IoT-Vision Enabled Assistance for Epileptic Patients

Use Case Document

Session: 2020 – 2024

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Contents

List of Tables

1 Project Identification

1.1 Project Title

IoT-Vision Enabled Assistant for Epileptic Patients

1.2 Executive Summary

IoT-Vision Enabled Assistant for Epileptic Patients is an innovative and comprehensive solution that aims to detect, prevent and forecast seizures in real time to improve the lives of epileptic patients. The system uses cameras to monitor patient's activities in real time then send it to cloud server to analyze the data where it detects any abnormal patterns or symptoms that can lead to seizure. The system generates an alert notification if any seizure or its symptoms are detected and send it to its caretakers or family members through mobile and web application.

The main objective is to detect and forecast seizures by utilizing a personalized model technique which improves the accuracy of seizure detection and forecast and reduce false positive rate. System uses machine learning algorithms to learn activities and symptoms of each patient. This personalized model technique enables learning models to identify and understand unique behavioral patterns and triggering activities of each individual patient, which helps in forecasting and improving user's outcome with epileptic disease.

The system has user-friendly and accessible mobile, web and desktop application which provides a high level of flexibility and convenience to patients, their family members and caretakers. The applications are simple to use, interactive and provides real time monitoring which makes it easier for caretakers to give response in case of any emergency. The system is designed to be cost-effective. It provides round -the-clock safety and comfort and assistance only when epileptic patient needs it. Hence, it reduces the burden on caretakers and nursing sector and maintains an independent, comfortable, healthy and private life of epileptic patients.

In conclusion, it is revolutionary system that uses cameras and machine learning algorithms to detect and forecast the seizures. Personalized model technique used in this system helps in improving the accuracy of seizure detection and reduce false positives. The user-friendly and accessible mobile, desktop, and web applications provide a high degree of flexibility and convenience to patients, their family members and caretakers, making it easier for them to respond in case of any emergency hence improves the quality of life of patients and caretakers. Overall this project has potential to make significant impact on the lives of millions of people suffering with epilepsy.

2 Actors

2.1 Administrator

Administrator is primary actor. He manages and configure user accounts, services plans and discounts. He is responsible to ensure smooth operation of system.

2.2 Caretaker

Caretaker is primary actor. He is responsible for monitoring and managing patient's well being as well as provide him support in case of emergency.

2.3 Server

Server acts as supporting actor. It is responsible for all main functionality of system such as processing and analyzing data for pattern extraction, seizure detection and forecast and alarm generation.

2.4 Web Application

Web portal is primary actor. It is responsible for patient management, camera management, monitor stream and activities logs and receiving push notifications.

2.5 Desktop Application

Desktop application is primary actor. It is responsible for receiving stream from cameras, generating logs and sending it to server using web APIs.

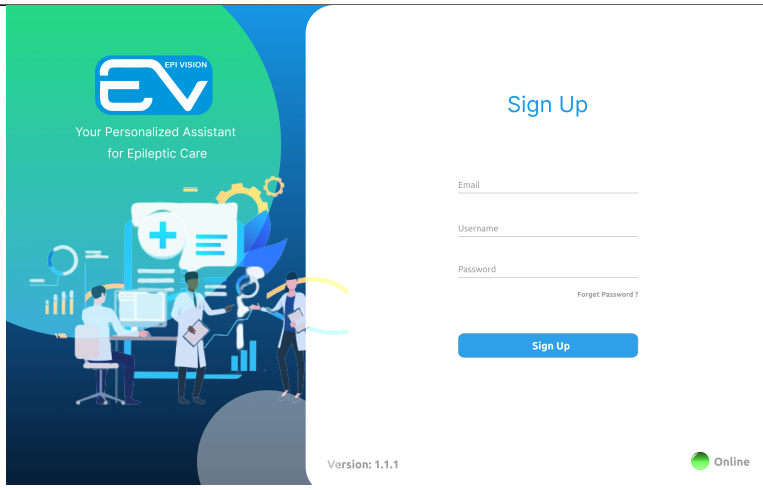
3 Use Cases

3.1 Patient Account Management

3.1.1 Patient Registration

Table 1: Patient Registration

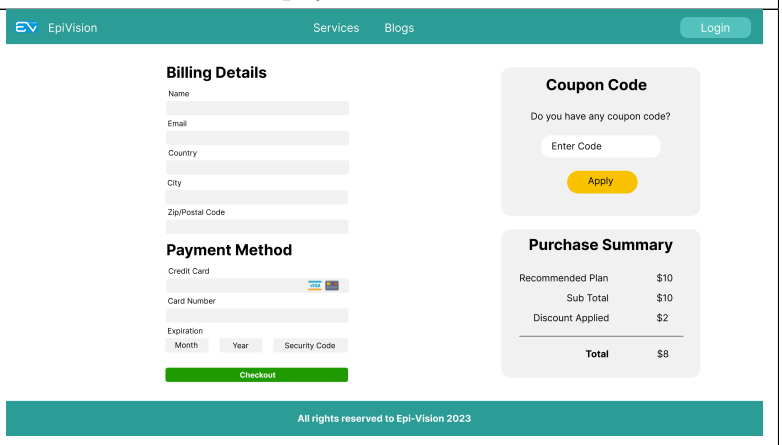
Use Case ID	UC001
Actors	Patient
Description	This use case involves the user registeration on the acquisition web portal to access the system's services.
Preconditions	The user must access the acquisition web portal.
Postconditions	The user successfully registers an account.
Main Flow	1. The user accesses the acquisition web portal. 2. The user selects the purchase plan option.
	3. It redirects the user to sign up page.

	4. The user provides the required information, such as name, age, and contact details. 5. The user submits the registration form. 6. The user completes the payment process. 7. The system verifies the provided information. 8. The system creates a user account and assigns a unique identifier. 9. The system sends a confirmation email to the user. 10. The user receives the confirmation email and verifies their account.
Sign Up	 Patient Registration

3.1.2 Payment Gateway

Table 2: Payment Gateway

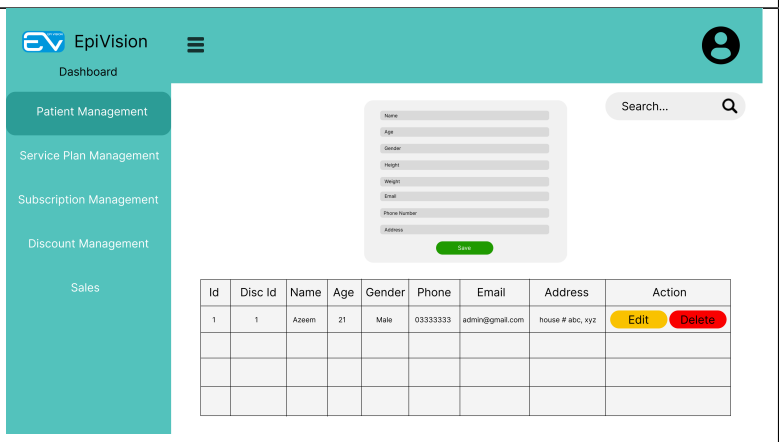
Use Case ID	UC002
Actors	Patient
Description	This use case involves a payment gateway for processing user payments on the acquisition web portal.
Preconditions	The user must have selected a service plan and initiated the account creation process.
Postconditions	The user's payment is successfully processed and confirmed.
Main Flow	1. The user selects a service plan.
	2. The user fills his personal information to create an account.

	3. The user proceed to payment process. 4. The user provides the necessary payment details, such as credit card information. 5. The payment gateway securely processes the payment. 6. The payment gateway sends a confirmation status to the acquisition web portal. 7. The acquisition web portal updates the user's account status based on the payment confirmation.
Prototype	 Payment

3.1.3 View Patient

Table 3: View Patient

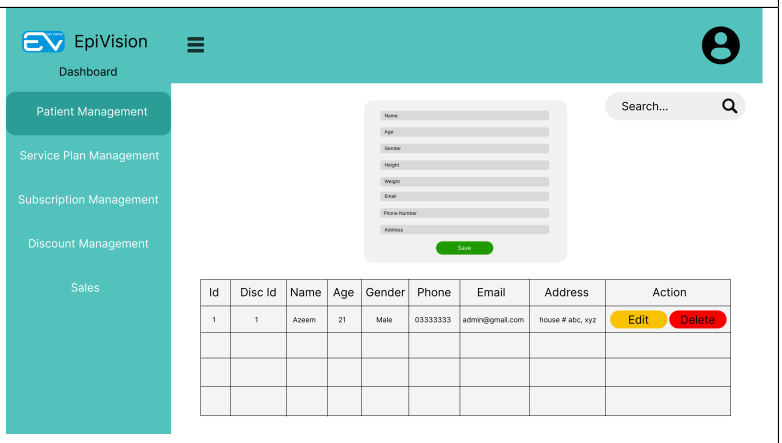
Use Case ID	UC003
Actors	Administrator
Description	This use case involves the administrator retrieving patient's information from the system.
Preconditions	The administrator must be authenticated and have the necessary privileges to retrieve patient information.
Postconditions	The patient information is successfully retrieved from the system.
Main Flow	1. The administrator logs into the system. 2. The administrator navigates to the patient management section.
	3. The administration see a table containing record of all patients in a system.

	4. The administrator selects the specific patient record to view. 5. The system retrieves and displays the patient information.
Prototype	 View Patient

3.1.4 Update Patient

TABLE 4: Update Patient Profile

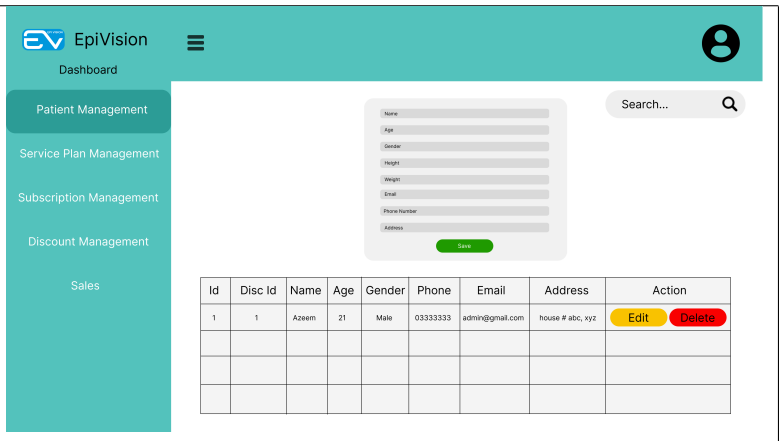
Use Case ID	UC004
Actors	Admin, Patient
Description	This use case involves updating a user profile either by the admin or the patient.
Preconditions	The admin or the patient must be authenticated and have the necessary privileges to update a user profile.
Postconditions	The patient profile is successfully updated in the system.
Main Flow	1. The admin or the patient logs into the system. 2. The admin or the patient navigates to the patient management section and patient profile section respectively. 3. The admin or the patient selects the update profile option. 4. The admin or the patient modifies the relevant details in the patient profile, such as name, email, or other information.

	5. The system validates the provided information and updates the profile.
Prototype	 Update Patient

3.1.5 Delete Patient

TABLE 5: Delete Patient

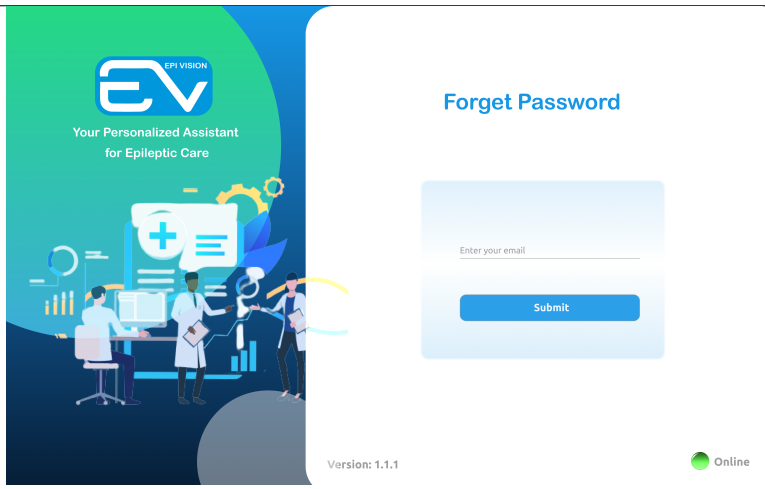
Use Case ID	UC005
Actors	Administrator, Patient
Description	This use case involves the administrator and patient to delete a user record from the system.
Preconditions	The administrator or patient must be authenticated and have the necessary privileges to delete a user.
Postconditions	The user record is successfully deleted from the system.
Main Flow	1. The administrator or patient logs into the system. 2. The administrator or patient navigates to the patient management section and settings section respectively. 3. The administrator or patient selects the delete user option. 4. The administrator selects the specific user record to remove from the system. 5. The system confirms the deletion and removes the user record.

Prototype	 Delete Patient

3.1.6 Account Recovery

TABLE 6: Account Recovery

Use Case ID	UC006
Actors	Patient
Description	This use case involves the user recovering their account in case of forgotten credentials or locked accounts.
Preconditions	The user must have a registered account on the acquisition web portal.
Postconditions	The user successfully recovers their account and gains access.
Main Flow	1. The user accesses the account recovery option on web portal. 2. The user selects the account recovery method, such as email or security questions. 3. The user provides the necessary information to verify their identity. 4. The system verifies the provided information. 5. If the information matches, the system allows the user to reset their password or unlock their account. 6. The user completes the account recovery process and gains access to their account.

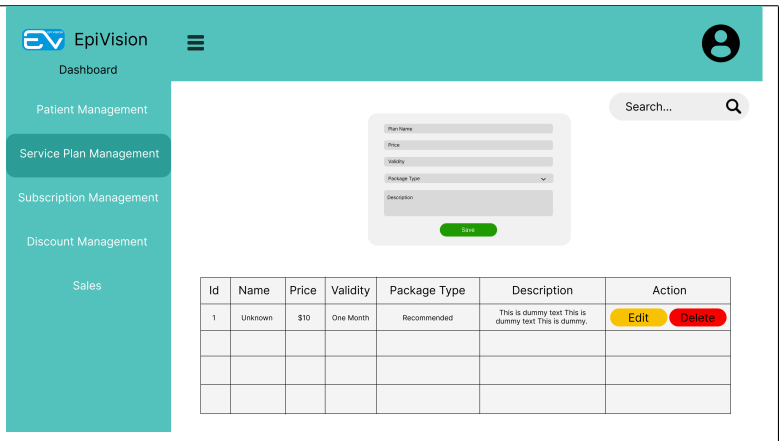
Prototype	 Account Recovery

3.2 Service Plan Management

3.2.1 Create Service Plans

TABLE 7: Create Service Plans

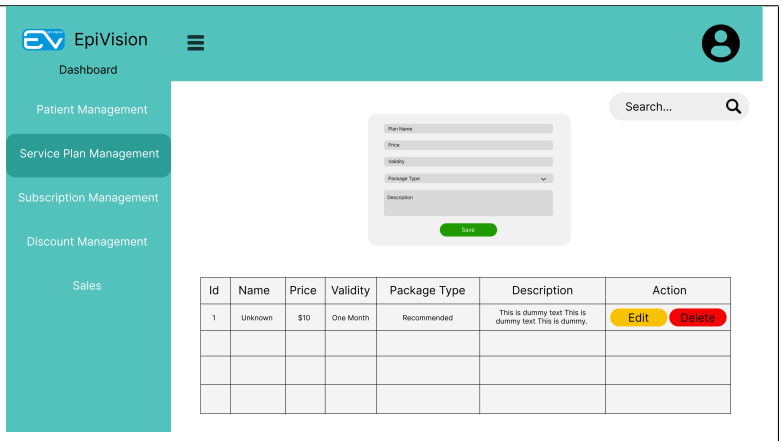
Use Case ID	UC007
Actors	Administrator
Description	This use case involves the administrator creating a new service plan in the system.
Preconditions	The administrator must be authenticated and have the necessary privileges to create a service plan.
Postconditions	A new service plan is successfully created in the system.
Main Flow	1. The administrator logs into the system. 2. The administrator navigates to the service plan management section. 3. The administrator selects the create service plan option. 4. The administrator provides the necessary details for the new service plan, such as plan name, description, and pricing. 5. The system validates the provided information and creates a new service plan.

Prototype	 Create Service Plan

3.2.2 View Service Plan

TABLE 8: View Service Plan

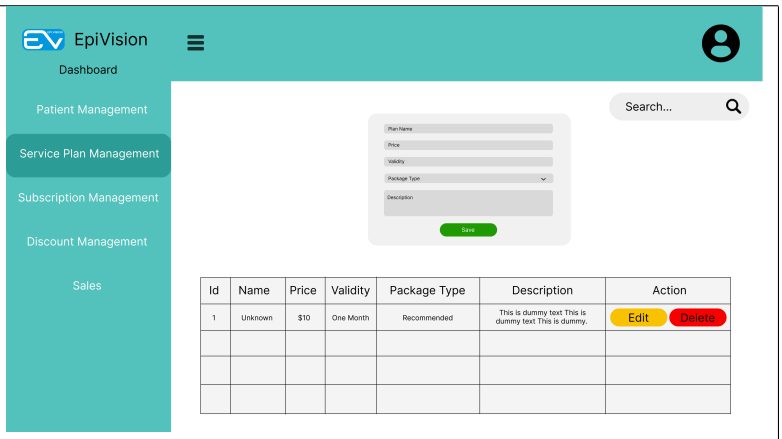
Use Case ID	UC008
Actors	Administrator
Description	This use case involves the administrator retrieving service plan information from the system.
Preconditions	The administrator must be authenticated and have the necessary privileges to retrieve service plan information.
Postconditions	The service plan information is successfully retrieved from the system.
Main Flow	1. The administrator logs into the system. 2. The administrator navigates to the service plan management section. 3. The administrator selects the retrieve service plan option. 4. The administrator selects the specific service plan to view. 5. The system retrieves and displays the service plan information.

Prototype	 View Service Plan

3.2.3 Update Service Plan

TABLE 9: Update Service Plan

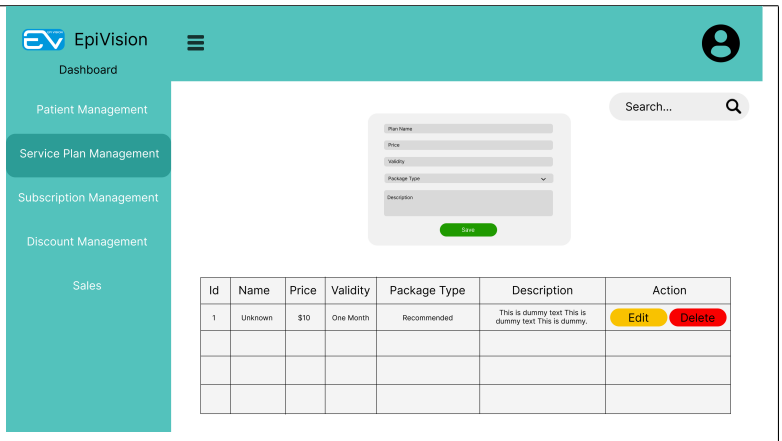
Use Case ID	UC009
Actors	Administrator
Description	This use case involves the administrator updating service plan information in the system.
Preconditions	The administrator must be authenticated and have the necessary privileges to update service plan information.
Postconditions	The service plan information is successfully updated in the system.
Main Flow	1. The administrator logs into the system. 2. The administrator navigates to the service plan management section. 3. The administrator selects the update service plan option. 4. The administrator selects the specific service plan to edit. 5. The administrator modifies the relevant details for the service plan, such as plan name, description, or pricing. 6. The system validates the provided information and updates the service plan record.

Prototype	 Update Service Plan

3.2.4 Delete Service Plan

TABLE 10: Delete Service Plan

Use Case ID	UC010
Actors	Administrator
Description	This use case involves the administrator deleting a service plan from the system.
Preconditions	The administrator must be authenticated and have the necessary privileges to delete a service plan.
Postconditions	The service plan is successfully deleted from the system.
Main Flow	1. The administrator logs into the system. 2. The administrator navigate to service plan management section. 3. The administrator selects the delete service plan option and select specific plan to remove. 4. The system confirms the deletion and removes the service plan record.

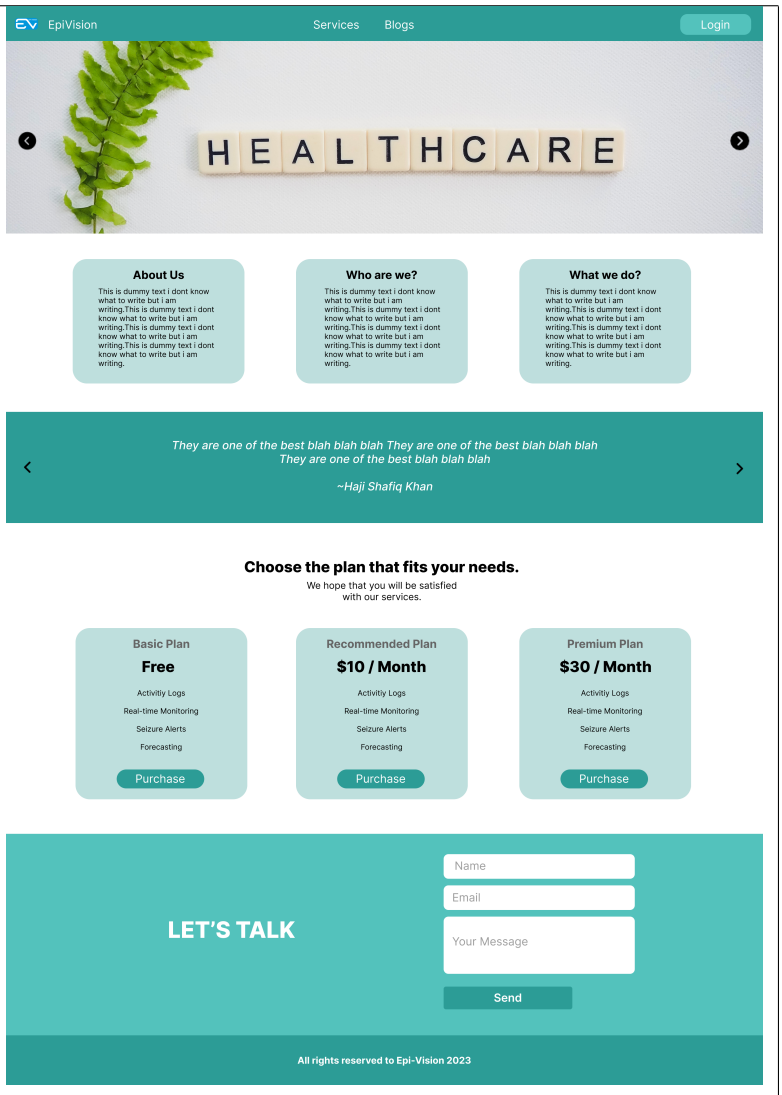
Prototype	 Delete Service Plan

3.3 User and Patient Management

3.3.1 Choose Service Plan

TABLE 11: Choose Service Plan

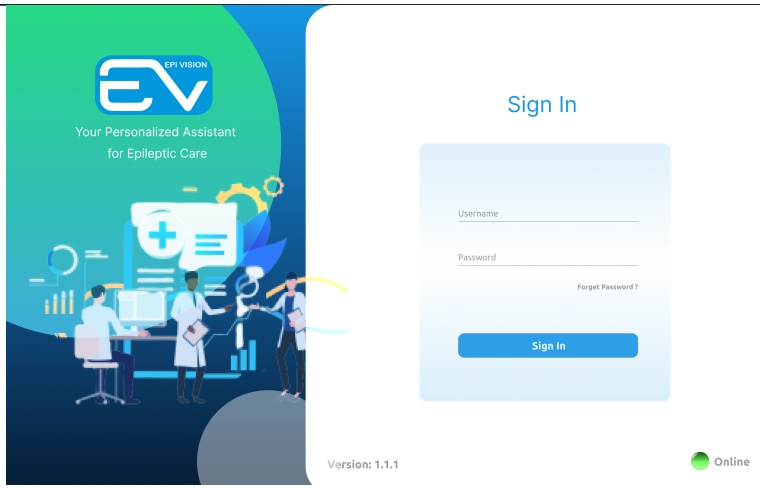
Use Case ID	UC011
Actors	Patient
Description	This use case involves the user selecting a service plan based on their requirements and budget.
Preconditions	The user must have access to acqusition web portal.
Postconditions	The user successfully chooses a service plan.
Main Flow	1. The user access the acquisition web portal. 2. The user navigates to the service plans section. 3. The user views the available service plans and their details. 4. The user selects a service plan that meets their requirements. 5. The user proceeds to the sign up process.

Prototype	 Service Plan Selection

3.3.2 User Login

Table 12: User Login

Use Case ID	UC012
Actors	Patient
Description	This use case involves the user logging into the web portal to access their account.
Preconditions	The user must have a registered account on the acquisition web portal.
Postconditions	The user successfully logs into their account.
Main Flow	1. The user accesses the login page of web portal.

	2. The user enters their credentials (username and password). 3. The system verifies the credentials. 4. If the credentials are valid, the user is granted access to their account.
Prototype	 Login

3.3.3 Patient's Face Recognition

TABLE 13: Patient's Face Recognition

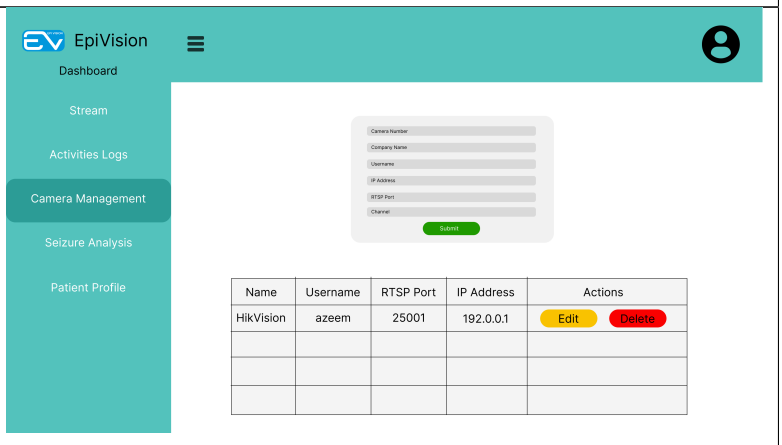
Use Case ID	UC013
Actors	Desktop Application
Description	This use case involves the recognition of a patient's face for identification purposes in the desktop application.
Preconditions	The desktop application must have access to the camera stream and patient information.
Postconditions	The patient's face is successfully recognized by the system.
Main Flow	1. The caretaker launches the desktop application. 2. The desktop application captures the user's face from the camera stream. 3. The desktop application compares the captured face with the stored face pictures in the system. 4. If a match is found, the patient is recognized and logs will be generated.

	5. If no match is found, the patient is not recognized, and logs generation is denied.

3.4 Camera Management

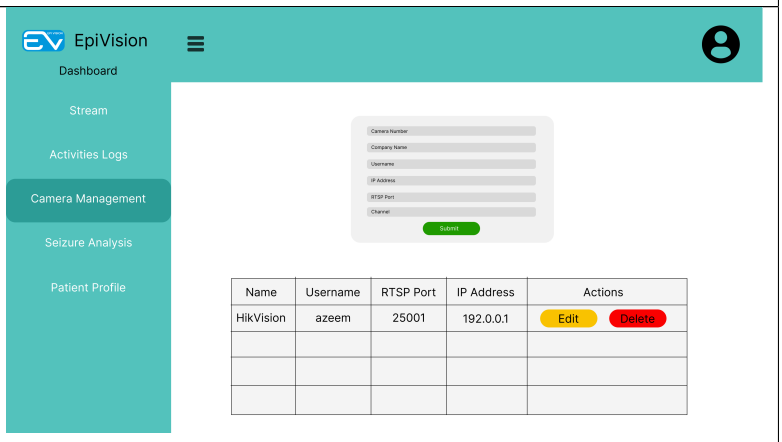
3.4.1 Create Camera

TABLE 14: Create Camera

Use Case ID	UC014
Actors	Patient
Description	This use case involves creating a new camera record in the system.
Preconditions	The patient must be authenticated and have the necessary privileges to create a camera record.
Postconditions	A new camera record is successfully created in the system.
Main Flow	1. The patient logs into the system. 2. The user navigates to the camera management section. 3. The user selects the create camera option. 4. The user provides the necessary details for the new camera, such as brand name, RTSP port number, IP address, and channel number. 5. The system validates the provided information and creates a new camera record.
Prototype	 Add Camera

3.4.2 View Cameras

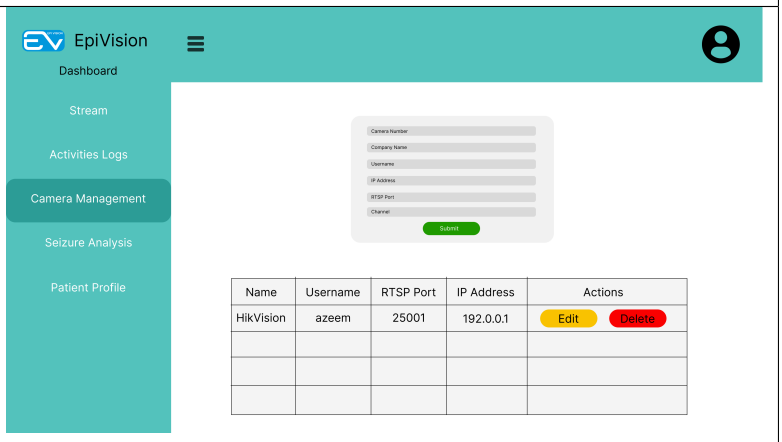
Table 15: View Cameras

Use Case ID	UC015
Actors	Patient
Description	This use case involves retrieving camera information from the system.
Preconditions	The patient must be authenticated and have the necessary privileges to retrieve camera information.
Postconditions	The camera information is successfully retrieved from the system.
Main Flow	1. The patient logs into the system. 2. The user navigates to the camera management section. 3. The user selects the retrieve camera option. 4. The user selects the specific camera record to view.
	5. The system retrieves and displays the camera information.
Prototype	 View Camera

3.4.3 Update Camera

Table 16: Update Camera

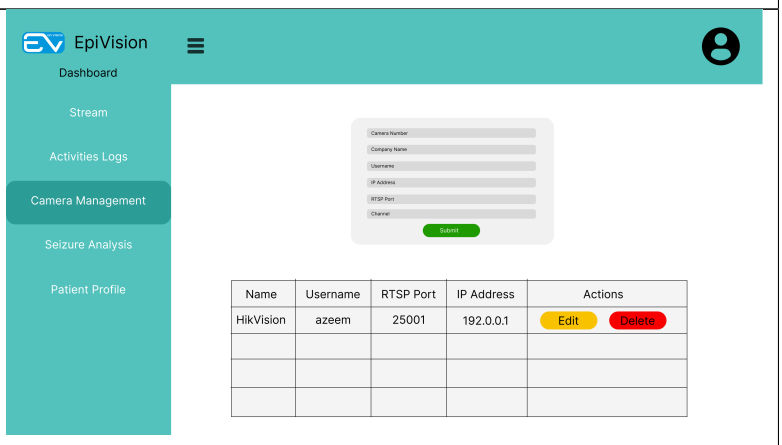
Use Case ID	UC016
Actors	Patient
Description	This use case involves updating camera information in the system.

Preconditions	The patient must be authenticated and have the necessary privileges to update camera information.
Postconditions	The camera information is successfully updated in the system.
Main Flow	1. The patient logs into the system. 2. The user navigates to the camera management section.
	3. The user selects the update camera option. 4. The user selects the specific camera record to edit. 5. The user modifies the relevant details for the camera, such as brand name, RTSP port number, IP address, or channel number. 6. The system validates the provided information and updates the camera record.
Prototype	 Update Camera

3.4.4 Delete Camera

TABLE 17: Delete Camera

Use Case ID	UC017
Actors	Patient
Description	This use case involves deleting a camera record from the system.
Preconditions	The patient must be authenticated and have the necessary privileges to delete a camera record.

Postconditions	The camera record is successfully deleted from the system.
Main Flow	1. The patient logs into the system. 2. The user navigates to the camera management section. 3. The user selects the delete camera option. 4. The user selects the specific camera record to remove from the system. 5. The system confirms the deletion and removes the camera record.
Prototype	 Delete Camera

3.4.5 Start Camera Streaming

TABLE 18: Start Camera Streaming

Use Case ID	UC018
Actors	Desktop Application
Description	This use case involves the desktop application receiving and streaming video from the cameras to the web application.
Preconditions	The desktop application must be running and connected to the cameras.
Postconditions	The video stream is successfully received and streamed to the web application.
Main Flow	1. The desktop application establishes connections with the cameras.

	2. The desktop application receives video streams from the connected cameras. 3. The desktop application encodes the video streams. 4. The desktop application streams the encoded video to the web application. 5. The web application displays the received video stream to the user.

3.4.6 Synchronization of Multiple Cameras

Table 19: Synchronization of Multiple Cameras

Use Case ID	UC019
Actors	Desktop Application
Description	This use case involves synchronizing multiple cameras to ensure accurate recording and tracking of activities.
Preconditions	The desktop application must be connected to multiple cameras.
Postconditions	The cameras are successfully synchronized for recording and tracking activities.
Main Flow	1. The desktop application establishes connections with multiple cameras. 2. The desktop application receives video streams from each camera. 3. The desktop application synchronizes the timestamps of the video streams. 4. The desktop application associates the synchronized video streams with the corresponding activities.

3.5 Activity and Seizure Monitoring

3.5.1 Activities Logging

Table 20: Activities Logging

Use Case ID	UC020
Actors	Desktop Application, Server

Description	This use case involves the desktop application capturing activities from the camera stream and logging them for further processing.
Preconditions	The desktop application must be running and receiving camera streams.
Postconditions	The activities are successfully captured and logged for processing.
Main Flow	1. The desktop application receives the camera stream. 2. The desktop application detects and identifies activities from the stream. 3. The desktop application associates each activity with the corresponding camera. 4. The desktop application generates activity logs containing details of each activity. 5. The desktop application sends the activity logs to the server for processing.

3.5.2 Seizure Detection

Table 21: Seizure Detection

Use Case ID	UC021
Actors	Server
Description	This use case involves the server analyzing activity logs to detect seizures and generate alerts.
Preconditions	The server must receive the activity logs from the desktop application.
Postconditions	Seizures are successfully detected, and alerts are generated.
Main Flow	1. The server receives the activity logs from the desktop application.
	2. The server analyzes the activity logs to detect patterns associated with seizures. 3. If a seizure is detected, the server generates an alert. 4. The server sends the alert to the web application and/or mobile application.

3.5.3 Seizure Forecast

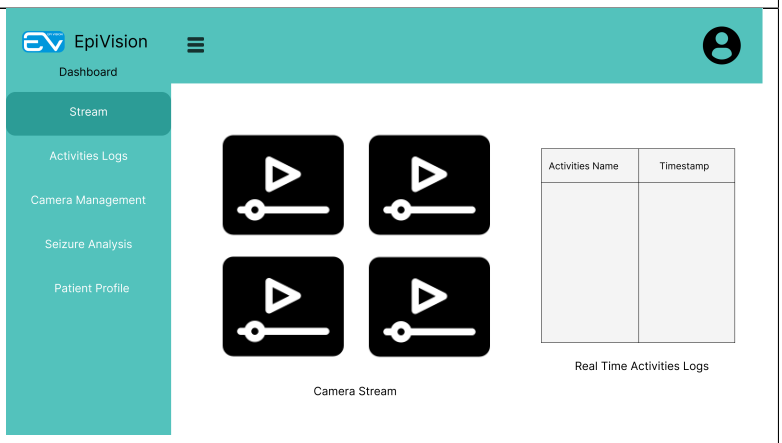
Table 22: Seizure Forecast

Use Case ID	UC022
Actors	Server
Description	This use case involves the server using collected patterns and data to predict seizures for proactive intervention.
Preconditions	The server must have access to patient-specific data and patterns.
Postconditions	Seizure predictions are successfully generated based on the collected patterns.
Main Flow	1. The server analyzes the collected patterns and data, such as sleep patterns, food patterns, and medication patterns. 2. The server identifies triggers and patterns associated with seizures. 3. The server uses the identified triggers and patterns to predict future seizures. 4. The seizure predictions are generated, stored for further analysis and intervention and server generates the alarm. 5. The server sends the alert to the web application and/or mobile application.

3.5.4 View Deidentified Stream

Table 23: View Deidentified Stream

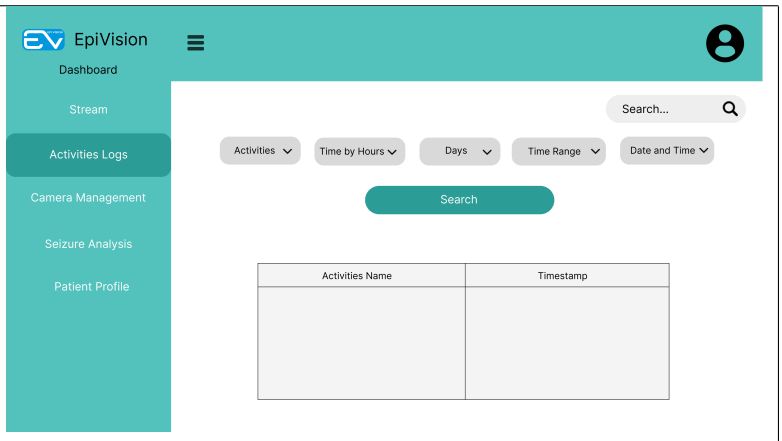
Use Case ID	UC023
Actors	Patient
Description	This use case involves the user viewing the deidentified camera stream in the web application.
Preconditions	The user must be authenticated and have the necessary privileges to access the deidentified stream.
Postconditions	The user successfully views the deidentified camera stream.
Main Flow	1. The user logs into the web application. 2. The user navigates to the stream section.

	3. The web application retrieves the deidentified camera stream. 4. The user is presented with the camera stream.
Prototype	 Stream

3.5.5 View Activity Logs

TABLE 24: View Activity Logs

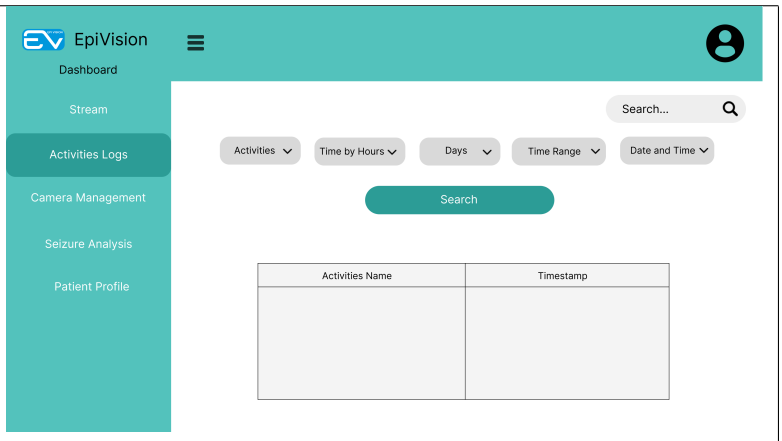
Use Case ID	UC024
Actors	Patient
Description	This use case involves the user viewing the activities logs in the web application.
Preconditions	The user must be authenticated and have the necessary privileges to access the activities logs.
Postconditions	The user successfully views the activities logs in the web application.
Main Flow	1. The user logs into the web application. 2. The user navigates to the activities logs section. 3. The web application retrieves the activities logs from the database. 4. The user is presented with the activities logs, including information such as activities, timestamps, and associated camera numbers.

Prototype	 View Activity Logs

3.5.6 Adhoc Queries for Activity Logs

TABLE 25: Adhoc Queries for Activity Logs

Use Case ID	UC025
Actors	Patient
Description	This use case involves the user performing adhoc queries or event mining queries to retrieve specific information from the activity logs.
Preconditions	The user must be logged into the web portal and have access to the query functionality.
Postconditions	The user successfully retrieves the requested information based on the adhoc query or event mining query.
Main Flow	1. The user logs into the acquisition web portal. 2. The user navigates to the activities logs section. 4. The user provides the necessary parameters or conditions for the query. 5. The system executes the query and retrieves the requested information from the activity logs.

Prototype	 Search Queries on Activities Logs

3.5.7 Generate Seizure Alarm

Table 26: Generate Seizure Alarm

Use Case ID	UC026
Actors	Server
Description	This use case involves the server generating an alarm in response to the detection or forecasting of seizure.
Preconditions	The server must have access to the activities logs and detection algorithms.
Postconditions	An alarm is successfully generated by the server.
Main Flow	1. The server continuously monitors the activities logs and analyzes the data. 2. The server applies detection algorithms to identify specific activities or pattern such as seizure. 3. If a specific activity or pattern is detected, the server generates an alarm. 4. The alarm is sent to the web and mobile applications to notify the user.

3.5.8 Send Seizure Alarm

Table 27: Send Seizure Alarm

Use Case ID	UC027
Actors	Server, Web Application, Mobile Application

Description	This use case involves sending push notifications to the web application and/or mobile application to notify users of detected seizures or alerts.
Preconditions	Seizures or alerts must be detected and generated by the server.
Postconditions	Push notifications are successfully sent.
Main Flow	1. The server detects seizures or generates alerts based on the analysis of activity logs. 2. The server prepares push notifications containing relevant information about the seizures or alerts. 3. The server sends the push notifications to the web application and/or mobile application. 4. The web application and/or mobile application receive and display the push notifications to the users.

3.6 Personalized Model

3.6.1 Personalized Model

Table 28: Personalized Model

Use Case ID	UC028
Actors	Server
Description	This use case involves personalizing the seizure prediction model for a specific patient based on their collected data and patterns.
Preconditions	The system must have collected data and patterns specific to the patient.
Postconditions	The seizure prediction model is successfully personalized for the specific patient.
Main Flow	1. The system collects and analyzes data. 2. The system identifies patient-specific triggers and patterns associated with seizures. 3. The system adjusts the seizure prediction model to incorporate the patient-specific triggers and patterns.

3.7 Authentication of Services

3.7.1 Authentication of Services

Table 29: Authentication of Services

Use Case ID	UC029
Actors	Patient
Description	This use case involves the user authenticating their access to the system's services through the web portal.
Preconditions	The user must have a registered account on the acquisition web portal.
Postconditions	The user successfully authenticates their access to the services.
Main Flow	1. The user logs into the web portal or desktop application. 2. The user navigates to any services section. 3. The user selects the desired service. 4. The system verifies the user's credentials and access rights. 5. If the user is authorized, the system grants access to the requested service.