SOFTWARE ENGINEERING

SOFTWARE REQUIREMENT SPECIFICATION

Care Connect - Smart Healthcare Solution

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Software Requirements Specification

# Care Connect - Smart Healthcare Solution

# 1. Introduction

## 1.1 Purpose

This Software Requirements Specification (SRS) document outlines the detailed functional and non-functional requirements for the 'Care Connect - Smart Healthcare Solution.' The document serves as a blueprint for the development and implementation of a comprehensive healthcare management system that aims to enhance patient care, improve healthcare provider efficiency, and integrate advanced technologies like telemedicine and real-time monitoring. It is intended to ensure that all stakeholders have a clear understanding of the system's objectives, scope, and features.

## 1.2 Document Conventions

This document follows these conventions for clarity:  
- **Bold**: Section headers and important terms.  
- *Italic*: Emphasis and notes.  
- `Monospace`: Code snippets, file names, and commands.  
- **Bullet** **Points**: Lists and key features.

## 1.3 Intended Audience and Reading Suggestions

This document is intended for:  
- **Development** **Team**: For understanding system requirements, architecture, and design.  
- **Project** **Managers**: To track project milestones, deliverables, and timelines.  
- **Stakeholders**: To ensure the system meets business objectives and regulatory compliance.  
- **Healthcare** **Providers**: To familiarize themselves with the system's functionalities and benefits.  
- **Quality** **Assurance** **Team**: To develop comprehensive test cases and ensure the system's reliability.

## 1.4 Product Scope

The Care Connect platform is designed to revolutionize healthcare delivery by providing a unified, secure, and efficient system for managing patient care. The platform will offer telemedicine services, personalized health insights, and real-time monitoring, ensuring improved patient engagement, streamlined healthcare operations, and robust data security. It aims to cater to a diverse audience, including patients, healthcare providers, and healthcare institutions, by providing them with innovative tools and services.

## 1.5 References - IEEE Standard for SRS Documents: IEEE Std 830-1998, "IEEE Recommended Practice for Software Requirements Specifications," IEEE, 1998.

- **Django Official Documentation**: For backend development and deployment.  
- **Django REST Framework Documentation**: For building APIs.  
- **TensorFlow/PyTorch Documentation**: For integrating machine learning models.  
- **Material-UI Guidelines**: For front-end design and consistency.  
- **Healthcare Data Security Regulations**: HIPAA and GDPR compliance guidelines.

# 2. Overall Description

## 2.1 Product Perspective

Care Connect is a state-of-the-art healthcare management system designed as a web-based application. It integrates patient-centric and provider-centric functionalities, offering a scalable and secure platform that supports seamless communication and data exchange across healthcare systems. The platform will leverage cloud-based infrastructure to ensure high availability, data redundancy, and performance optimization.

**System Architecture Overview**:  
- **Frontend**: CSS and Bootstrap with Material-UI for an intuitive and responsive user interface.  
- **Backend** Django and Django REST Framework (DRF) for scalable and secure server-side operations.  
- **Database**: SQL for robust data management, with support for complex queries and high concurrency.  
- **Real-Time Functionality**: Implemented using Django Channels for WebSocket support, enabling live consultations and real-time notifications.  
- **Chatbot**: Gemini Flash 2.5 for AI-driven diagnostics and personalized health recommendations.

## 2.2 Product Functions

**Telemedicine Functions**

1. **Online Consultation Booking**

* Schedule virtual appointments with doctors.
* Integrate time slots based on doctor availability.
* Video and Audio Consultations
* Secure, high-quality video and audio calls between patients and doctors.
* Options to share screen or medical files during calls.

### 

### EHR Functions

* Secure storage for patient records, lab reports, and diagnostic data.
* Accessible to both patients and doctors via secure login.
* Maintain a timeline of past appointments, prescriptions, and notes

1. **Chatbot Functions**

* Offer preliminary assessment based on symptoms provided by the patient.
* **S**uggest appropriate next steps, such as booking a consultation or visiting a specialist.

## 2.3 User Classes and Characteristics

The system will serve the following user classes:  
- **Patients**: Individuals seeking convenient access to healthcare services, including remote consultations, personalized health management, and real-time monitoring.  
- **Healthcare Providers:** Doctors, nurses, and administrative staff who require efficient tools for managing patient care, scheduling, and clinical workflows.  
- **Healthcare Institutions**: Hospitals, clinics, and other healthcare facilities looking to adopt innovative solutions to enhance operational efficiency and patient engagement.

## 2.4 Operating Environment

The Care Connect system will be accessible through modern web browsers (Chrome, Firefox, Safari, Edge) on desktop. The system will also support integration with existing healthcare systems and third-party APIs for extended functionality.

## 2.5 Design and Implementation Constraints

The system development will adhere to the following constraints:  
- **Interoperability**: Must support integration with various EHR systems, medical devices, and healthcare APIs.  
- **Scalability**: Designed to handle a growing number of users and large volumes of data without performance degradation.  
- **Performance**: The system should provide a seamless user experience with minimal latency during peak usage times.

## 2.6 User Documentation

Comprehensive user documentation will be provided, including:  
- **User Manuals**: Detailed instructions on system usage for patients, healthcare providers, and administrators.  
- **Online Help**: Interactive help guides and FAQs accessible within the application.  
- **Training Materials**: Tutorials, videos, and webinars for training healthcare providers and administrative staff.

## 2.7 Assumptions and Dependencies

The system development assumes the following:  
- **Stable Internet Access**: Assumes users have reliable internet connections to access the system.  
- **Third-Party APIs**: Relies on third-party services for functionalities like video consultations, payment processing, and machine learning integrations.  
- **Agile Development**: The project will follow an agile methodology, allowing for iterative development and continuous feedback from stakeholders.

# 3. External Interface Requirements

## 3.1 User Interfaces

This section outlines the logical characteristics of each interface between the "Care Connect" software product and its users:

**Screen Layout and Navigation:**

The interface will adhere to the Material Design guidelines, ensuring consistency and ease of use across all screens. The main navigation bar will include options for the Patient Portal, Telemedicine, and Analytics. Each screen will consist of a header with quick access to notifications and user settings, a content area, and a footer with links to support and legal information.

**Standard Elements:**

* Buttons: Standard buttons include "Book Appointment," "Start Consultation," "Submit Feedback," and "ASK AI." Each button will be color-coded based on its function (e.g., green for confirmatory actions, red for cancellations).
* Input Fields: Fields for patient data input, such as name, date of birth, and medical history, will have clear labels, placeholder text, and validation messages. Critical fields will be marked with an asterisk (\*).
* Error Messages: Error messages will be prominently displayed in red and will include specific guidance on how to resolve the issue (e.g., "Invalid email format").

**Accessibility:**

The interface will support screen readers, high contrast mode, and keyboard navigation to ensure accessibility for users with disabilities.

**Sample Screens:**

* Patient Dashboard: A comprehensive view of the patient's upcoming appointments, recent consultations, and personalized health recommendations.
* Telemedicine Interface: A video consultation screen with options for chat, file sharing, and a notes panel for the healthcare provider.

## 3.2 Hardware Interfaces

This section details the logical and physical characteristics of interfaces between the software product and the hardware components:

**Supported Device Specifications:**

* Desktop and Laptop Computers: The application is designed to work on devices running Windows, macOS, and Linux.
* Recommended Resolution: 1024x768 pixels for desktop.
* Connection Speed: A minimum of 5 Mbps internet connection is recommended for smooth video consultations and real-time features.

## 3.3 Software Interfaces

This section covers the connections between "Care Connect" and other software components:

**Operating Systems:**

* The platform supports Windows 10 or later, macOS 10.15 or later, and popular Linux distributions.

**Supported Browsers**:

* Google Chrome: Version 90 or later (recommended for best performance).
* Mozilla Firefox: Version 88 or later.
* Microsoft Edge: Version 90 or later.
* Safari: Version 14 or later (for macOS).
* Opera: Version 75 or later.

**Databases:**

* SQL: The primary database for storing patient records, appointment details, and system logs.

**APIs:**

* Django REST Framework: Provides RESTful APIs for mobile and web applications to interact with the backend.
* Bootstrap is used to create a project to create responsive and visually appealing web designs efficiently with minimal custom CSS.

## 

## 3.4 Communications Interfaces

This section specifies the communications functions required by "Care Connect":

**Communication Standards:**

* HTTP/HTTPS: All web communications will use HTTPS for secure data transfer between clients and the server.
* WebSocket: Implemented via Django Channels for real-time communications, such as video consultations and instant messaging.

**Message Formatting:**

* JSON: The standard format for data exchange between the client, server, and third-party services.

**Security:**

* Multi-Factor Authentication (MFA): Enhanced security for user login, requiring an additional verification step.

**Data Transfer Rates and Synchronization:**

* The application will support high-speed data transfer over Ethernet and Wi-Fi, with real-time synchronization for critical data like live consultations and patient monitoring.

# 4. System Features

## 4.1 TELEMEDICINE:

**4.1.1 Description and Priority:**

The Telemedicine Consultations feature allows patients and healthcare providers to conduct virtual consultations using video, audio, and text communication tools. This feature is essential for providing remote healthcare services and enhancing accessibility.

* **Priority**: High
* **Benefit**: 9
* **Penalty**: 7
* **Cost**: 8
* **Risk**: 6

**4.1.2 Stimulus/Response Sequences:**

1. **Patient Scheduling a Consultation**
   * **User**: Patient logs into the system and selects “Schedule Consultation.”
   * **System**: The system displays available appointment slots. The patient selects a slot and confirms the appointment.
   * **System**: The system sends a confirmation email and SMS to the patient and the healthcare provider.
2. **Healthcare Provider Initiating Consultation**
   * **User**: Healthcare provider logs into the system and views upcoming consultations.
   * **System**: The system displays a list of scheduled consultations.
   * **User**: The healthcare provider clicks on “Start Consultation” for a scheduled appointment.
   * **Response**: The system initiates a video call and notifies the patient.
3. **During Consultation**
   * **User**: Both parties join the video call.
   * **System**: The system establishes a secure video and audio connection.
   * **User**: Healthcare provider requests document sharing.
   * **System**: The system allows for secure upload and download of documents.
4. **Post-Consultation Actions**
   * **User**: Healthcare provider completes the consultation.
   * **System**: The system updates the patient’s EHR and sends a summary report to the patient.
   * **User**: Patient provides feedback on the consultation.
   * **System**: The system records feedback and updates the provider’s performance metrics.

**4.1.3 Functional Requirements:**

REQ-1: **User Authentication and Authorization**

* The system shall require secure login for patients and healthcare providers.
* Access to consultation features shall be role-based, ensuring appropriate permissions.

REQ-2: **Appointment Scheduling**

* The system shall allow patients to view available appointment slots and schedule consultations.
* The system shall provide healthcare providers with an interface to manage their availability and view scheduled appointments.

REQ-3: **Video, Audio, and Text Communication**

* The system shall provide a high-quality video conferencing tool with low latency.
* The system shall support real-time audio communication.
* The system shall enable text chat during consultations.

REQ-4: **Document Sharing**

* The system shall support secure sharing of medical documents, images, and test results during consultations.
* Documents shared shall be encrypted and accessible only to the involved parties.

REQ-5: **EHR Integration**

* The system shall allow healthcare providers to access and update patient records during consultations.
* All changes to EHRs shall be securely logged and auditable.

REQ-6: **Billing and Payment**

* The system shall integrate with payment gateways for processing consultation fees.
* The system shall provide patients with a summary of charges and payment history.

REQ-7: **Error Handling and Validation**

* The system shall handle invalid input by providing error messages and allowing users to correct information.
* The system shall ensure that all communication and data sharing are encrypted to protect user privacy.

## 4.2 Virtual Health Assistant:

**4.2.1 Description and Priority:**

The Virtual Health Assistants feature utilizes ML-driven chatbots to provide initial interactions with patients and automate appointment setting. These chatbots can answer basic health-related questions, guide users through appointment scheduling, and collect preliminary information before consultations with healthcare providers.

* **Priority**: High
* **Benefit**: 8
* **Penalty**: 6
* **Cost**: 7
* **Risk**: 5

**4.2.2 Stimulus/Response Sequences:**

1. **User Initiates Chat with Virtual Assistant**
   * **User**: Patient or healthcare provider accesses the chatbot interface on the platform.
   * **System**: The system activates the virtual health assistant and displays a greeting message.
2. **Chatbot Handles Basic Health Queries**
   * **User**: User types a health-related question.
   * **System**: The chatbot processes the query using AI algorithms and provides a relevant answer based on available data.

**4.2.3 Functional Requirements:**

REQ-1: **Chatbot Interaction**

* The system shall provide an AI-driven chatbot interface capable of understanding and processing natural language queries.
* The chatbot shall respond to basic health-related questions using predefined answers and data from a medical knowledge base.

REQ-2: **Preliminary Information Collection**

* The chatbot shall collect basic user information, including symptoms, medical history, and contact details, before a consultation.
* The collected information shall be securely stored and made accessible to healthcare providers in the EHR system.

REQ-3: **User Experience and Interface**

* The chatbot interface shall be user-friendly and accessible on both web and mobile platforms.
* The chatbot shall support multi-language interactions based on user preferences.

REQ-4: **Error Handling and Validation**

* The system shall handle unrecognized queries by providing error messages or escalation options to human support.
* The chatbot shall validate user inputs for appointment scheduling and preliminary information, ensuring accuracy and completeness.

REQ-5: **Data Security and Privacy**

* The chatbot interactions shall be encrypted to protect user privacy and comply with relevant data protection regulations.
* The system shall ensure that all collected data is stored securely and accessible only to authorized personnel.

REQ-6: **Performance Monitoring**

* The system shall monitor the chatbot's performance, including response accuracy and user satisfaction.
* The system shall provide analytics on chatbot interactions to help improve functionality and user experience.

## 4.3 Electronic Health Records (EHR):

**4.3.1 Description and Priority**:

The Electronic Health Records (EHR) feature provides centralized storage of patient data with real-time updates and interoperability. This feature ensures that patient information is consistently available across different healthcare providers and systems, facilitating accurate and efficient care.

* **Priority**: High
* **Benefit**: 9
* **Penalty**: 8
* **Cost**: 8
* **Risk**: 7

**4.3.2 Stimulus/Response Sequences:**

1. **Data Entry and Update**
   * **User**: Healthcare provider inputs or updates patient data in the system (e.g., medical history, test results).
   * **System**: The system processes and saves the data, updating the patient’s record in real-time.
2. **Accessing Patient Records**
   * **User**: A healthcare provider requests access to a patient’s EHR.
   * **System**: The system retrieves and displays the patient’s complete health record, ensuring up-to-date information is shown.
3. **Data Retrieval for Consultations**
   * **User**: During a consultation, a healthcare provider requests specific patient data (e.g., previous diagnoses, medication history).
   * **System**: The system retrieves and displays the requested information, providing a comprehensive view for decision-making.

**4.3.3 Functional Requirements:**

REQ-1: **Centralized Data Storage**

* The system shall provide a centralized database for storing all patient health records.
* Patient data shall be stored in a structured format to facilitate easy retrieval and updates.

REQ-2: **Real-Time Updates**

* The system shall ensure that any updates to patient records are reflected in real-time.
* The system shall support concurrent data access and updates by multiple authorized users without data conflicts.

REQ-3: **Data Access and Retrieval**

* The system shall provide secure access to patient records for authorized healthcare providers.
* The system shall support fast and efficient retrieval of patient data for use in consultations and other medical activities.

REQ-4: **Data Security and Privacy**

* The system shall implement encryption for data storage and transmission to protect patient privacy.
* The system shall enforce role-based access controls to ensure that only authorized personnel can access or modify patient records.

REQ-5: **User Interface and Usability**

* The system shall provide an intuitive user interface for healthcare providers to easily enter, view, and update patient data.
* The system shall include search and filter functionalities to quickly locate specific patient records or data points.

REQ-6: **Backup and Disaster Recovery**

* The system shall implement automated backup procedures to protect against data loss.
* The system shall include disaster recovery mechanisms to restore data and functionality in case of a failure or breach.

## 4.4 User Management:

**4.4.1 Description and Priority:**

The User Management feature provides role-based access control and multi-factor authentication to ensure secure and appropriate access to the system. This feature manages user roles, permissions, and authentication methods, enhancing security and compliance with access control policies.

* **Priority**: High
* **Benefit**: 9
* **Penalty**: 7
* **Cost**: 6
* **Risk**: 5

**4.4.2 Stimulus/Response Sequences:**

1. **User Registration and Role Assignment**
   * **User**: An administrator registers a new user and assigns a role (e.g., patient, healthcare provider, administrator).
   * **System**: The system creates a new user account with the assigned role and permissions.
2. **User Login**
   * **User**: A user attempts to log into the system using their username and password.
   * **System**: The system verifies the credentials. If valid, the user is prompted for multi-factor authentication (e.g., SMS code or authenticator app).
3. **Multi-Factor Authentication**
   * **User**: The user provides the multi-factor authentication code.
   * **System**: The system verifies the code. If correct, the user is granted access; if incorrect, the user is prompted to retry or seek help.
4. **Access Control Based on Roles**
   * **User**: A user attempts to access a specific feature or data based on their role.
   * **System**: The system checks the user's permissions and either grants or denies access based on their role.
5. **Role Modification and Permission Updates**
   * **User**: An administrator updates a user’s role or permissions.
   * **System**: The system updates the user’s access rights accordingly and provides confirmation of the changes.
6. **Password Management**
   * **User**: A user requests to change or reset their password.
   * **System**: The system sends a password reset link or verification code to the user's registered email or phone. Upon verification, the user can set a new password.

**4.4.3 Functional Requirements:**

REQ-1: **Role-Based Access Control**

* The system shall support role-based access control (RBAC) to manage user permissions based on roles (e.g., patient, healthcare provider, administrator).
* The system shall ensure that users can only access features and data relevant to their assigned role.

REQ-2: **Multi-Factor Authentication**

* The system shall implement multi-factor authentication (MFA) to enhance security during the login process.
* MFA methods shall include options such as SMS codes, email verification, or authenticator app codes.
* The system shall support configuration of MFA settings for different user roles.

REQ-3: **User Account Management**

* The system shall allow administrators to create, modify, and deactivate user accounts.
* User account details shall include role assignments, access permissions, and contact information.

REQ-4: **Access Permissions**

* The system shall enforce access permissions based on user roles, preventing unauthorized access to restricted features or data.
* The system shall include an interface for administrators to manage and review user permissions.

REQ-5: **Password Management**

* The system shall provide functionality for users to change or reset their passwords securely.
* Password reset processes shall include secure verification methods to prevent unauthorized password changes.

REQ-6: **User Interface and Usability**

* The system shall provide an intuitive interface for users to manage their accounts, including login, password changes, and MFA setup.
* The system shall offer an administrator dashboard for efficient user and role management.

REQ-7: **Security and Compliance**

* The system shall ensure that all authentication and authorization processes comply with relevant security standards and regulations.
* The system shall implement encryption for user credentials and sensitive data to protect against unauthorized access.

# 5. Other Nonfunctional Requirements

## 5.1 Performance Requirements

The **Care Connect - Smart Healthcare Solution** is designed to deliver optimal performance across various use cases, including telemedicine, real-time monitoring, and large-scale data management. The following performance requirements must be met:

* **Telemedicine:** Video consultations should maintain a latency of less than 150 milliseconds and a minimum resolution of 720p under standard internet conditions (minimum 5 Mbps).
* **Real-Time Monitoring:** Patient data updates, including vital signs and alerts, must be reflected in the system within 2 seconds of data acquisition.
* **Data Processing:** The system should be capable of handling up to 1,000 concurrent users with a response time of no more than 2 seconds for standard queries and 5 seconds for complex analytics queries.
* **Scalability:** The system must support horizontal scaling to accommodate increasing user loads, with automated load balancing to ensure consistent performance during peak times.
* **Reliability:** The platform should maintain an uptime of 99.95% to ensure high availability, with scheduled maintenance periods limited to off-peak hours.

These performance metrics are critical to ensure that healthcare providers can deliver timely care, and patients can have a seamless experience using the platform.

## 5.2 Safety Requirements

The **Care Connect** platform must adhere to stringent safety standards to mitigate risks associated with healthcare operations. The following safety requirements are essential:

* **Data Integrity:** The system must implement strong error-checking mechanisms to prevent data corruption during transmission and storage, particularly for critical patient information.
* **System Failure Response:** In the event of a system failure, automatic failover protocols must be in place to switch to a backup system without data loss or significant downtime. Logs should be maintained to trace the failure and trigger an incident report.
* **User Safety Alerts:** The platform should generate alerts for healthcare providers when abnormal patient data (e.g., vitals) is detected, with fail-safes to ensure alerts are delivered even in low connectivity scenarios.

These safety measures are in place to protect both patients and healthcare providers, ensuring that the platform can be trusted for critical healthcare operations.

## 5.3 Security Requirements

Security is a top priority for the **Care Connect** platform, given the sensitivity of healthcare data. The following security requirements are crucial:

* **User Authentication:** The system must enforce multi-factor authentication (MFA) for all users, including patients, healthcare providers, and administrators. Role-based access control (RBAC) should be implemented to restrict access to sensitive functions based on user roles.
* **Data Encryption:** All patient data, both in transit and at rest, must be encrypted using industry-standard protocols (e.g., AES-256 for data at rest, TLS 1.2+ for data in transit). Additionally, data should be anonymized where possible to further protect patient privacy.
* **Data Breach Response:** In the event of a data breach, the system must have protocols in place for immediate containment, notification to affected users within 72 hours, and a detailed post-incident review to prevent future breaches.
* **Secure API Access:** All API endpoints must require authentication, with access tokens that expire after a short duration to minimize risks from token theft. APIs should also be rate-limited to prevent abuse.

By implementing these security measures, the **Care Connect** platform will safeguard sensitive healthcare data and maintain user trust.

## 5.4 Software Quality Attributes

To meet user expectations and ensure long-term viability, the **Care Connect** platform must exhibit the following software quality attributes:

* **Reliability:** The system should perform consistently under specified conditions, with a target of 99.95% uptime.
* **Maintainability:** The system should be modular and well-documented, allowing for easy updates and bug fixes without affecting overall functionality.
* **Scalability:** The architecture must support the ability to scale horizontally, accommodating increased loads without performance degradation.
* **Testability:** The system should be designed with testability in mind, allowing for automated testing of all major functionalities to ensure high quality before deployment.
* **Portability:** The platform should be deployable on various cloud environments (AWS, Azure) and support integration with different operating systems and devices.
* **Robustness:** The system should handle errors gracefully, with comprehensive logging and alerting mechanisms to detect and address issues promptly.

These quality attributes ensure that the **Care Connect** platform meets the needs of all stakeholders while maintaining high standards of performance and reliability.

## 5.5 Business Rules

The **Care Connect** platform must adhere to the following business rules to ensure proper operation:

* **Role-Based Access:** Only authorized individuals (e.g., healthcare providers, administrators) may access specific patient data or perform actions like approving medical procedures or updating patient records.
* **Consent Management:** Patients must provide explicit consent for their data to be used for specific purposes, such as research or third-party sharing. The system must track consent status and prevent data use without proper authorization.
* **Emergency Access:** In emergencies, certain rules may be bypassed (e.g., access to a patient's full medical history), but such actions must be logged and reviewed post-event to ensure compliance with legal and ethical standards.

These business rules guide the operation of the **Care Connect** platform, ensuring it aligns with legal requirements and ethical practices in healthcare.

# 6. Other Requirements

## 6.1 Appendix A: Glossary

**EHR (Electronic Health Records):** A digital version of a patient’s paper chart.

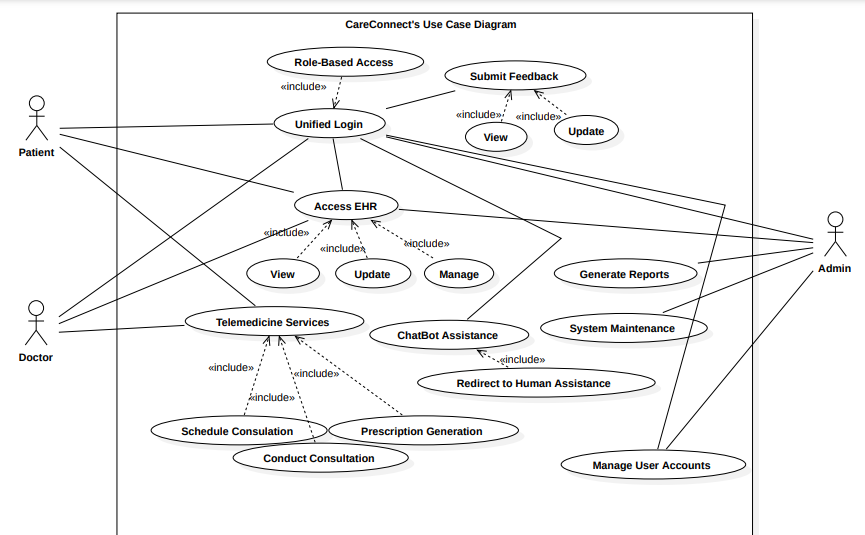
**MFA (Multi-Factor Authentication):** A security system that requires more than one form of verification.

**RBAC (Role-Based Access Control):** Access control based on the user’s role within the organization.

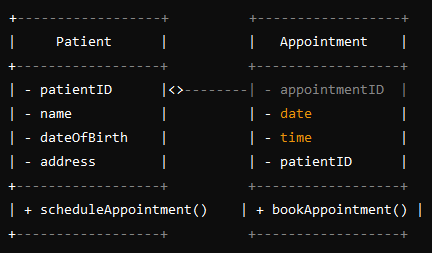
**GDPR (General Data Protection Regulation):** Regulation in Indian laws on data protection and privacy.

## 6.2 Appendix B: Analysis Models

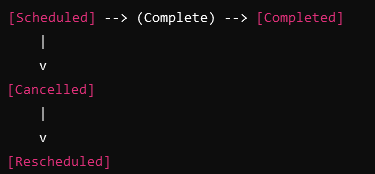
**USE CASE Diagrams**:



**Class Diagrams**:



**State-Transition Diagrams:**



**Entity-Relationship Diagrams:**



## 6.3 Appendix C: To Be Determined List

**Integration with Third-Party Systems:** Finalize specifications for integration points with external healthcare systems.

**Detailed Backup and Archiving Policy:** Complete the policy for backup frequency and archival storage requirements.

**User Training Plan:** Develop a comprehensive training plan including schedules and materials.

**Regulatory Certification Details:** Obtain specific details on certification processes for GDPR and HIPAA compliance.