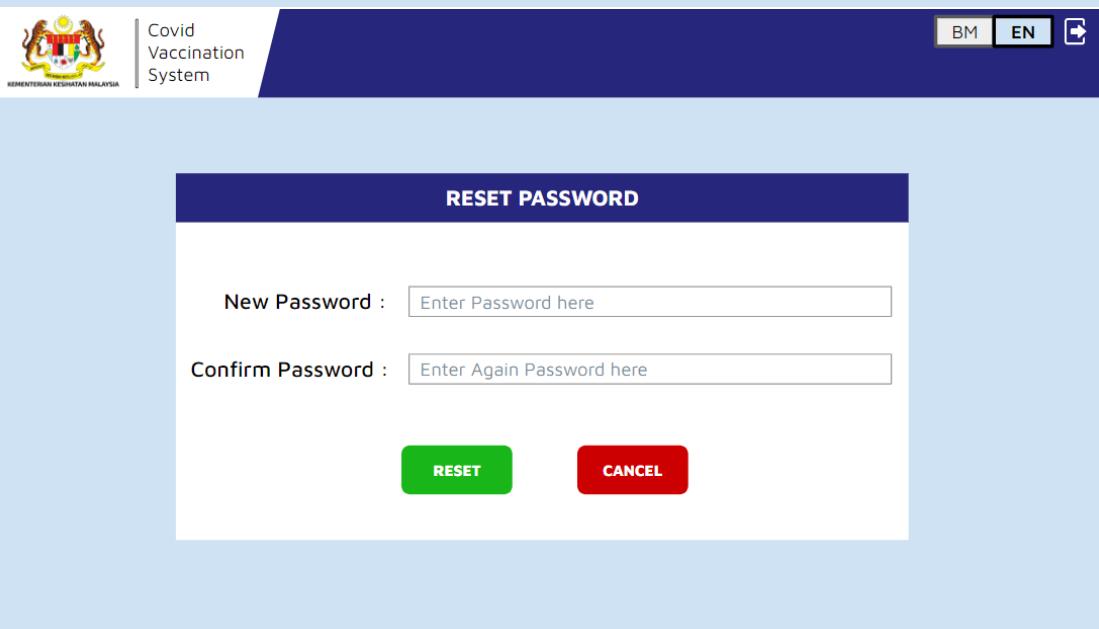


The login function in the vaccination system requires users to enter their username and password in order to log in to the system. Only valid username and password are allowed otherwise the system will not let the users log in to the system and will display an error message such as "Wrong Username or Password" to inform users that they have entered an incorrect username or password.

5.3.2 Reset Password



The screenshot shows the 'RESET PASSWORD' page. At the top left is the Malaysian coat of arms and the text 'KEMENTERIAN KESIHATAN MALAYSIA'. Next to it is the system name 'Covid Vaccination System'. On the right side are language options 'BM' and 'EN' with a dropdown arrow. The main area has a dark blue header bar with the text 'RESET PASSWORD' in white. Below this, there is a form field labeled 'Email :' with a placeholder 'Enter Your Email Here'. A note below the field says 'Only Email that has been registered is allow..'. At the bottom of the form are two buttons: a green 'CONFIRM' button and a red 'CANCEL' button.

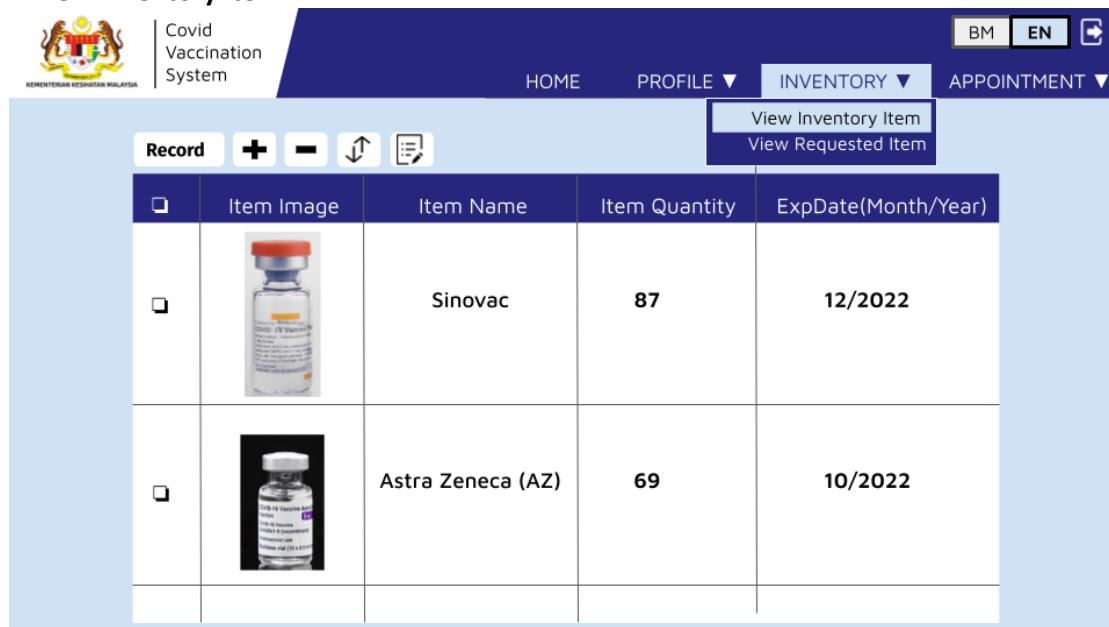


The screenshot shows the 'RESET PASSWORD' page again. The layout is identical to the first one, but now it includes fields for entering a new password. There are two input fields: 'New Password :' and 'Confirm Password :'. Both fields have a placeholder 'Enter Password here' or 'Enter Again Password here'. At the bottom of the form are two buttons: a green 'RESET' button and a red 'CANCEL' button.

The reset password function in the vaccination system allows users to reset their password only if they had entered the valid email address. Only valid email is allowed in this situation otherwise the system will not allow users to reset their password. When resetting their password, users will need to enter a new password and re-enter their new password again in order to reset their password successfully.

5.4 Module 4 : Inventory

5.4.1 View Inventory Item

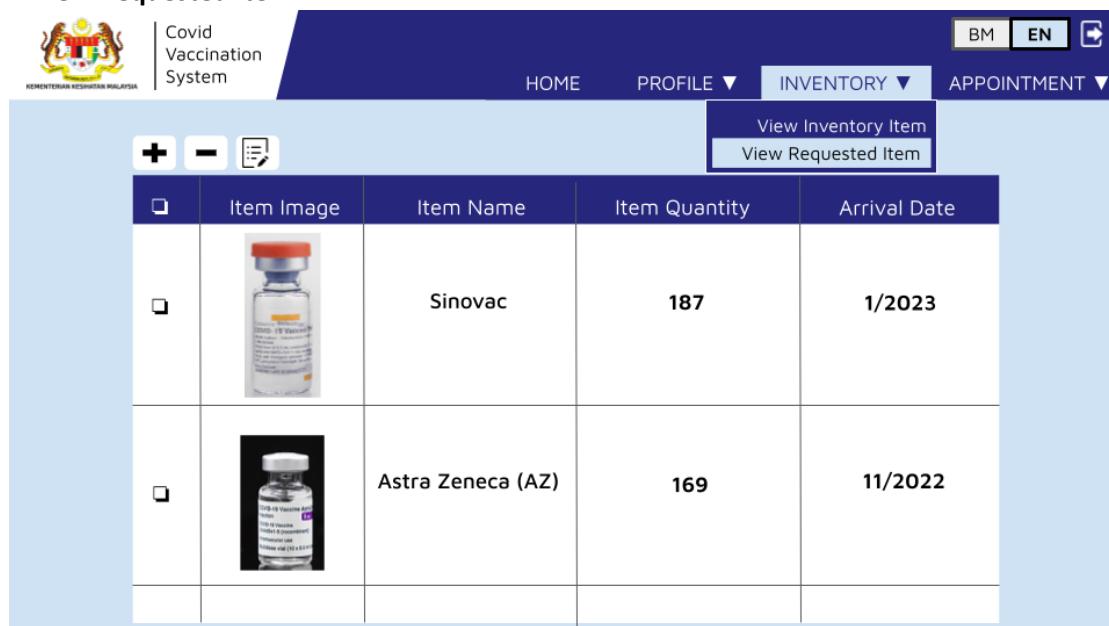


The screenshot shows a table with five columns: Item Image, Item Name, Item Quantity, and ExpDate(Month/Year). There are two rows of data.

Record	Item Image	Item Name	Item Quantity	ExpDate(Month/Year)
<input type="checkbox"/>		Sinovac	87	12/2022
<input type="checkbox"/>		Astra Zeneca (AZ)	69	10/2022

This page is for the inventory's staff who are in charge of the inventory. The page includes some of the functions which are the add, remove, sort, and also the view item. In the page of view item, it will display 5 columns, the first column is to let the user select the item for the purpose of add, remove, edit as well as record and the other column is about the vaccine details.

5.4.2 View Requested Item



The screenshot shows a table with five columns: Item Image, Item Name, Item Quantity, and Arrival Date. There are two rows of data.

+	-	View Inventory Item		View Requested Item
Item Image	Item Name	View Inventory Item		View Requested Item
<input type="checkbox"/>		Sinovac	187	1/2023
<input type="checkbox"/>		Astra Zeneca (AZ)	169	11/2022

This page is slightly different from the above as it doesn't have the record button because this is showing the requested item. The remaining button is still the same function such as the "+" add more requested item if needed, "-" remove

the requested item when it doesn't need any more or mistakenly requested it and the last button is for the edit function which can edit the requested item amount before the 10 days of the arrival date.

5.5 Module 5 : Appointment

This will be the main page of the appointment module. This page will show the 4 options to the patient and nurse to make their action related to the appointment. Users can try to select which action they want to do from these selections by clicking on them. For applying appointment and enquire, the system will prompt users to choose the path for different authorisation.

5.5.1 Make Online Appointment

Personal Information	
Name	: LEE CHEN HONG
IC Number	: 020528-10-1829
Email	: leech@gmail.com
Phone Number	: 011-16231130
Address	: No.15, Lorong 2, Taman Mutiara 3, 01000 Kangar, Perlis

SOFTWARE DESIGN DOCUMENT (SDD)

This page will need patients to insert their personal information to make a new appointment for taking vaccines at the clinic. The system will check the validity of information and check if any existing appointment belongs to the identity card number.

The screenshot shows the 'Appointment Date' section of the Covid Vaccination System. At the top, there is a header with the Malaysian coat of arms, the text 'KEMENTERIAN KESIHATAN MALAYSIA', 'Covid Vaccination System', language options 'BM EN', and a search icon. Below the header, there are navigation links: HOME, PROFILE ▾, PATIENT ▾, VACCINE ▾, and APPOINTMENT ▾. The main content area has a title 'Appointment Date'. It features a table showing time slots from 8:00AM to 8:00PM. The 'Status' column indicates availability: red for occupied and green for available. Below the table, there are dropdown menus for 'Date' (2022, September, 18) and 'Time' (2.00 PM). At the bottom are 'CONFIRM' and 'CANCEL' buttons.

After inserting the personal information and no matched result in the database, the page will show the time slot that is available for appointment. Green slot show available and red slot show its already full appointment. After selecting the valid time slot, the appointment will be created and stored inside the database.

5.5.2 Make Physical Appointment

The screenshot shows the 'LOGIN' page. At the top, there is a header with the Malaysian coat of arms, the text 'KEMENTERIAN KESIHATAN MALAYSIA', 'Covid Vaccination System', language options 'BM EN', and a search icon. Below the header, there are navigation links: HOME, PROFILE ▾, PATIENT ▾, VACCINE ▾, and 'Appointment ▾'. The main content area has a title 'LOGIN'. It displays a red error message 'Wrong Username or Password'. There are input fields for 'Username' (lwheo3) and 'Password' (*****). Below the password field is a link 'Forgot Password?'. At the bottom are 'CONFIRM' and 'CANCEL' buttons.

The page shows the login page to let nurse to login before make physical appointment at the clinic by devices provided. Only the nurse registered in the system is able to login to the appointment module.

**Personal Information**

Name : LEE CHEN HONG
 IC Number : 020528-10-1829
 Email : leech@gmail.com
 Phone Number : 011-16231130
 Address : No.15, Lorong 2, Taman Mutiara 3,
 01000 Kangar,
 Perlis

NEXT

After validation, the page will show the nurse to enter the information of the patient for making an appointment. The system will check that the patient is already registered in the clinic. If have matched the result, the system will also check if any existing valid appointment was made before. If not, the system will require user to register the patient first before applying for the appointment.

**Appointment Date**

Time	8:00AM	10:00AM	12:00PM	2:00PM	4:00PM	6:00PM	8:00PM
Status							

Date : 2022 ▼ September ▼ 18 ▼

Time : 2.00 ▼ PM ▼

CONFIRM**CANCEL**

After inserting the personal information and no matched result in the database, the page will show the time slot that is available for appointment. Green slot show available and red slot show its already full appointment. After selecting the valid time slot, the appointment will be created and stored inside the database.

5.5.3 Manage Patient Appointment

The page shows the login page for nurses before managing patient appointments.

No	Patient Name	Appointment Date	Status
1	Ali	20 May 2023, 4.00pm	Valid

The page shows the managing page for nurses to manage existing appointments by editing or cancelling appointments with a valid reason.

The screenshot shows a web-based application for managing vaccination appointments. At the top, there is a header with the logo of the Ministry of Health Malaysia, the text "Covid Vaccination System", language options ("BM", "EN", and a flag icon), and navigation links for "HOME", "PROFILE ▾", "PATIENT ▾", "VACCINE ▾", and "APPOINTMENT ▾". The main content area is titled "Edit Appointment Date". It features a table showing time slots from 8:00AM to 8:00PM. The "Status" column for each slot is color-coded: red for unavailable slots (8:00AM, 10:00AM, 12:00PM, 2:00PM, 4:00PM, 6:00PM) and green for available slots (10:00AM, 12:00PM, 2:00PM, 4:00PM, 6:00PM, 8:00PM). Below the table, there are dropdown menus for "Date" (set to "2022 ▾ September ▾ 18 ▾") and "Time" (set to "2.00 ▾ PM ▾"). A text input field labeled "Reason :" is provided for entering a reason for the appointment change. At the bottom are two buttons: a green "CONFIRM" button and a red "CANCEL" button.

After finding the existing appointment, the page will show the time slot available for changing appointments and require a valid reason.

5.5.4 Apply Appointment Changes

Manage Appointment Detail

Appointment Found

Identity Card No: 021220101562

No	Patient Name	Appointment Date	Status
1	Ali	20 May 2023, 4.00pm	Valid

CONFIRM **CANCEL**

Edit **CANCEL**

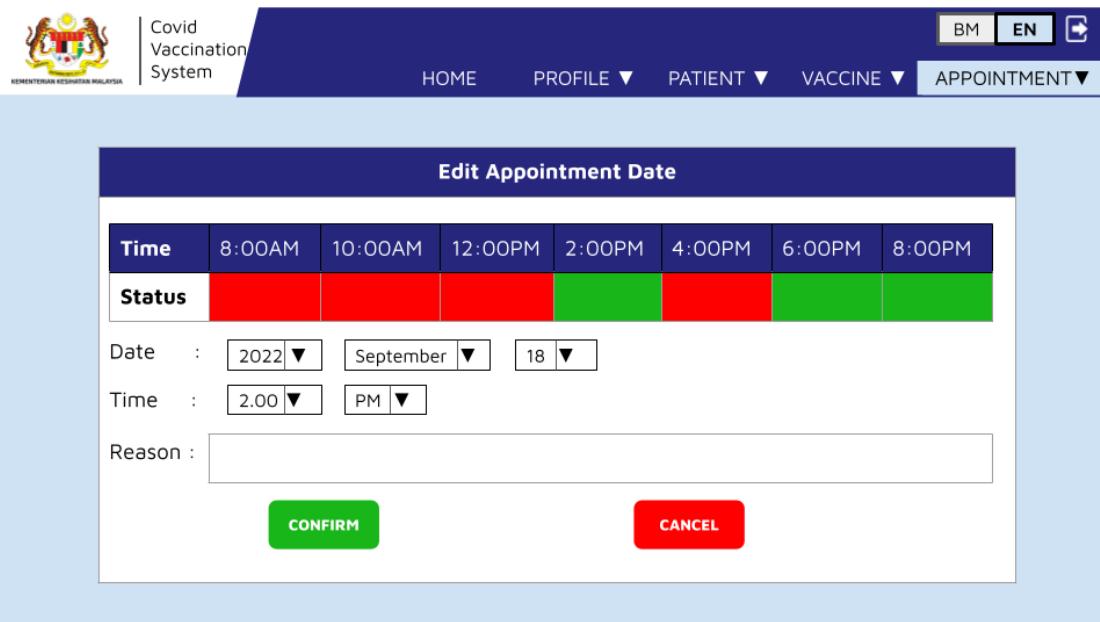
Apply Changes on Appointment

Appointment Not Found

Identity Card No: 021220101562

CONFIRM **CANCEL**

Before applying changes, the system will need patients to insert their identity card number for checking the existence of appointments inside the database.



Edit Appointment Date

Time	8:00AM	10:00AM	12:00PM	2:00PM	4:00PM	6:00PM	8:00PM
Status							

Date : 2022 ▼ September ▼ 18 ▼

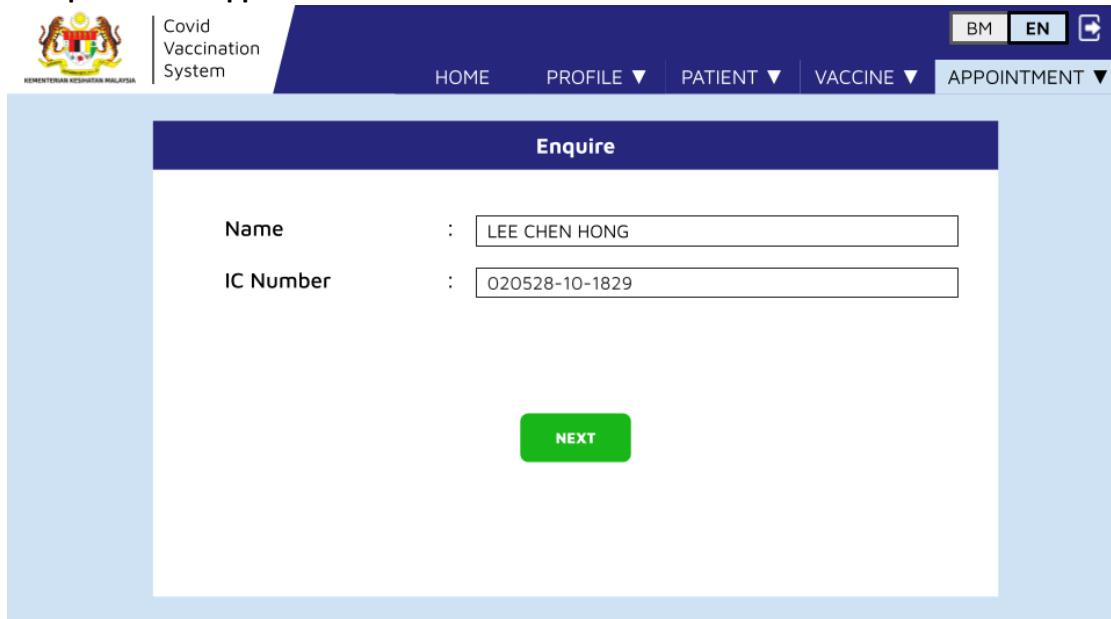
Time : 2.00 ▼ PM ▼

Reason :

CONFIRM **CANCEL**

After finding the existing appointment, the page will show the time slot available for changing appointments and require a valid reason.

5.5.5 Enquire about Appointment



Enquire

Name : LEE CHEN HONG

IC Number : 020528-10-1829

NEXT

The page shows the login page for patient to insert their name and identity card number for checking their enquire history if available.

The screenshot shows the 'Enquire' section of the Covid Vaccination System. At the top, there are language options (BM, EN) and a back arrow icon. Below that is a navigation bar with links for HOME, PROFILE ▾, PATIENT ▾, VACCINE ▾, and APPOINTMENT ▾. The main content area has a title 'Enquire' and a table with four columns: No, Enquire Title, Last Updated, and Status. Two rows of data are present:

No	Enquire Title	Last Updated	Status
1.	Location of Clinic	18-APRIL-2023, 2.45pm	Replied
2.	Vaccine Type of Clinic	19-APRIL-2023, 12.05pm	Pending

A blue button labeled 'New Enquire' is located at the bottom of the table.

The page shows the history of the enquiries made by the patient according to the identity card number. The eye icon is to view the detail of enquiry and reply from the clinic.

The screenshot shows the 'Enquire' section of the Covid Vaccination System. At the top, there are language options (BM, EN) and a back arrow icon. Below that is a navigation bar with links for HOME, PROFILE ▾, PATIENT ▾, VACCINE ▾, and APPOINTMENT ▾. The main content area has a title 'Enquire' and a table with four columns: No, Enquire Title, Last Updated, and Status. The table is empty, and a central message 'No Enquire Found' is displayed.

If no enquiry history, the page shows as above.

The page will show when patient request a new enquiry with the clinic.

The page will show the reply from the clinic.

5.5.6 Provide Solution for Enquire

The screenshot shows the 'Enquire For Nurse' login page. At the top right, there are language options 'BM' and 'EN'. Below them is a blue header bar with the text 'Enquire For Nurse'. The main form area contains two input fields: 'Username' with the value 'LEE CHEN HONG' and 'Password' with masked input. A green 'NEXT' button is located at the bottom of the form.

The page will show when a nurse wants to log in to the enquiry page.

The screenshot shows the 'Enquiry' page. At the top right, there are language options 'BM' and 'EN'. Below them is a blue header bar with the text 'Enquiry'. The main content is a table showing two entries:

No	Enquire Title	Last Updated	Status	Action
1.	Location of Clinic	18-APRIL-2023, 2.45pm	Replied	
2.	Vaccine Type of Clinic	19-APRIL-2023, 12.05pm	Pending	

The page shows all the enquiries made by the patient. The eye icon is view the enquire and the reply icon is reply the enquire.

View Enquire

Title : Vaccine Type In Clinic

Content :
What Type of Vaccine the Clinic will provide??

Reply **Back**

The page shows the view page of an enquire.

Reply Enquire

Title : Type of Vaccine

Content :
What type of Vaccine the Clinic provide??

Reply:
We provide **Sinovac** and **Astra Zeneca (AZ)** only.

Send **Back**

The page shows the reply page of enquire.

5.5.7 View Appointment Detail

The image contains two screenshots of a web application interface for the 'Covid Vaccination System'. Both screenshots show a header with the Malaysian coat of arms, the text 'KEMENTERIAN KESIHATAN MALAYSIA', and 'Covid Vaccination System'. The header also includes language options 'BM' and 'EN', and navigation links 'HOME', 'PROFILE ▾', 'PATIENT ▾', 'VACCINE ▾', and 'APPOINTMENT ▾'.

Screenshot 1 (Appointment Not Found):

- The title bar says 'Check Appointment Detail'.
- A red error message 'Appointment Not Found' is displayed.
- An input field shows 'Identity Card No: 021220101562'.
- Buttons for 'CONFIRM' (green) and 'CANCEL' (red) are present.

Screenshot 2 (Appointment Found):

- The title bar says 'Check Appointment Detail'.
- A green success message 'Appointment Found' is displayed.
- An input field shows 'Identity Card No: 021220101562'.
- Buttons for 'CONFIRM' (green) and 'CANCEL' (red) are present.
- A table below lists the appointment details:

No	Patient Name	Appointment Date	Status
1	Ali	20 May 2023, 4.00pm	Valid

The page shows the view for the patient and nurse to insert an identity card number for checking the existing appointment according to the identity card number.

6. TRACEABILITY MATRIX

6.1 Module 1 : Vaccination

Use Case ID	Requirement ID	Functional Requirement	Design_ID	Design Item (Class)
U01_5	REQ_V001	Distribute vaccine	AD01_5	Distribution
U01_2	REQ_V002	Obtain vaccine information	AD01_2	GetVaccine
U01_4	REQ_V003	Request vaccine supply	AD01_4	GetVaccine
U01_3	REQ_V004	Record the vaccination of patient	AD01_3	Vaccination
U01_1	REQ_V005	View the details for each vaccination	AD01_1	Vaccination
	REQ_V006	Update the vaccination details		Vaccination
U01_6	REQ_V007	View vaccination report	AD01_6	Report
	REQ_V008	Generate report		Report
U01_7	REQ_V009	Order vaccines	AD01_7	GetVaccine

6.2 Module 2 : Patient

Use Case ID	Requirement ID	Functional Requirement	Design_ID	Design Item (Class)
U02_3	REQ_P001	View patient's personal data	AD02_3	Nurse
	REQ_P002	Edit Patient's data		Nurse
	REQ_P003	Check medical history		Nurse
U02_5	REQ_P004	Record on-the-spot checking	AD02_5	Nurse
	REQ_P005	Rearrange appointments		Nurse
U02_4	REQ_P006	Record the post-vaccine	AD02_4	Record Vaccine Decorator
U02_1	REQ_P007	Add new patients	AD02_1	Nurse
	REQ_P009	Verify a patient's personal information		Nurse

SOFTWARE DESIGN DOCUMENT (SDD)

U02_2	REQ_P010	Remove patients	AD02_2	Nurse
U02_6	REQ_P011	Register as patient for vaccination online	AD02_6	Patient

6.3 Module 3 : User

Use Case ID	Requirement ID	Functional Requirement	Design_ID	Design Item (Class)
U03_1	REQ_U002	Reset Password	AD03_3	User
U03_2	REQ_U003	View Schedule	AD03_5	User
U03_3	REQ_U004	Edit Profile	AD03_4	User
U03_4	REQ_U005	Create New User	AD03_2	Admin
U03_5	REQ_U006	Assign Roles	AD03_1	Admin
U03_6	REQ_U007	Delete User	AD03_6	Admin
U03_7	REQ_U008	View User Information	AD03_7	Admin

6.4 Module 4 : Inventory

Use Case ID	Requirement ID	Functional Requirement	Design_ID	Design Item (Class)
U04_1	REQ_I001	View total Items	AD04_1	Inventory Staff
U04_2	REQ_I002	Record medical supplies	AD04_2	Inventory Staff
U04_3	REQ_I003	Record vaccine supplies	AD04_3	Inventory Staff
U04_4	REQ_I004	Manage Inventory	AD04_4	Inventory Staff

6.5 Module 5 : Appointment

Use Case ID	Requirement ID	Functional Requirement	Design_ID	Design Item (Class)
U05_1	REQ_A001	Verify appointment date	AD05_7	Appointment
U05_2	REQ_A002	Make physical appointments	AD05_2	Appointment

SOFTWARE DESIGN DOCUMENT (SDD)

U05_3	REQ_A003	Make online appointments	AD05_1	Appointment
U05_4	REQ_A004	Manage Patient's Appointment	AD05_3	Patient
U05_5	REQ_A005	Apply appointment changes	AD05_4	Patient
U05_6	REQ_A006	Provide enquire solution	AD05_5	Enquire
U05_7	REQ_A007	Enquire about appointment	AD05_6	Enquire