Mualij

Software Design and Requirement Specification

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Software Requirement Specification

1.1 Abstract

In the ever-evolving landscape of healthcare, the exchange of knowledge and expertise among professionals is crucial for delivering high-quality patient care**Invalid source specified.**.Traditional methods of consultation and information exchange, such as in-person meetings and static databases, can be time-consuming and inefficient. To address these challenges, we propose Mualij, a Doctor-to-Doctor Information sharing System designed similarly to Stack Overflow **Invalid source specified.**. This platform will enable doctors to ask questions and have them answered by their peers, fostering a collaborative environment for professional knowledge sharing and problem-solving.

Additionally, Mualij will incorporate multiple ML models to predict diseases given required parameters for now heart disease(failure) prediction and pneumonia detection. These model will provide accurate and relevant information, assisting doctors in making precise decisions. This integration of models will not only enhance the platform's utility but also ensure that doctors have access to the latest and most reliable medical information.

The primary goal of Mualij is to create an efficient, user-friendly platform that facilitates seamless communication among healthcare providers. By providing a dedicated space for doctors to share insights, discuss complex cases, and seek advice from their peers, we aim to improve the overall quality of healthcare

delivery. The inclusion of AI-driven prediction of heart disease(failure) prediction and pneumonia detection models will further support doctors in their practice, helping them stay updated with the latest advancements and treatment protocols.

1.2 Introduction

The healthcare sector is continuously evolving, with technology playing an increasingly pivotal role in enhancing patient care and accessibility to medical services. The advent of digital platforms has revolutionized many aspects of healthcare, including patient management, diagnosis, and treatment planning. However, there remains a significant gap in the provision of platforms dedicated to professional interaction among doctors. Traditional methods of consultation and information exchange, such as in-person meetings, emails, and static databases, can be inefficient and time-consuming. To address these challenges, we propose the development of Mualij, a comprehensive Doctor-to-Doctor Information sharing System.

Mualij is designed to function as a dynamic, interactive platform where doctors can ask questions, share insights, and provide answers to their peers. This system draws inspiration from Stack Overflow, a widely used platform in the technology sector, known for its robust question-and-answer format. By adapting this model to the healthcare domain, Mualij aims to facilitate the seamless exchange of knowledge and expertise among doctors, fostering a collaborative environment that supports continuous learning and professional development.

At the core of Mualij provides heart disease(failure) prediction and pneumonia detection. Initially the system will only have support for heart disease(failure) prediction and pneumonia detection, and later on more diseases will be added. Cardiovascular diseases are among the leading causes of morbidity and mortality worldwide **Invalid source specified.**, making it imperative for doctors to have access to the latest and most accurate information. The AI component of Mualij leverages advanced machine learning algorithms to provide precise and relevant answers. This feature ensures that doctors receive timely and reliable information, aiding them in their clinical decision-making processes.

The significance of Mualij lies in its potential to transform the way doctors interact and share knowledge. By providing a dedicated platform for professional collaboration, Mualij aims to overcome the limitations of traditional consultation methods. The system's user-friendly interface, empower doctors to seek advice, discuss complex cases, and stay updated with the latest advancements in their field. Furthermore, the platform's integration of features such as upvoting, commenting, and tagging will enhance the organization and accessibility of information, making it easier for doctors to find and contribute valuable insights.

Overall, this project sets out to address the fundamental challenges in professional interaction among doctors, with a focus on enhancing knowledge sharing and collaboration. By integrating AI technology and adopting a user-centric approach, Mualij aims to make a significant contribution to the healthcare industry's ongoing evolution.

1.3 Problem Statement

To develop a Doctor-to-Doctor Information sharing System with integrated AI capabilities for predicting heart disease(failure) and pneumonia detection providing a platform for professional knowledge sharing and consultation among doctors.

1.4 Objectives

- Develop a user-friendly platform for doctors to ask and answer questions.
- Implement ML technology to make prediction related to heart disease(failure) and pneumonia detection.
- Facilitate professional collaboration and knowledge sharing among healthcare providers.
- Ensure the platform is secure and maintains the confidentiality of user interactions.
- Integrate features for upvoting, commenting, and tagging questions for better organization and accessibility.

1.5 Features/Scope

- User registration and authentication for verified doctors.
- Question and answer functionality with tagging and categorization.
- AI-driven responses for heart disease(failure) prediction and pneumonia detection
- Upvote and comment features for community engagement.
- Real-time notification system.
- User profiles showcasing professional background and expertise.
- Advanced search functionality to find relevant questions and answers.
- Data encryption and privacy protection measures.

1.6 Functional Requirements

In order to function fully, the capabilities, features, and behaviors exhibited by the system are termed as functional requirements. These requirements outline the complete functionality of the system describing what it should do and how it should behave in various scenarios.

The followings are the functional requirements in the context of our system:

- (FR-01-01): The system shall allow users to create post.
- (FR-01-02): The system shall allow users to sign up or login.
- (FR-01-03): The system shall be able to distinguish between Doctors and general users through verification.
- (FR-01-04): The system shall allow users to tag posts for categorization.
- (FR-01-05): The system shall allow users to interact with model that will predict heart disease(failure) prediction and pneumonia detection
- (FR-01-06): The system shall allow the user to interact with post i.e upvote, downvote and comment.
- (FR-01-07): The system shall allow users to maintain their profile.
- (FR-01-08): The system shall allow user to search for their desired post/questions.

1.7 Non-Functional Requirements

Non-functional requirements specify how the system should do it. Non-functional requirements do not affect the basic functionality of the system report.
The followings are non-functional requirements for our system

- **Usability:**The users must find it easy to work with the system, post questions and interaction with post.
  The system should be easy to navigate and user-friendly.
- **Reliability / Availability:** The system must be available 24/7 for theusers.
- **Scalability:** The system must be designed to handle the growing numberof users smoothly.
- **Performance:** The system must be able to load post in a reasonable time frame.
- **Supportability:** The system must be able to handle multiple user requestssimultaneously.

- **Security:** The system must be able to handle personal data of users securely.
- **Compatibility:** The system must be compatible with different versions of android available.
- **Robustness:** The system must be able to process varying lengths posts.

1.8 Use Case Diagram

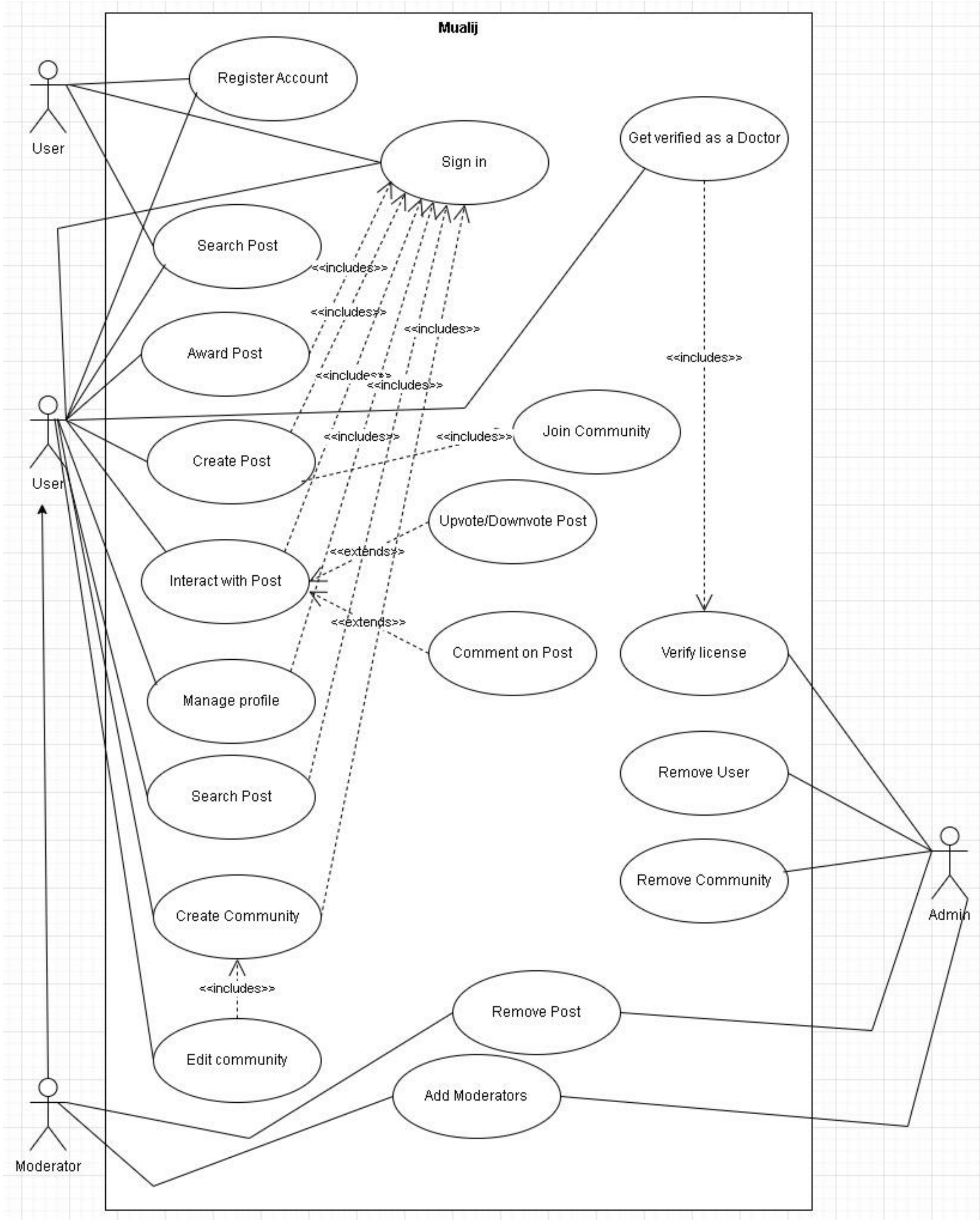


Figure 1 Use Case Diagram

1.8.1 Sign In

Table 1 Sign in use Case Table

Name	Sign In
Participating Actors	User
Goals	Sign in to the app
Triggers	User requests to login
Pre-Condition	User should be registered or have a valid google account User request to log in
Post-Condition	User is logged into the system User has granted access to multiple functionalities e.g. post a query etc
Basic Flow	User opens the app. User Enters email and password or User clicks on the continue with google button. System authenticates the user. User gains access to his/her account and can use function-alities of the system.
Alternative Flow	If the user doesn't have google account or not registered. Then they have to create one and retry signing in.
Exceptions	User has not registered an account with app.

1.8.2 Account Registration

Table 2 Account registration Use Case Table

Name	Account registration
Participating Actors	User
Goals	Account registered successfully
Triggers	User requests to register account
Pre-Condition	• User has not already registered an account with our system • User opens the Account Registration page to register anaccount.
Post-Condition	• Account registered successfully • User can log in to his/her account
Basic Flow	• User opens the app • User clicks on continue with google or sign-up button. • User selects desired google account to get register
Alternative Flow	• There is no alternative flow
Exceptions	• User is not interested to get registered with our app • Error in accessing the Account Registration page

1.8.3 Create post

Table 3 Create Post Use Case Table

Name	Create Post
Participating Actors	User
Goals	Post created successfully
Triggers	User requests to create a post
Pre-Condition	• User should have a valid account • User should be to logged in
Post-Condition	• Post uploaded successfully
Basic Flow	• User create a community or join any community • User create a post after clicking on create a post • User add description or photo about post • User add tag in description • User clicks on post button
Alternative Flow	No alternate flow
Exceptions	User has not registered an account with the app

1.8.4 Delete Post

Table 4 Delete Post Use Case Table

Name	Delete Post
Participating Actors	User
Goals	Post deleted successfully
Triggers	User requests to delete a post

Pre-Condition	• User should have a valid account • User should be logged in • Post should be authored by user
Post-Condition	• Post deleted successfully
Basic Flow	• User goes to their profile to view their posts • User clicks on a post • User clicks delete post button
Alternative Flow	No alternate flow
Exceptions	User has not registered an account with the app

1.8.5 Interact with post

Table 5 Interact with Post Use Case Table

Name	Interact with post
Participating Actors	User
Goals	Upvote, Downvote or comment on post
Triggers	User requests to Upvote, Downvote or comment on post
Pre-Condition	• User is logged into the system • User is a member of community
Post-Condition	• The upvote/downvote is updated on post • The comment is added on post
Basic Flow	• User read the post • User clicks on upvote or downvote
Alternative Flow	User read the post • User add comment to post
Exceptions	• User’s reaction is not updated • Error while loading post or comments

1.8.6 Ai model prediction

Table 6 AI model prediction Use Case Table

Name	Ai model prediction
Participating Actors	User
Goals	User gets the predicted result successfully

Triggers	User requests to interact with Ai model
Pre-Condition	• User is logged into the system
Post-Condition	• User gets his results successfully
Basic Flow	• User clicks on button to open input parameter page • User enters the parameter • User clicks on predict button • User gets the results
Alternative Flow	No alternate flow
Exceptions	• Users are not registered • User do not enter required parameters • Error while getting the results

1.8.7 Profile Management

Table 7 Profile Management Use Case Table

Name	Profile Management
Participating Actors	User
Goals	Update profile successfully
Triggers	User requests to manage profile
Pre-Condition	• User is registered and logged in
Post-Condition	• Profile of user is successfully updated
Basic Flow	• User clicks on profile icon button • User clicks on edit profile button • User updates the entries • User clicks on update profile button
Alternative Flow	No alternate flow
Exceptions	• Profile of user is not loaded successfully • User do not fill required fields • Profile is not updated

1.8.8 Search Post

Table 8 Search Post Use Case Table

Name	Search Post
Participating Actors	User
Goals	Get desired Post
Triggers	User requests to search the post
Pre-Condition	• User is logged into the system • User opens the main/home page
Post-Condition	Search results successful
Basic Flow	• User clicks on search button • User enters the query • User click search button
Alternative Flow	• *No alternative*
Exceptions	• User gets irrelevant post • Error in fetching posts

1.8.9 Create Community

Table 9 Create Community Use Case Table

Name	Create Community
Participating Actors	User
Goals	Community created successfully
Triggers	User requests to create a community
Pre-Condition	• User should have a valid account • User should be logged in
Post-Condition	• Community created successfully

Basic Flow	• User clicks Create community button • User enters community name • User becomes moderator of created community
Alternative Flow	There is no alternate flow
Exceptions	User has not registered an account with the app

1.8.10 Edit Community

Table 10 Edit Community Use Case Table

Name	Edit Community
Participating Actors	User
Goals	Community information edited successfully
Triggers	User requests to edit their created community
Pre-Condition	• User should have a valid account • User should be logged in • User should be the owner of the community
Post-Condition	• Community info changed successfully
Basic Flow	• User visits their created community • User clicks Edit info • User changes banner/description/moderators • User clicks set changes
Alternative Flow	There is no alternate flow
Exceptions	User has not registered an account with the app

1.8.11 Add Moderators

Table 11 Add Moderators Use Case Table

Name	Add Moderators
Participating Actors	User

Goals	Moderator(s) added successfully
Triggers	User requests to add mods to their community
Pre-Condition	• User should have a valid account • User should be logged in • User should be the owner of community
Post-Condition	• Community info changed successfully
Basic Flow	• User visits their created community • User clicks Edit info • User changes banner/description/moderators • User clicks set changes
Alternative Flow	There is no alternate flow
Exceptions	User has not registered an account with the app

1.8.12 Join Community

Table 12 Join Community Use Case Table

Name	Join Community
Participating Actors	User
Goals	Community joined successfully
Triggers	User requests to join a community
Pre-Condition	• User is registered and logged in
Post-Condition	• User is part of the community
Basic Flow	• User visits community to join • User clicks Join button
Alternative Flow	No alternate flow
Exceptions	• User not logged in

1.8.13 Remove Post

Table 13 Remove Post Use Case Table

Name	Remove Post
Participating Actors	Moderator
Goals	Post removed successfully
Triggers	Moderator requests to remove a user's post
Pre-Condition	• Moderator is registered and logged in
Post-Condition	• Post removed from community
Basic Flow	• Mod sees post • Mod clicks Remove post • Mod sets reason for removal • Mod clicks Next
Alternative Flow	No alternate flow
Exceptions	• User not logged in

1.8.14 Remove Community

Table 14 Remove Community Use Case Table

Name	Remove Community
Participating Actors	Admin
Goals	Community removed successfully
Triggers	Admin requests to remove a community
Pre-Condition	• Admin is logged in
Post-Condition	• Community removed from platform
Basic Flow	• Admin sees community • Admin clicks Remove community • Admin sets reason for removal • Admin clicks Next
Alternative Flow	No alternate flow
Exceptions	• Admin not logged in • Community does not exist

1.9 Wireframes

Wireframing is a way to design a website service at the structural level. A wire- frame is commonly used to lay out content and functionality on a page that considers user needs and user journeys. The followings are wireframes for our system.

1.9.1 Login wireframe

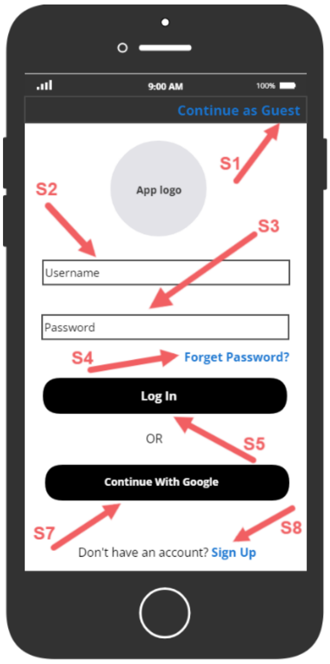


Figure 2 Login wireframe

Table 15 Log in Wireframe Table

	User
S1	As a user I shall be able to skip the login process to become a guest user.
S2	As a user I shall be able to enter username for log in.
S3	As a user I shall be able to enter password for log in
S4	As a user I shall be able to recover my forgotten password.
S5	As a user I shall be able to Log In after entering required information.
S6	As a user I shall be able to have an alternative way of login through google.
S7	As a user I shall be able to Sign up if I don’t have an account yet.

1.9.2 Sign Up Wireframe

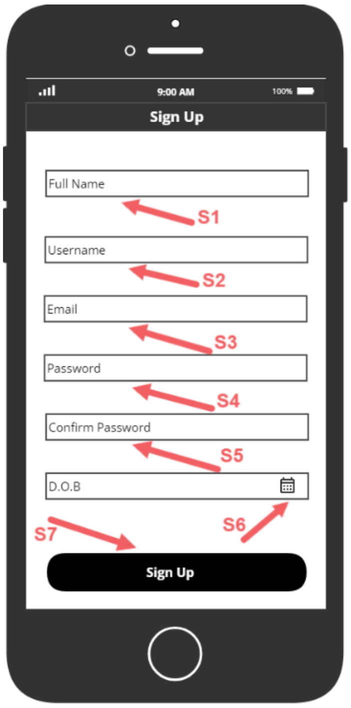


Figure 3 Sign Up wireframe

Table 16 Sign Up Wireframe Table

	User
S1	As a user I shall be able to enter my Full Name.
S2	As a user I shall be able to enter my Username
S3	As a user I shall be able to enter my email.
S4	As a user I shall be able to Password.
S5	As a user I shall be able to confirm my Password.
S6	As a user I shall be able to add my D.O.B.
S7	As a user I shall be able to Sign Up after entering Required Information.

1.9.3 Guest User Home

Figure 4 Guest Home page

Table 17 Guest Home Page Wireframe Table

	Guest User
S1	As a guest user I shall be able to search for a post or any other user.
S2	As a guest user I shall be able to Login to make an account.
S3	As a guest user I shall not be able to upvote/like a post.
S4	As a guest user I shall not be able to downvote/dislike a post.
S5	As a guest user I shall not be able to post comment on a post.

1.9.4 General User Home

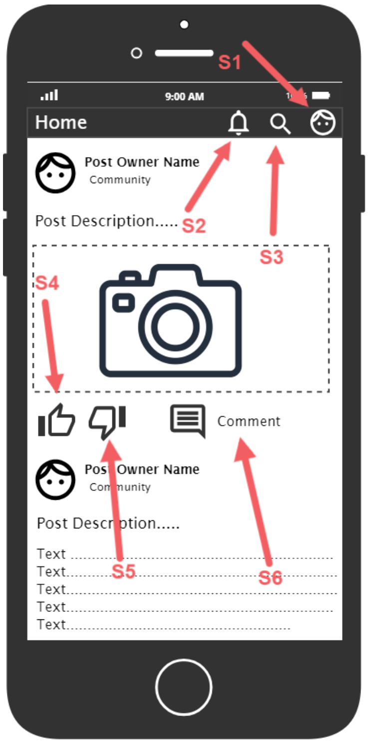


Figure 5 General User Home wireframe

Table 18 General User Home Wireframe Table

	User
S1	As a user I shall be able to open menu bar to explore other necessary options.
S2	As a user I shall be able to get notifications related to posts and communities etc.
S3	As a user I shall be able to search a particular post, user and community.
S4	As a user I shall be able to upvote/like a post.
S5	As a user I shall be able to downvote/dislike a post.
S6	As a user I shall be able to post a comment on post of a community.

1.9.5 Create A Community

Figure 6 Create A Community wireframe

Table 19 Create A Community Wireframe Table

	User
S1	As a user I shall be able to name a community that I want to.
S2	As a user I shall be able to create a community after naming it.

1.9.6 Post Link Wireframe

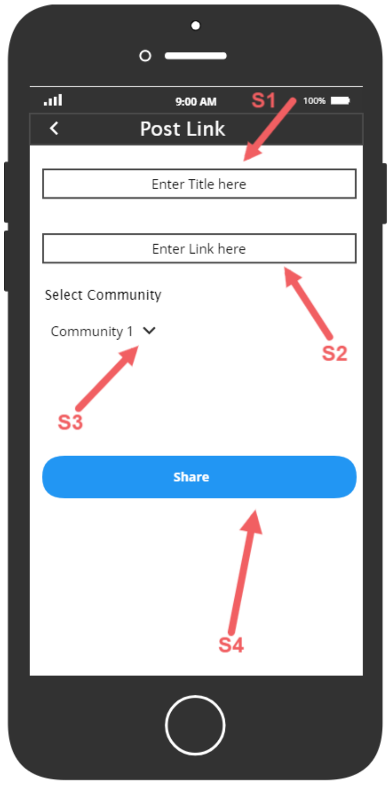


Figure 7 Post A Link wireframe

Table 20 Post A Link Wireframe Table

	User
S1	As a user I shall be able to add title to a post.
S2	As a user I shall be able to enter a valid link.
S3	As a user I shall be able to share a post after entering all required details.

1.9.7 Post Text Wireframe

Figure 8 Post Text wireframe

Table 21 Post Text Wireframe Table

	User
S1	As a user I shall be able to enter a post title.
S2	As a user I shall be able to write post description.
S3	As a user I shall be able to select community in which I am going to make a post.
S4	As a user I shall be able to share the post after entering all required information.

1.9.8 Post image Wireframe

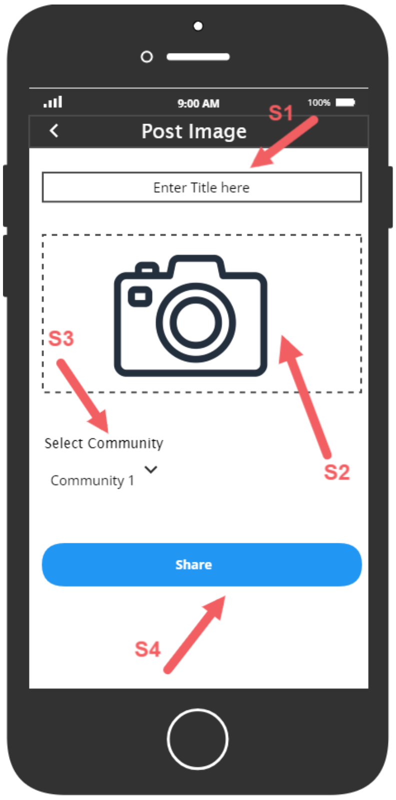


Figure 9 Post Image wireframe

Table 22 Post Image Wireframe Table

	User
S1	As a user I shall be able to add title to a post.
S2	As a user I shall be able to add an image to a post.
S3	As a user I shall be able to select a community in which I am going to post.
S4	As a user I shall be able to share the post after entering required information.

1.9.9 Community Admin Home

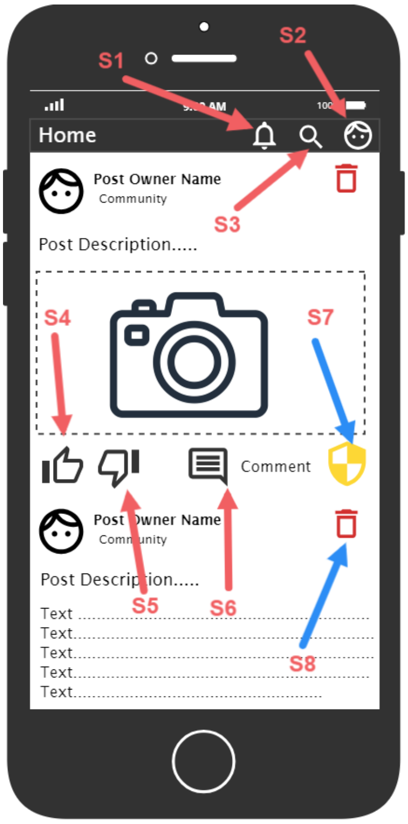


Figure 10 Community Admin Home wireframe

Table 23 Community Admin Home Wireframe Table

	Community Admin User
S1	As an Admin user I shall be able to get notification of post and communities.
S2	As an Admin user I shall be able to open menu bar to explore other necessary options.
S3	As an Admin user I shall be able to search for a particular post.
S4	As an Admin user I shall be able to upvote/like a post of a community.
S5	As an Admin user I shall be able to downvote/dislike a post of a community.
S6	As an Admin user I shall be able to post a comment on a community post.
S7	As an Admin user I shall be able to give post feedback to post owner.
S8	As an Admin user I shall be able to delete a post from community that is against rules and regulations.

1.9.10 Menu Bar Wireframe

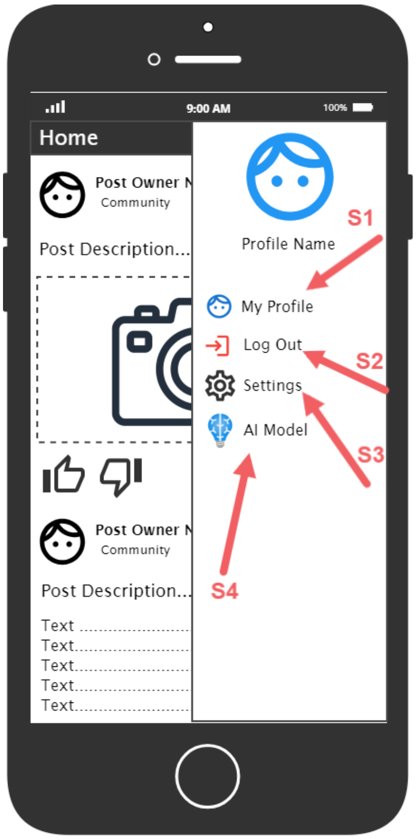


Figure 11 Menu Bar wireframe

Table 24 Menu Bar Wireframe Table

	User
S1	As a user I shall be able to explore my profile option.
S2	As a user I shall be able to log out my account.
S3	As a user I shall be able to explore settings.
S4	As a user I shall be able to interact an Ai model for heart related predictions.

1.9.11 General User Profile Wireframe

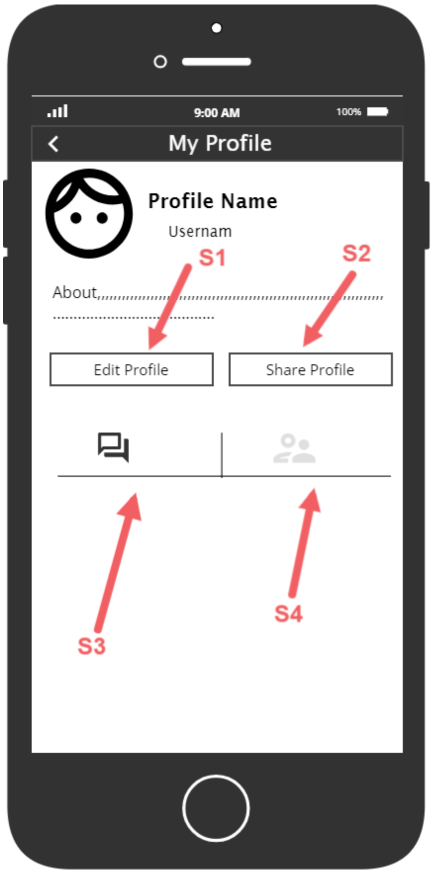


Figure 12 General User wireframe

Table 25 General User Wireframe Table

	User
S1	As a user I shall be able to edit my profile to make any change.
S2	As a user I shall be able to share my profile with others.
S3	As a user I shall be able to view the post that I have already posted.
S4	As a user I shall be able to view all the communities I have joined.

1.9.12 Doctor Profile

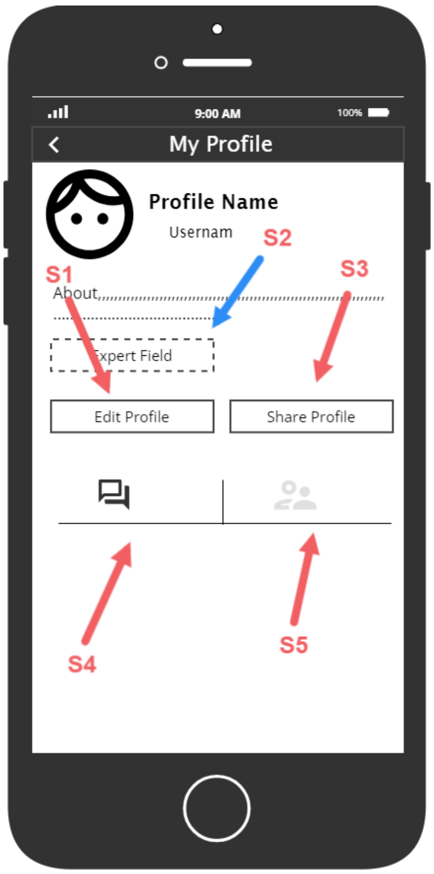


Figure 13 Doctor Profile wireframe

Table 26 Doctor Profile Wireframe Table

	Doctor
S1	As a doctor I shall be able to edit a profile.
S2	As a doctor I shall be able to show my expert field of study.
S3	As a doctor I shall be able to share my profile to other users.
S4	As a doctor I shall be able to view all the post I have posted.
S5	As a doctor I shall be able to view communities that I have joined.

1.9.13 General User Profile Management

Figure 14 General User Profile wireframe

Table 27 General User Profile Wireframe Table

	User
S1	As a user I shall be able to Edit my Profile name.
S2	As a user I shall be able to edit my profile picture.
S3	As a user I shall be able to add my bio/about.
S4	As a user I shall be able to verify my email.
S5	As a user I shall be able to add my location.
S6	As a user I shall be able to add my date of birth.
S7	As a user I shall be able to upgrade my account if I am a doctor.
S8	As a user I shall be able to save all the changes that I have edited.

1.9.14 Doctor Registration

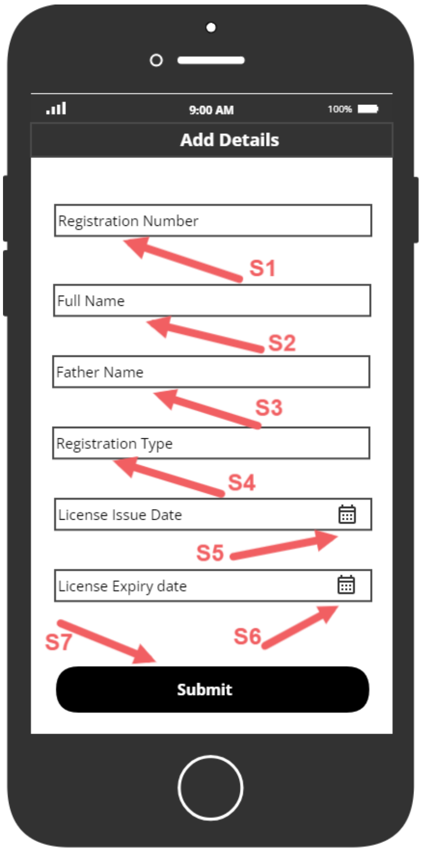


Figure 15 Doctor Registration wireframe

Table 28 Doctor Registration Wireframe Table

	Doctor
S1	As a doctor I shall be able to enter my registration number given by PMDC.
S2	As a doctor I shall be able to enter my full Name.
S3	As a doctor I shall be able to enter my father name.
S4	As a doctor I shall be able to enter my registration type.
S5	As a doctor I shall be able to enter my license issue date.
S6	As a doctor I shall be able to enter my license expiry date.
S7	As a doctor I shall be able to submit my entered credentials.

1.9.15 Doctor Profile Management

Figure 16 Doctor Profile Management wireframe

Table 29 Doctor Profile Management Wireframe Table

	Doctor
S1	As a doctor I shall be able to edit my profile name.
S2	As a doctor I shall be able to edit my profile picture.
S3	As a doctor I shall be able to add my bio/about.
S4	As a doctor I shall be able to add my expert field of study.
S5	As a doctor I shall be able to verify my email.
S6	As a doctor I shall be able to add my location.
S7	As a doctor I shall be able to add my date of birth.
S8	As a doctor I shall be able to save all the changes that I have edited.

1.9.16 Doctor Pending Approval

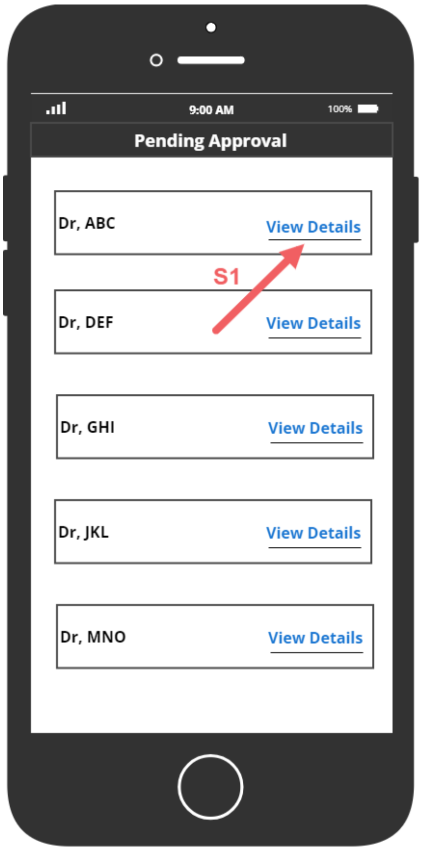


Figure 17 Doctor pending approval wireframe

Table 30 Doctor Pending Approval Wireframe Table

	Admin
S1	As an admin I shall be able to view details of pending request from doctor for registration

1.9.17 Pending Approval Decision

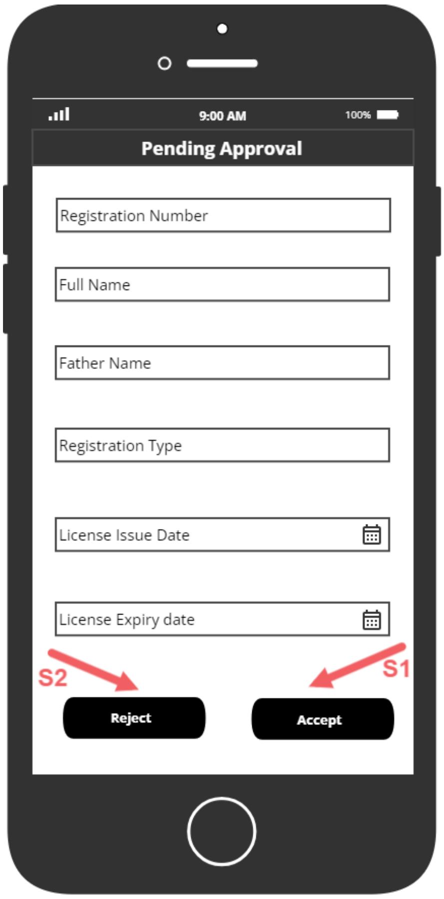


Figure 18 Pending approval decision wireframe

Table 31 Pending Approval Decision Wireframe Table

	Admin
S1	As an admin I shall be able to Accept the request made by the doctor.
S2	As an admin I shall be able to Reject the request made by the doctor.

Chapter 2

Design Specification

2.1 Detailed literature review

The application of machine learning (ML) in healthcare has the potential to revolutionize the diagnosis and treatment of critical diseases such as heart disease(failure) and pneumonia detection, two of the most prevalent causes of global mortality [1]. Traditional diagnostic methods often involve manual analysis, are time-consuming, and prone to subjective interpretation, leading to diagnostic errors or delays in treatment [2]. The integration of ML into healthcare diagnostics aims to enhance accuracy, efficiency, and scalability, addressing these limitations [3]. This literature review explores state-of-the-art studies focused on binary prediction models for heart disease and pneumonia detection using ML, providing a synthesis of the methods, datasets, and advancements in the field, as well as identifying challenges and gaps in the current research landscape.

Heart disease remains one of the most critical global health challenges, and timely diagnosis can significantly improve patient outcomes [4]. ML models have been employed to predict the likelihood of heart disease by analyzing structured clinical data and physiological signals, identifying patterns indicative of cardiovascular problems. Several studies have investigated various algorithms, data preprocessing techniques, and features that contribute to heart disease prediction.

Dey and colleagues compared the performance of several ML algorithms for heart disease prediction, using the Cleveland Heart Disease dataset, which contains 303 patients and 14 attributes [5]. The algorithms analyzed include

Logistic Regression (LR), Decision Trees (DT), Random Forest (RF), Support Vector Machines (SVM), and Neural Networks (NN). Random Forest emerged as the top-performing model, achieving an accuracy of 85% [5]. This study emphasized the importance of feature selection techniques, as removing irrelevant or redundant features improved model accuracy and training efficiency [6]. The study also underlined the role of hyperparameter tuning in optimizing model performance, showing that tuning parameters such as the number of trees in Random Forest could lead to significant improvements in accuracy and precision [5].

Additionally, Dey et al. discussed the use of cross-validation to address overfitting, a common issue in ML models when the training dataset is relatively small, as in the case of the Cleveland dataset [5]. The study advocated for a balanced approach between model complexity and interpretability, noting that simpler models like Logistic Regression may be preferred in clinical settings due to their ease of interpretation, even though more complex models like Random Forest provide higher accuracy [5].

Kwon and colleagues explored the use of deep learning models for heart disease prediction, combining structured clinical data with physiological signals such as electrocardiogram (ECG) data. The hybrid CNN-LSTM (Convolutional Neural Network and Long Short-Term Memory) architecture was designed to handle both spatial and temporal data, making it well-suited for ECG analysis. The model achieved an 80% accuracy rate, outperforming traditional ML models in most cases.

The strength of this study lies in its ability to integrate multimodal data—combining tabular patient data with ECG signals, which are time-series data [7]. By using deep learning techniques, Kwon et al. demonstrated the potential for models to learn complex representations of data that are difficult to capture with traditional models [7]. However, the study also noted challenges related to computational costs and the need for large datasets to train deep learning models effectively [7]. Given that deep learning models require significant computational resources, their implementation in real-time clinical settings may be challenging without optimized hardware and infrastructure [7].

Patel and Shah examined the impact of feature engineering on the performance of heart disease prediction models [3]. The study applied dimensionality reduction techniques such as Principal Component Analysis (PCA) to reduce the dataset's complexity while retaining critical information [3]. Additionally, interaction terms were created to account for relationships between different clinical features, enhancing the model's ability to capture complex patterns in the data [3]. The authors tested ensemble learning techniques, including Gradient Boosting and AdaBoost, which yielded an accuracy of 88% [3].

Their findings underscore the importance of feature engineering in developing robust models [3]. Feature engineering is often a time-consuming and iterative process, but it plays a pivotal role in improving model performance, particularly when using structured clinical data [3]. Ensemble methods, which combine multiple weak learners into a strong learner, were shown to outperform single-model approaches, highlighting the benefit of leveraging different algorithms to capture data patterns [3].

Li and colleagues conducted an extensive meta-analysis of ML algorithms used in heart disease prediction over the past decade [4]. This study provided a comprehensive review of methods, datasets, and challenges, offering insights into the evolution of the field [4]. One of the key trends identified was the shift from traditional statistical methods, such as logistic regression and decision trees, to more advanced ML models like Random Forest, Support Vector Machines, and deep learning [4].

Pneumonia, particularly in vulnerable populations such as children and the elderly, remains a leading cause of morbidity and mortality worldwide [2]. Chest X-rays are the most common diagnostic tool for pneumonia, but interpreting these images requires expert radiologists and can be subject to human error [8]. ML models, especially deep learning models, have shown great promise in automating pneumonia detection [8].

Rajpurkar and colleagues developed **CheXNet**, a deep learning model designed to detect pneumonia from chest X-rays [2]. CheXNet is based on a 121-layer CNN architecture and was trained on the ChestX-ray14 dataset, which contains over 100,000 chest X-ray images labeled with various diseases [2]. CheXNet achieved an accuracy of 82%, surpassing the performance of practicing radiologists in detecting pneumonia [2]. This study highlights the significant potential of deep learning in image-based diagnostics, particularly in resource-constrained settings where access to radiologists may be limited [2].

However, the authors acknowledged the challenge of model interpretability, as deep neural networks often operate as "black boxes," making it difficult to understand how the model arrives at its decisions [2]. To address this, Rajpurkar et al. employed techniques such as **Grad-CAM** (Gradient-weighted Class Activation Mapping) to visualize which areas of the X-ray the model focused on, providing a degree of transparency that can be critical in clinical settings [2].

Liang and colleagues introduced a novel approach to pneumonia detection by applying **transfer learning** [8]. Their model leveraged pre-trained CNNs, such as ResNet and VGG, initially trained on large, non-medical datasets like ImageNet, and fine-tuned them on medical data [8]. Transfer learning reduced the training time and computational cost while maintaining high accuracy (87%) on pneumonia detection [8].

Transfer learning is particularly valuable in medical imaging, where labeled datasets are often scarce or difficult to obtain [8]. By transferring knowledge from a related domain, ML models can learn more efficiently from smaller medical datasets [8]. The study also explored the potential for generalizing transfer learning across different populations and healthcare environments, a critical consideration when deploying ML models in global health contexts [8].

Yao et al. investigated the use of attention mechanisms in conjunction with CNNs to improve the interpretability and accuracy of pneumonia detection models [9]. Attention mechanisms allow the model to focus on specific parts of an image, emulating the way a radiologist might analyze a chest X-ray [9]. By guiding the model's focus, the attention-based CNN achieved an accuracy of 89%, while also providing a clearer rationale for its predictions [9].

This study is notable for its focus on model transparency, an essential factor for clinical adoption [9]. Healthcare professionals are more likely to trust and use ML models when they can understand the reasoning behind the model's decisions [9]. Yao et al.'s attention-guided approach represents a significant step towards integrating **explainable AI** (XAI) techniques into medical diagnostics, which is a growing area of interest in both academic and clinical settings [9].

While the reviewed studies demonstrate significant advancements in using ML for heart disease prediction and pneumonia detection, several challenges remain [1]. Key issues include:

- **Data Imbalance**: Both heart disease and pneumonia datasets often suffer from class imbalance, where healthy patients far outnumber those diagnosed with the condition [4]. This imbalance can skew the model's predictions towards the majority class, reducing its effectiveness in identifying the minority class [4]. Techniques such as SMOTE and cost-sensitive learning can help address this, but further research is needed to develop more robust solutions [1].

- **Model Interpretability**: As ML models, particularly deep learning models, become more complex, their interpretability decreases. This lack of transparency is a major barrier to clinical adoption, as healthcare professionals need to understand how the model arrived at its decision to trust its recommendations [2]. Techniques like LIME (Local Interpretable Model-agnostic Explanations) and Grad-CAM are promising, but they are not yet widely integrated into clinical practice [2].

- **Integration with IoT and Real-Time Data**: The integration of **Internet of Things (IoT)** devices for real-time monitoring of heart disease and pneumonia symptoms presents a promising avenue for future research [8]. However, challenges such as data security, patient privacy, and the need for low-latency, high-reliability models must be addressed before such systems can be widely adopted [8].

- **Transfer Learning**: As demonstrated by Liang et al., transfer learning can significantly improve model performance, particularly when data is scarce [8]. Future research should focus on exploring how pre-trained models can be adapted to different medical conditions and populations to enhance generalizability and reduce bias [8].

- **Data Privacy and Security**: With the increasing use of personal health data in ML models, ensuring the privacy and security of patient data is paramount [1]. Robust encryption, secure data transmission protocols, and adherence to healthcare regulations such as HIPAA are essential for maintaining trust and safeguarding sensitive information [1].

The application of ML in heart disease prediction and pneumonia detection has the potential to transform healthcare by providing faster, more accurate diagnoses. Ensemble methods, deep learning models, and advanced feature engineering techniques have consistently achieved high levels of accuracy [4]. However, challenges such as data imbalance, model interpretability, and computational efficiency must be addressed to make these models clinically viable [9]. Future research should focus on integrating real-time data from IoT devices, improving the interpretability of deep learning models, and exploring the potential of transfer learning to overcome data scarcity [8]. By addressing these challenges, ML models can become a valuable tool in improving patient outcomes and advancing the field of medical diagnostics [5].

2.2 Proposed methodology

Mualij aims to provide robust machine learning models for predicting heart disease and detecting pneumonia based on clinical and demographic data, as well as chest X-ray images. This structured approach is divided into key phases: dataset collection, data preprocessing, model development, evaluation, and integration into an application. By employing scientifically sound methods and techniques, this methodology seeks to ensure valid and reliable results, addressing critical health issues.

- **Dataset Collection**

  The initial phase focuses on obtaining comprehensive datasets from various reputable online sources. For heart disease prediction, data will be collected from databases such as the UCI Machine Learning Repository and Kaggle. For pneumonia detection, chest X-ray images will be sourced from publicly available datasets like ChestX-ray14 or other medical imaging repositories [5] [7].The datasets for both heart disease and pneumonia will comprise several essential features.

  - **Heart Disease Prediction**:
    - **Demographic Information**: Variables such as age, gender, and family history of heart disease that influence heart health [3].
    - **Clinical Parameters**: Key indicators including blood pressure, cholesterol levels, and other relevant medical test results that provide insight into cardiovascular health [4].
    - **Lifestyle Factors**: Data on habits like smoking, physical activity, and dietary choices, crucial for understanding heart disease risk factors [2].
    - **Historical Health Records**: Previous diagnoses and treatments related to cardiovascular health [8].
  - **Pneumonia Detection**:
    - **Chest X-Ray Images**: High-quality images labeled with various diseases, specifically focusing on pneumonia cases [7].
    - **Clinical Metadata**: Associated patient data, including age, gender, and medical history, which may affect pneumonia risk.

Collecting comprehensive datasets from diverse online sources provides a necessary foundation for building robust predictive models for both conditions, ensuring improved generalizability.

- **Data Preprocessing**

Data preprocessing is a crucial step that significantly impacts the models' performance. Proper preprocessing enhances data quality, ensuring that machine learning algorithms can operate effectively. The preprocessing phase will include:

  - **Data Cleaning**: Identifying and rectifying missing values, removing duplicates, and addressing inconsistencies using techniques like mean, median, or mode imputation [9]. This step is essential to maintain data integrity and improve model accuracy.
  - **Normalization**: Numerical features will be normalized to a standard scale, ensuring each feature contributes equally to the models' performance [1]. Methods like Min-Max scaling or Z-score normalization will be applied based on data distribution.
  - **Feature Selection**: To improve model interpretability and performance, irrelevant or redundant features will be removed using techniques such as Recursive Feature Elimination (RFE) and correlation analysis [10]. This step streamlines the dataset for both heart disease and pneumonia detection models.
  - **Data Transformation**: Categorical variables will be encoded using one-hot or label encoding. For pneumonia detection, chest X-ray images will undergo preprocessing techniques like resizing and normalization [6].

- **Model Development**

Following data preprocessing, various traditional machine learning models will be developed for predicting heart disease and detecting pneumonia. The selection of algorithms will include:

  - **Heart Disease Prediction**:
    - **Logistic Regression**: Provides interpretable coefficients for the relationship between features and the likelihood of heart disease [3].
    - **Decision Trees**: Offers visual representations of decision rules for clear interpretation [4].

  - **Random Forest**: An ensemble method improving prediction accuracy by combining multiple decision trees [2].
  - **Support Vector Machines (SVM)**: Effective in high-dimensional spaces, adept at classifying non-linearly separable data [10].
  - **K-Nearest Neighbors (KNN)**: Classifies instances based on the majority class of nearest neighbors [6].
- **Pneumonia Detection**:
  - **Convolutional Neural Networks (CNN)**: Deep learning models designed specifically for image data, effective for classifying chest X-ray images [11].
  - **Transfer Learning Models**: Pre-trained CNNs like VGG16 or ResNet will be fine-tuned on the pneumonia dataset to leverage existing knowledge and improve performance [12].

These model selections are strategically aligned with the research objectives for both heart disease and pneumonia, ensuring that the resulting predictions are accurate and interpretable.

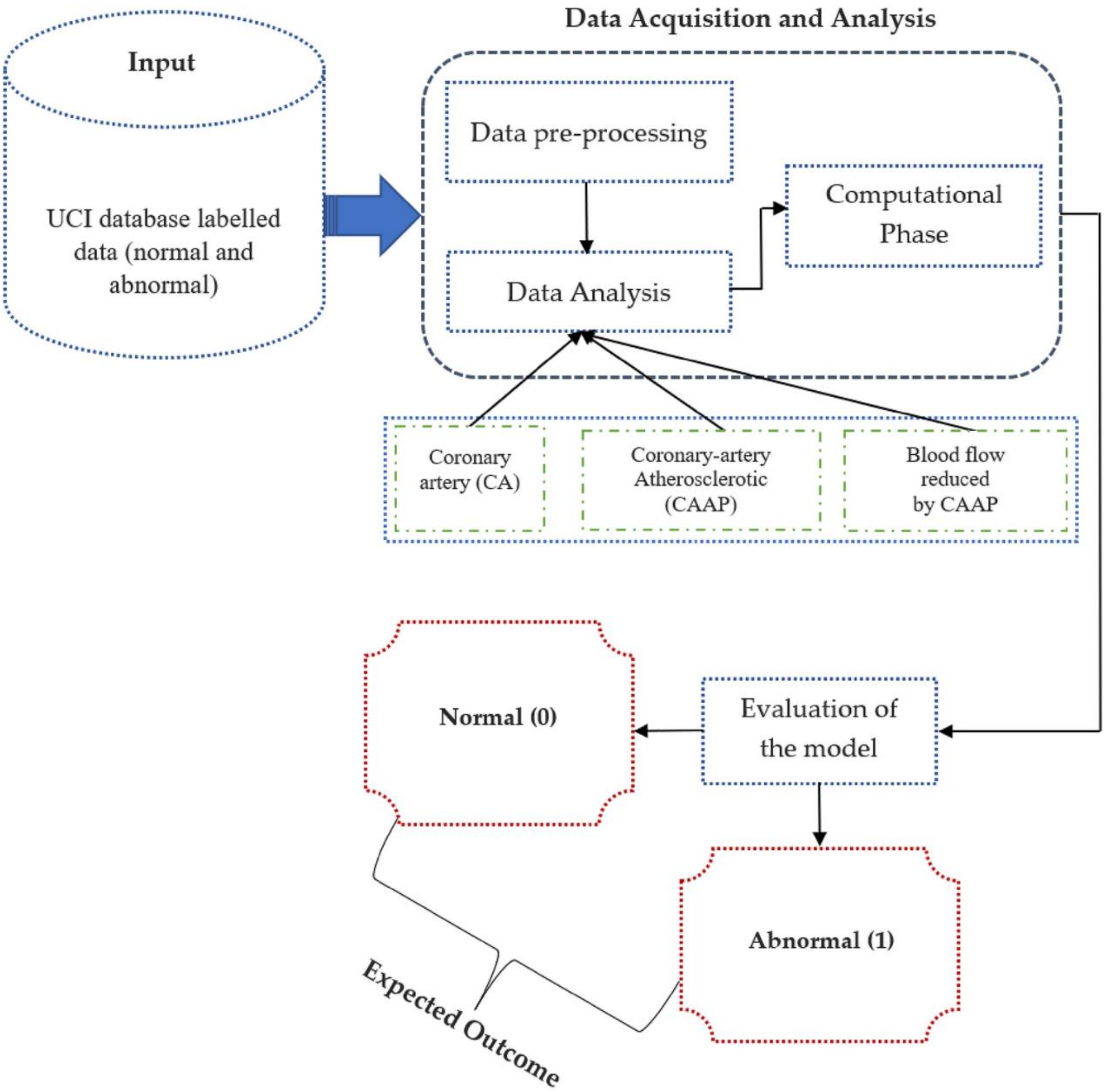


Figure 32 Working flow from data to model evaluation

- **Model Evaluation**

A comprehensive evaluation of the developed models is crucial for validating their performance. This phase will utilize various metrics and techniques:

- **Performance Metrics**: Each model will be evaluated using accuracy, precision, recall, F1 score, and AUC-ROC metrics for both heart disease and pneumonia detection.

- **Confusion Matrix**: This will visually represent true positive, true negative, false positive, and false negative rates, facilitating a nuanced understanding of model performance [10].
- **Cross-Validation**: Implementing k-fold cross-validation ensures that the model's performance is robust and not reliant on a specific training/testing split [5].
- **Model Comparison**: A comparative analysis will identify the best-performing model for each task, considering accuracy, interpretability, and computational efficiency.

This thorough evaluation process ensures that the selected models are both reliable and effective in achieving the research aims.

- **Integration and Application Development**

Once the optimal models are identified, the results will be integrated into a user-friendly application designed for healthcare professionals:

- **Application Development**: A web-based application will allow users to input patient data and receive predictions regarding heart disease risk and pneumonia detection. Emphasizing user experience, the application will be designed for ease of use by healthcare providers, facilitating timely decision-making.
- **Diagram of Models**: Diagrams illustrating the structure and workflow of the machine learning models will provide visual clarity on model functionality. These diagrams will help stakeholders understand the underlying processes and methodologies employed in predictions.
- **Deployment**: After successful training and evaluation, the application will be deployed on a secure server, enabling real-time predictions for new patient data. Continuous monitoring of model performance will be implemented to ensure ongoing accuracy and relevance, adapting to any changes in data over time [12].

This methodology is carefully designed to ensure that the chosen methods and techniques are the best fit for achieving the research aims and objectives. By employing a structured approach encompassing dataset collection from multiple online sources, preprocessing, model development, evaluation, and integration, this methodology promises to yield scientifically sound findings that contribute to the effective prediction of heart disease and detection of pneumonia.

2.3 Data collection techniques

Data collection is a pivotal step in the research process, providing essential information needed for insightful analysis and sound decision-making. This section outlines the methodologies and strategies employed for gathering data relevant to heart disease prediction and pneumonia detection. These techniques are designed to ensure the collection of high-quality and reliable data, which is critical for achieving the research objectives.

- **Research Aims and Objectives**

  The primary aim of this research is to develop predictive models for heart disease and pneumonia detection using machine learning techniques. To achieve this aim, the following specific objectives will guide the data collection process:

  - **For Heart Disease (failure) Prediction**:
    - To identify and collect relevant demographic, clinical, and lifestyle factors associated with heart disease.
    - To ensure the dataset is diverse and representative of various population segments, enhancing the model's generalizability.
    - To establish a reliable dataset that can be effectively utilized to train and validate machine learning algorithms.
  - **For Pneumonia Detection**:
    - To gather a dataset of chest X-ray images labeled for pneumonia and other respiratory conditions.
    - To include clinical metadata that can provide context and enhance prediction accuracy.

- **Types of Data to be Collected**

  The data collected for this project will consist of both quantitative and qualitative information, categorized as follows:

  - **Quantitative Data**: This includes numerical values that can be measured and analyzed statistically. Examples include:
    - **For Heart Disease**: Age, blood pressure levels, cholesterol levels, Body Mass Index (BMI) etc.

    - **For Pneumonia**: Image pixel values from chest X-rays, patient age, and relevant laboratory test results.

  - **Qualitative Data**: This refers to descriptive data that provides context to the quantitative findings. Examples include:

    - **For Heart Disease**: Lifestyle habits (e.g., smoking status, exercise frequency), family history of heart disease, previous medical conditions.

    - **For Pneumonia**: Patient symptoms, medical history related to respiratory issues.

Collecting both types of data allows for a comprehensive analysis, providing insights into not only the statistical relationships but also the underlying factors influencing health outcomes.

- **Methods of Data Collection**

  To achieve the research objectives, several methods will be employed for data collection:

  - **Online Data Sources**: Data will be collected from reputable online legal data sources, such as the UCI Machine Learning Repository and Kaggle. This will involve searching for datasets that include demographic, clinical, and lifestyle information relevant to heart disease, as well as datasets containing chest X-ray images for pneumonia detection. The goal is to gather data from multiple datasets, which will then be merged to create a comprehensive dataset for training the machine learning models [12] [6].

  - **Clinical Data Repositories**: Existing datasets from clinical repositories may be utilized to source relevant data. These datasets often contain a wealth of information gathered from diverse patient populations and clinical settings, particularly for pneumonia detection [13].

  - **Surveys and Questionnaires**: If time permits after model development, surveys may be conducted to gather additional qualitative data regarding lifestyle habits and health status from patients. This will enhance the dataset and provide deeper insights into the factors affecting both heart disease and pneumonia risk.

- **Procedures for Data Storage and Processing**

To ensure data integrity and security, the following procedures will be implemented for data storage and processing:

- **Data Storage**: All collected data will be securely stored in a cloud-based database with appropriate access controls. Data will be encrypted to protect sensitive information, ensuring compliance with data protection regulations [11].

- **Data Processing**: The data processing phase will involve cleaning, normalizing, and transforming the data to enhance its quality. This includes merging datasets to create a cohesive and comprehensive dataset, handling missing values, standardizing measurement units, and encoding categorical variables. Processing scripts will be developed to automate these tasks, ensuring consistency and efficiency [14].

- **Data Quality Assurance**

Maintaining the quality of the collected data is crucial for the reliability of the research findings. The following measures will be taken to ensure data quality:

- **Validation**: Collected data will be validated through cross-checking against trusted sources and employing consistency checks to identify anomalies [10].

- **Pilot Testing**: Before full-scale data collection, a pilot test of the survey and interview process will be conducted to identify any issues in the data collection instruments, ensuring they are clear and effective [6].

- **Feedback Mechanism**: A feedback mechanism will be established for respondents to provide input on the clarity of questions and their overall experience. This feedback will be used to refine the data collection tools further [15].

The data collection techniques employed in this research are designed to gather comprehensive, high-quality data relevant to both heart disease prediction and pneumonia detection. By utilizing a combination of online data sources and merging various datasets, the project aims to construct a robust dataset that will support the development of reliable predictive models. The careful consideration of research aims, types of data, and procedures for collection and processing will ensure the integrity and validity of the research findings.

2.4 Experimental Design

Experimental design is the creation of a detailed experimental plan that allowmeds for the maximum acquisition of information specific to the objectives of predicting heart disease and detecting pneumonia using machine learning techniques. The following points outline the framework for this experimental design:

- **Research Objectives**

The primary objectives of this experiment are:

  - **Heart Disease Prediction**: To develop and evaluate a machine learning model that predicts the likelihood of heart disease based on demographic, clinical, and lifestyle data.

  - **Pneumonia Detection**: To develop and evaluate a deep learning model that accurately detects pneumonia from chest X-ray images.

These objectives guide the entire experimental process, ensuring that the methodologies are aligned with the desired outcomes.

- **Data Collection**

Data will be collected from various reputable online sources. The datasets for this experiment will include:

  - **Heart Disease**: A diverse set of patient records containing demographic, clinical, and lifestyle information. Datasets will be obtained from repositories like the UCI Machine Learning Repository and Kaggle.

  - **Pneumonia**: A collection of chest X-ray images sourced from public datasets, such as ChestX-ray14, with appropriate annotations indicating the presence or absence of pneumonia.

The datasets will include a range of samples representing different population segments, enhancing the generalizability of the predictive models.

- **Preprocessing**

The preprocessing phase is crucial for ensuring the quality of the data used in modeling. This phase will involve:

- **Data Cleaning**: Removal of duplicates, handling missing values through imputation (mean, median, or mode), and standardizing entries to ensure consistency.
- **Normalization**: Normalizing quantitative features (e.g., blood pressure, cholesterol levels) to a standard scale to improve model performance.
- **Image Processing**: For pneumonia detection, chest X-ray images will be resized and normalized, and augmentation techniques may be applied to increase dataset diversity.
- **Feature Engineering**: For heart disease, relevant features will be selected, and categorical variables will be transformed into numerical formats for model compatibility.

- **Model Selection and Training**

For each task, appropriate models will be selected and trained:

- **Heart Disease Prediction**: A combination of algorithms such as Logistic Regression, Decision Trees, Random Forest, Support Vector Machines (SVM), and K-Nearest Neighbors (KNN) will be trained using the processed dataset. Hyperparameter tuning will be conducted to optimize model performance.
- **Pneumonia Detection**: A Convolutional Neural Network (CNN) will be utilized for image classification. The model will leverage transfer learning techniques with pre-trained models (e.g., VGG16, ResNet) to enhance detection accuracy.

During training, different parameters such as learning rate, batch size, and the number of epochs will be tested to identify the optimal settings for each model.

- **System Development**

A user-friendly application will be developed that allows healthcare professionals to input patient data for heart disease and upload chest X-ray images for pneumonia detection. The application will use the trained models to provide real-time predictions and insights.

- **Evaluation Metrics**

To assess the performance of the models, various metrics will be employed:

- **For Heart Disease Prediction**: Metrics such as accuracy, precision, recall, F1 score, and AUC-ROC will be calculated to evaluate the predictive capabilities of the models.

- **For Pneumonia Detection**: Evaluation will involve metrics such as accuracy, precision, recall, F1 score, and AUC-ROC for classification performance. Additionally, tools like ROC curves will be used to visualize model performance.

- **Experiment Setup**

The experimental setup will follow these steps:

1. **Dataset Splitting**: The datasets will be divided into three subsets: training, validation, and testing. A typical ratio will be 70% training, 15% validation, and 15% testing.

2. **Model Training**: The models will be trained using the training data, and hyperparameters will be adjusted based on validation results.

3. **Performance Assessment**: Finally, the models will be evaluated on the testing subset, measuring the specified performance metrics.

The experimental design outlined here provides a comprehensive framework for conducting research aimed at predicting heart disease and detecting pneumonia using machine learning. By systematically addressing each component—research objectives, data collection, preprocessing, model training, evaluation metrics, and experiment setup—this design ensures a thorough investigation into the effectiveness of the proposed models, yielding valuable insights for healthcare applications.

2.5 Class Diagram

The class diagram of our system provides a structured overview of the key classes and their relationships.

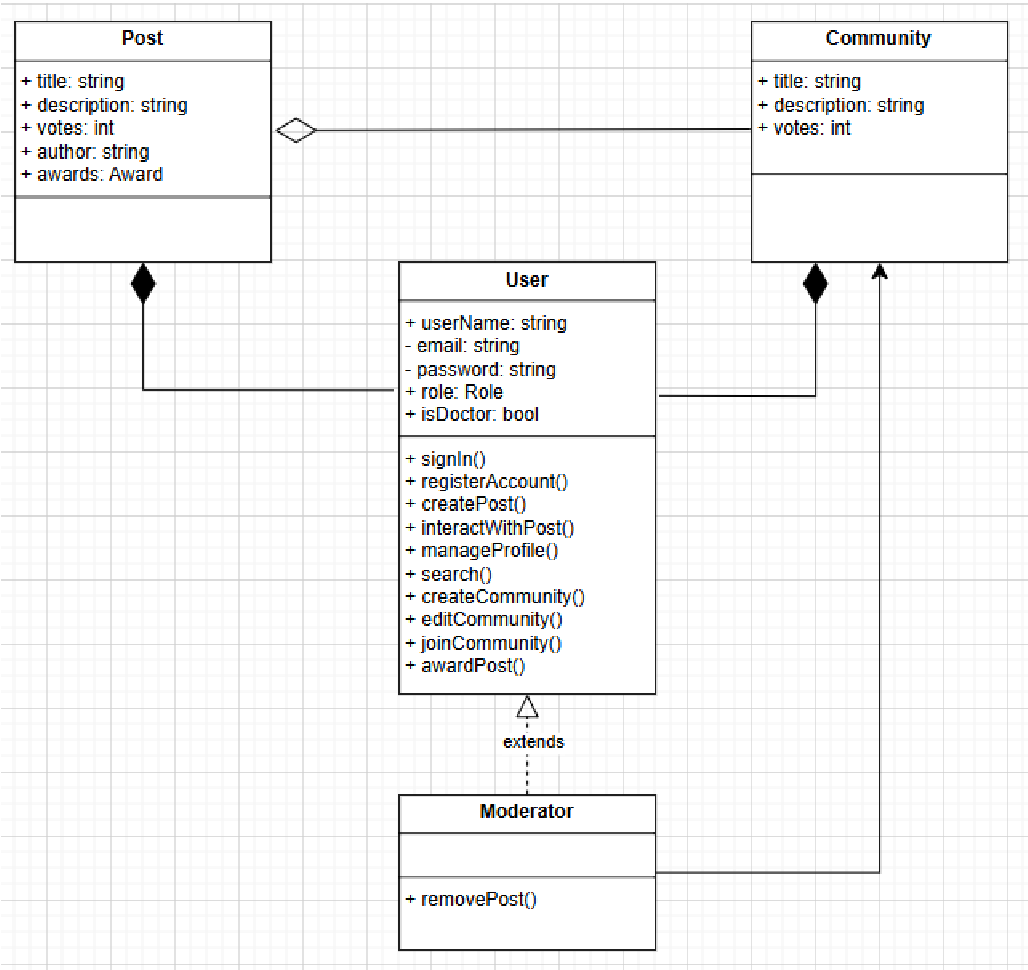


Figure 19 Class diagram

2.6 Component Diagram

A component diagram, also known as a UML component diagram, describes the organization and wiring of the physical components in a system. Component dia- grams are often drawn to help model implementation details and double-check that every aspect of the system's required functions is covered by planned development. Here is the following component diagram of our system:

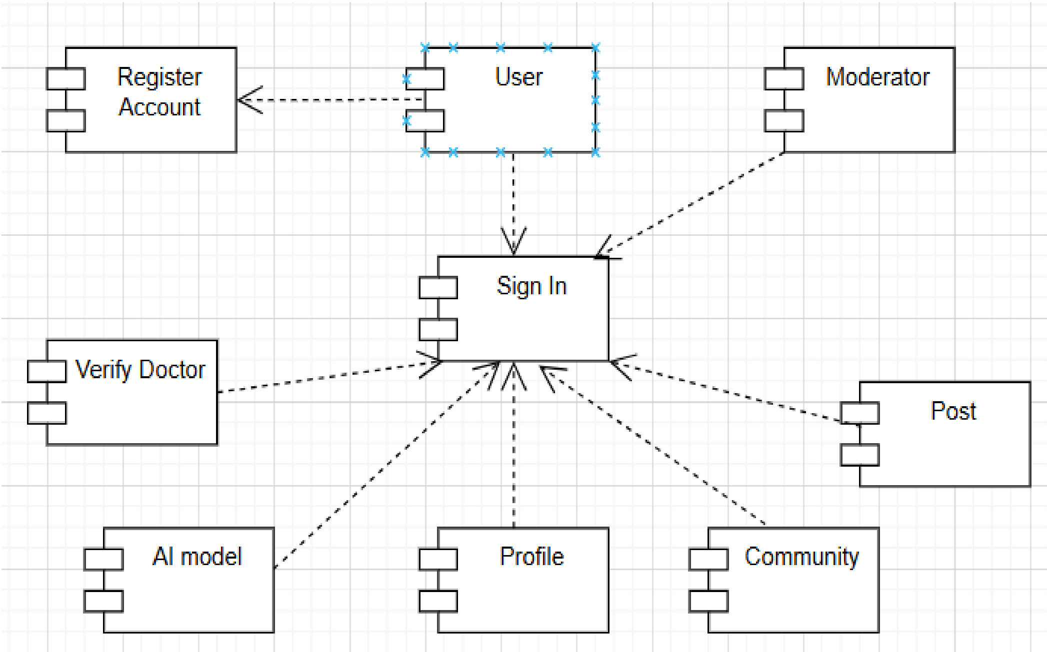


Figure 20 Component Diagram

2.7 Deployment Diagram

A deployment diagram is a UML diagram type that shows the execution architecture of a system, including nodes such as hardware or software execution environments, and the middleware connecting them. Here is the following deployment diagram of our system:

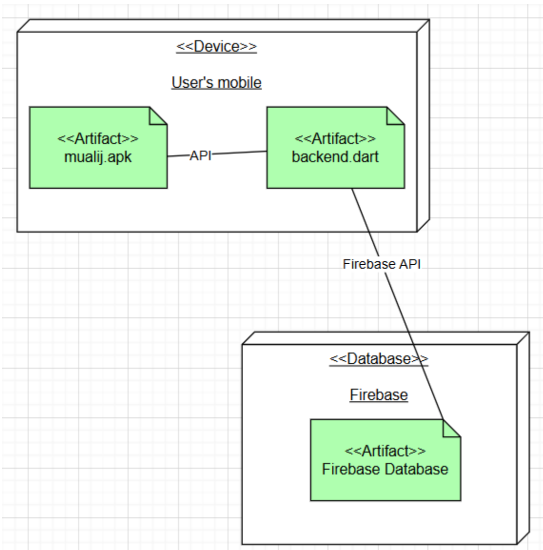


Figure 21 Deployment Diagram

2.8 ER Diagram

The ER diagram captures the structure of our system's data storage and how different entities are connected.

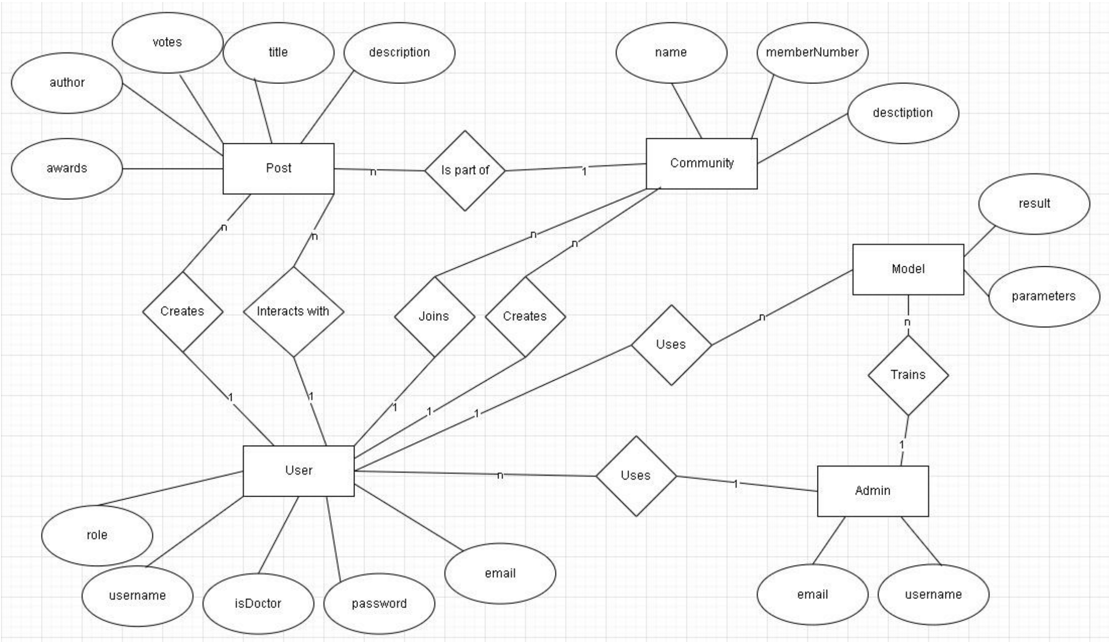


Figure 22 ER Diagram

2.9 Sequence Diagram

A sequence diagram or system sequence diagram (SSD) shows process interactions arranged in time sequence in the field of software engineering.

2.9.1 Login Sequence Diagram

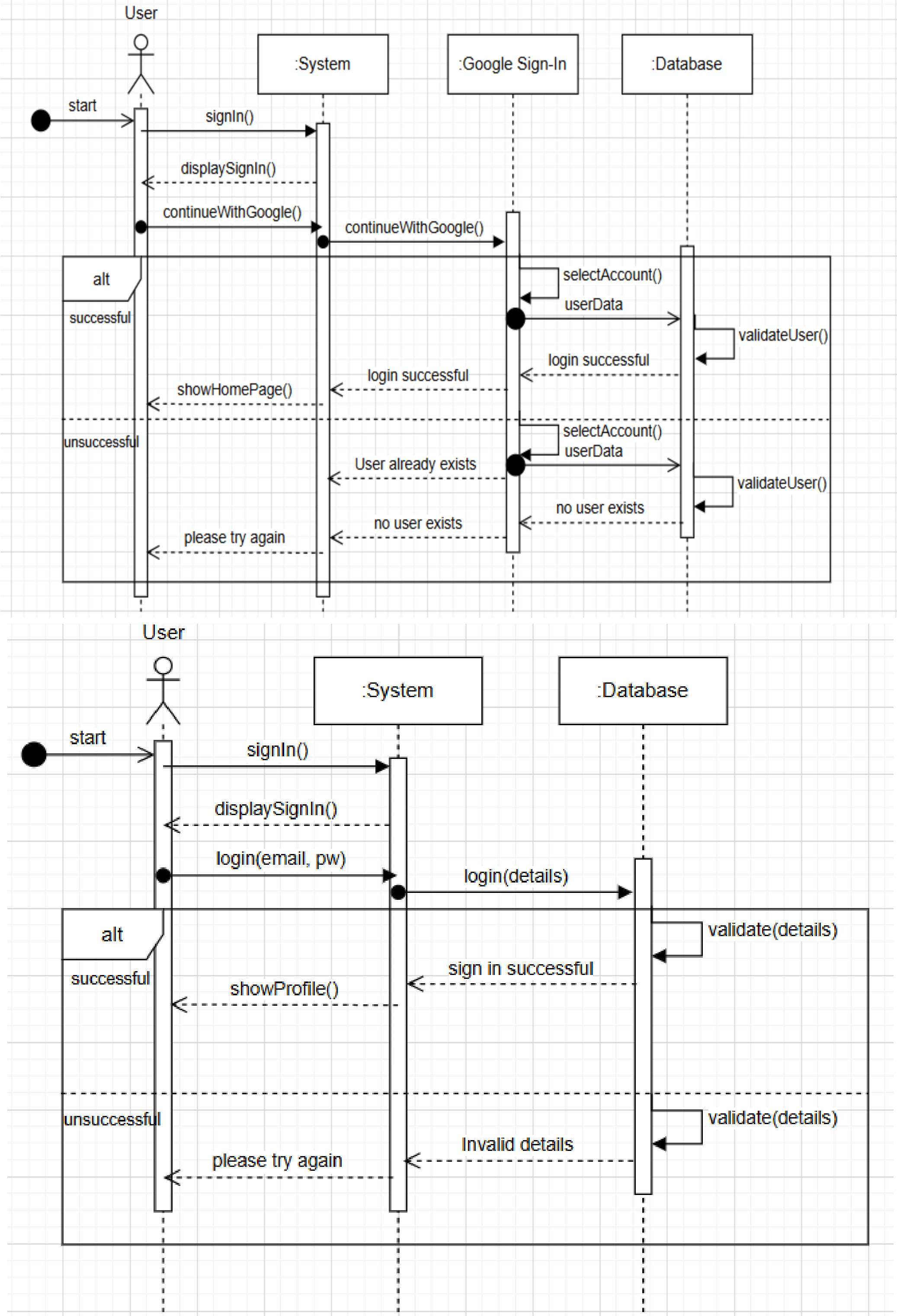


Figure 23 Login Sequence Diagram

2.9.2 Account Registration Sequence Diagram

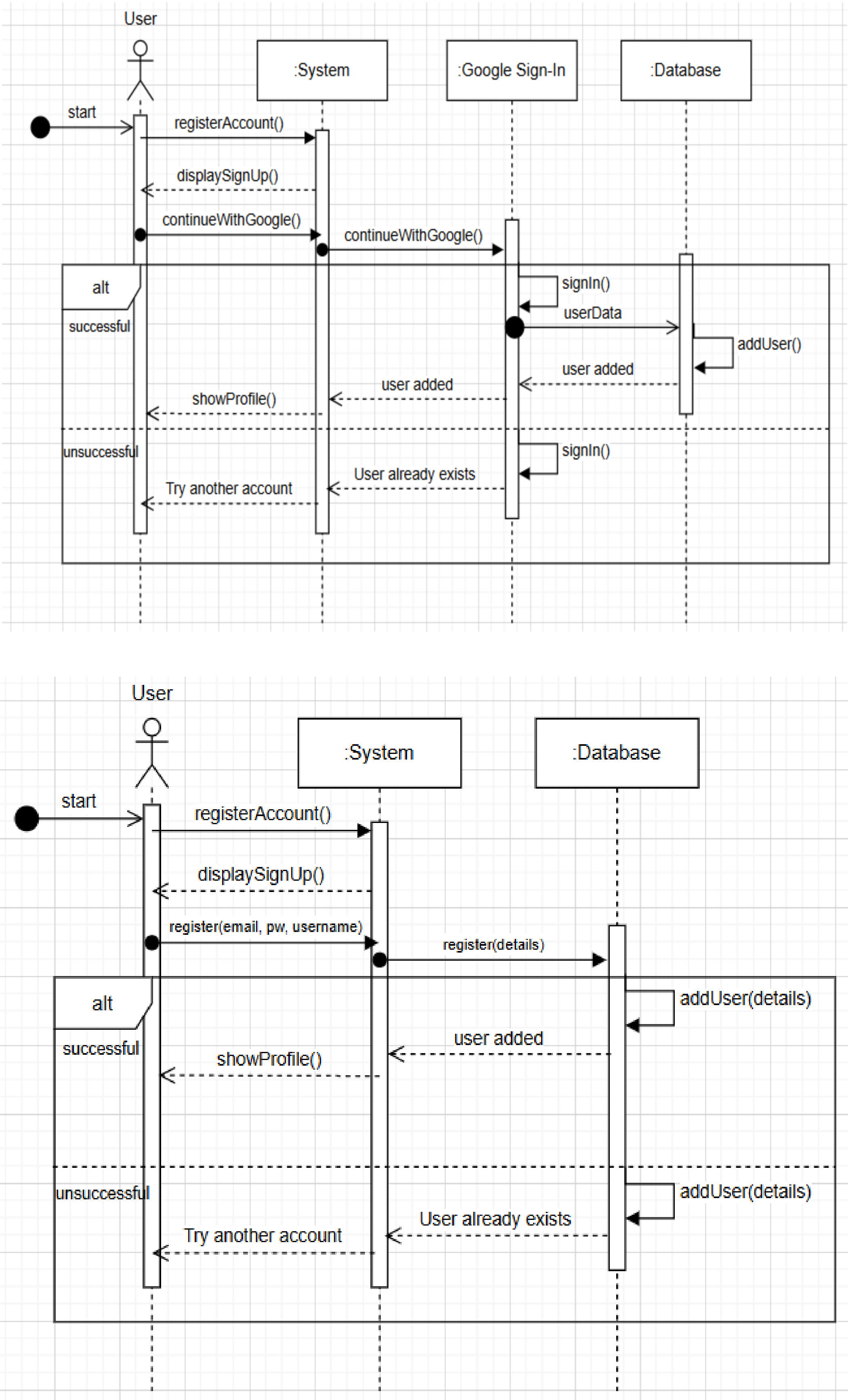


Figure 24 Registration Sequence Diagram

2.9.3 Create Post Sequence Diagram

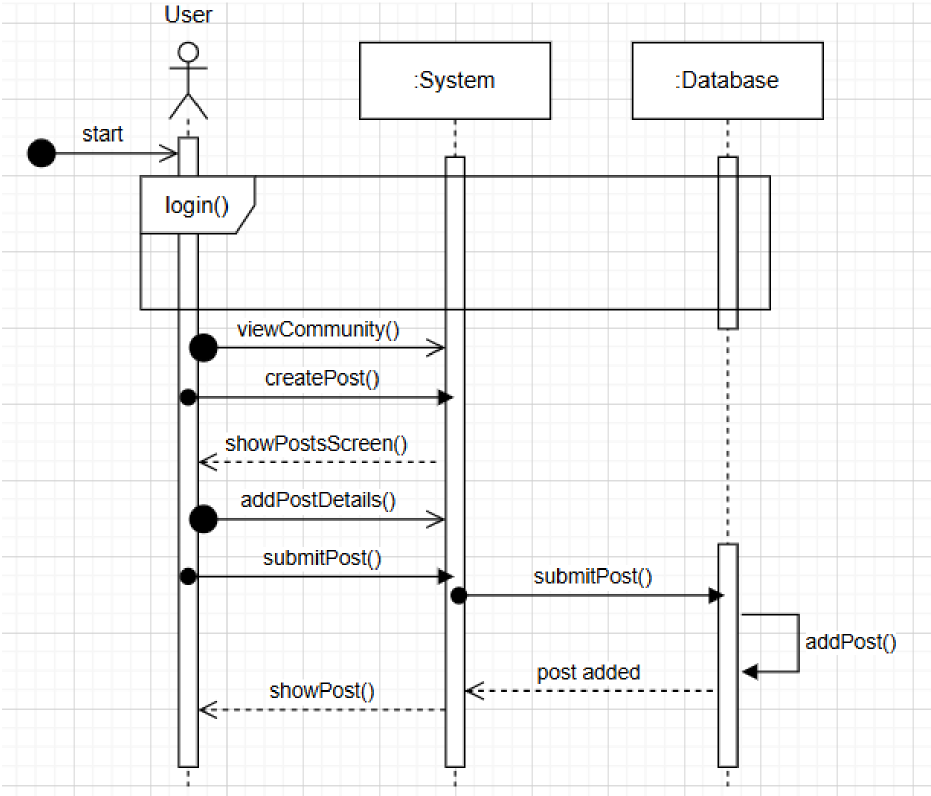


Figure 25 Create Post Sequence Diagram

2.9.4 Delete Post Sequence Diagram

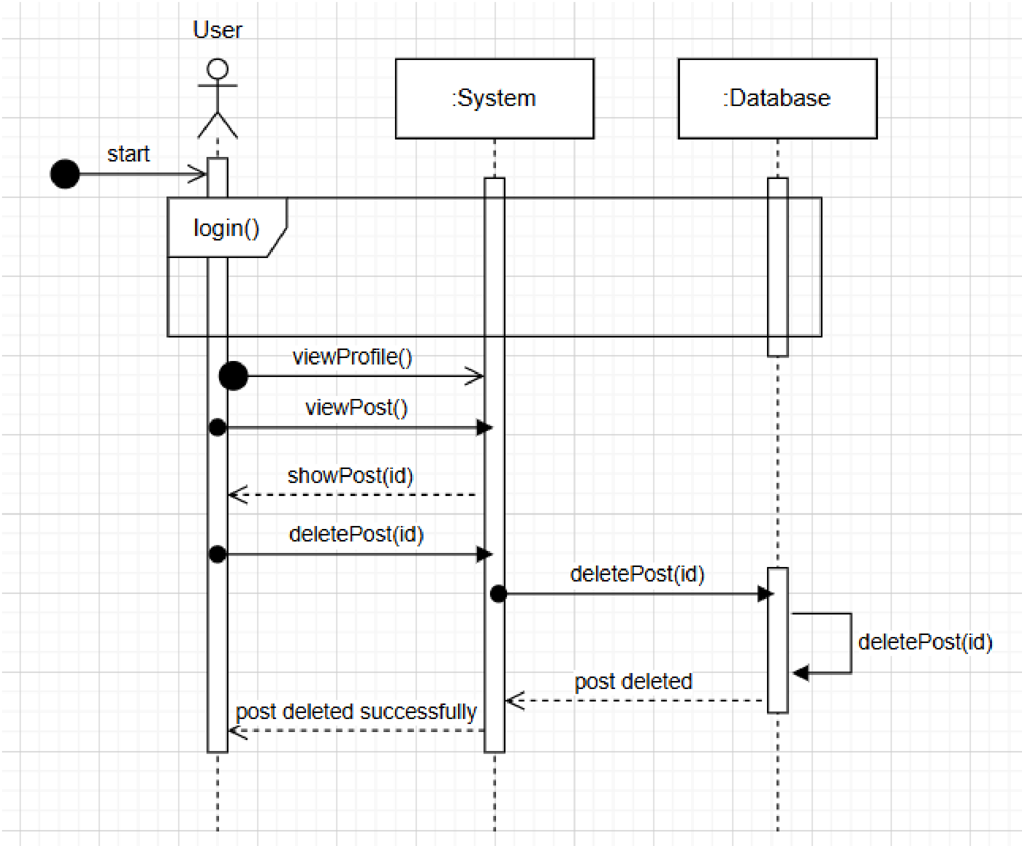


Figure 26 Delete Post Sequence Diagram

2.9.5 Interact with Post Sequence Diagram

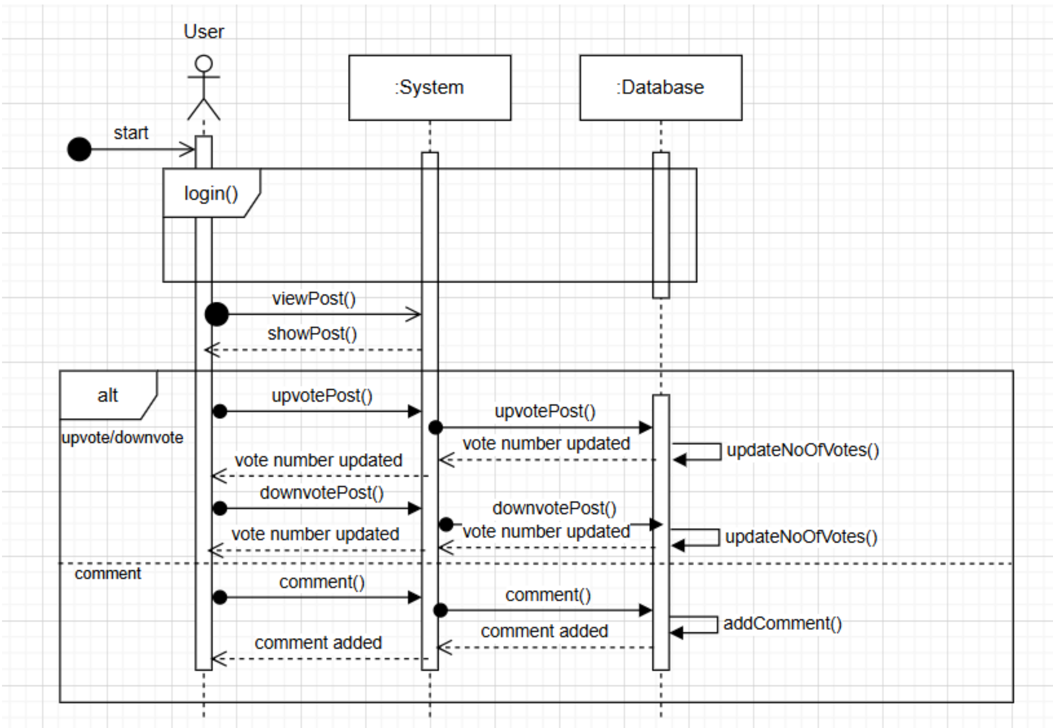


Figure 27 Interact with Post Sequence Diagram

2.9.6 AI model prediction Sequence Diagram

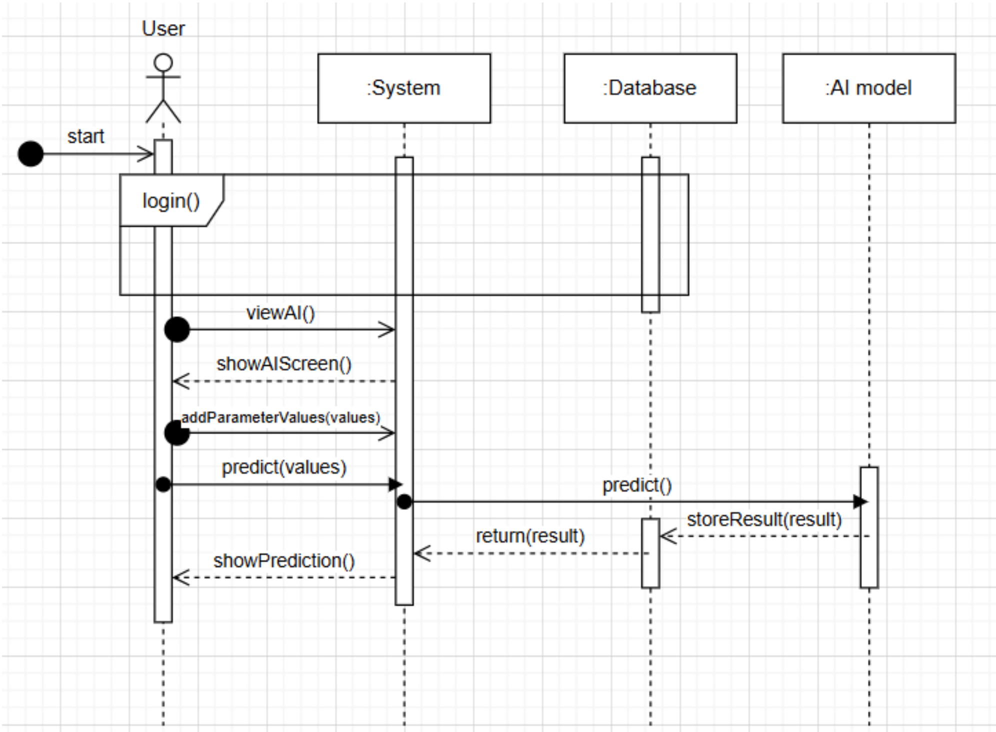


Figure 28 AI model prediction Sequence Diagram

2.9.7 Profile Management Sequence Diagram

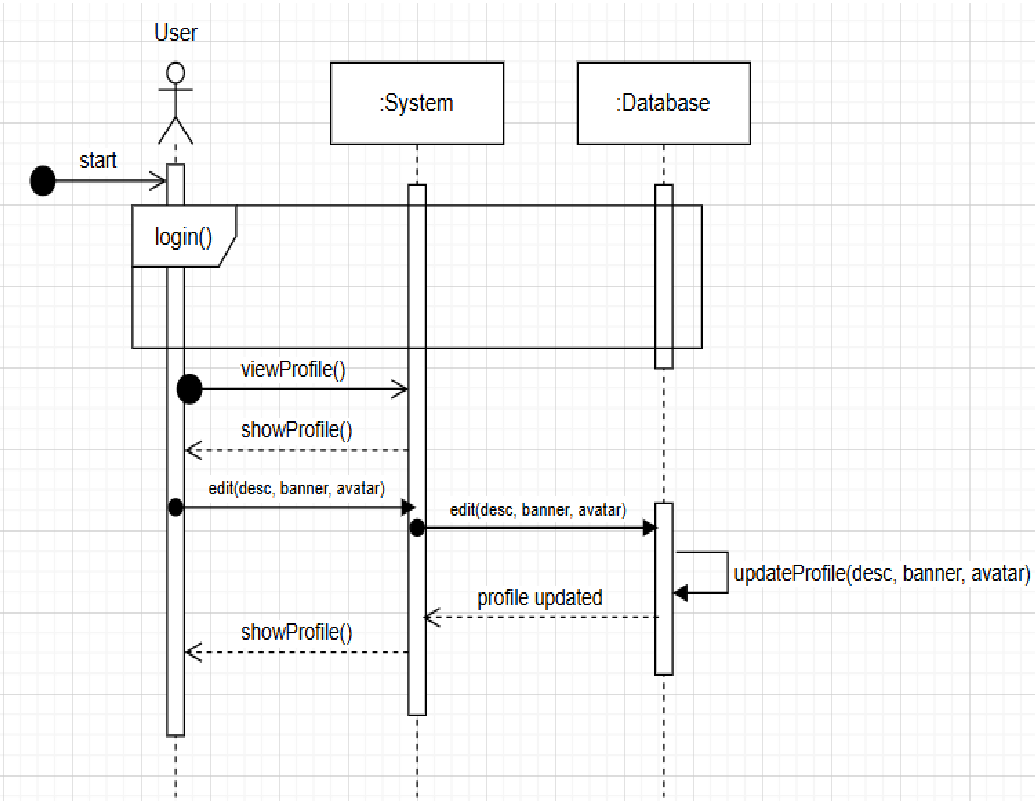


Figure 29 Profile Management Sequence Diagram

2.9.8 Search Post Sequence Diagram

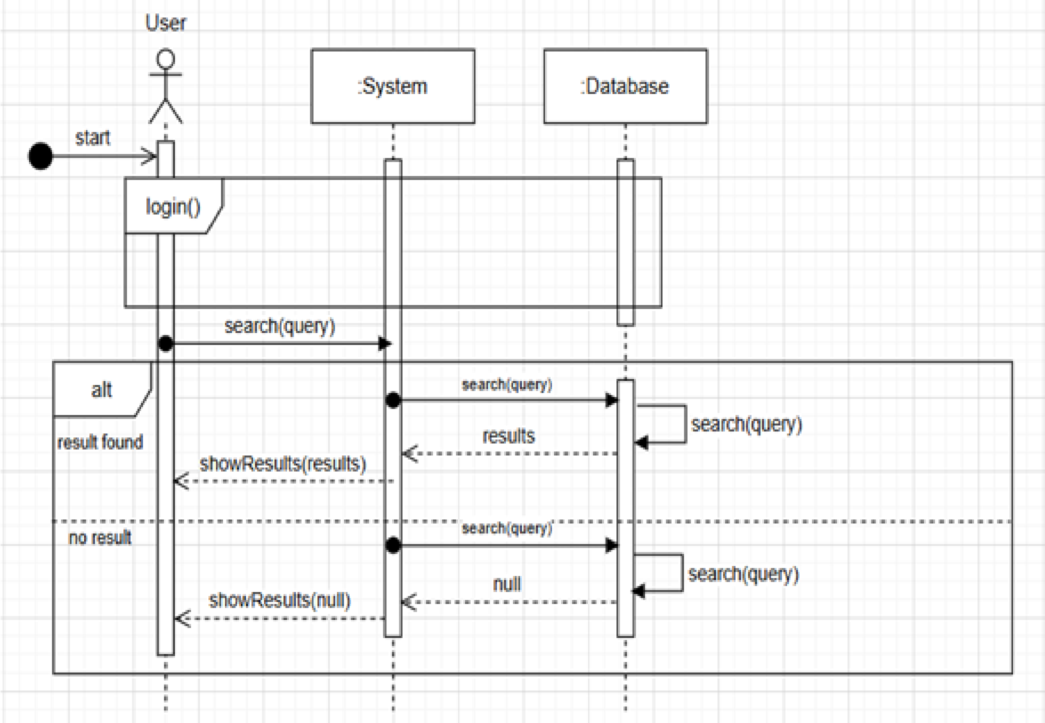


Figure 30 Search Post Sequence Diagram

2.9.9 Community Creation Sequence Diagram

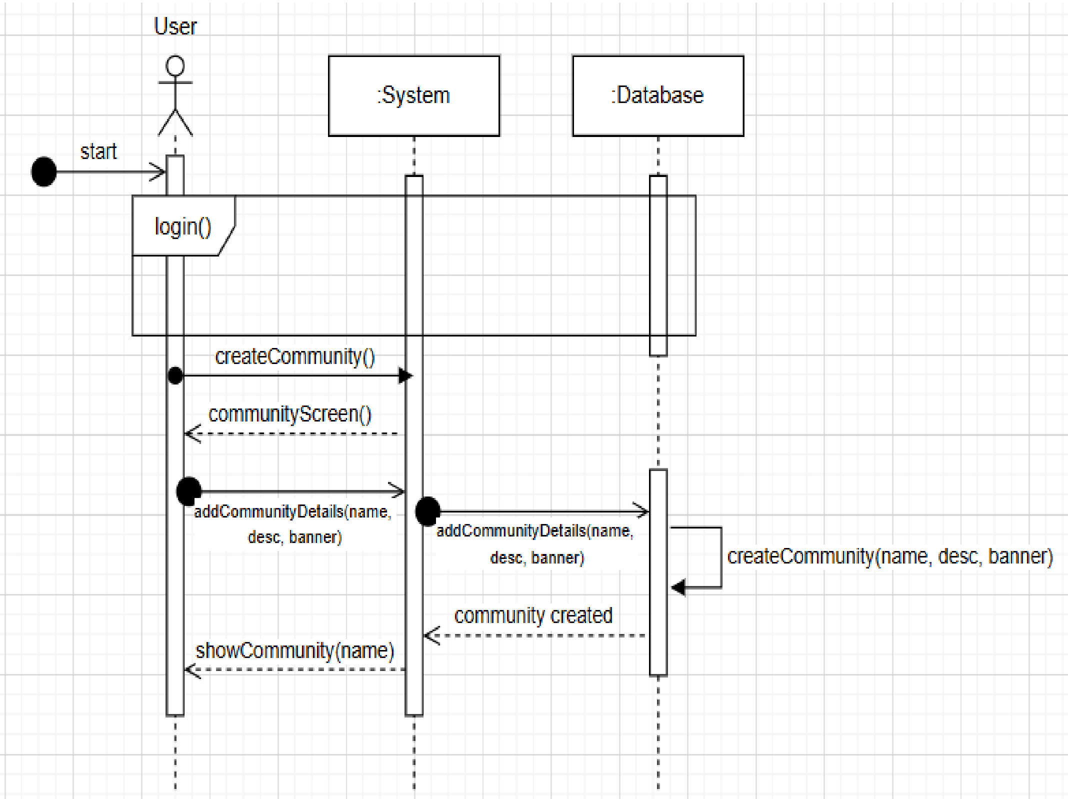


Figure 31 Community Creation Sequence Diagram

2.9.10 Edit Community Sequence Diagram

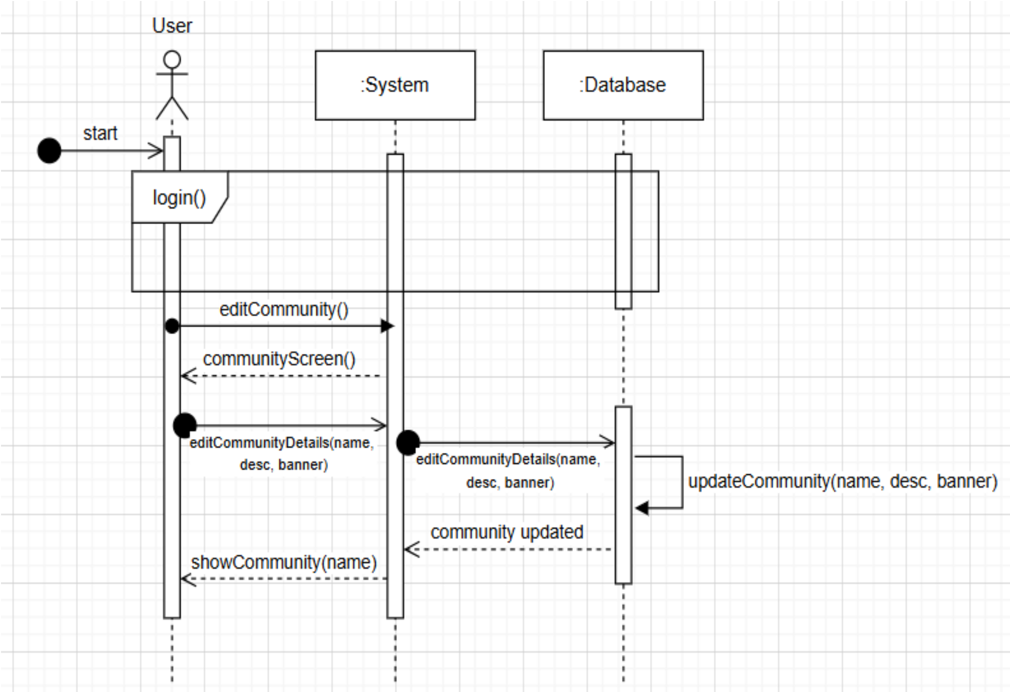


Figure 32 Edit Community Sequence Diagram

2.9.11 Add Moderators Sequence Diagram

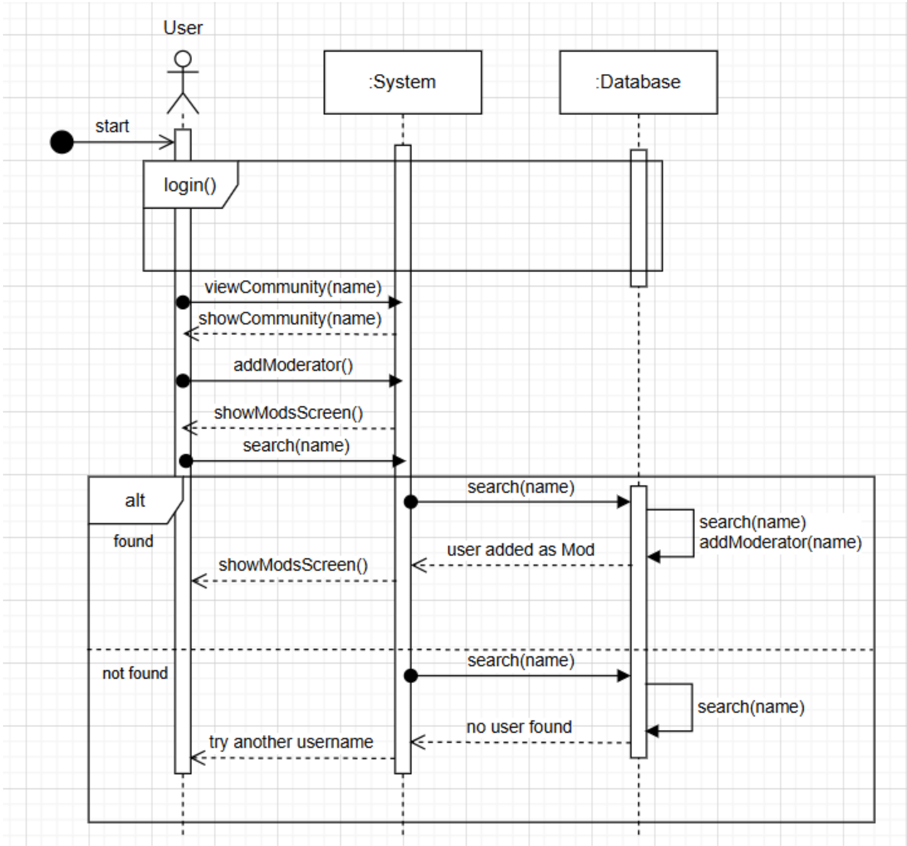


Figure 33 Add moderators Sequence Diagram

2.9.12 Join Community Sequence Diagram

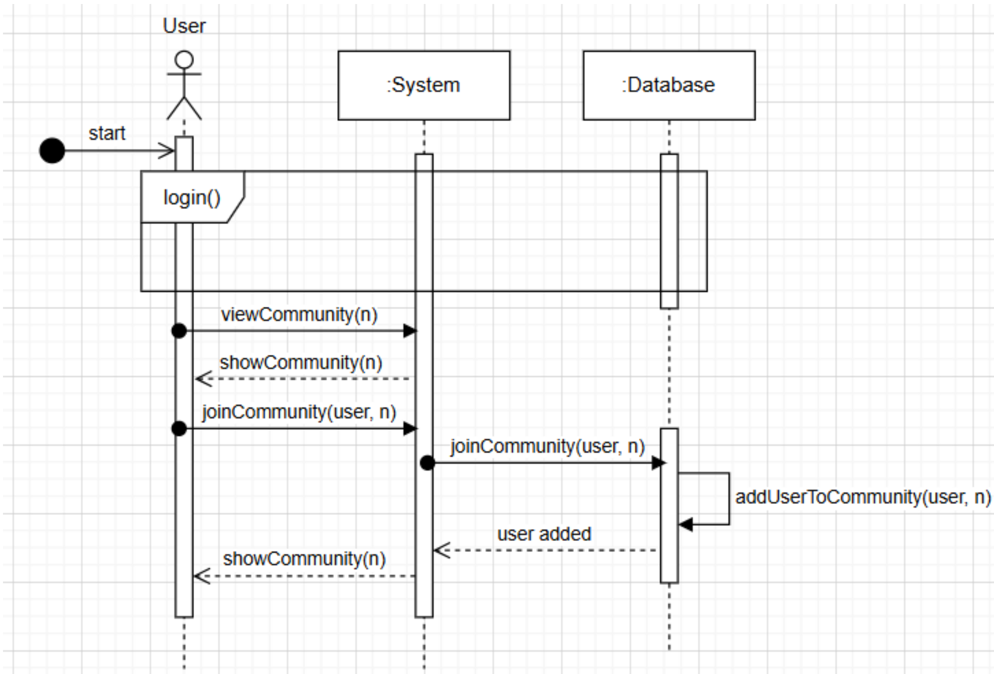


Figure 34 Join Community Sequence Diagram

2.9.13 Award Post Sequence Diagram

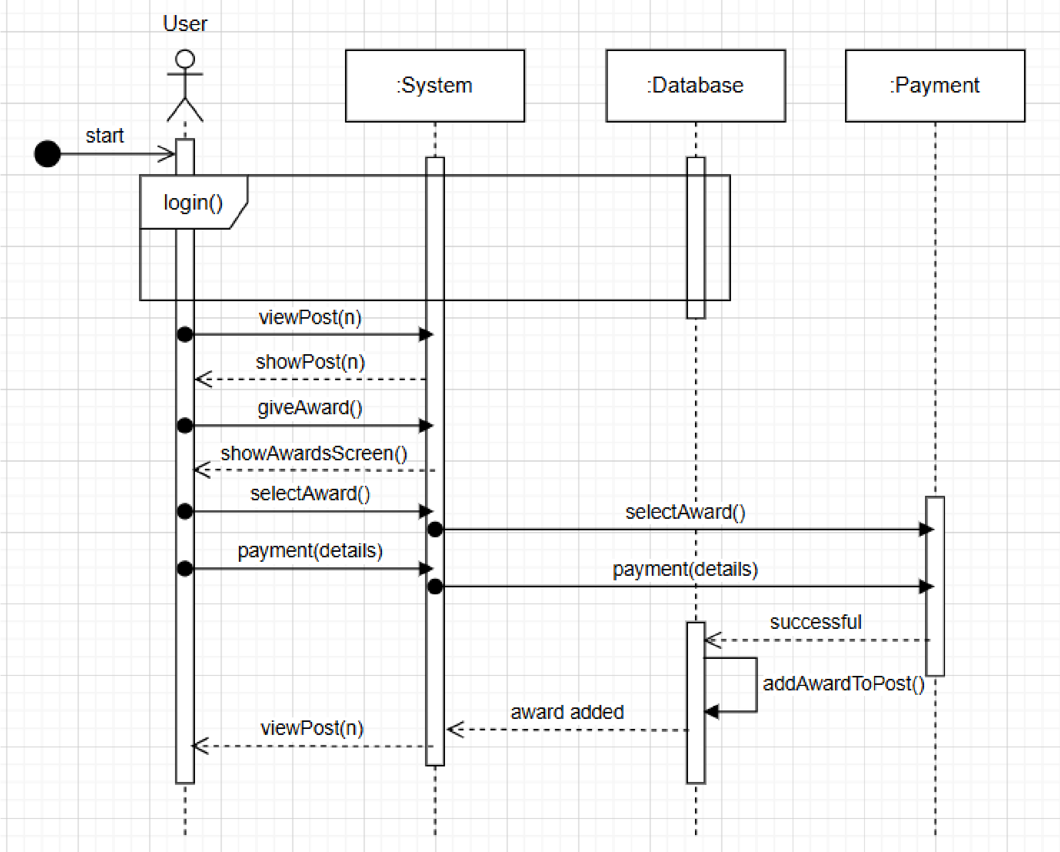


Figure 35 Award Post Sequence Diagram

2.9.14 Remove Post (Moderator) Sequence Diagram

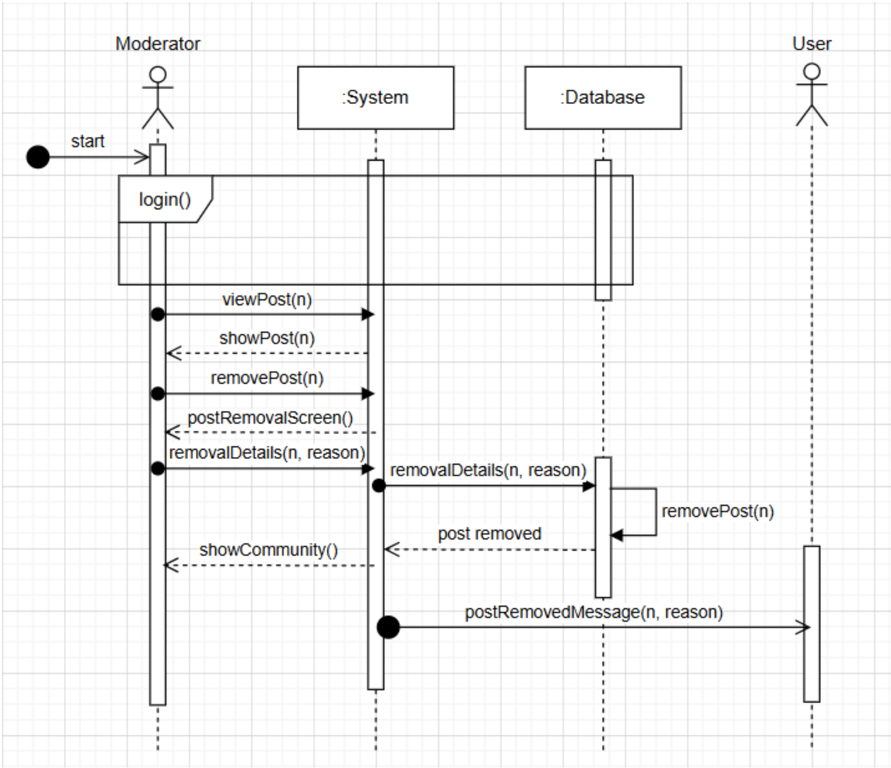


Figure 36 Remove Post Sequence Diagram

2.9.15 Get verified as a Doctor Sequence Diagram

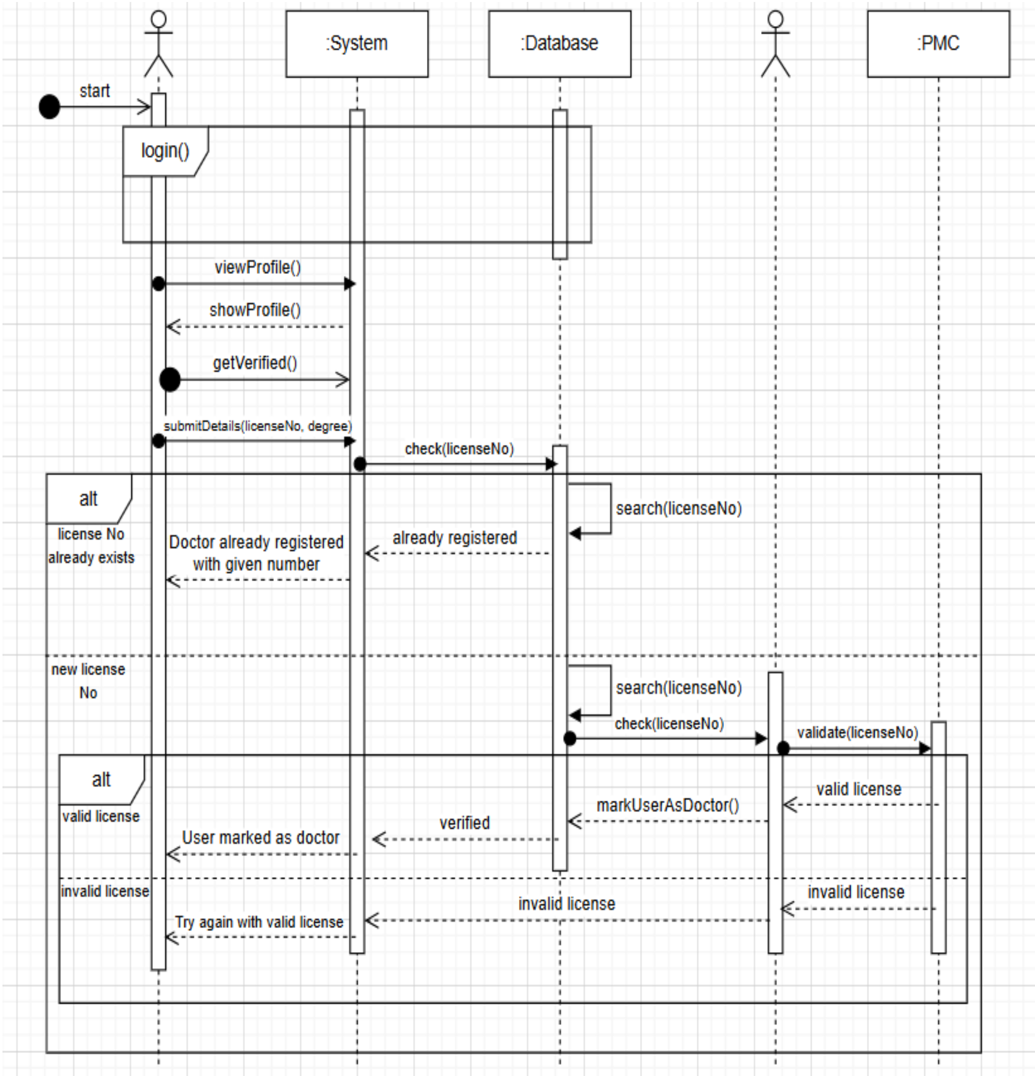


Figure 37 Get verified as a Doctor Sequence Diagram

2.10 State Chart Diagram

A state diagram (also known as a state machine or state chart diagram) is an illustration of all the possible behavioral states a software system component may exhibit and the various state changes it's predicted to undergo over the course of its operations.

2.10.1 Login State Chart Diagram

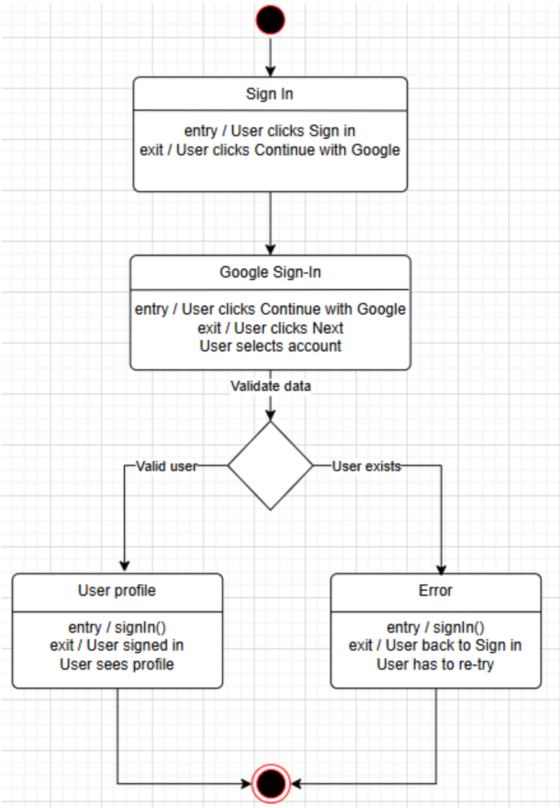


Figure 38 Login State Chart Diagram

2.10.2 Account Registration State Chart Diagram

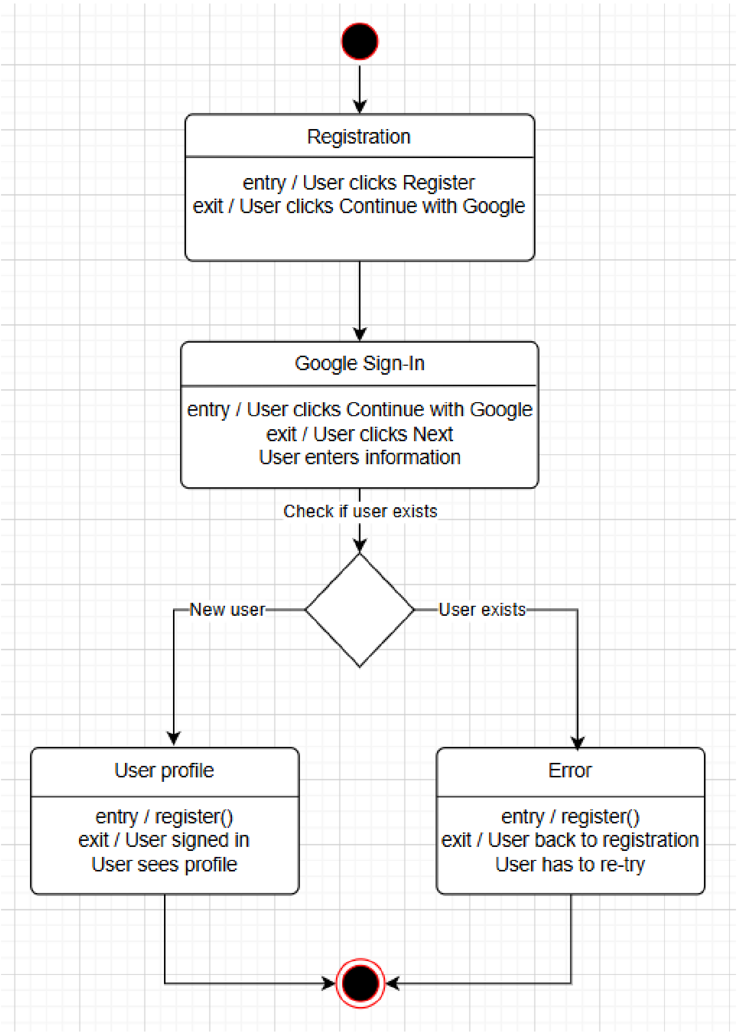


Figure 39 Account Registration State Chart Diagram

2.10.3 Create Post State Chart Diagram

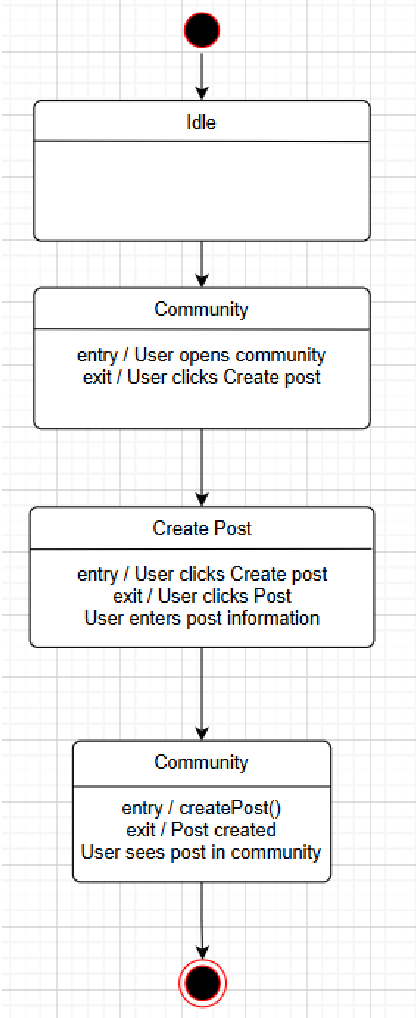


Figure 40 Create Post State Chart Diagram

2.10.4 Delete Post State Chart Diagram

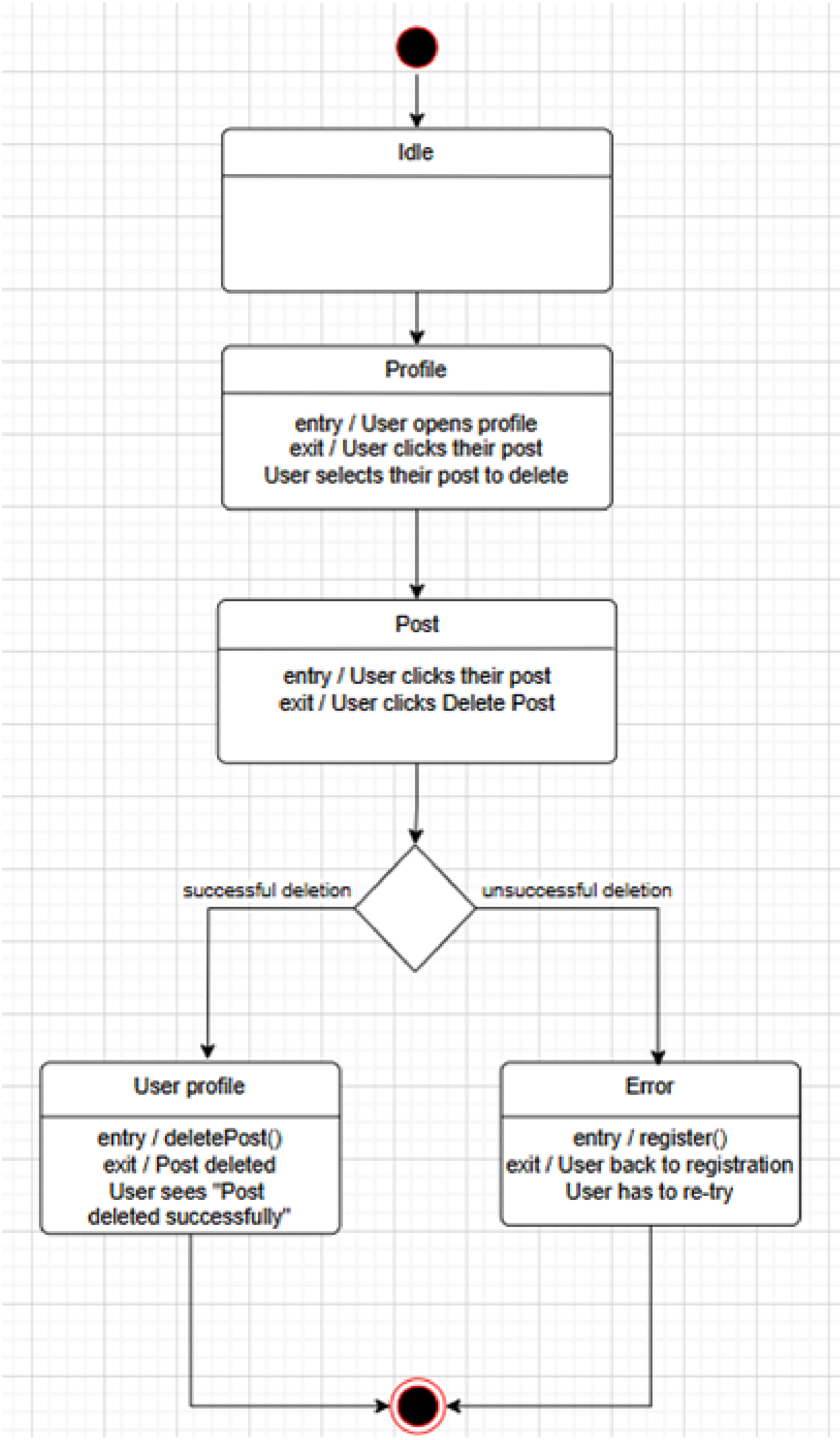


Figure 41 Delete Post State Chart Diagram

2.10.5 Interact with post State Chart Diagram

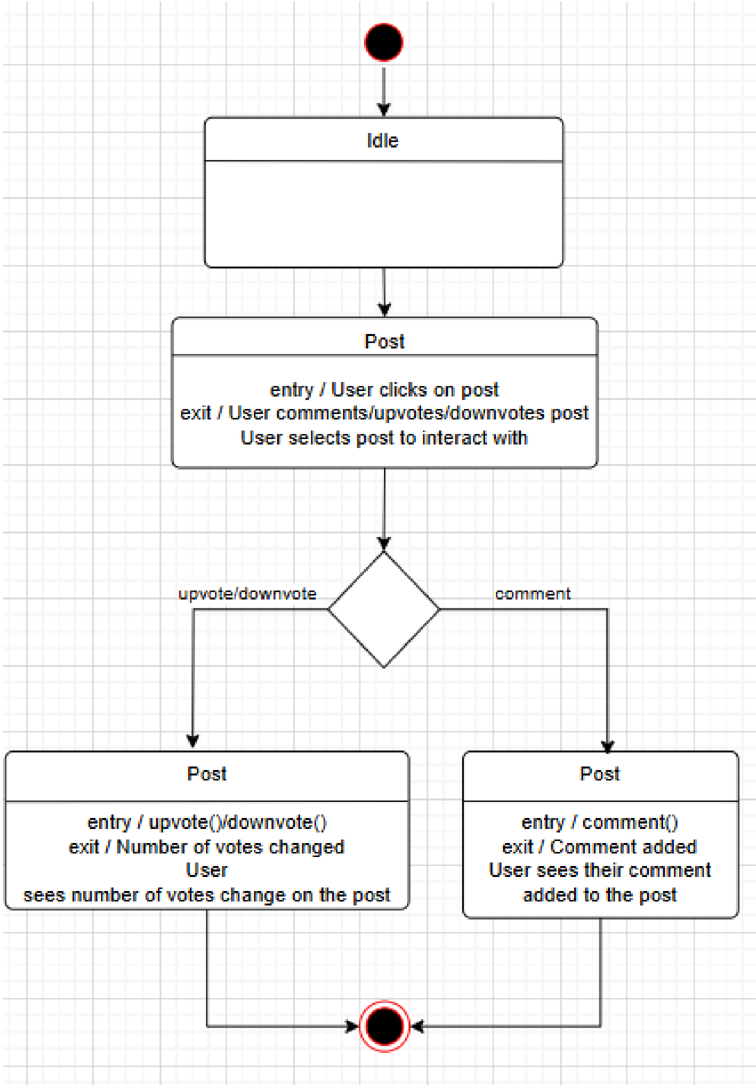


Figure 42 Interact with post State Chart Diagram

2.10.6 AI model prediction State Chart Diagram

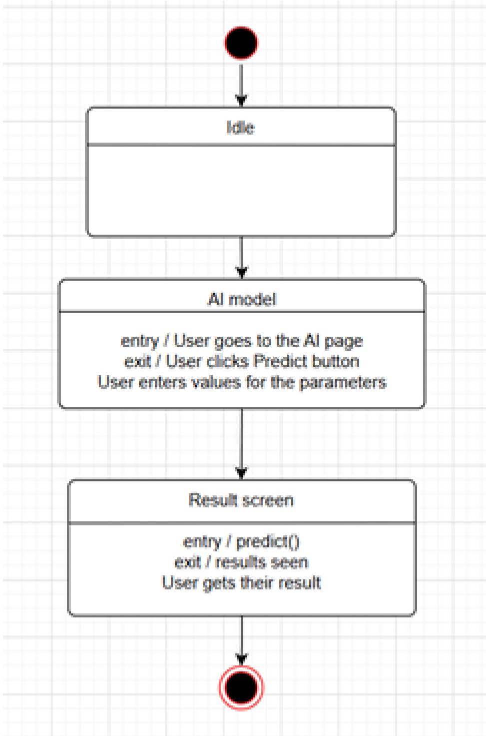


Figure 43 AI model prediction State Chart Diagram

2.10.7 Profile Management State Chart Diagram

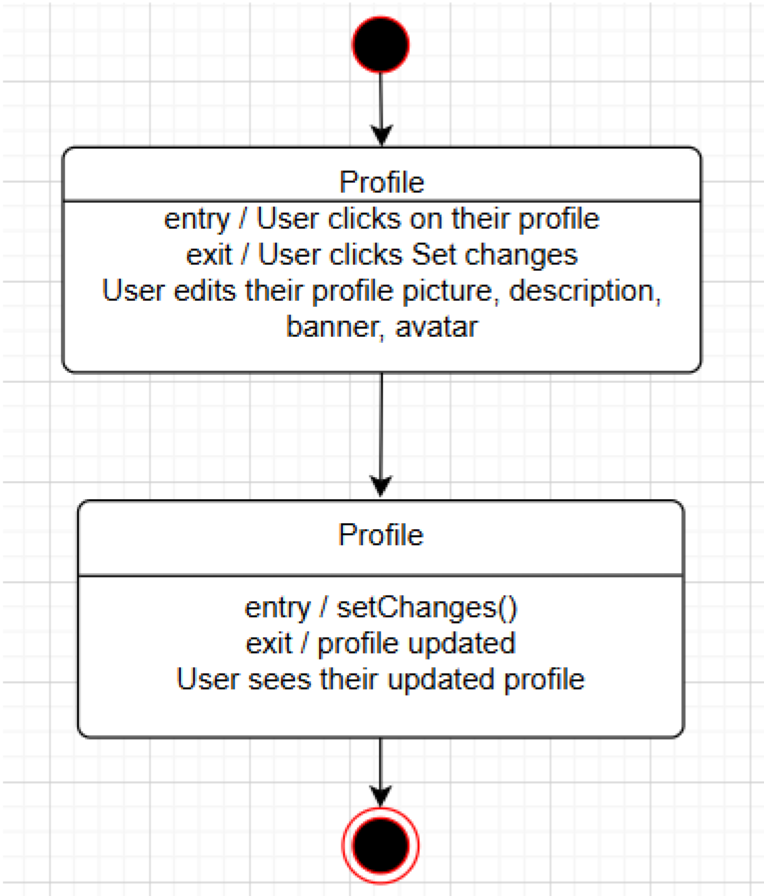


Figure 44 Profile Management State Chart Diagram

2.10.8 Search Post State Chart Diagram

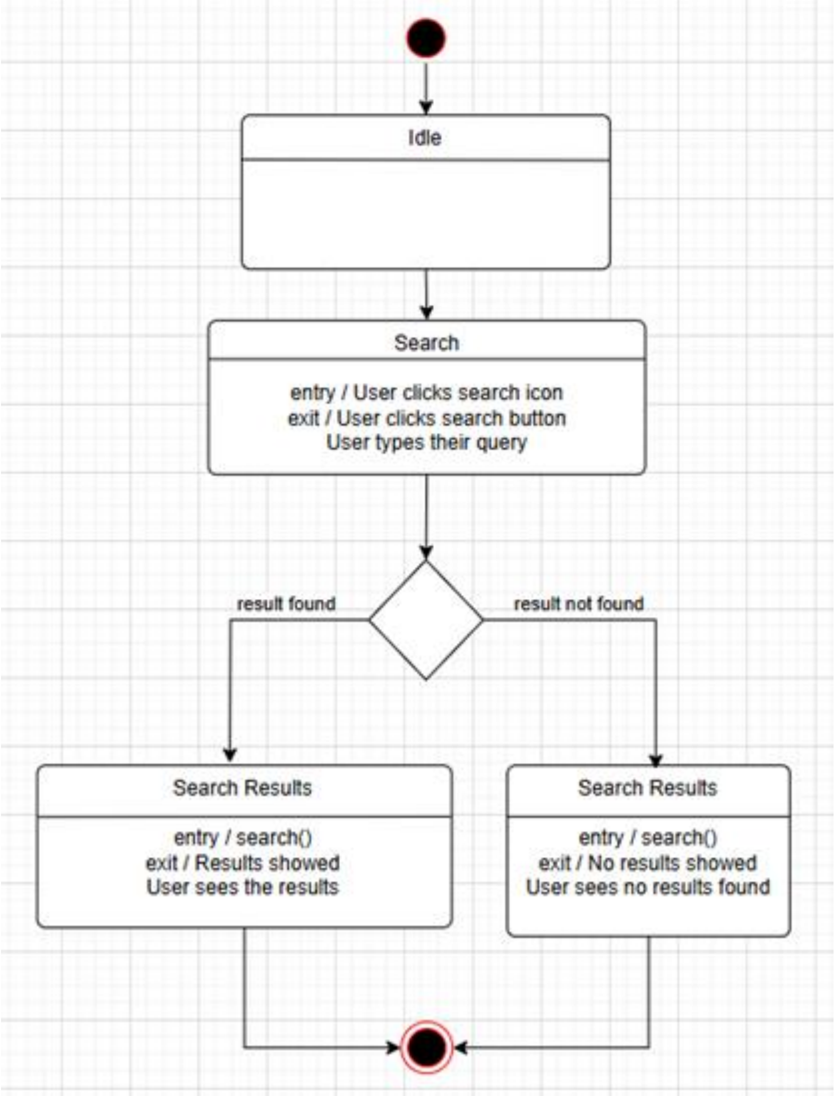


Figure 45 Search Post State Chart Diagram

2.10.9 Create Community State Chart Diagram

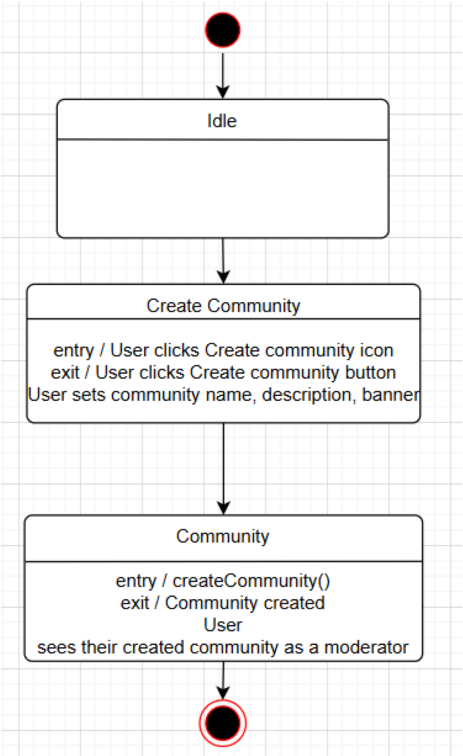


Figure 46 Create Community State Chart Diagram

2.10.10 Edit Community State Chart Diagram

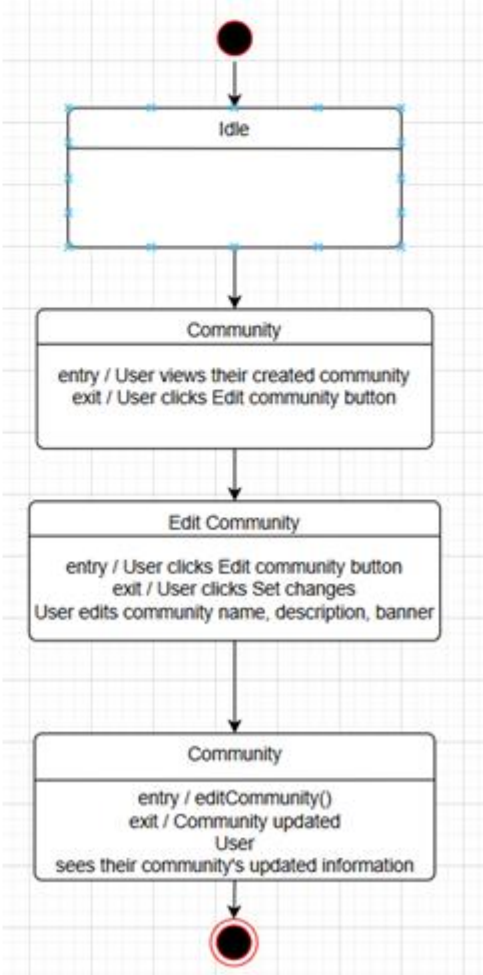


Figure 47 Edit Community State Chart Diagram

2.10.11 Add Moderators State Chart Diagram

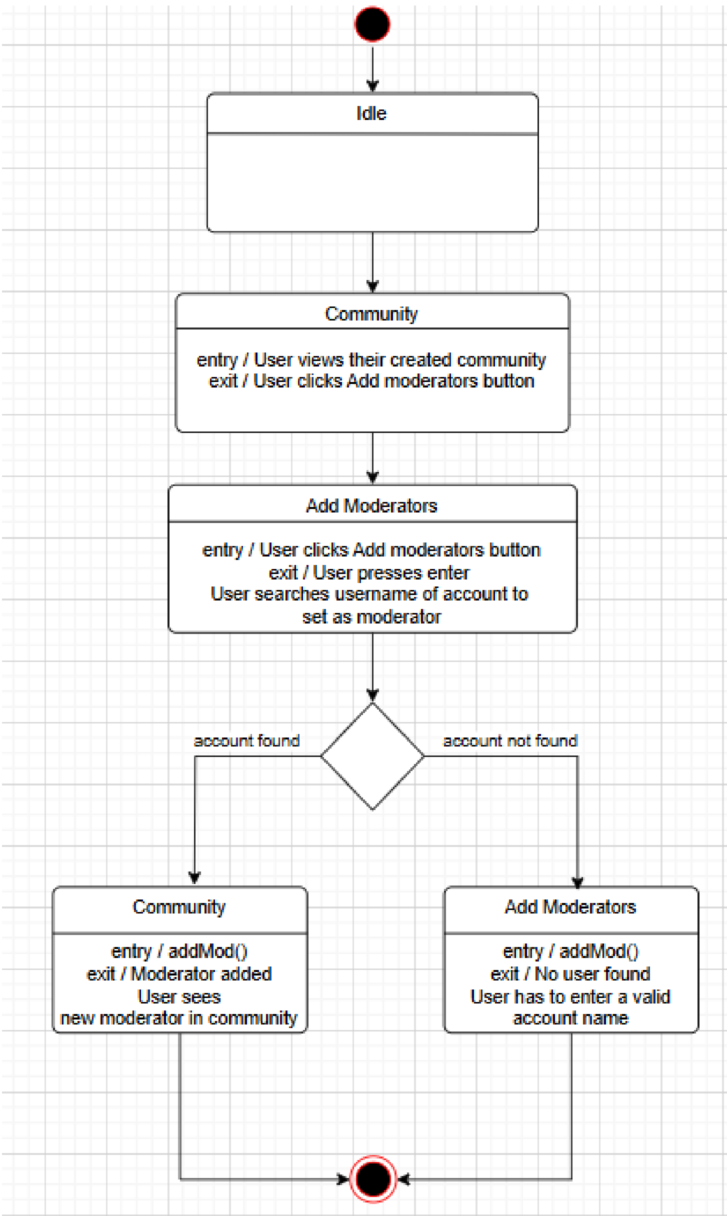


Figure 48 Add Moderators State Chart Diagram

2.10.12 Join Community State Chart Diagram

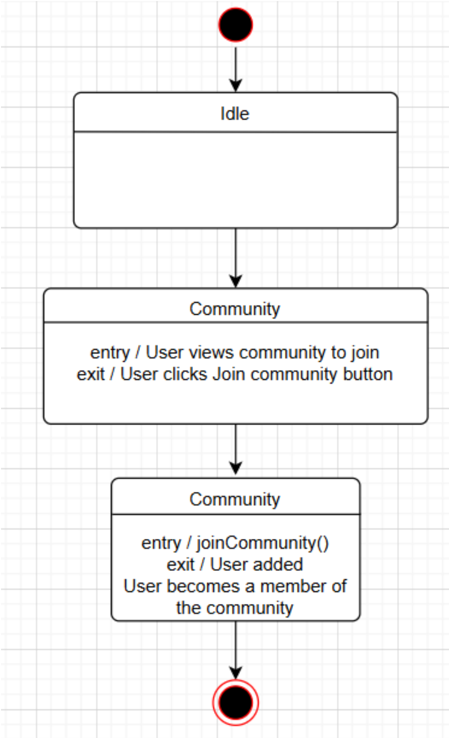


Figure 49 Join Community State Chart Diagram

2.10.13 Award Post State Chart Diagram

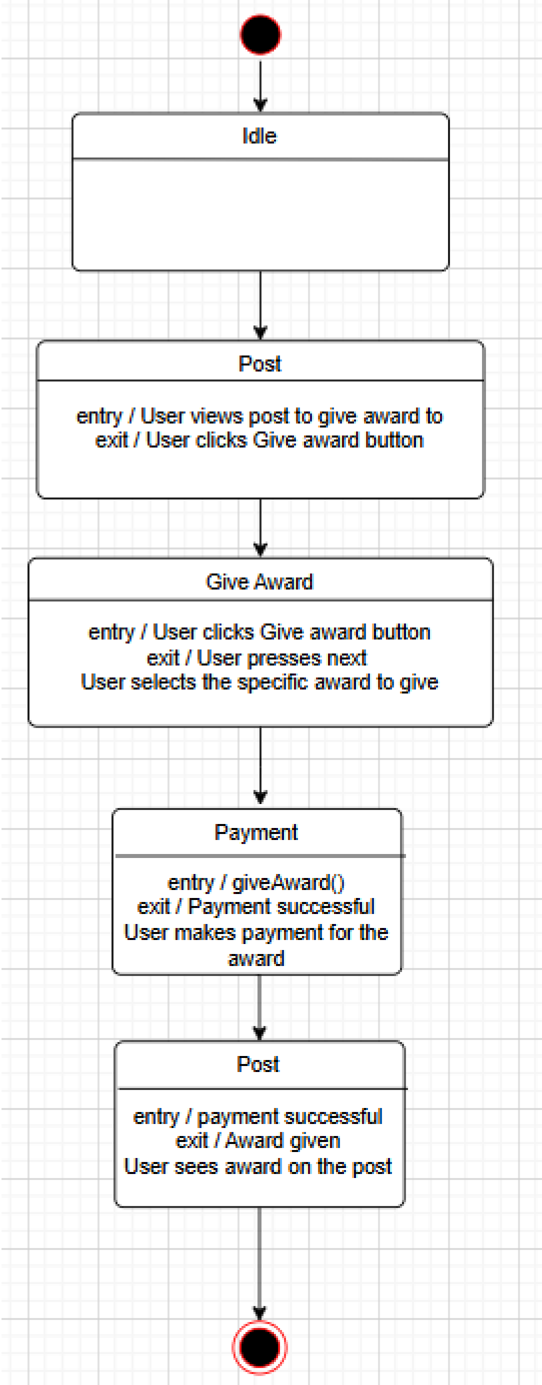


Figure 50 Award Post State Chart Diagram

2.10.14 Remove Post (Moderator) State Chart Diagram

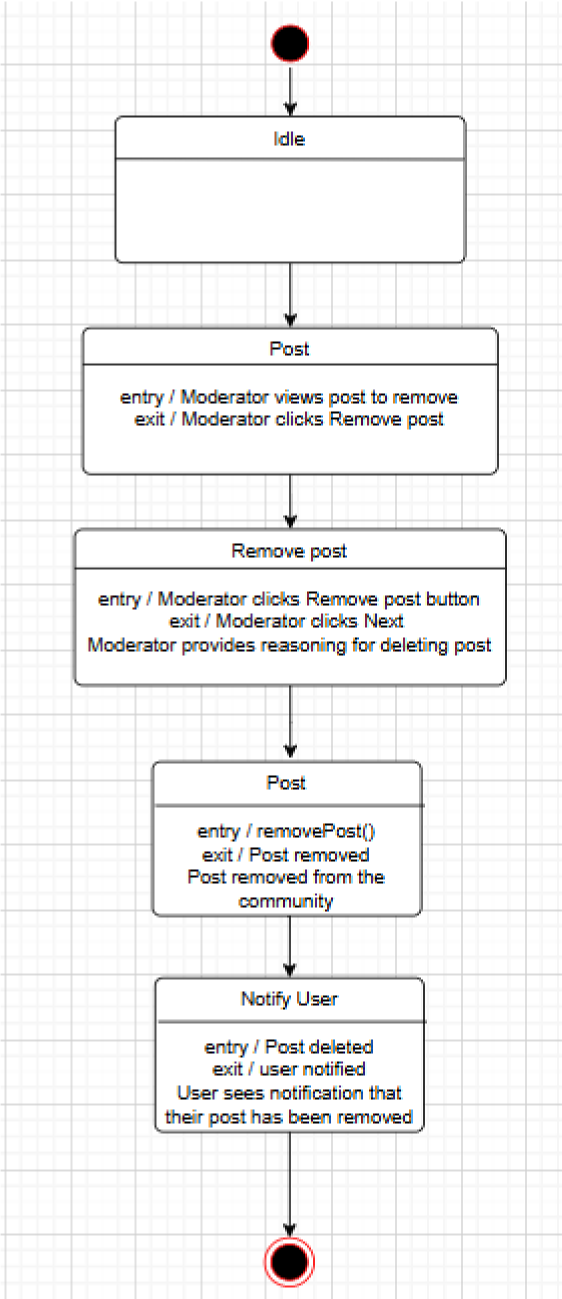


Figure 51 Remove Post (Moderator) State Chart Diagram

2.10.15 Get verified as a Doctor Activity Diagram

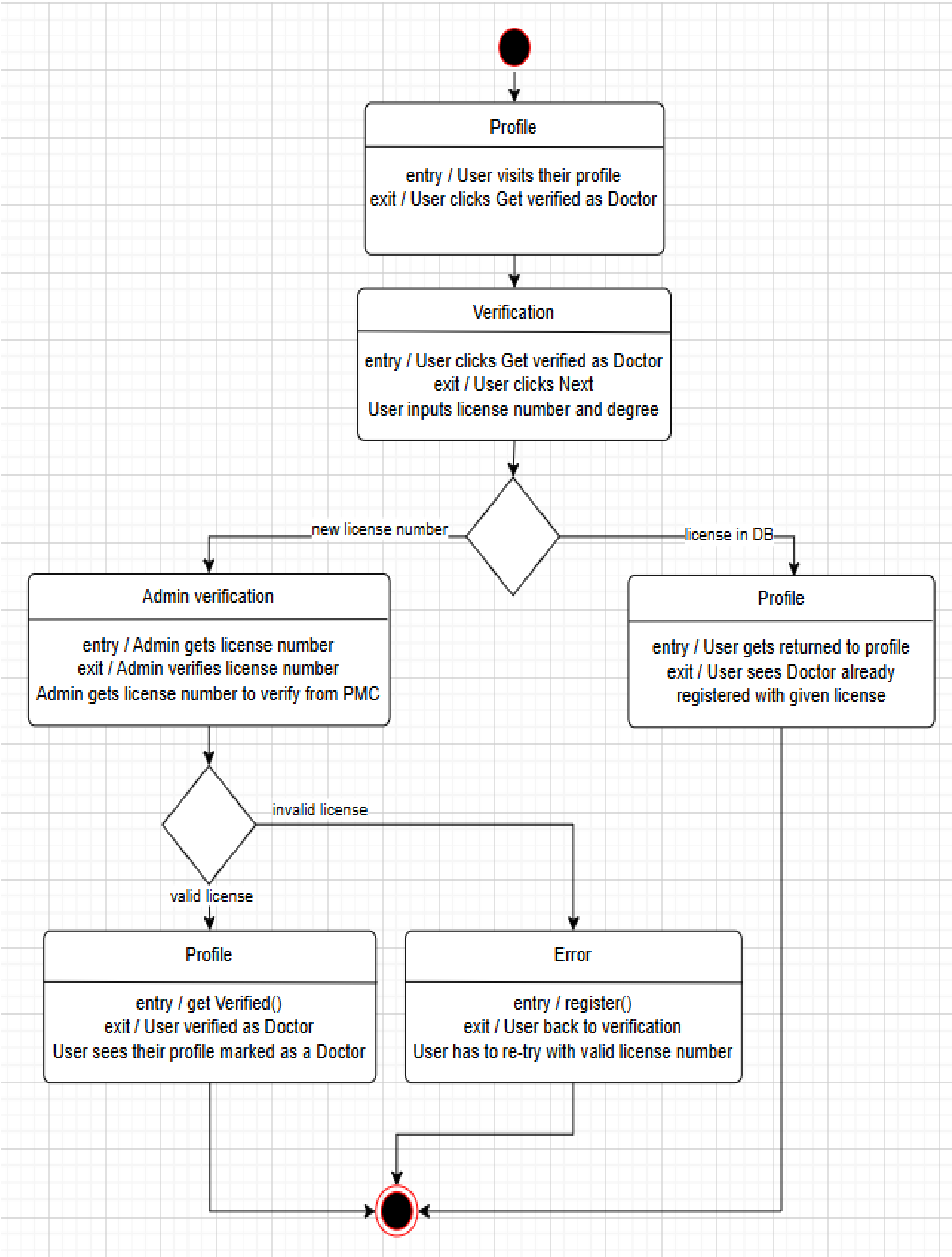


Figure 52 Get verified as a Doctor State Chart Diagram

2.11 Activity Diagram

Activity diagrams are graphical representations of workflows of stepwise activities and actions with support for choice, iteration, and concurrency. In the Unified Modeling Language, activity diagrams are intended to model both computational and organizational processes (i.e., workflows), as well as the data flows intersecting with the related activities. Although activity diagrams primarily show the overall flow of control, they can also include elements showing the flow of data between activities through one or more data stores. Here are the activity diagrams related to our system are as follows:

2.11.1 Login Activity Diagram

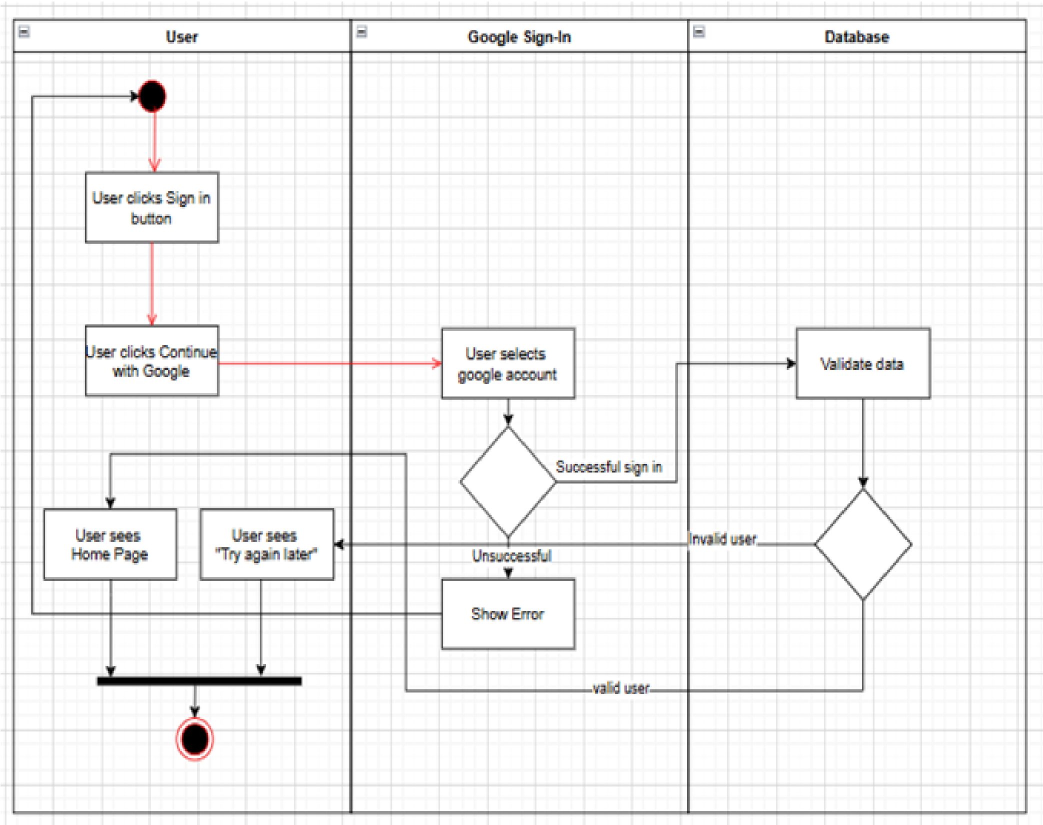


Figure 53 Login Activity Diagram

2.11.2 Account Registration Activity Diagram

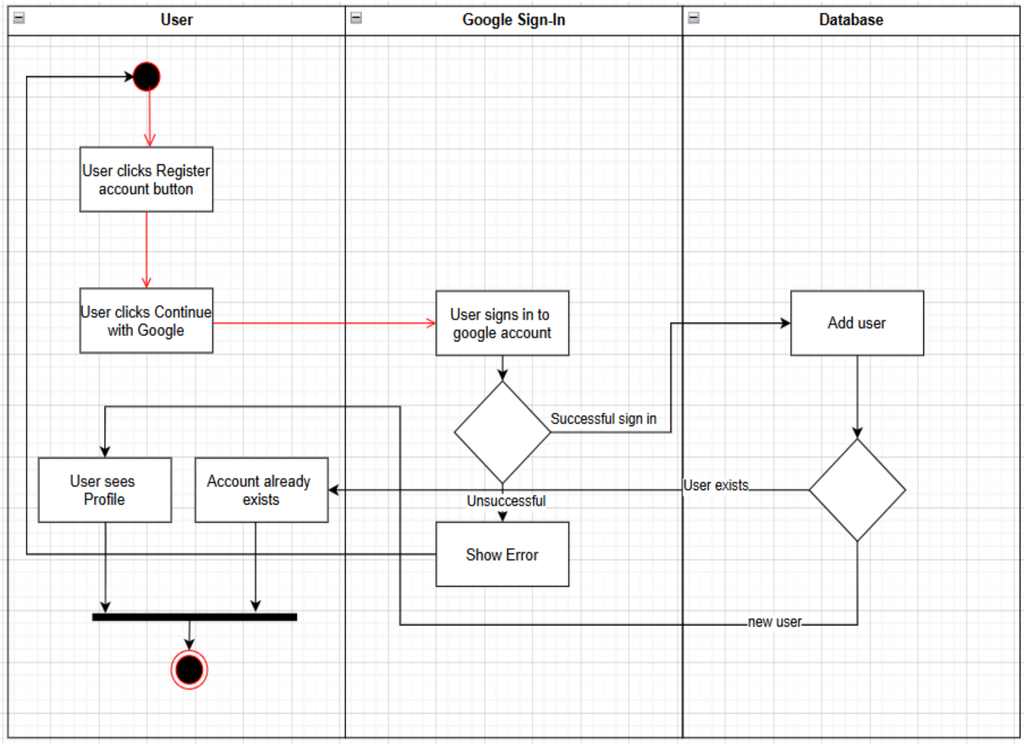


Figure 54 Account Registration Activity Diagram

2.11.3 Create Post Activity Diagram

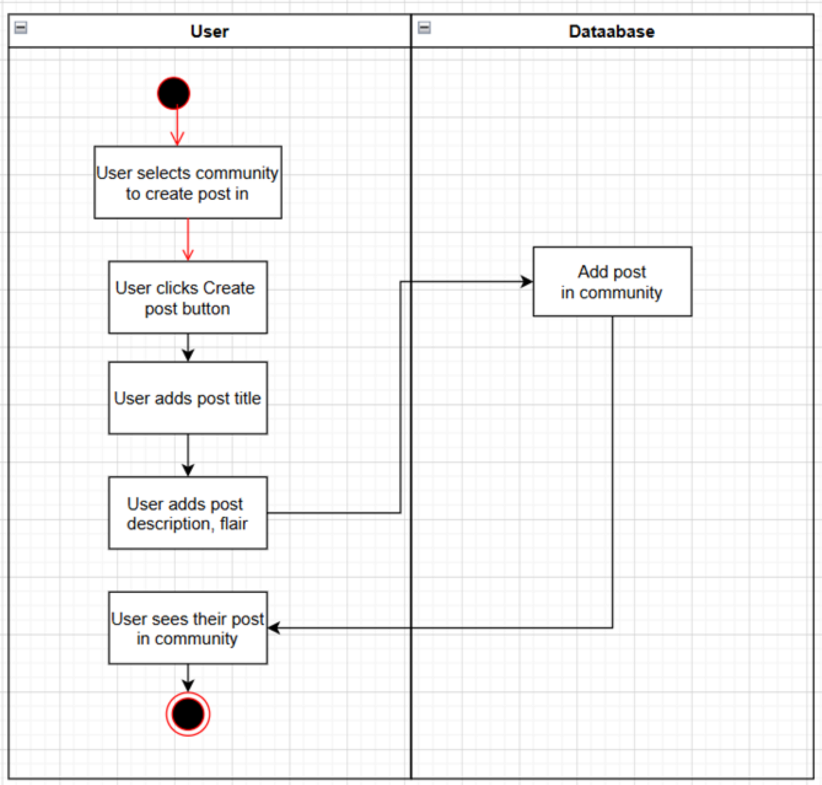


Figure 55 Create Post Activity Diagram

2.11.4 Delete Post Activity Diagram

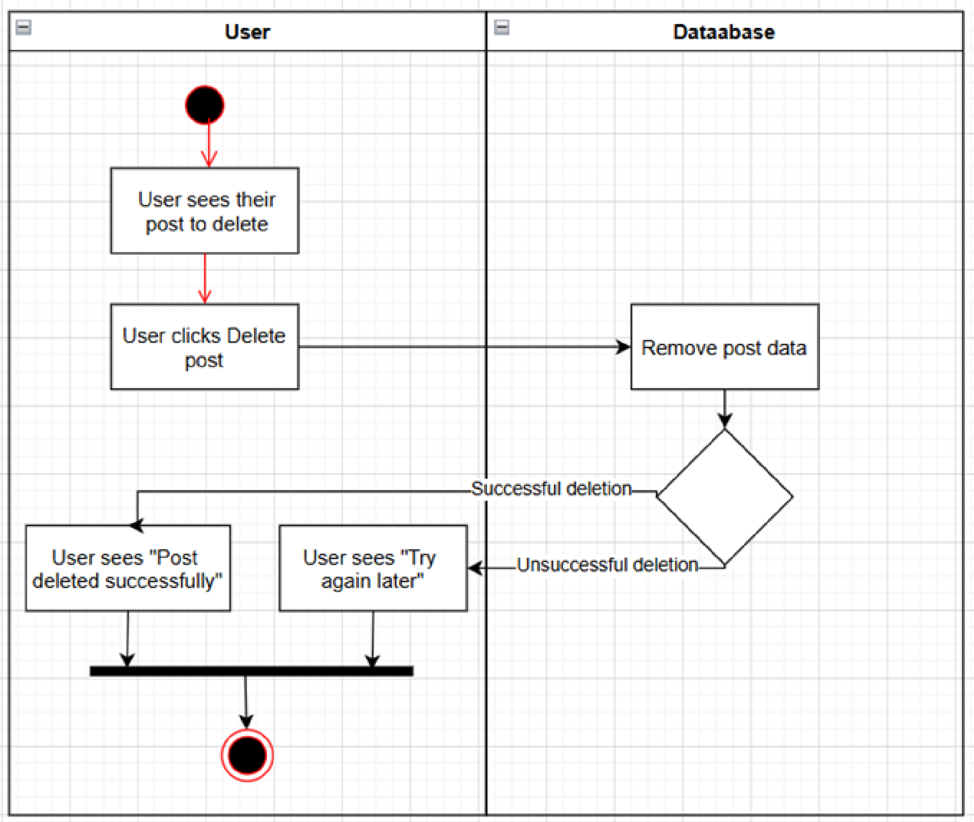


Figure 56 Delete Post Activity Diagram

2.11.5 Interact with Post Activity Diagram

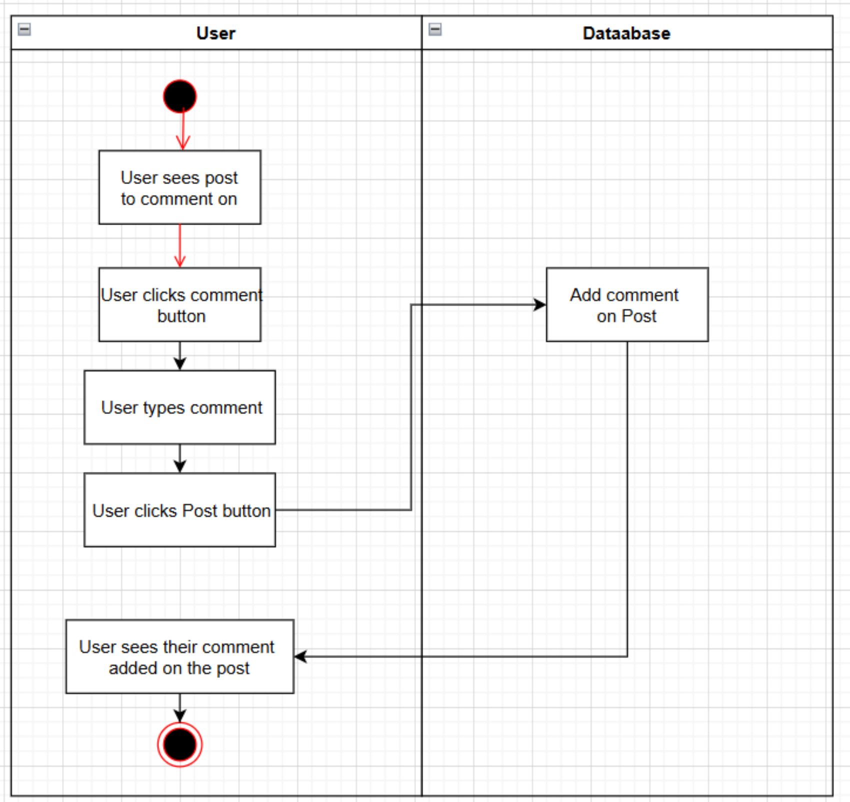


Figure 57 Interact with Post Activity Diagram

2.11.6 AI model prediction Activity Diagram

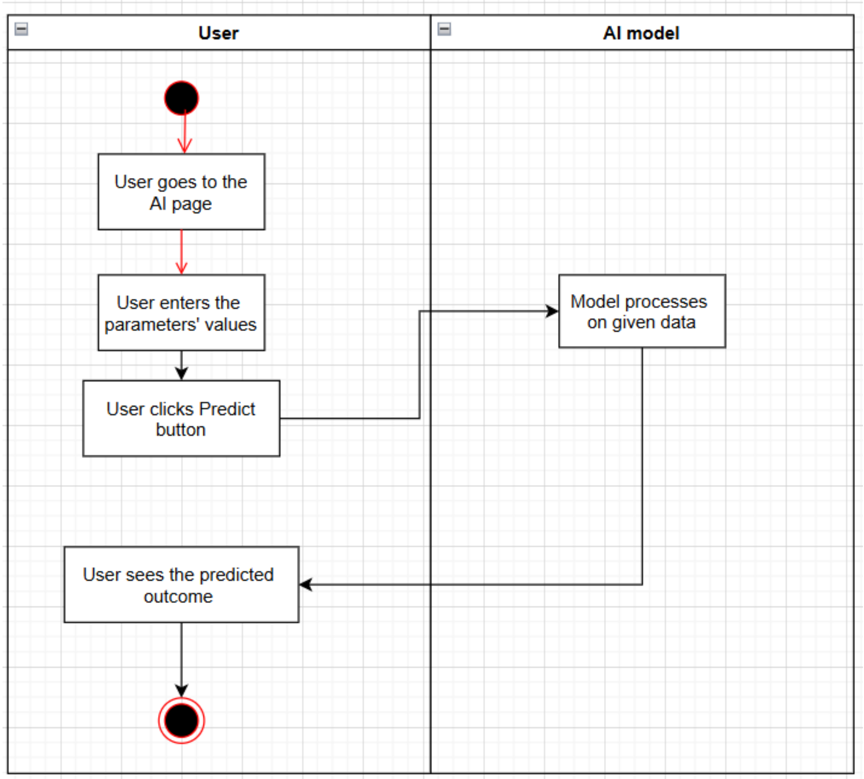


Figure 58 AI model prediction Activity Diagram

2.11.7 Profile Management Activity Diagram

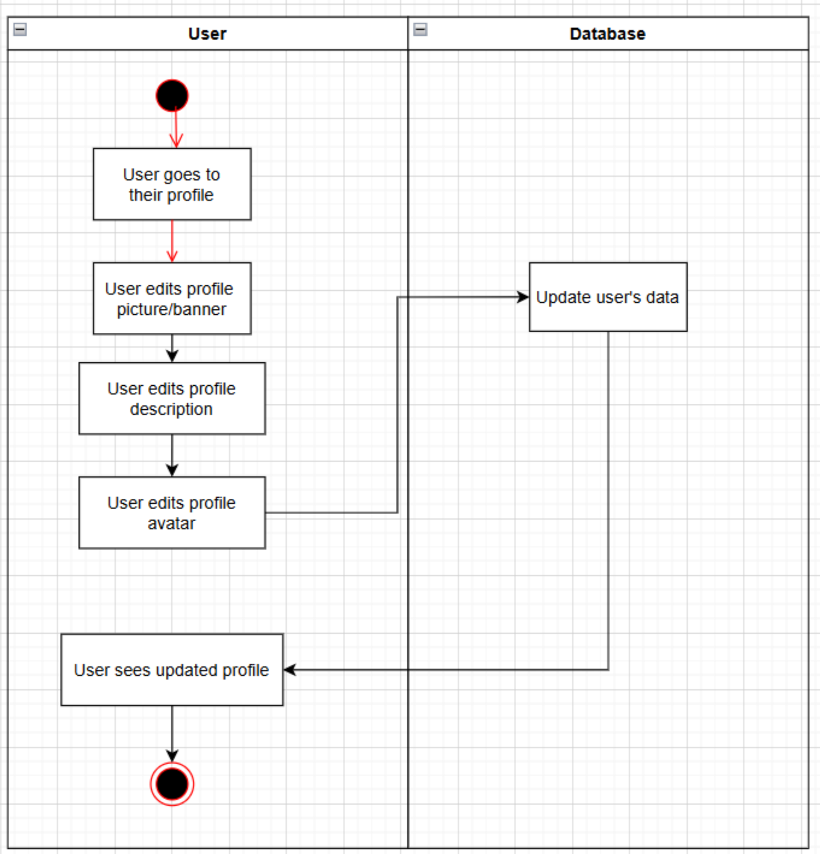


Figure 59 Profile Management Activity Diagram

2.11.8 Search Post Activity Diagram

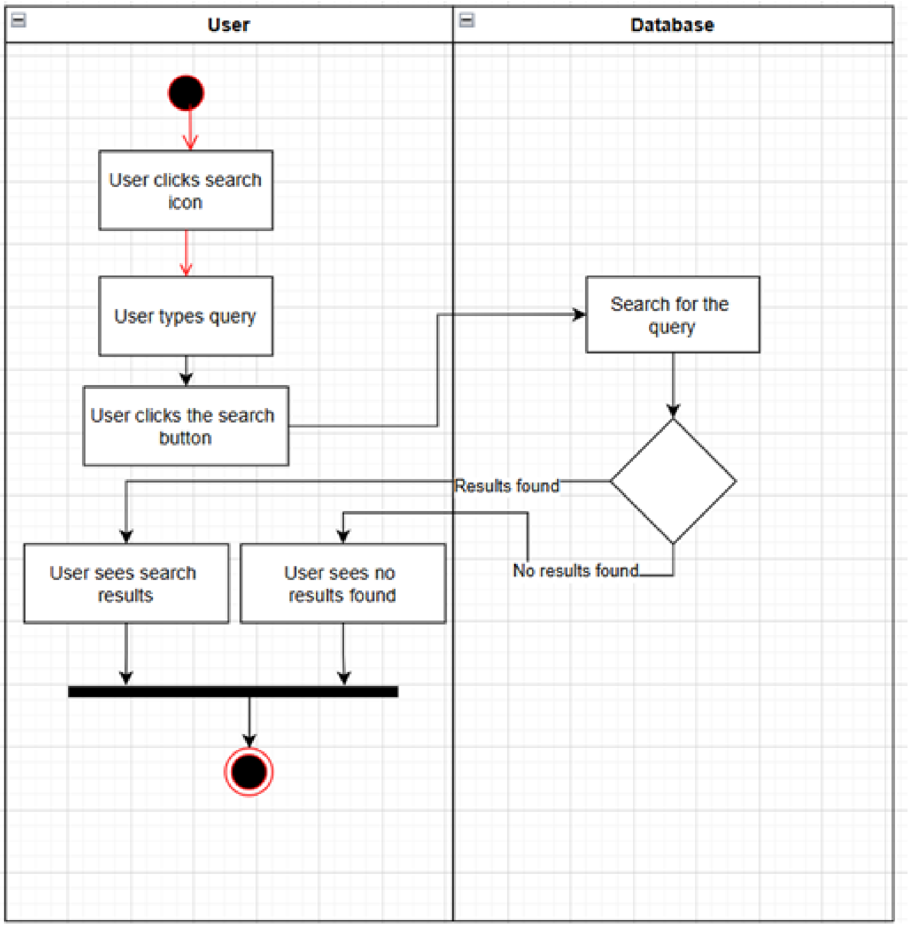


Figure 60 Search Post Activity Diagram

2.11.9 Create Community Activity Diagram

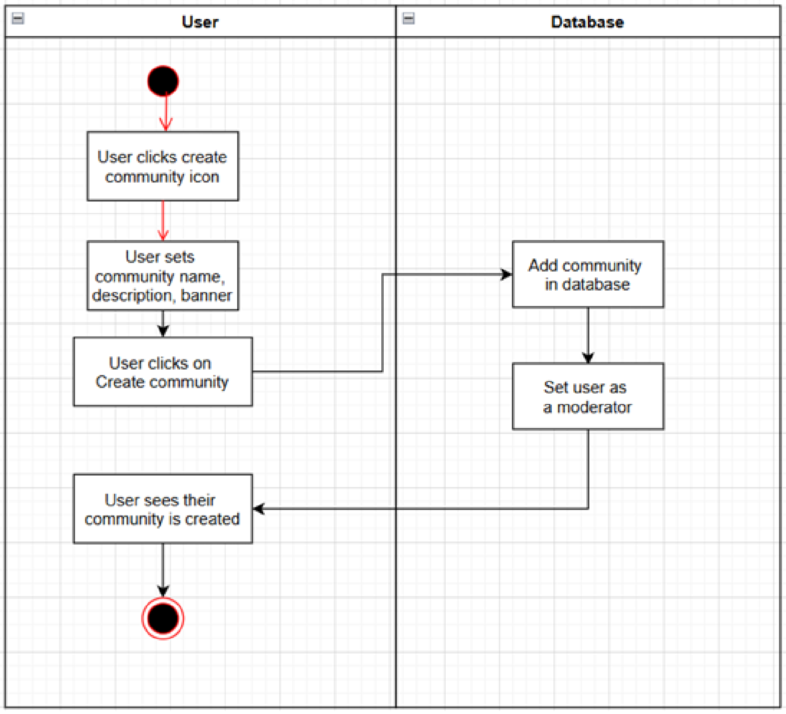


Figure 61 Create Community Activity Diagram

2.11.10 Edit Community Activity Diagram

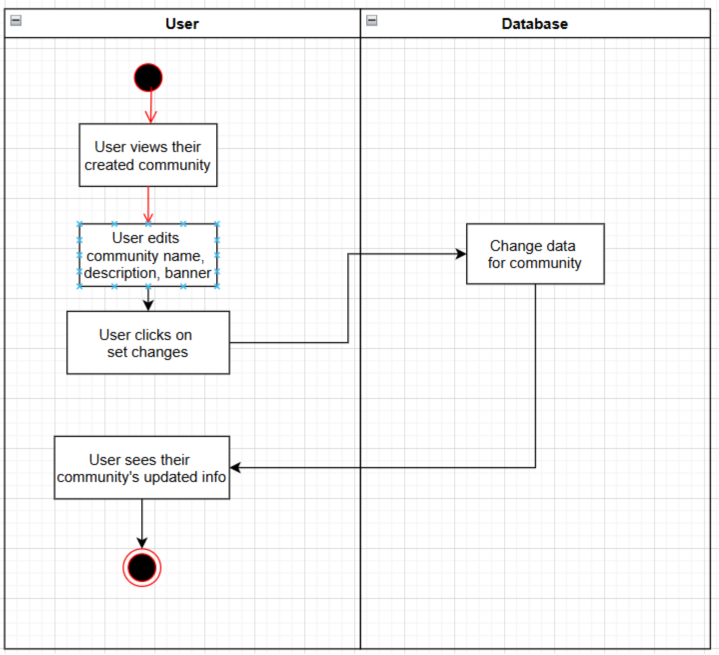


Figure 62 Edit Community Activity Diagram

2.11.11 Add Moderators Activity Diagram

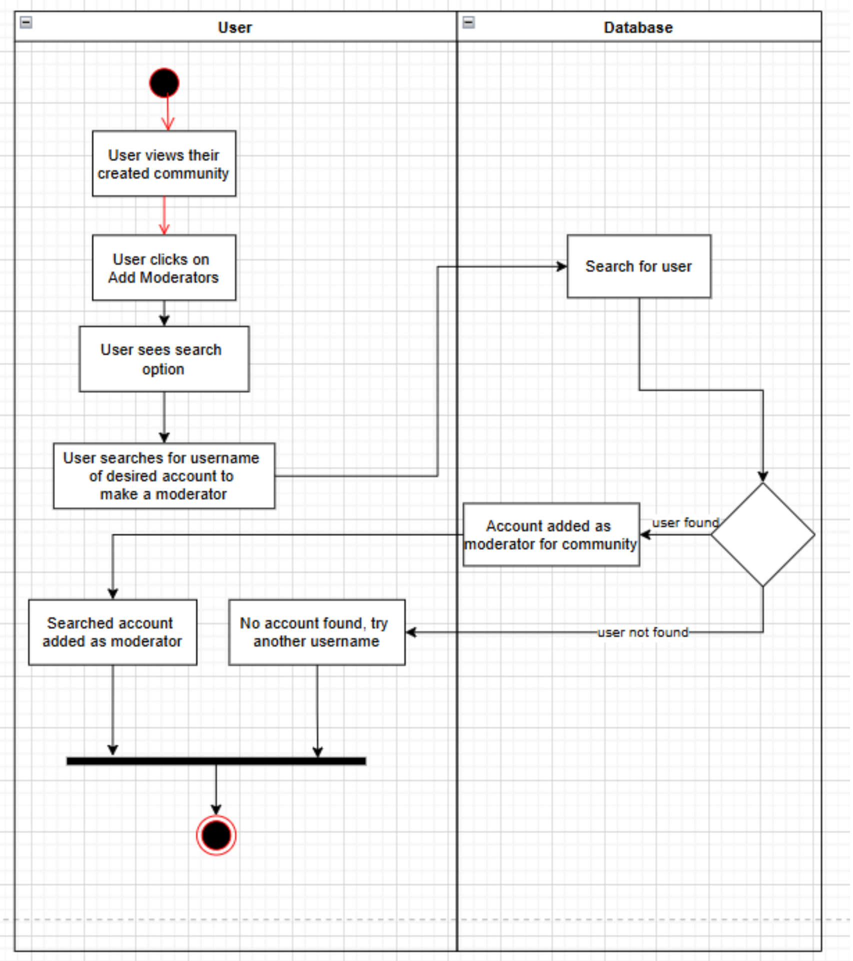


Figure 63 Add Moderators Activity Diagram

2.11.12 Join Community Activity Diagram

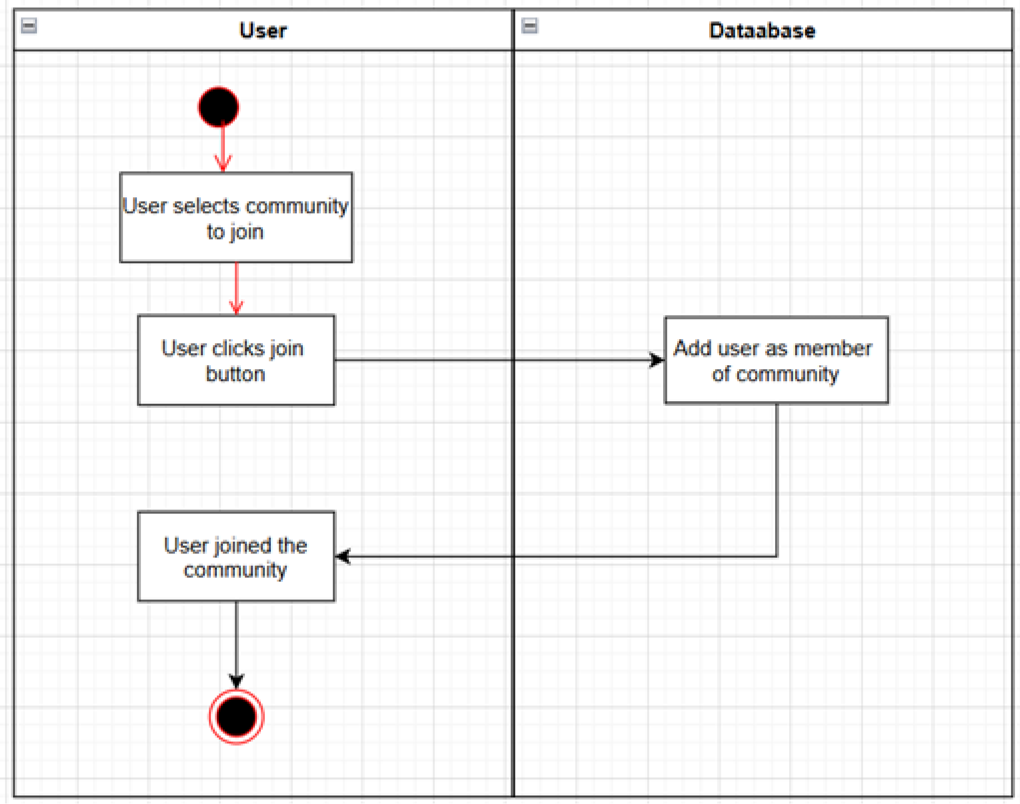


Figure 64 Join Community Activity Diagram

2.11.13 Award Post Activity Diagram

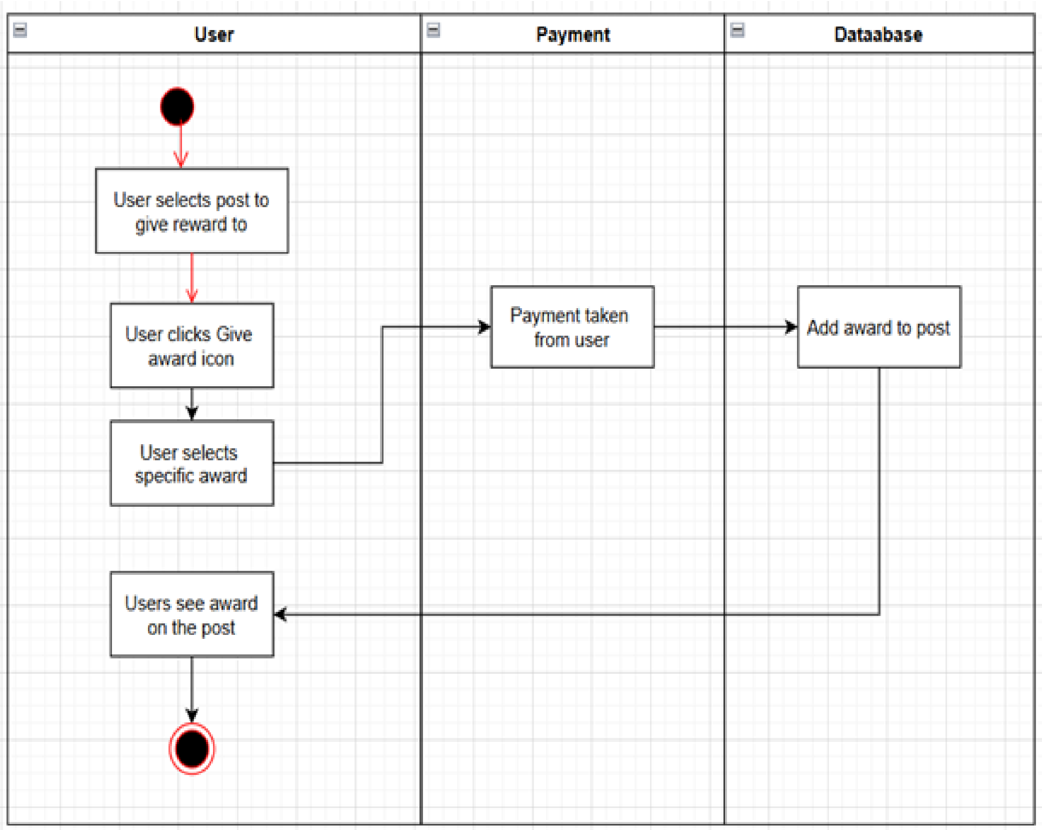


Figure 65 Award Post Activity Diagram

2.11.14 Remove Post (Moderator) Activity Diagram

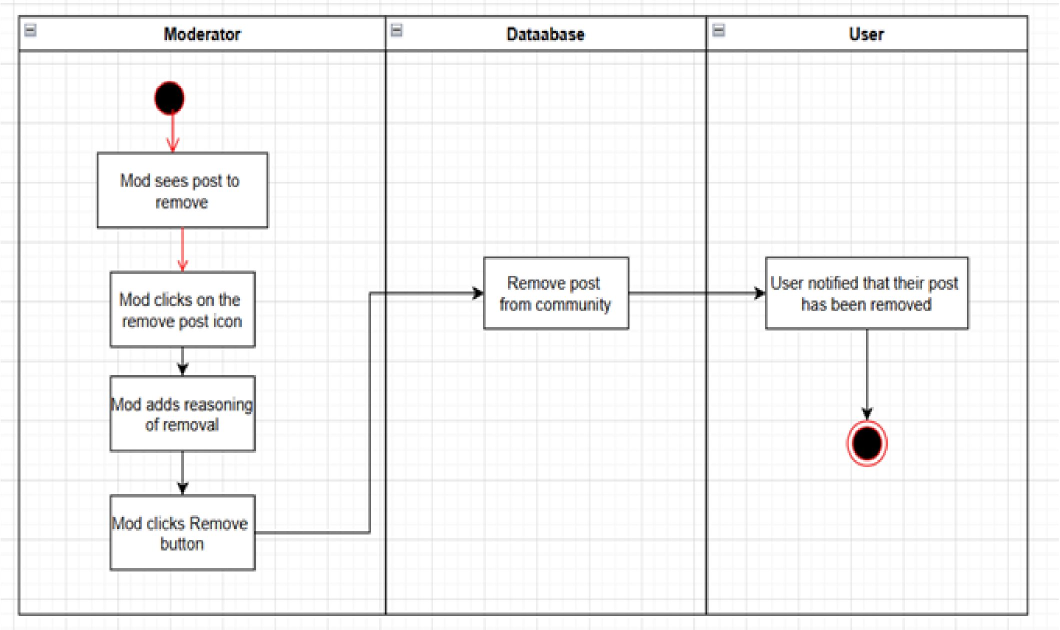


Figure 66 Remove Post (Moderator) Activity Diagram

2.11.15 Get verified as a Doctor

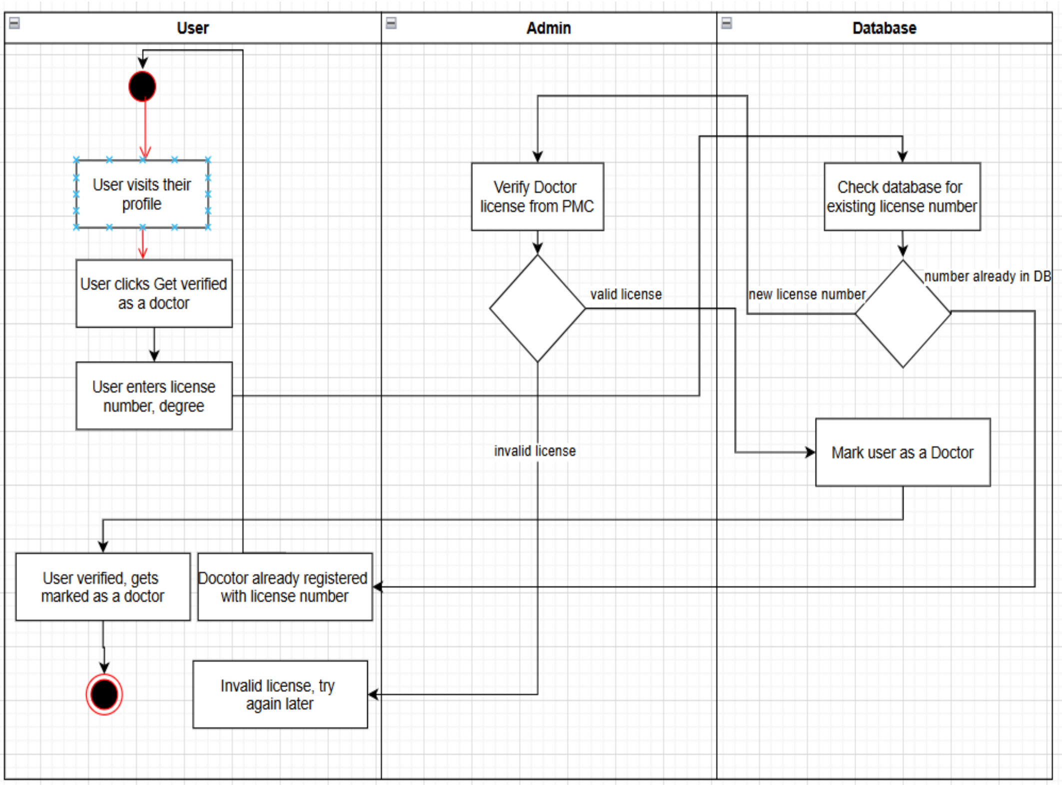


Figure 67 Get verified as a Doctor Activity Diagram

2.12 Collaboration Diagram

A collaboration diagram shows how software parts work together in the Unified Model Language (UML). Here are the collaboration diagrams for our system:

2.12.1 Login Collaboration Diagram

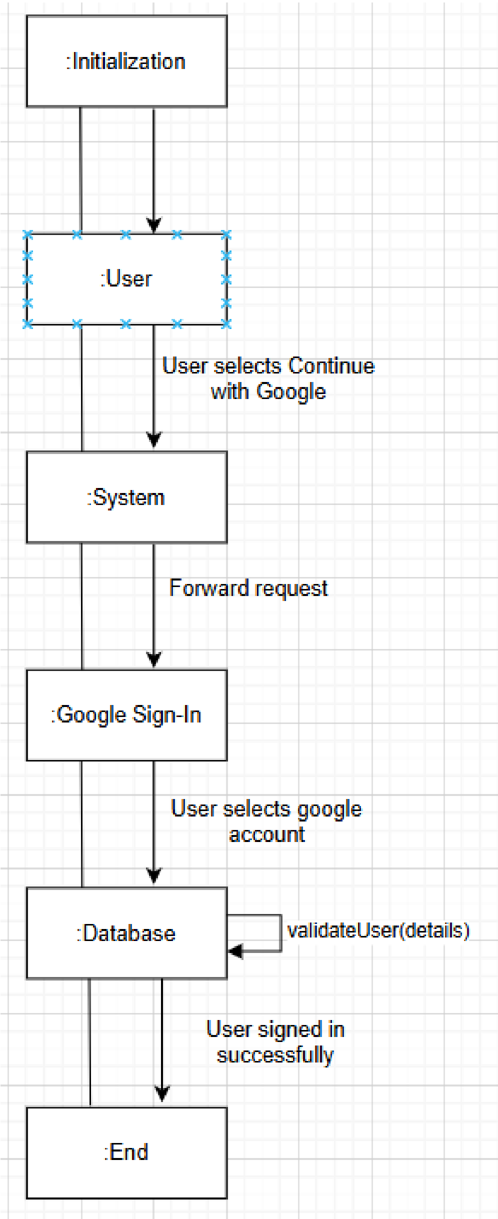
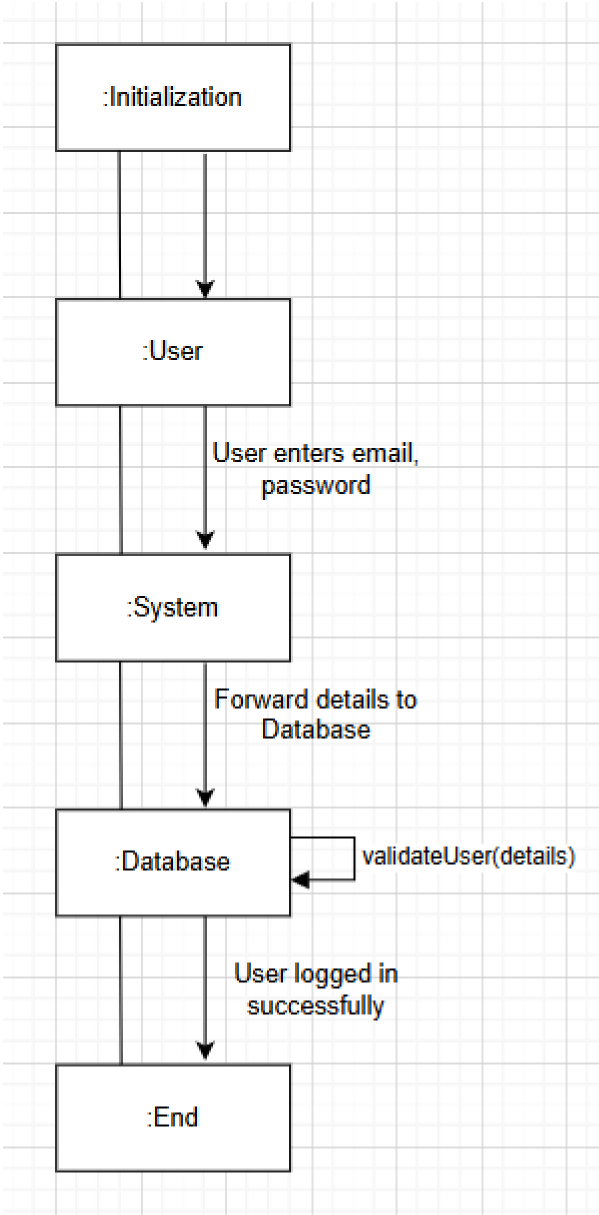


Figure 68 Login Collaboration Diagram


:Initialization
:User
User enters email, password
:System
Forward details to Database
:Database
validateUser(details)
User logged in successfully
:End

2.12.2 Account Registration Collaboration Diagram

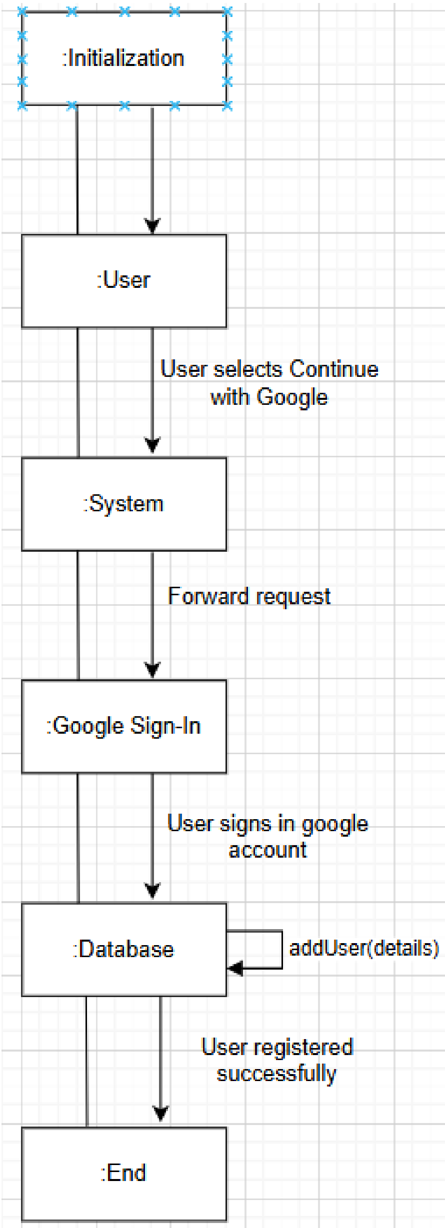
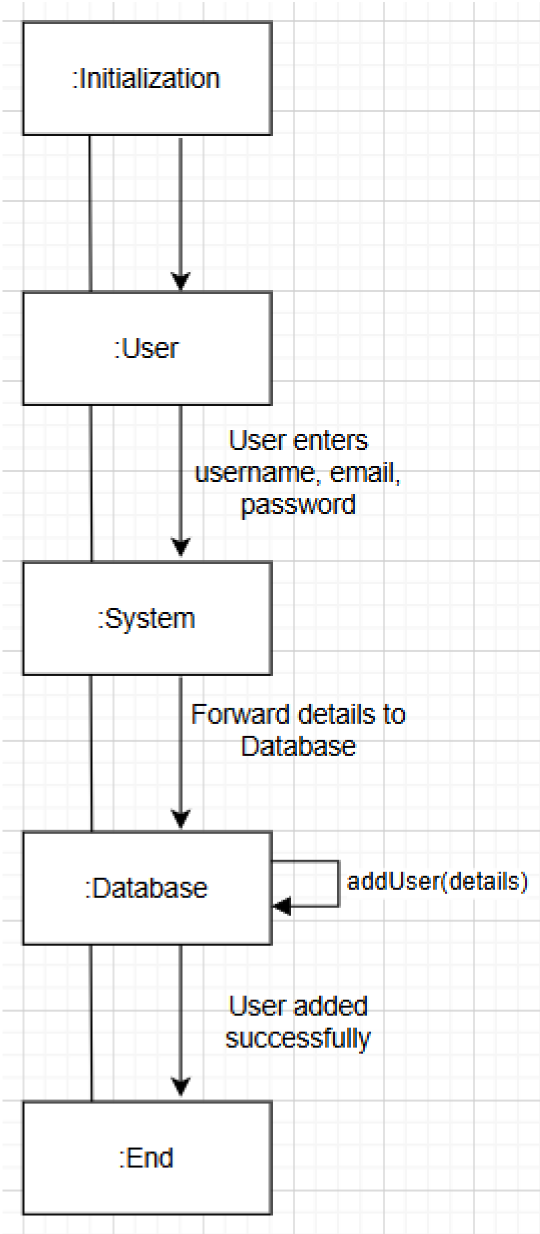


Figure 69 Account Registration Collaboration Diagram


:Initialization
:User
User enters
username, email,
password
:System
Forward details to
Database
:Database
addUser(details)
User added
successfully
:End

2.12.3 Create Post Collaboration Diagram

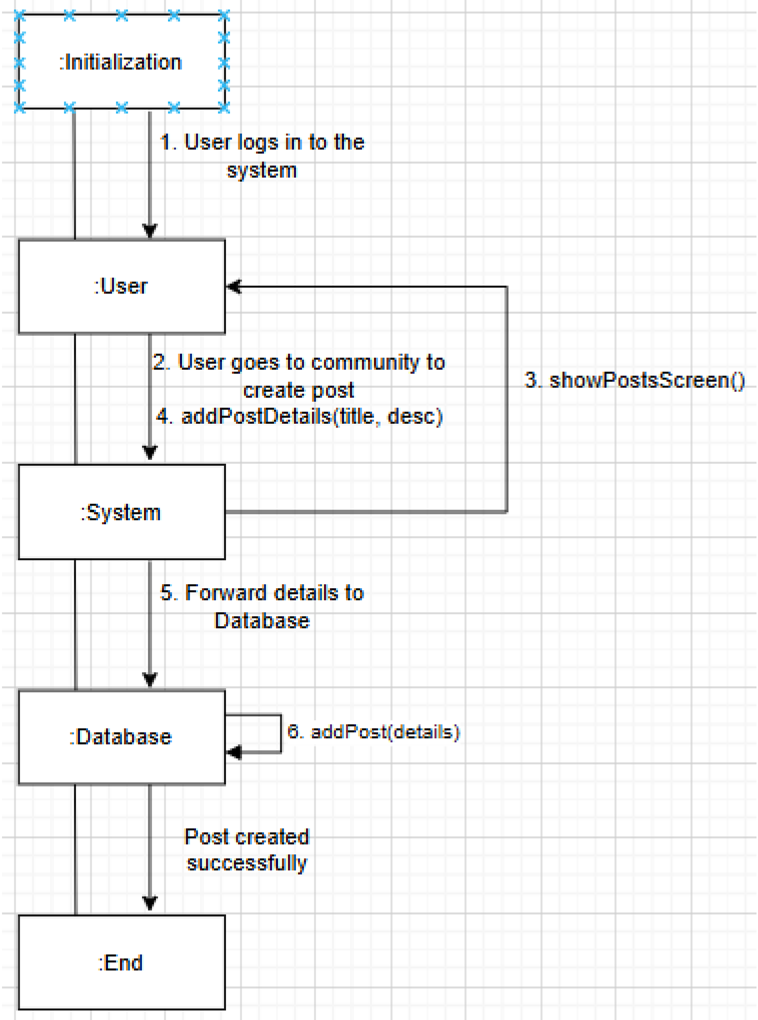


Figure 70 Create Post Collaboration Diagram

2.12.4 Delete Post Collaboration Diagram

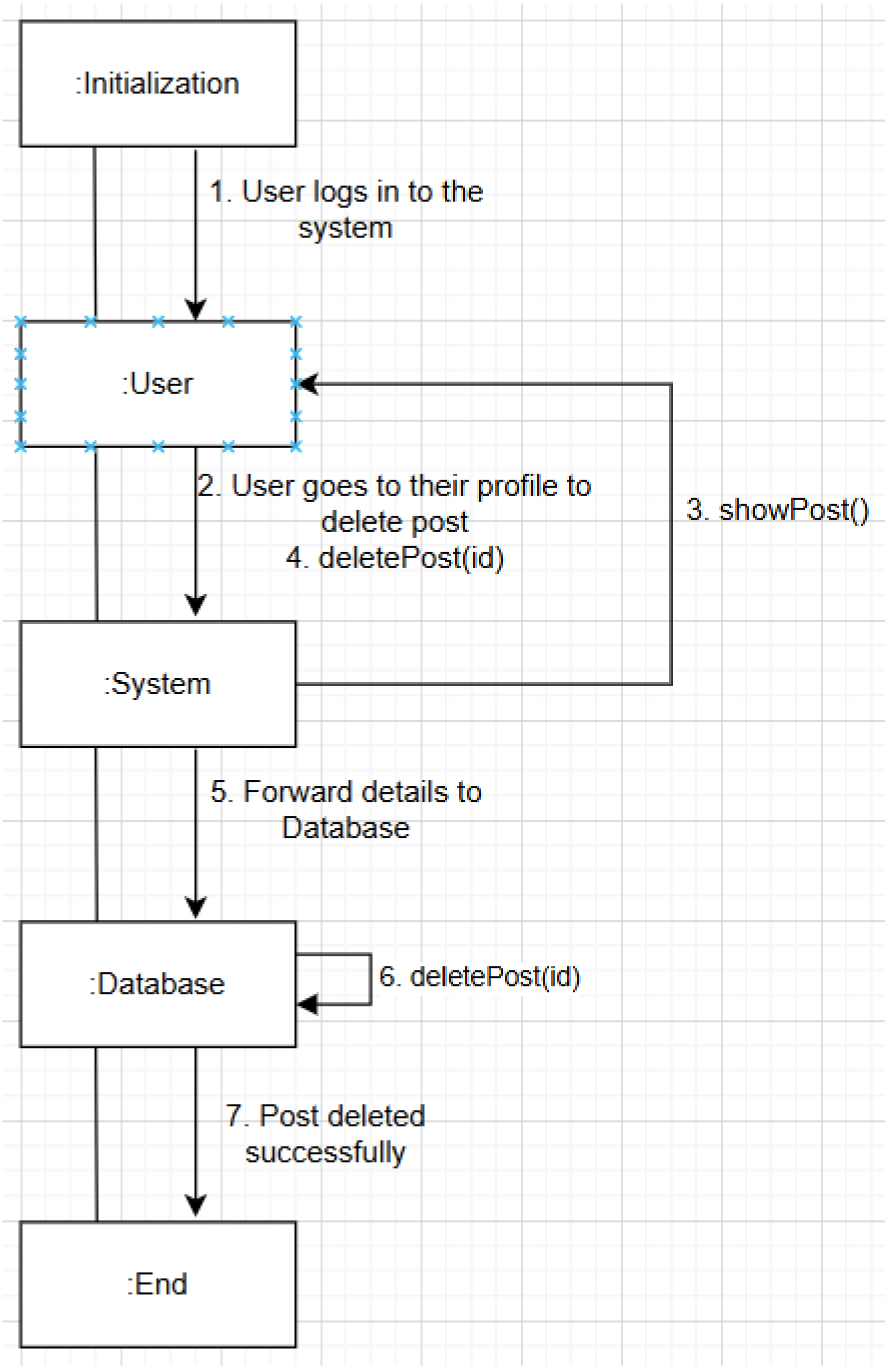


Figure 71 Delete Post Collaboration Diagram

2.12.5 Interact with Post Collaboration Diagram

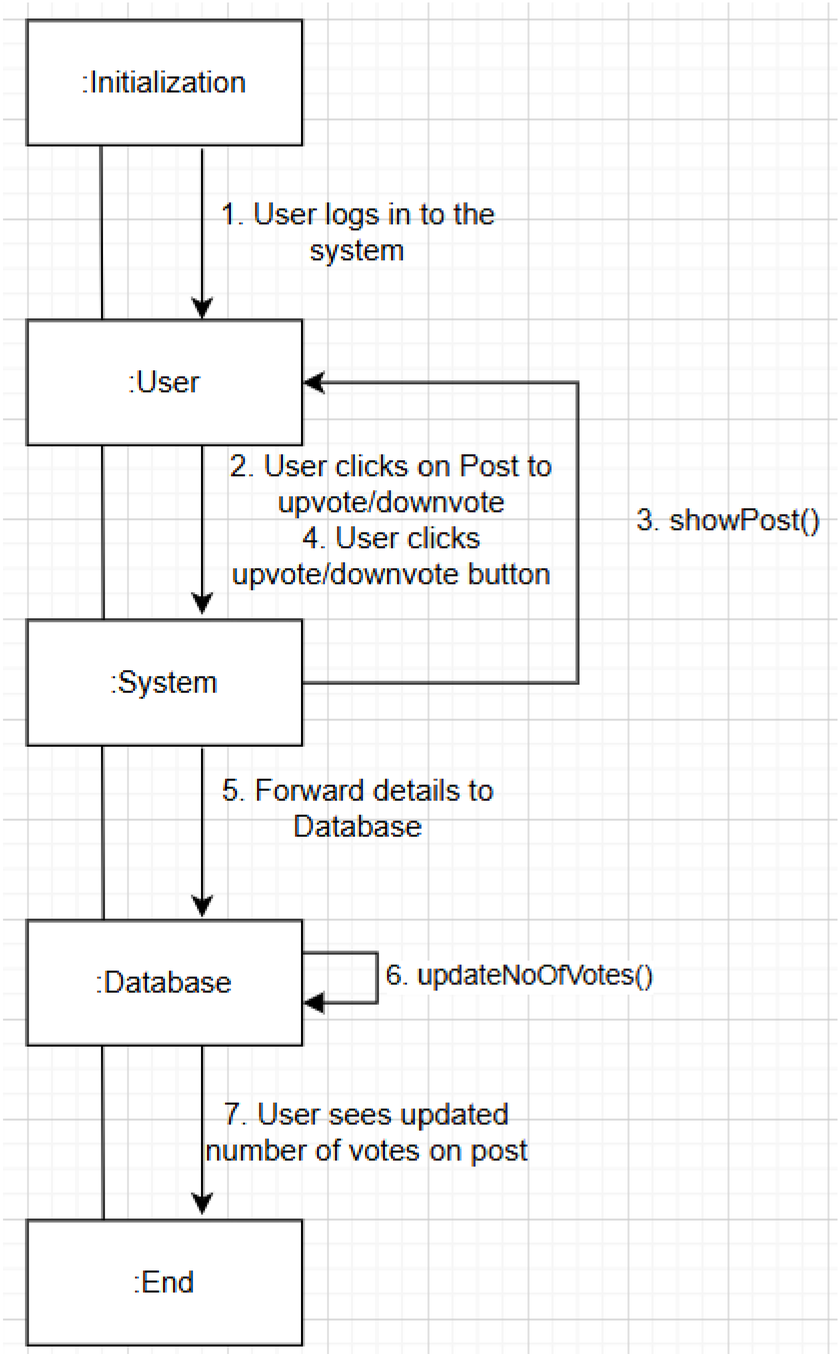
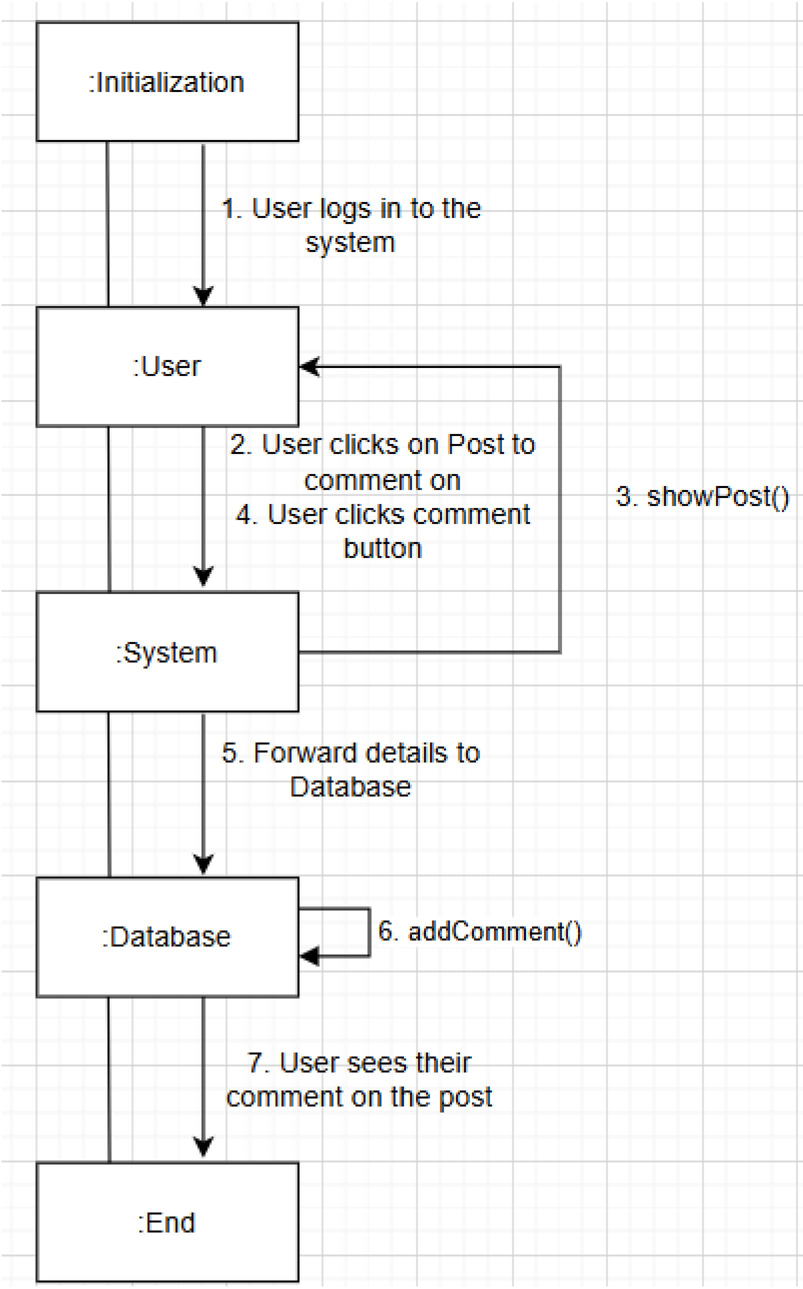


Figure 72 Interact with post Collaboration Diagram


:Initialization
1. User logs in to the system
:User
2. User clicks on Post to comment on
4. User clicks comment button
3. showPost()
:System
5. Forward details to Database
:Database
6. addComment()
7. User sees their comment on the post
:End

2.12.6 AI model prediction Collaboration Diagram

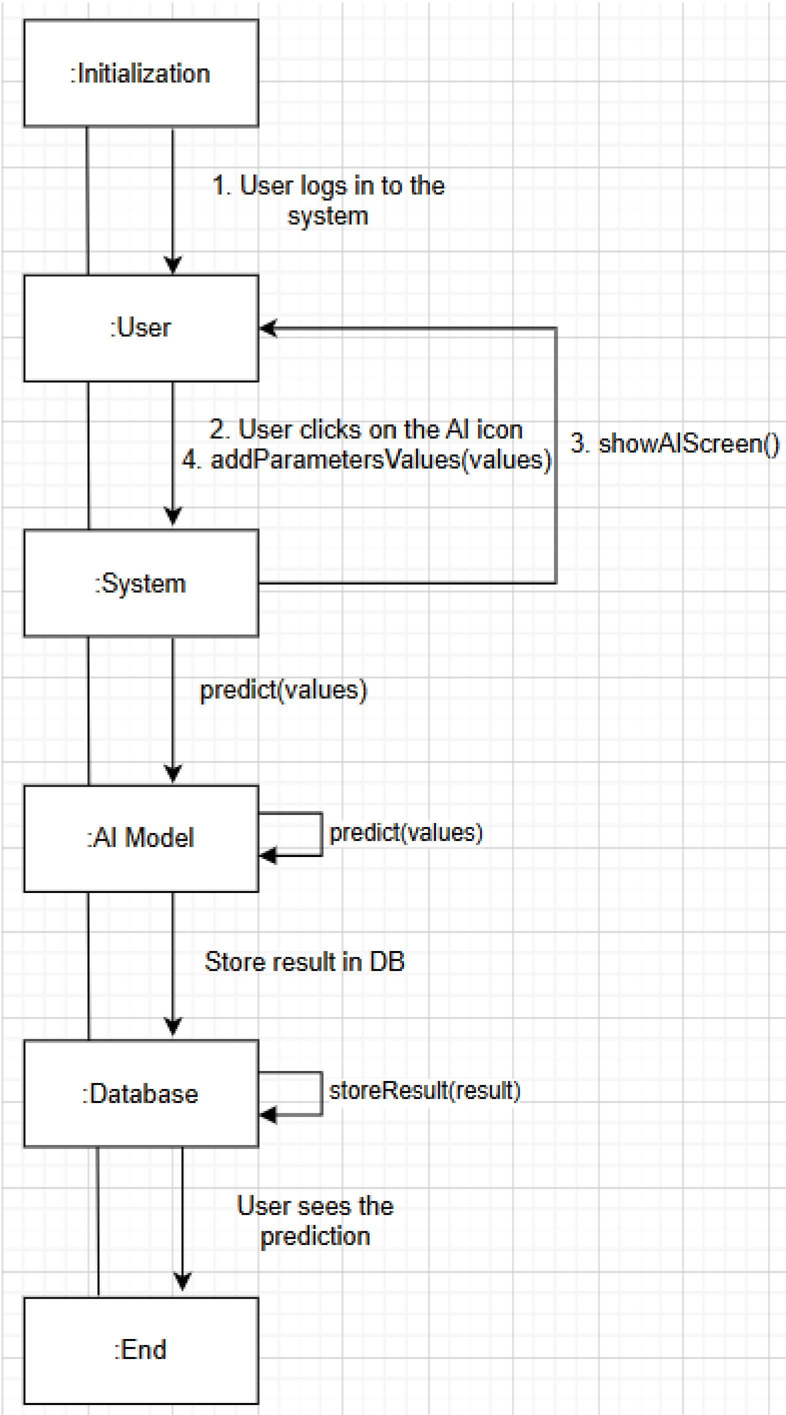


Figure 73 AI model prediction Collaboration Diagram

2.12.7 Profile Management Collaboration Diagram

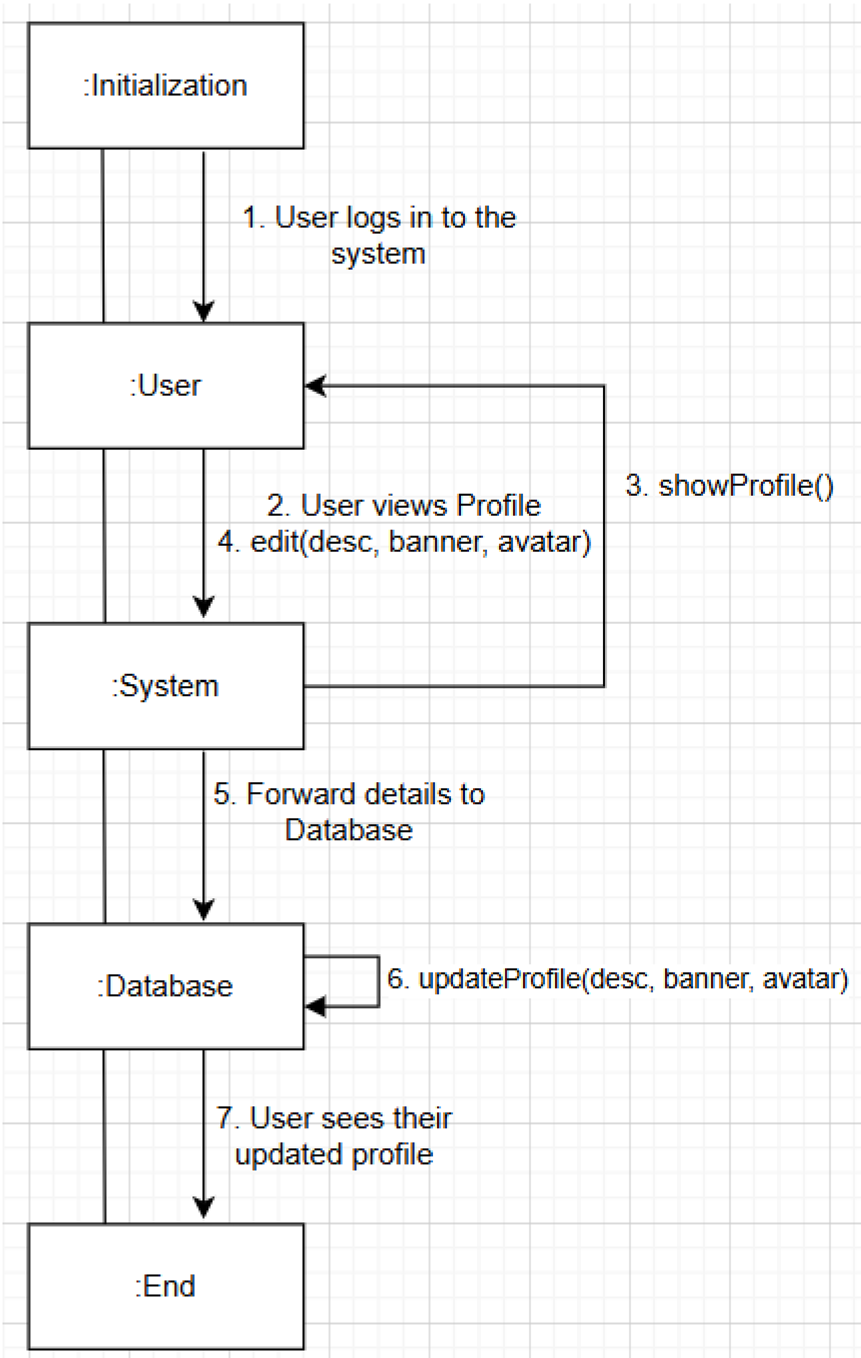


Figure 74 Profile Management Collaboration Diagram

2.12.8 Search Collaboration Diagram

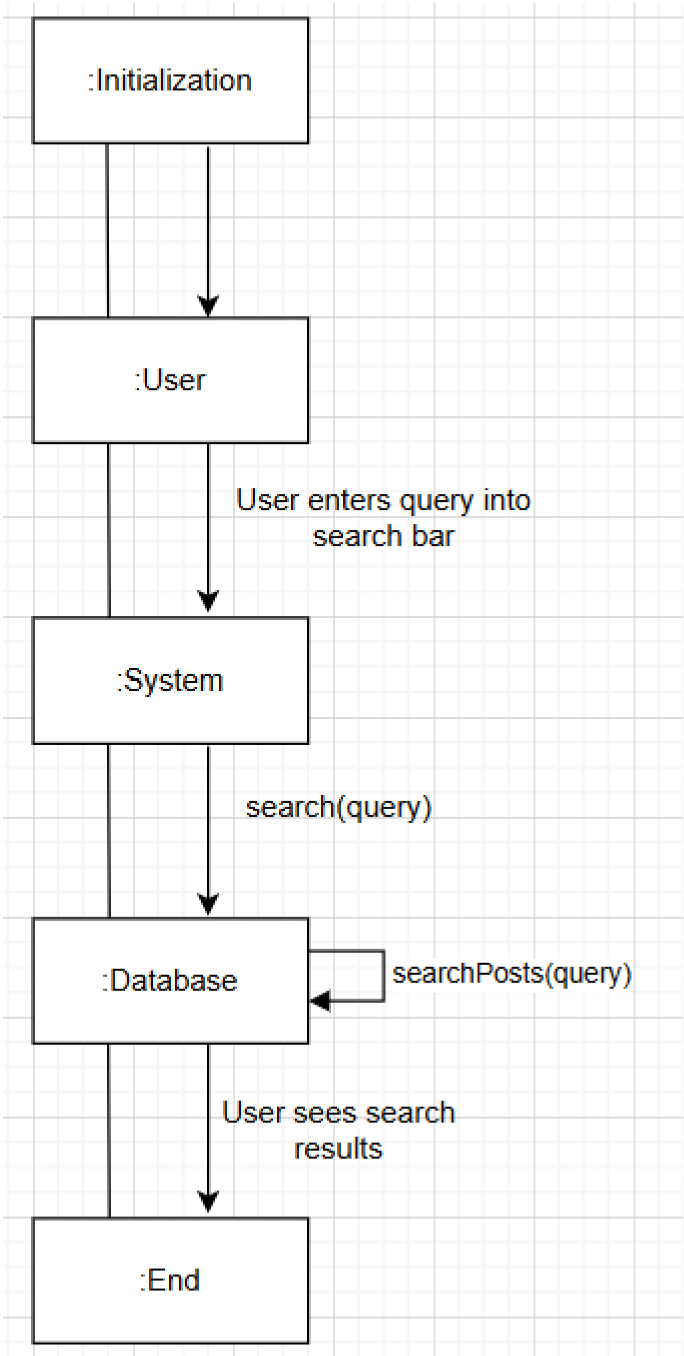


Figure 75 Search Collaboration Diagram

2.12.9 Create Community Collaboration Diagram

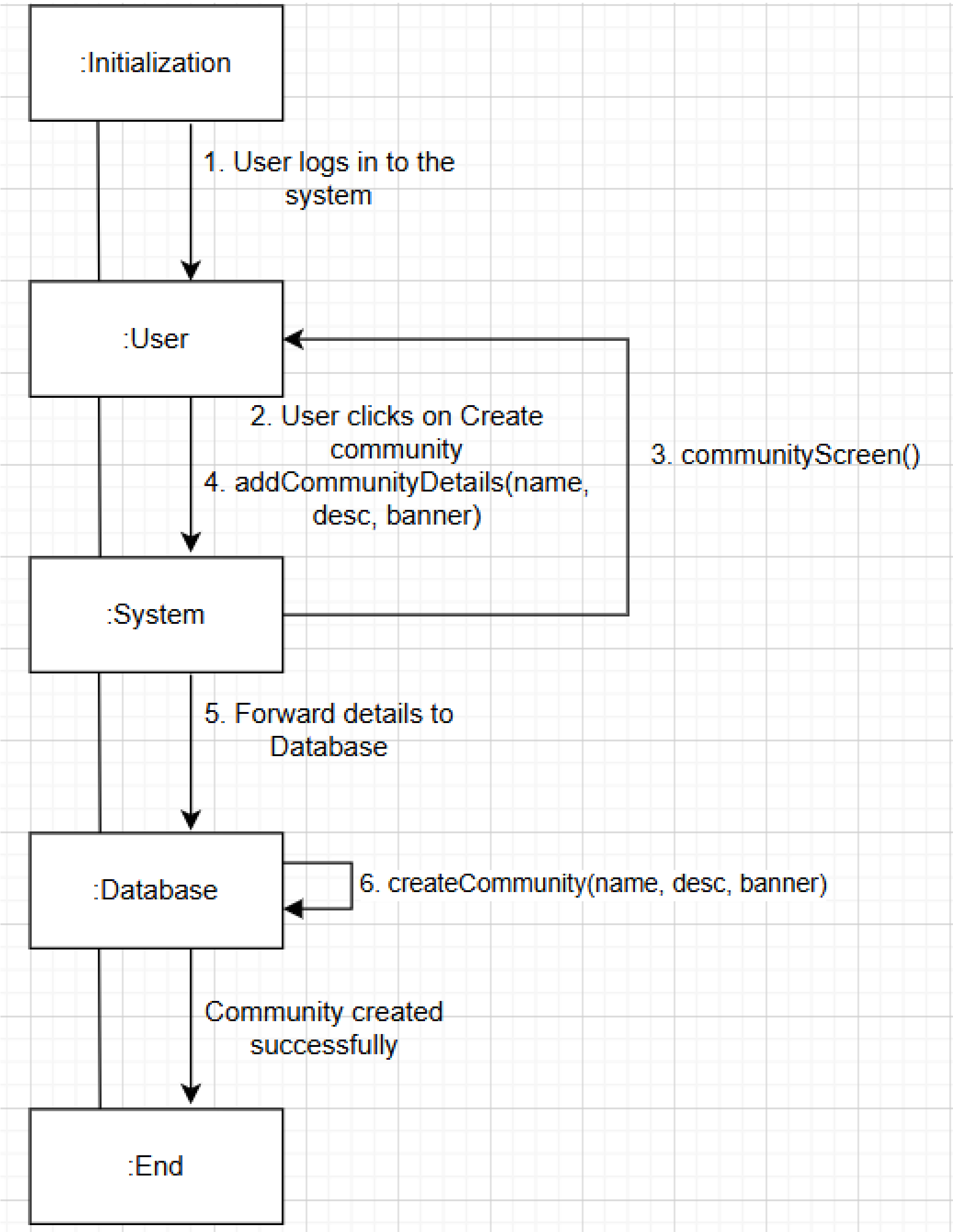


Figure 76 Create Community Collaboration Diagram

2.12.10 Edit Community Collaboration Diagram

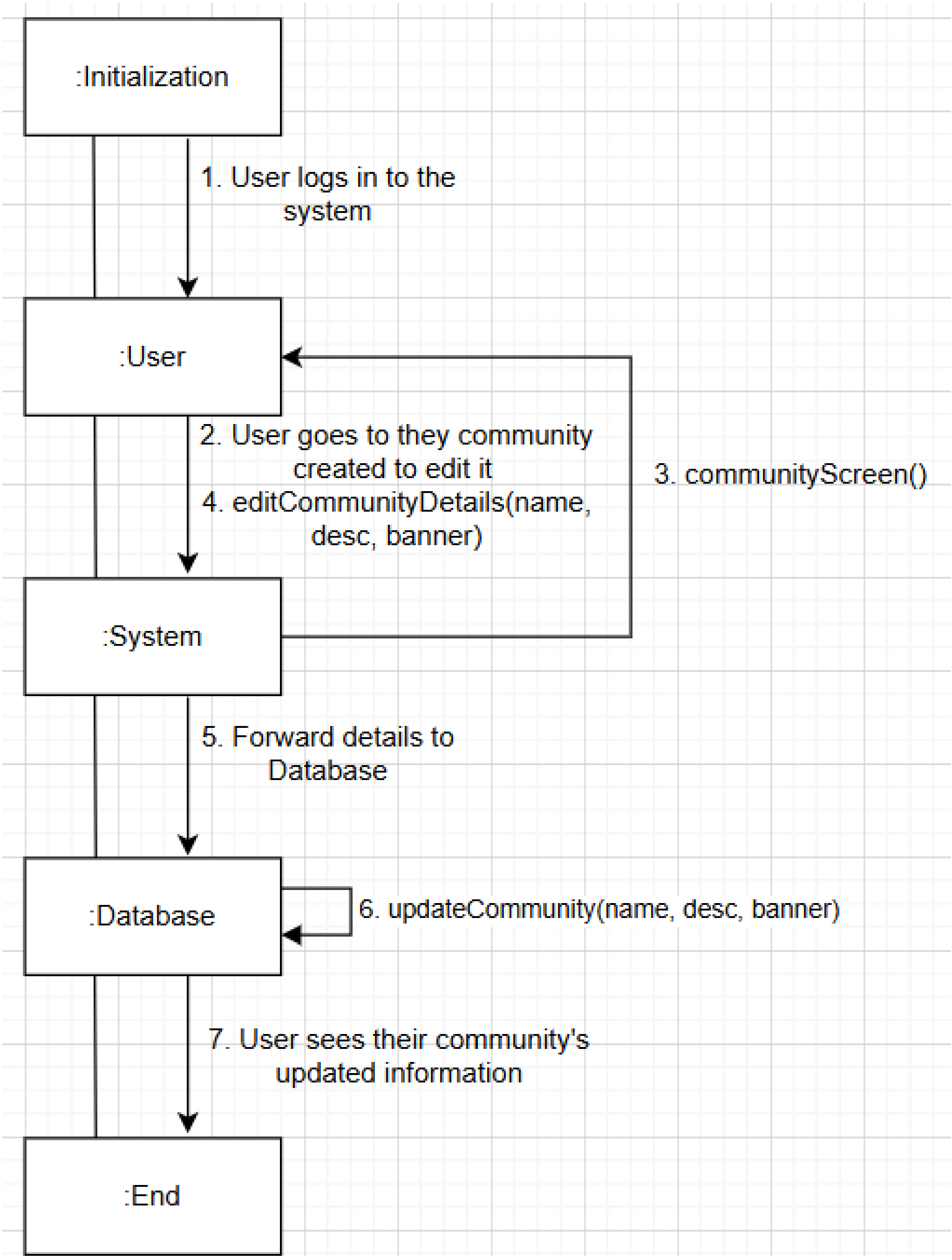


Figure 77 Edit Community Collaboration Diagram

2.12.11 Add moderators Collaboration Diagram

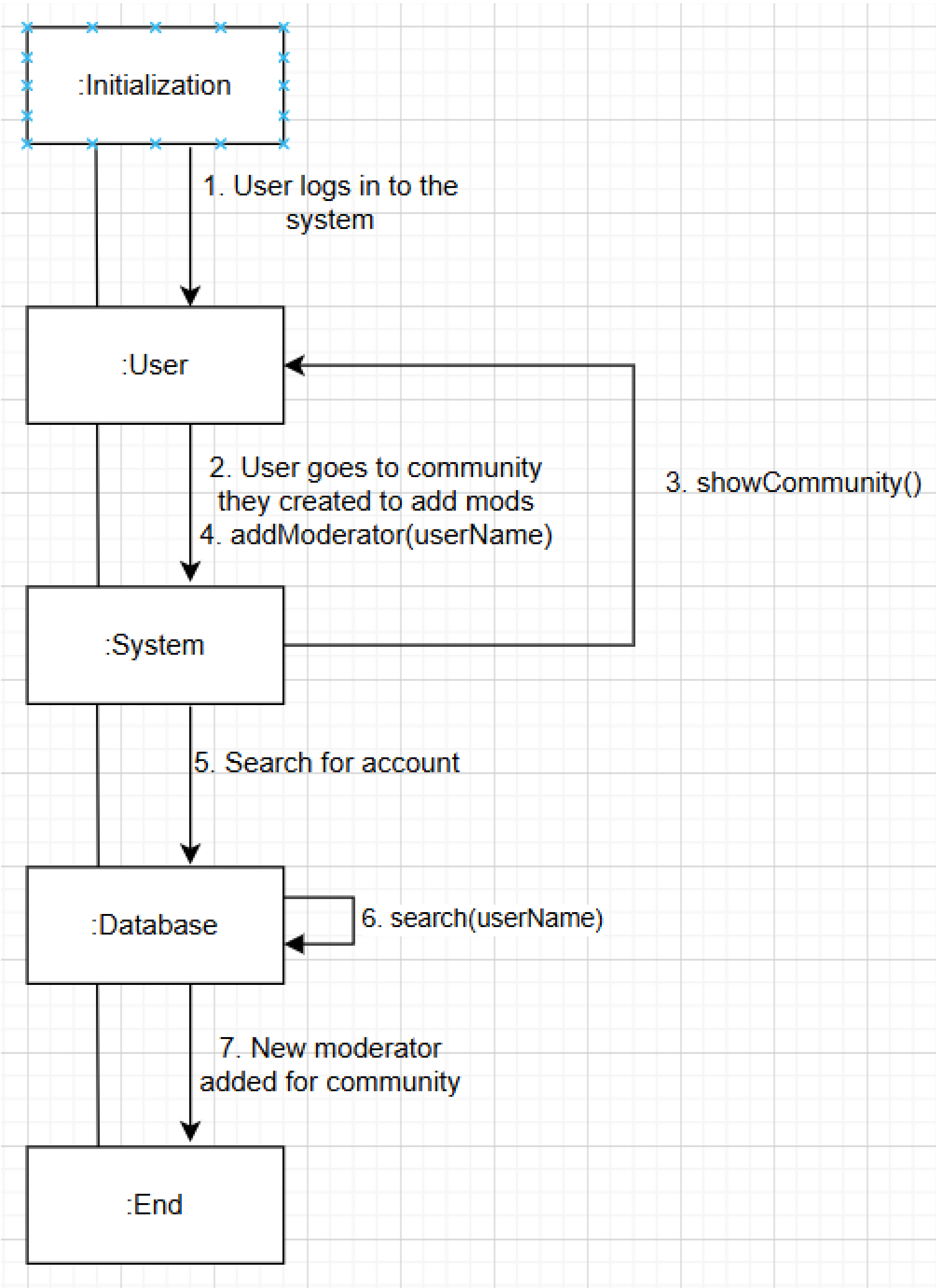


Figure 78 Add moderators Collaboration Diagram

2.12.12 Join Community Collaboration Diagram

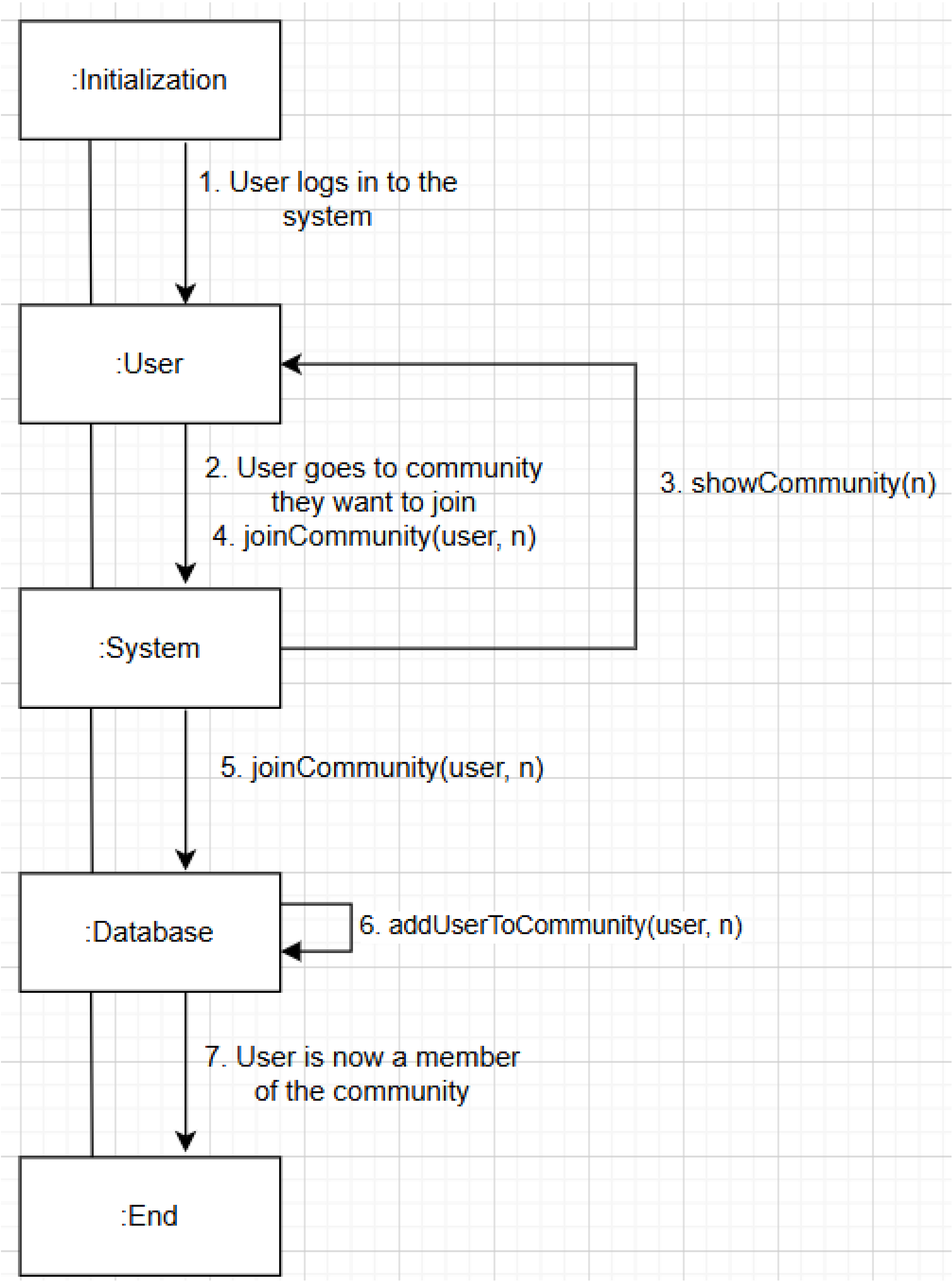


Figure 79 Join Community Collaboration Diagram

2.12.13 Award Post Collaboration Diagram

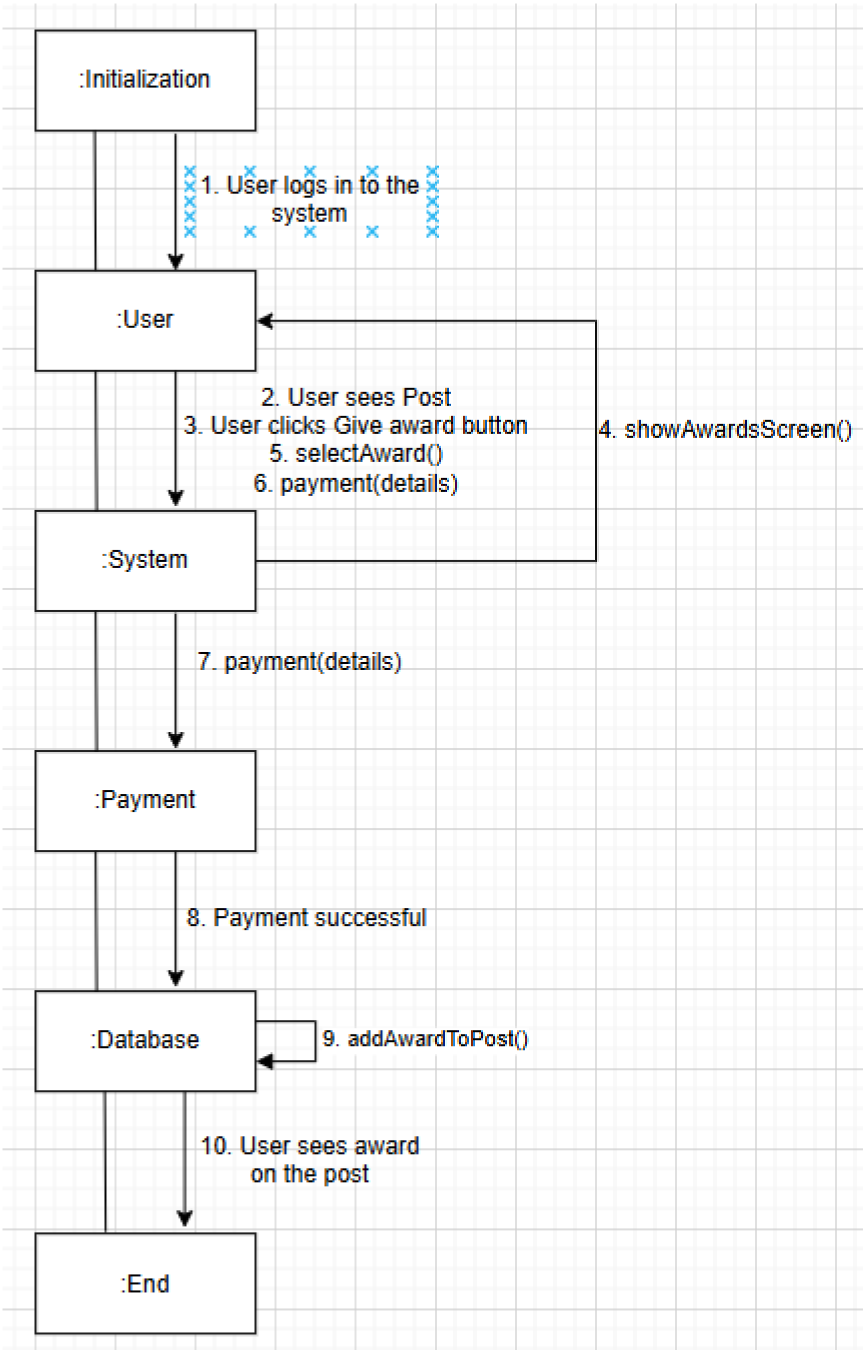


Figure 80 Award Post Collaboration Diagram

2.12.14 Remove Post Collaboration Diagram

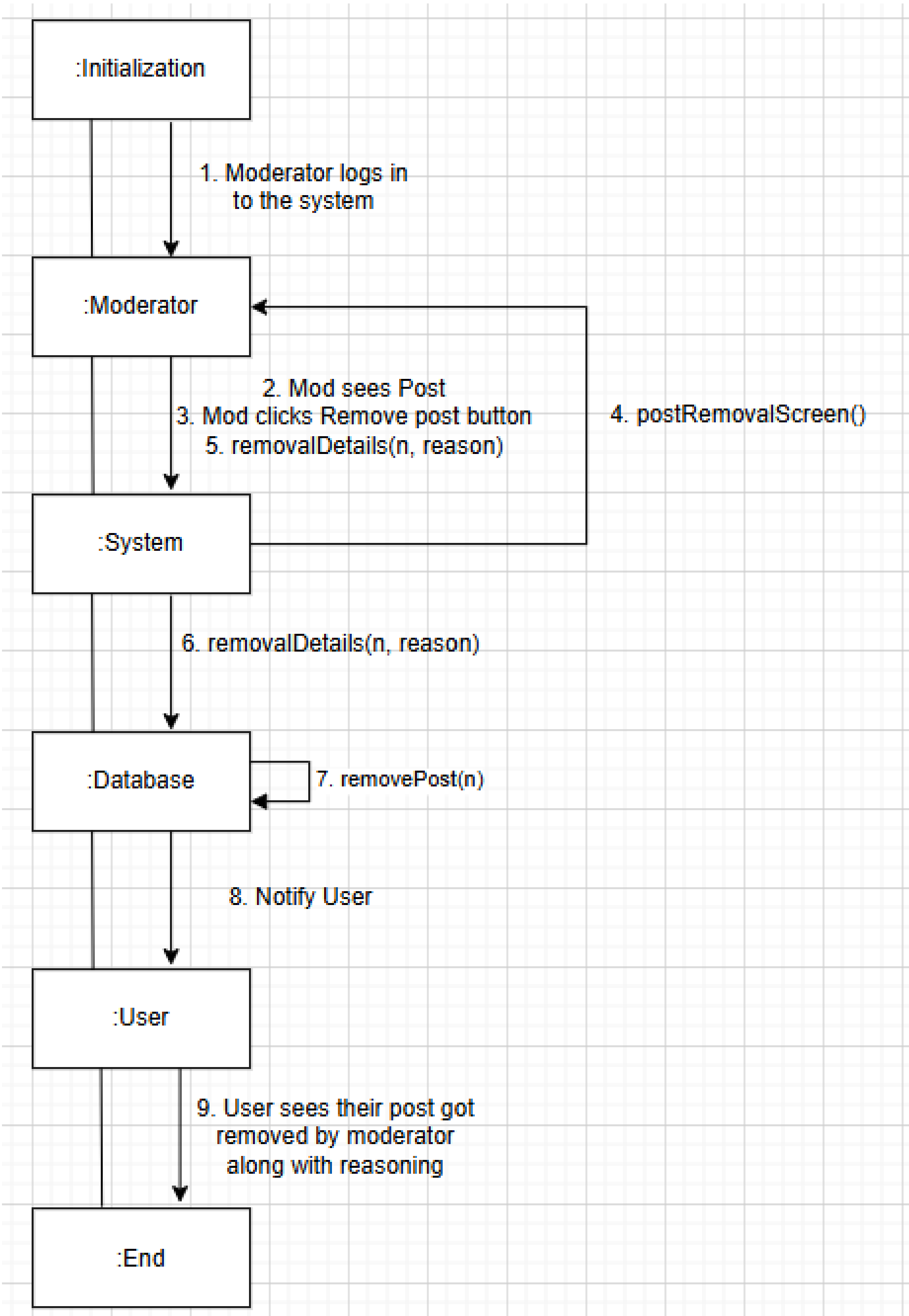


Figure 81 Remove Post Collaboration Diagram

2.12.15 Verify Doctor Collaboration Diagram

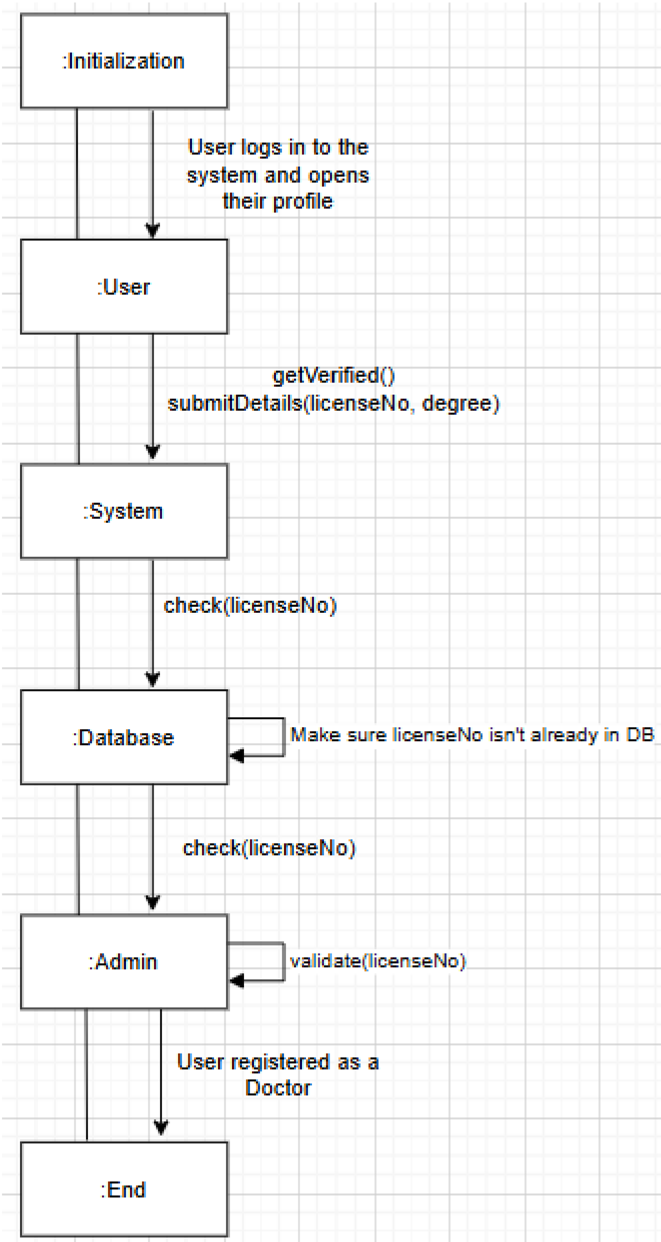


Figure 82 Verify Doctor Collaboration Diagram

References

[1] H. P. a. M. Shah, "Feature engineering techniques for heart disease prediction: A study of PCA and interaction terms," *Expert Systems with Applications,* vol. 137, pp. 302-311, 2019.

[2] D. P. Maalej, "User feedback in the appstore: An empirical study," in *21st IEEE International Requirements Engineering Conference*, Rio de Janeiro, Brazil, 2013.

[3] T. Gaziano, "Cardiovascular disease," in *Disease Control Priorities in Developing Countries, 2nd ed, D. T. Jamison, R. G. Feachem, M. W. Makgoba, et al., Eds.*, Washington, D.C., The World Bank, 2006, p. Chapter 33.

[4] L. K. M. P. X. Cao, "A framework for adapting agile development methodologies," *European Journal of Information Systems,* Vols. 18, no. 4, pp. 332-343, 2009.

[5] H. James, "Enhancing the Educational Landscape for Advanced Practice Nurses," *Journal of International Social Research,* vol. 16, p. 105, 2023.

[6] P. K. S. a. R. Singh, "Heart disease prediction using a hybrid machine learning model," *Expert Systems with Applications,* vol. 149, p. 113195, 2020.

[7] M. Allamanis, "Why, when, and what: analyzing stack overflow questions by topic, type, and code," *10th Working Conference on Mining Software Repositories (MSR),* pp. 53-56, 2013.

[8] A. P. a. M. P. A. Dey, "Comparative analysis of machine learning algorithms for heart disease prediction," *Journal of Healthcare Informatics Research,* Vols. 5, no. 2, pp. pp. 233-250, 2021.

[9] S. K. a. J. P. S. Kwon, "Deep learning for ECG-based heart disease prediction: A hybrid CNN-LSTM approach," *IEEE Transactions on Biomedical Engineering,* Vols. vol. 67, no. 12, pp. 3434-3443, 2020.

[10] S. J. a. M. Gupta, "Machine learning for heart disease prediction: A survey," *Journal of Medical Systems,* Vols. 43, no. 8, pp. 1-15, 2019.

[11] A. M. a. N. Shukor, "Predicting heart disease using machine learning algorithms: A systematic review," *International Journal of Computer Applications,* Vols. 175, no. 10, pp. 1-7, 2021.

[12] L. Z. a. X. W. G. Liang, "Transfer learning for pneumonia detection using pre-trained convolutional neural networks," *International Journal of Medical Informatics,* vol. 145, p. 104312, 2021.

[13] Z. L. a. M. Z. X. Liu, "Comparative study of ML models for heart disease and pneumonia detection using ensemble learning and CNNs," *Journal of Medical Systems,* vol. 46, p. 57, 2022.

[14] F. A. e. al., "Heart disease prediction using machine learning techniques: A comparative analysis," *Journal of Healthcare Engineering,* vol. 2020, pp. 1-10, 2020.

[15] M. K. a. I. Cakir, "Prediction of heart disease using machine learning techniques," *Health Information Science and Systems,* Vols. 6, no. 1, pp. 1-9, 2018.