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SmileTrack: A Smart Dental Clinic Management System

Software Requirement Specification and Analysis

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Introduction :

This project is a comprehensive Dental Clinic Management System designed to streamline clinic operations, enhance patient experience, and optimize workflow for clinic staff. It combines patient management, appointment scheduling, billing, and an AI-powered chatbot for patient assistance.

Purpose :

The purpose of this project is to provide a centralized platform for managing dental clinic activities, from handling patient records and appointments to processing billing and offering automated support. This system will help reduce administrative tasks, improve patient satisfaction, and support dental professionals in delivering efficient, high-quality care.

Intended Audience

This SRS document is intended for the following audiences:

1. Project Supervisor: To evaluate the project's scope, requirements, and feasibility.
2. Development Team: To understand the functional and technical requirements needed to implement the Dental Clinic Management System.

3. Dental Clinic Staff (Admin, Dentists, Assistants, Receptionists): To gain insights into the features and functionalities that will support daily operations within the clinic.
4. Quality Assurance Team: To identify and verify requirements that need to be met for successful system functionality.
5. Future Maintenance Team: To reference for system maintenance, updates, and potential expansions.

Conclusion

The Dental Clinic Management System will streamline clinic operations, improve patient interactions, and enhance administrative efficiency through a centralized platform. By implementing this system, dental clinics can offer higher-quality care and create a more organized, patient-focused environment.

Identified Stakeholders of Dental Clinic Management System

Stakeholders refer to any individuals or groups who will be directly or indirectly impacted by the system. This includes end-users who interact with the system and other parties connected to the clinic's operations.

Stakeholders:

1. Admin (Clinic Owner or Manager)
2. Dentist
3. Dental Assistants
4. Receptionist
5. Patients
6. Payment Gateway Providers

7. SMS/Email Service Providers

Quality Function Deployment (QFD) for Dental Clinic Management System

Objective:
The objective of QFD in this project is to convert the customers' needs into technical requirements that can be measured, developed, and implemented effectively, ensuring a high level of customer satisfaction.
Normal Requirements

These are the basic requirements that customers (clinic staff and patients) expect from the system, and their presence will ensure customer satisfaction.

1. Account Creation & Authentication:
   - Users (Admin, Dentist, Receptionist, Patient) will create accounts by providing credentials.
   - Predefined account access for system admins.
   - Users must log in before performing any actions.
   - Users can update their profiles and reset passwords if forgotten.

2. Patient Management:
   - Patients can register, create accounts, and update personal information.
   - System stores and manages electronic dental records (EDR), x-rays, treatments, and histories.

3. Appointment Scheduling:
   - Patients can view available slots and schedule appointments online.
   - Automated reminders (via SMS/email) for upcoming appointments.

4. Dental Treatment Tracking:
   - Track treatment details, including procedures, x-rays, and post-treatment instructions.

5. Billing & Payment System:

- System generates invoices after treatments.
- Secure payment integration with options for online and offline transactions.

6. Patient Feedback System:
- Collect feedback from patients post-treatment.
- Admins can view feedback reports for service improvement.

Expected Requirements
These are the features that are implicitly expected by users and are essential for smooth operation. Their absence will cause significant dissatisfaction.

1. System Security:
- The system must be secure, with encrypted data storage and communication.

2. Real-time Notifications:
- Automated SMS/email notifications for appointment confirmations, reminders, and cancellations.

3. Fast Performance:
- The system must respond quickly to user actions, especially in high-traffic situations (e.g., appointment bookings).

4. Multi-user Access:
- Multiple users (admin, dentist, receptionist) can work simultaneously without system slowdowns.

5. Backup of Patient Data:
- Ensure patient data (appointments, treatment records, etc.) is automatically backed up and accessible.

6. Responsive UI:
- The user interface should be intuitive, easy to navigate, and mobile-responsive.

Exciting Requirements
These are the features that go beyond the customers' expectations and significantly improve satisfaction when included.

1. AI-Powered Dental Chatbot:
   - The AI chatbot offers 24/7 support, answers FAQs, assists with appointment booking and provides basic treatment advice.

2. Symptom Checker:
   - The chatbot can analyze patient-reported symptoms and suggest potential conditions or urge patients to book appointments based on the symptoms.

3. Automated Follow-Up Reminders:
   - The system sends automated reminders for follow-up appointments and dental hygiene checkups, improving patient compliance.

4. Treatment History Insights:
   - Admins or dentists can see insights from a patient's treatment history, such as the most common issues or treatments, allowing for better treatment recommendations.

5. Integrated Telemedicine:
   - Allow virtual consultations through the system for follow-up visits, reducing the need for physical appointments.

User Story

User Registration, Login, and Authentication

Registration:
Patients, dentists, and admins can register on the platform by providing a username, email, and password. The password must include at least 8 characters, combining uppercase and lowercase letters, numbers, and symbols for enhanced security. During registration, dentists are required to provide additional information, including qualifications and professional details. Admin accounts are created by a system super-admin with specific roles and access rights.

Login and Authentication:
Users log in by entering their email and password. A password recovery mechanism is available, wherein users can reset their password via a one-time password (OTP) sent to their registered email. Two-factor authentication (2FA) can be enabled for enhanced security.

Patient Management

Patients have individual profiles that include their contact details, medical history, and dental treatment history. This data helps dentists and admins manage patient care and track ongoing treatments. Patients can also update their feedback for services received after completing treatments.

Appointment Management

Patients can book, reschedule, or cancel appointments with available dentists via the platform. They can view a dentist’s availability schedule and choose the most suitable time slot. Notifications are automatically sent to patients and dentists to confirm, reschedule, or cancel appointments.

Billing and Payment

After an appointment, the platform generates a digital invoice containing a unique invoice ID, the payment amount, and the payment date. Patients can complete payments through multiple payment gateways integrated into the system. Once payment is confirmed, the invoice is stored in the patient’s profile for future reference.

Feedback Collection

Patients can provide feedback on their treatment experience, which includes submitting ratings and comments. Feedback is associated with the relevant dentist and appointment and is visible to the admin for quality assurance.

AI-Powered Chatbot

The system features an AI chatbot that assists users in navigating the platform. Patients can ask the chatbot to help book appointments, retrieve billing information, or get answers to dental-related queries. The chatbot ensures users can access essential services 24/7.

Notifications

Notifications are sent to users to confirm appointments, remind them of upcoming appointments, or alert them about changes to their schedule.

Notifications also include payment confirmations and other important updates.

Admin Control

Admins have access to manage system operations, including:

1. **Patient Management:** Reviewing patient records and medical histories.
2. **Dentist Management:** Approving dentist registrations and verifying their qualifications.
3. **Appointment Oversight:** Viewing and modifying appointment sc hedules.
4. **Feedback Monitoring:** Review patient feedback to ensure service quality.
   Admins ensure smooth platform operations by troubleshooting issues, resolving conflicts, and updating system data as needed.

Usage Scenario

The Dental Clinic Management System is designed to streamline the management of patient appointments, treatment history, billing, and communication between clinic staff and patients. It is intended to provide an easy-to-use, secure, and efficient platform for admins, dentists, receptionists, dental assistants, and patients. The system ensures a smooth process for all stakeholders by automating and centralizing tasks.

1. Account Management:
   1. Create Account:
      - User Perspective: To access the system, a user must create an account by providing the following details:
      - Full Name
      - Email Address
      - Phone Number
      - Role (e.g., Patient, Dentist, Receptionist)
      - Password

      After providing these details, an account is created, and the user receives a confirmation message.
   - Admin Perspective: The administrator will create predefined accounts for dental staff members with roles and access rights as needed.

   2. Login:

- User Perspective: Once the account is created, users (patients and staff) can log in with their email/phone number and password. Admins log in with a predefined username and password.

3. Account Update:
   - User Perspective: Users can update personal information, such as email, phone number, and password. A verification process ensures that the updates are reflected in the system.

4. Password Recovery:
   - User Perspective: If a user forgets their password, they can recover it through email or mobile verification.

2. Patient Management:
1. Patient Registration:
   - User Perspective (Patient): Patients can register by entering their personal details, including medical history and contact information.
   - Admin Perspective: The admin can manage patient records, ensuring they are up-to-date and accessible for dental staff.

2. Electronic Dental Records (EDR):
   - User Perspective (Dentist/Staff): Dentists can access and update the patient's treatment history, including x-rays, past procedures, and ongoing treatment plans.
   - Admin Perspective: Admins manage the access permissions for sensitive data like patient records, ensuring compliance with data protection regulations.

3. Appointment Scheduling:
1. Appointment Booking:
   - User Perspective (Patient): Patients can view available time slots for dental treatments and book appointments through the online booking system.
   - Admin/Dentist Perspective: Receptionists and dentists can manage appointments via the appointment calendar, view patient details, and make changes if necessary.

2. Automated Reminders:
- User Perspective (Patient): Patients receive automated reminders (via SMS/email) about upcoming appointments.
- Admin Perspective: Admins can ensure the system is sending timely reminders and managing appointments efficiently.

4. Treatment & Procedure Management:
1. Treatment Tracking:
- User Perspective (Dentist): Dentists track treatments, set up future appointments, and update patient records with treatment steps and dates.
- Admin Perspective: Admins monitor the overall treatment progress and ensure that all procedures are being recorded correctly.

2. X-ray & Imaging Integration:
- User Perspective (Dentist): Dentists can upload and view dental images, such as x-rays, and attach them to patient records for easy access during treatments.

5. Billing & Payment:
1. Invoice Generation:
- User Perspective (Patient): After treatment, an invoice is generated automatically and displayed to the patient, detailing the cost of services rendered.
- Admin Perspective: The admin can view and manage invoices, track payments, and ensure financial records are accurate.

2. Payment Processing:
- User Perspective (Patient): Patients can make payments through various secure methods (credit card, bank transfer, etc.).
- Admin Perspective: Admins can track payments and manage payment statuses, including handling insurance claims.

6. Patient Feedback System:
   1. Feedback Collection:
      - User Perspective (Patient): After treatment, patients can rate their experience and provide feedback via the system.
      - Admin Perspective: Admins can access feedback and use it for improving services.

7. Notifications & Alerts:
   1. Appointment Notifications:
      - User Perspective (Patient): Patients receive SMS/email notifications for appointment confirmations, cancellations, and reminders.
      - Admin Perspective: Admins ensure that notifications are sent correctly and can customize reminder templates as needed.

8. AI-Powered Dental Chatbot:
   1. Patient Assistance via Chatbot:
      - User Perspective (Patient): Patients can interact with the AI-powered chatbot for general dental queries, scheduling, or understanding treatments.
      - Admin Perspective: Admins monitor chatbot interactions and ensure it provide accurate and helpful responses to patient inquiries.

9. Follow-Up & Post-Treatment Instructions:
   1. Automated Follow-Up Reminders:
      - User Perspective (Patient): Patients receive automatic follow-up reminders for post-treatment care or checkups.
      - Admin Perspective: Admins ensure that follow-up reminders are set based on treatment plans.

USE CASE DIAGRAM

A use case is a list of actions or event steps typically defining the interactions between a role (actor) and a system to achieve a goal. The actor can be a human or other external system. In this modeling, use case diagram is a graphical depiction of a user's possible interactions with a system.

A use case diagram shows various use cases and different types of users the system has and will often be accompanied by other types of diagrams as well. Use case diagrams are a blueprint for the system. Due to their simplistic nature, use case diagrams can be a good communication tool for stakeholders.

The drawings attempt to mimic the real world and provide a view for the stakeholder to understand how the system is going to be designed. Use case diagrams consist of actors, use cases and their relationships. The diagram is used to model the system/subsystem of an application. A single use case diagram captures a particular functionality of a system.

Primary Actor

Primary actors interact to achieve required system function and derive the intended benefit from the system. They work directly and frequently with the software.

Secondary Actor

Secondary actors support the system so that primary actors can do their work. They either produce or consume information.

Level 0

Name: Dental Clinic Management System (DCMS)
Primary Actor: User , admin
Secondary Actor: Email, SMS, SSL COMMERZ , AI Assistant.

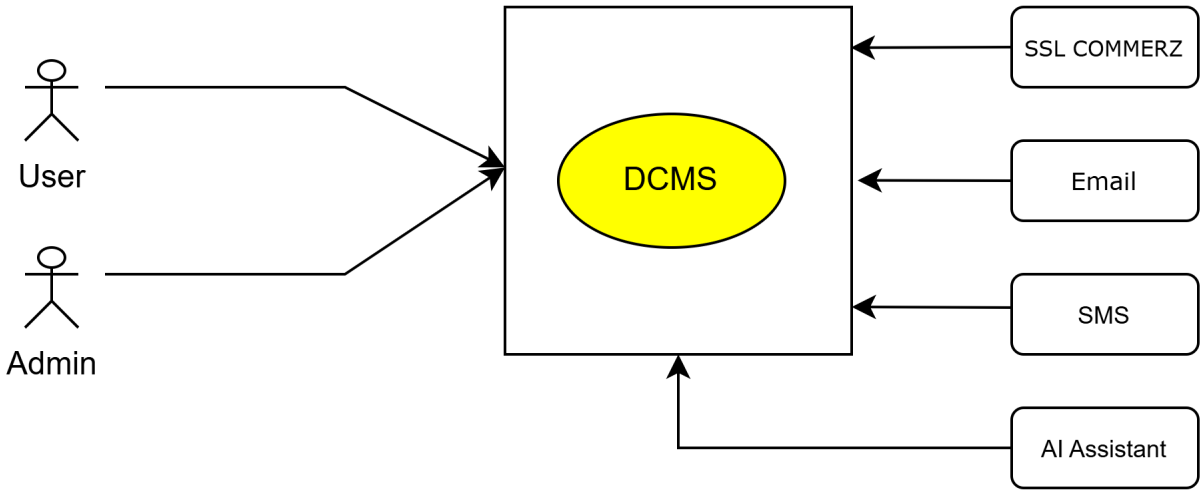


Fig1:: A Smart Dental Clinic Management System

Level 1

Name: DCMS Details
Primary Actor: Admin, Patient, Dentist.
Secondary Actor: Email, SMS, SSL COMMERZ, AI Assistant.

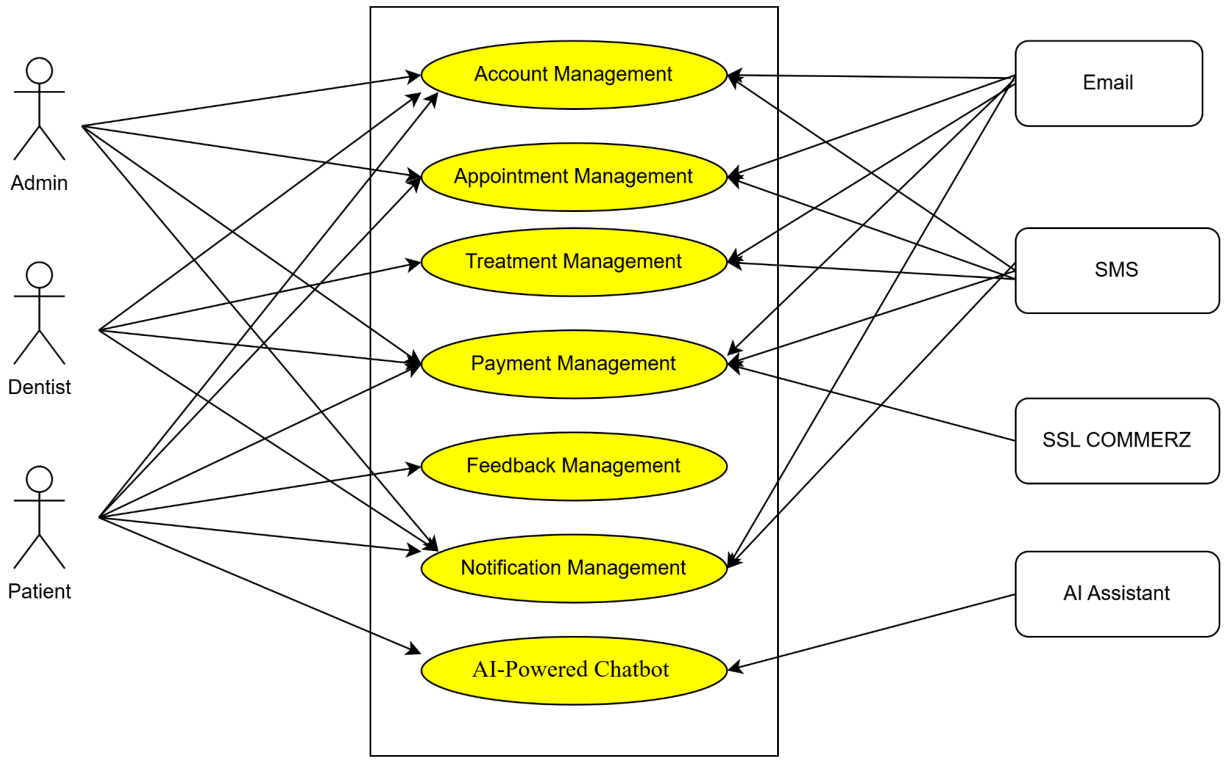


Fig2: A Smart Dental Clinic Management System details

Level 1.1

Account Management
Primary Actor: Admin, Dentist, Patient
Secondary Actor: Email, SMS

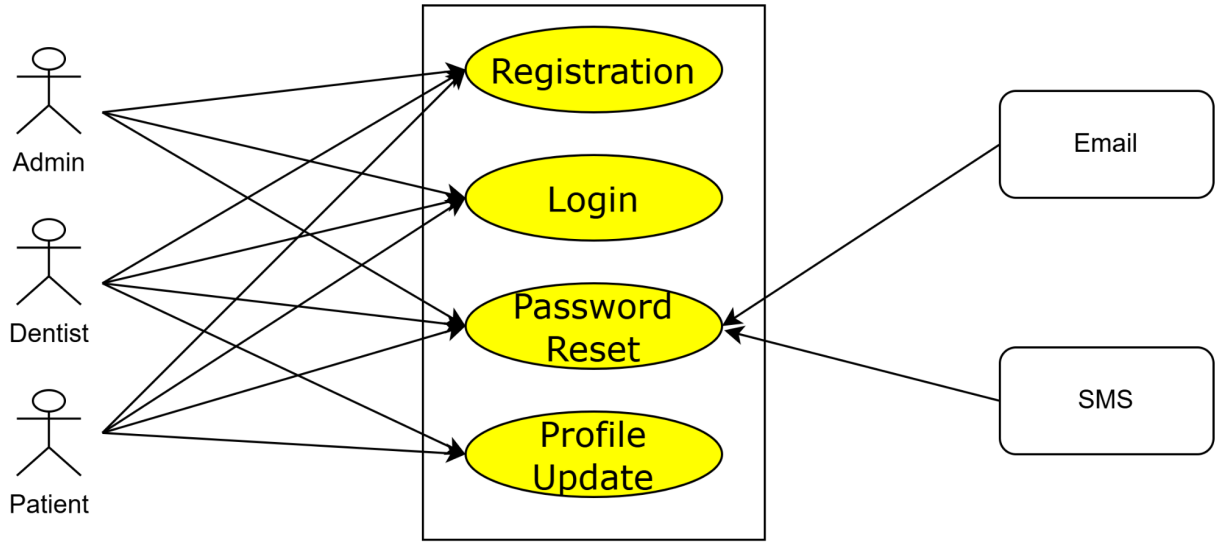


Fig 3: Account management

Use Case Description:
1. Registration: Patients, Admin, and Dentists can register by providing personal details (Name, Contact, Address). Admin can verify registration for patient.

2. Login: All users (Admin, Dentist, Patient) can log into the system.
3. Password Reset: Users can reset their password using OTP sent via SMS/Email.
4. Profile Update: Patients and dentists can update their profiles.

Level 1.2

Appointment Management
Primary Actor: Patient, Dentist
Secondary Actor: SMS, Email

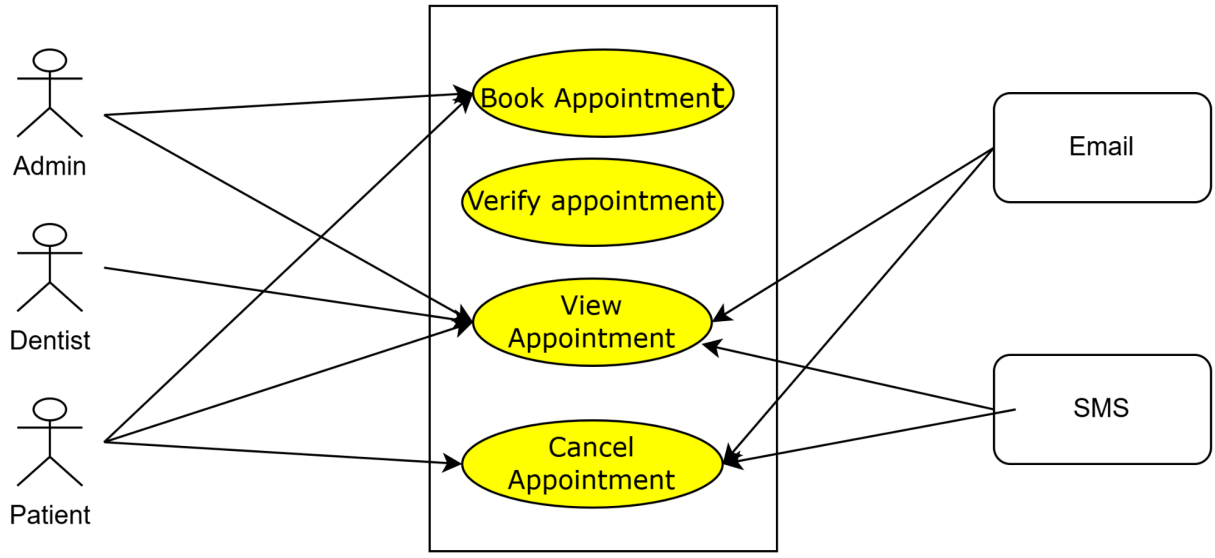


Fig 4: Appointment management

Use Case Description:
1. Book Appointment: Patients can book appointments for consultations or treatments. Receptionist will verify and confirm.

2. View Appointment: Patients and Doctor can view scheduled appointments.
3. Cancel Appointment: Patients can cancel appointments before the scheduled time.

Level 1.3

Treatment Management
Primary Actor: Dentist, Patient
Secondary Actor: SMS, Email

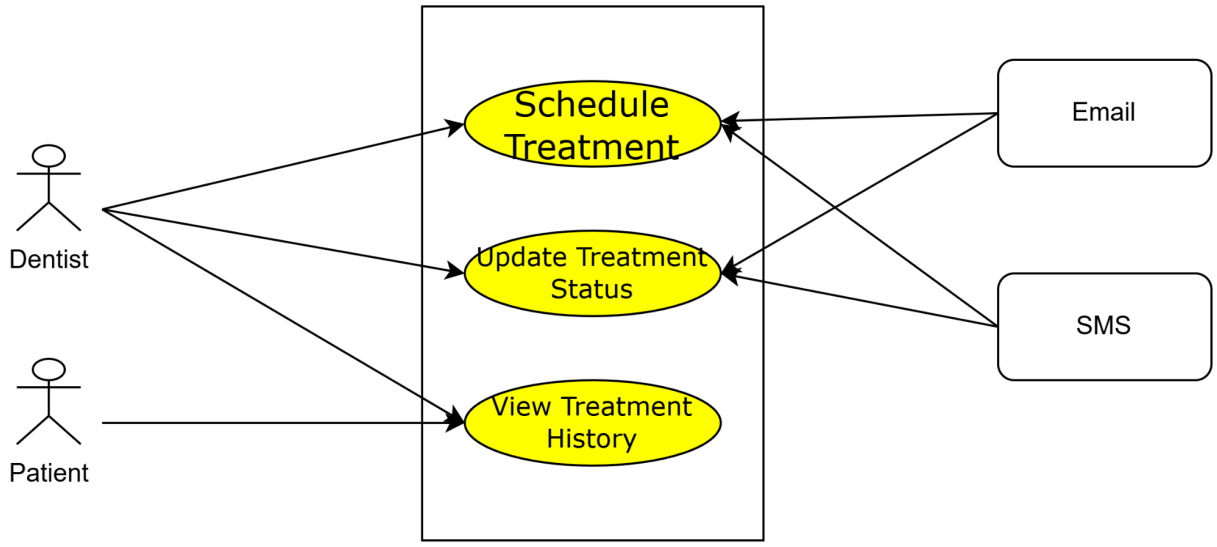


Fig 5 : Treatment Management

Use Case Description:

1. Schedule Treatment: Dentists can schedule treatment sessions for patients.
2. Update Treatment Status: Dentists can update the treatment status (Completed, Pending, or Scheduled).
3. View Treatment History: Dentists and patients can view previous treatments.

Level 1.4

Payment Management
Primary Actor: Patient, Admin
Secondary Actor: Payment Gateway, SMS

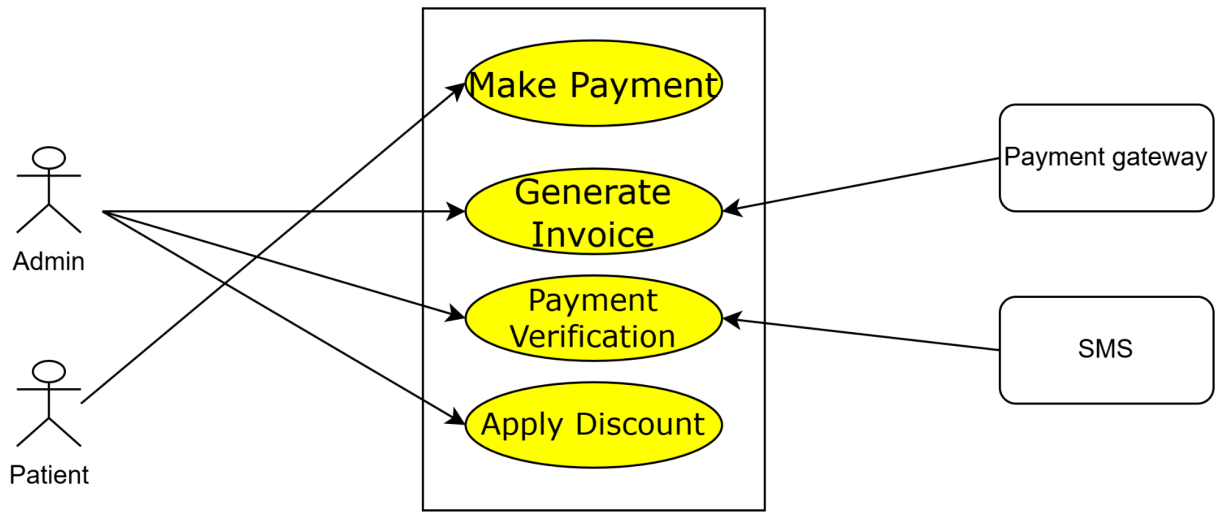


Fig 6 :Payment Management

Use Case Description:
1. Make Payment: Patients can pay through an online gateway or on-site.
2. Generate Invoice: Admin can generate invoices for completed treatments.
3. Payment Verification: Insurance providers can verify and approve payment claims for patients.
4. Apply Discount: Admin can apply discounts based on insurance coverage or special offers.

Level 1.5

Feedback Management
Primary Actor: Patient
Secondary Actor: None

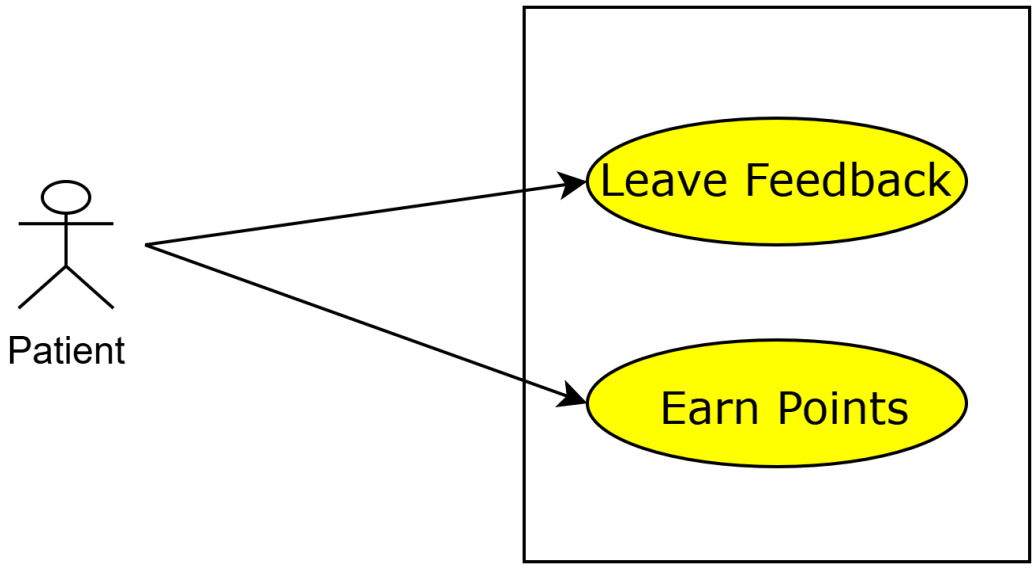


Fig 6 :Feedback Management

Use Case Description:

1. Leave Feedback: Patients can leave feedback or reviews for treatments and services.
2. Earn Points: Patients earn points for giving feedback, which can be redeemed for discounts or rewards.

Level 1.6

Notification Management
Primary Actor: Admin, Patient
Secondary Actor: Email, SMS

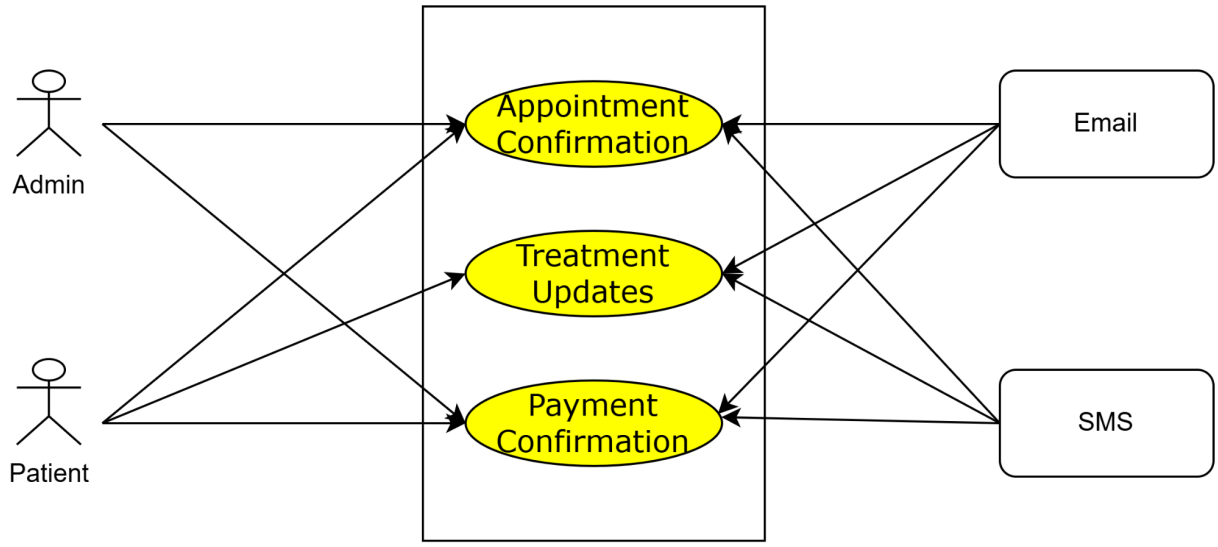


Fig 7 :Notification Management

Use Case Description:

1. Appointment Confirmation: Notifications will be sent to patients confirming the booking, cancellation, or rescheduling of appointments.
2. Treatment Updates: Patients will receive notifications for treatment updates.
3. Payment Confirmation: Notifications will be sent after payments are processed.

Level 1.7

AI Chatbot
Primary Actor:Patient
Secondary Actor: Gemini API

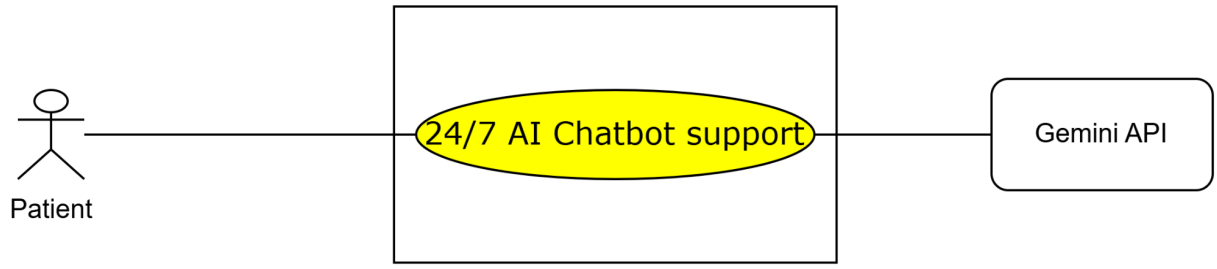


Fig 8 :AI Chatbot

Use Case Description:

1. **Access AI Chatbot for Support**
    - Patient interacts with the chatbot.
    - System processes responses via Gemini API.
2. **Provide Initial Dental Health Assistance**
    - Chatbot offers advice and resource suggestions.

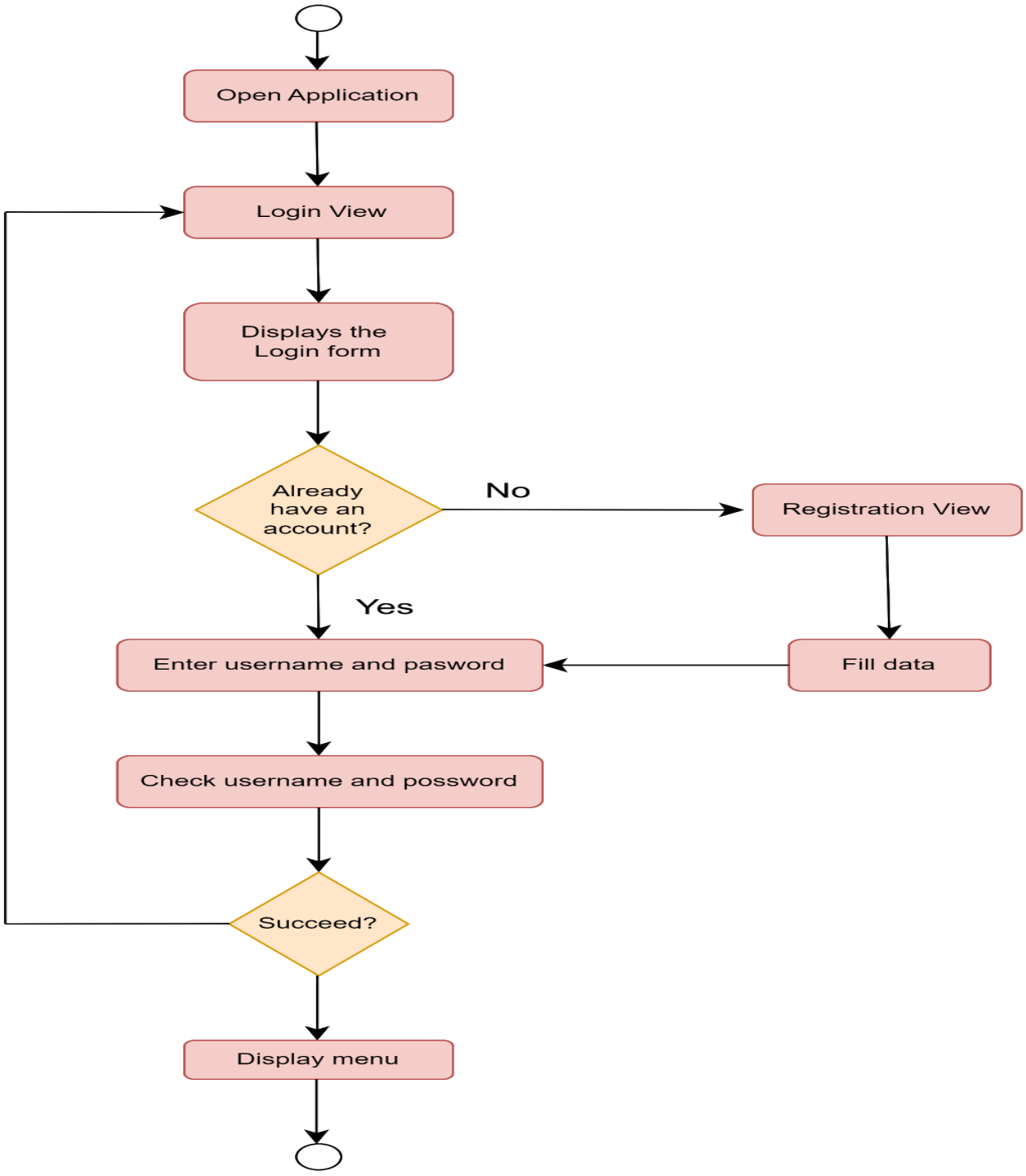
ACTIVITY DIAGRAM

Activity diagram is an important behavioral diagram in UML diagram to describe dynamic aspects of the system. Activity diagram is essentially an advanced version of flow chart that models the flow from one activity to another activity.
Activity diagrams are used to model the workflow or procedural logic of a system. They help in understanding, analyzing, and communicating the sequence of actions or steps required to accomplish a specific task or functionality.

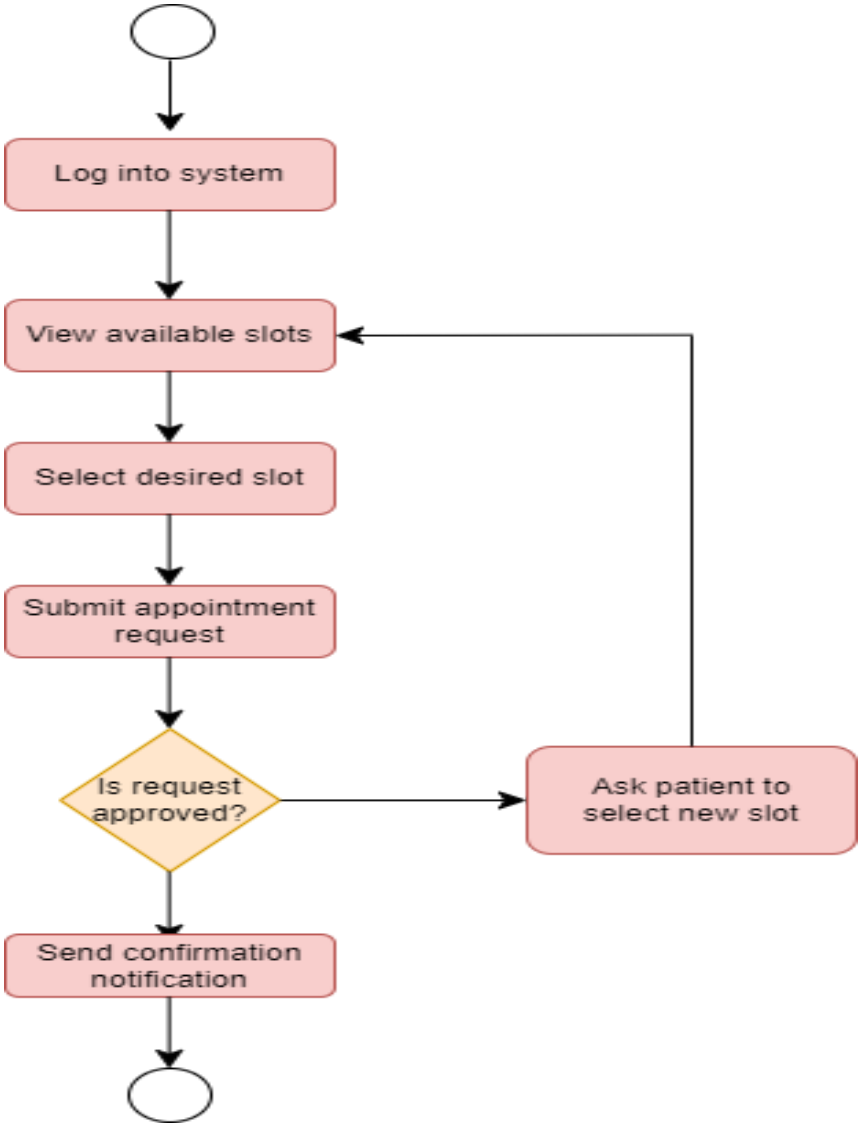
The main elements of an activity diagram include :

Activity : Represents a specific action or task that needs to be performed.
Control Flow : Indicates the flow of control from one activity to another.
Decision Nodes : Represents decision points where the flow of control diverges based on conditions.
Merge Nodes : Brings together multiple control flows into a single flow.
Fork and Join Nodes : Forks represent the splitting of control flows into multiple concurrent activities, while joins synchronize these parallel flows.
Start and End Nodes : Denote the beginning and termination points of the activity diagram.

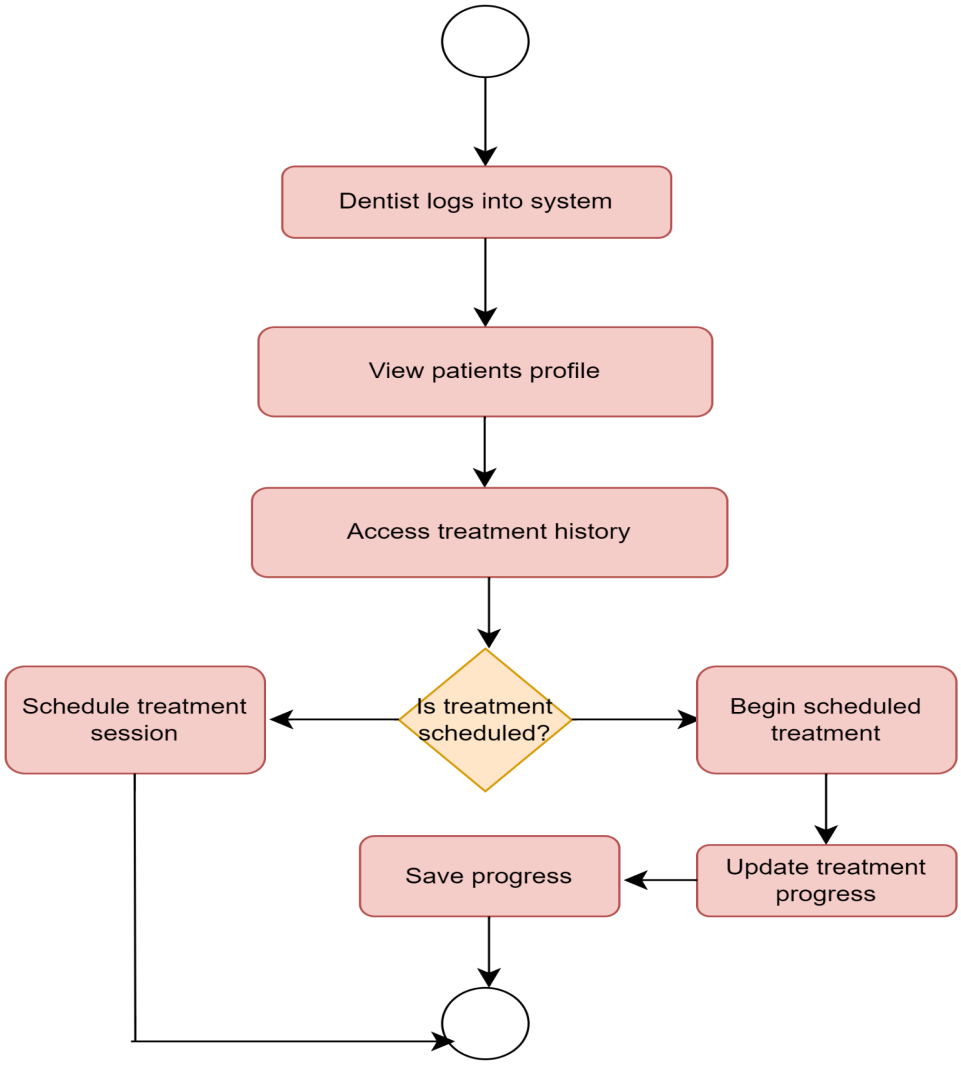
Level 1.1:
Name: Account Management
Reference: Use case diagram "Level 1.1"


Open Application
Login View
Displays the Login form
Already have an account?
No
Registration View
Yes
Enter username and pasword
Fill data
Check username and possword
Succeed?
Display menu

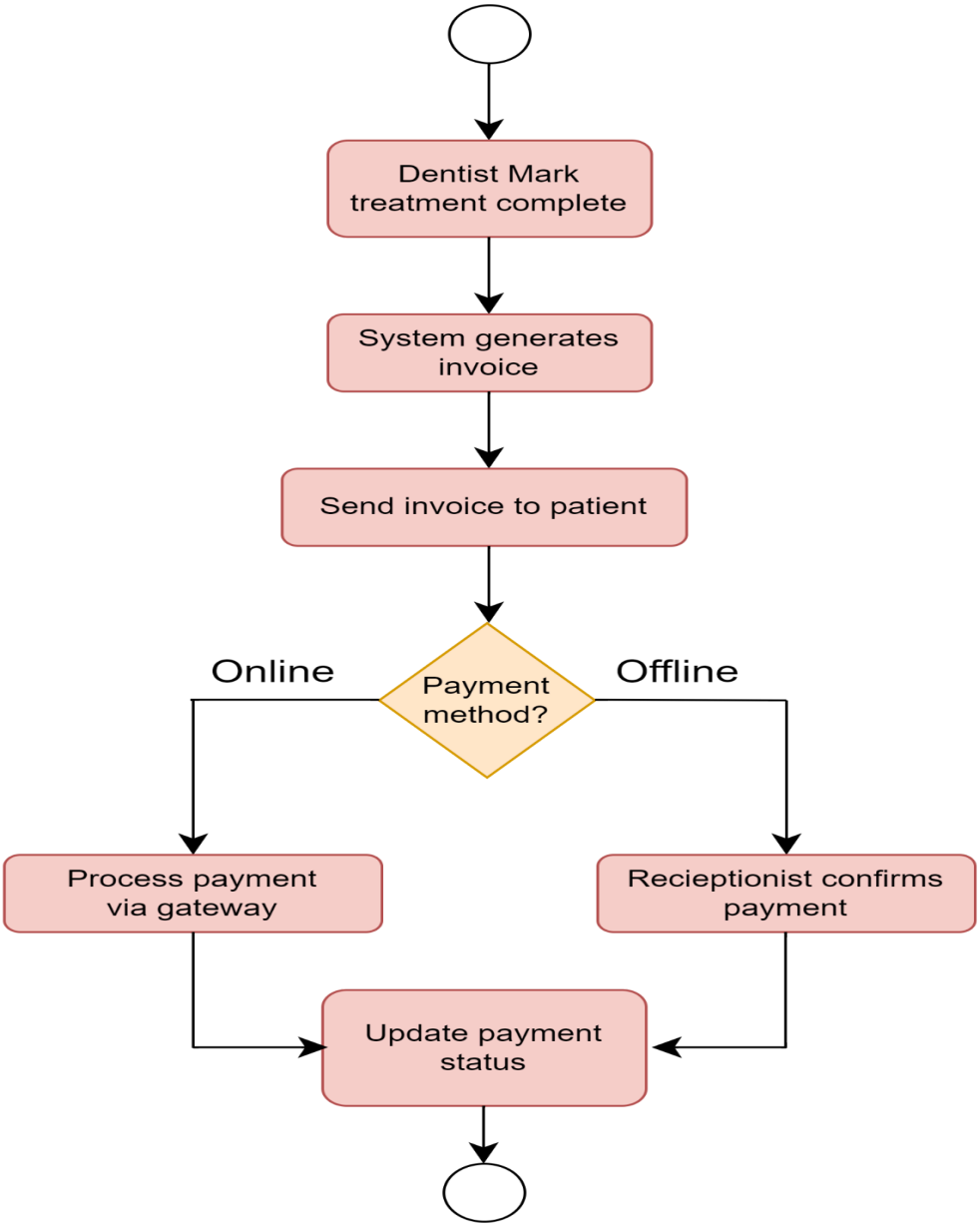
Level 1.2:
Name: Appointment Management
Reference: Use case diagram "Level 1.2"



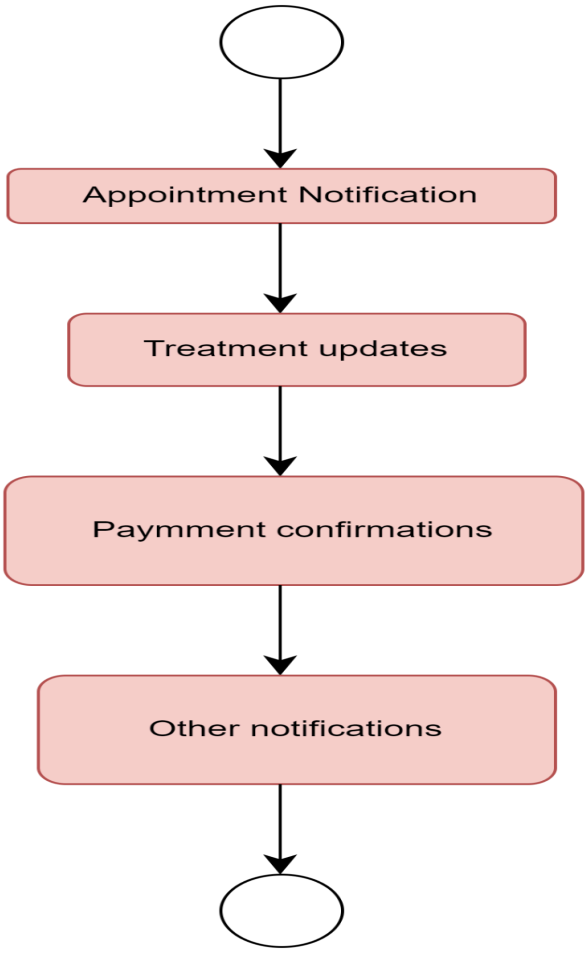
Level 1.3:
Name: Treatment Management
Reference: Use case diagram “Level 1.3”



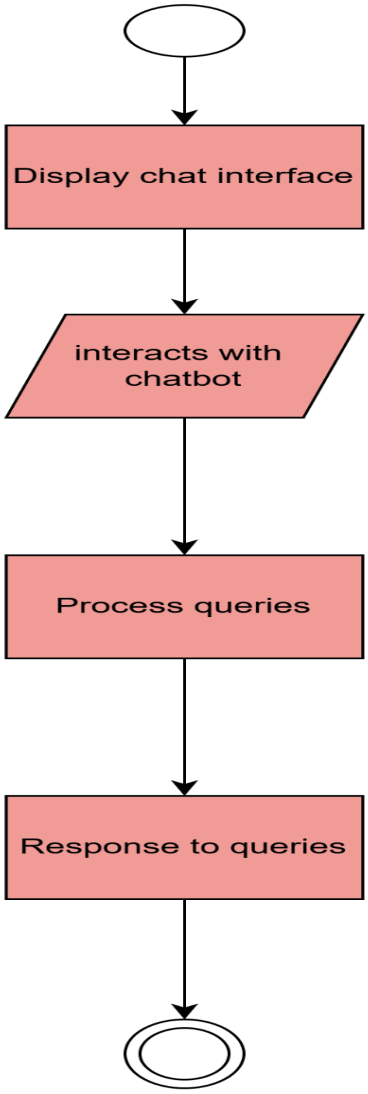
Level 1.4:
Name: Payment Management
Reference: Use case diagram "Level 1.4"



Level 1.6:
Name: Notification management
Reference: Use case diagram "Level 1.6"



Level 1.7:
Name: AI Chatbot
Reference: Use case diagram “Level 1.7”



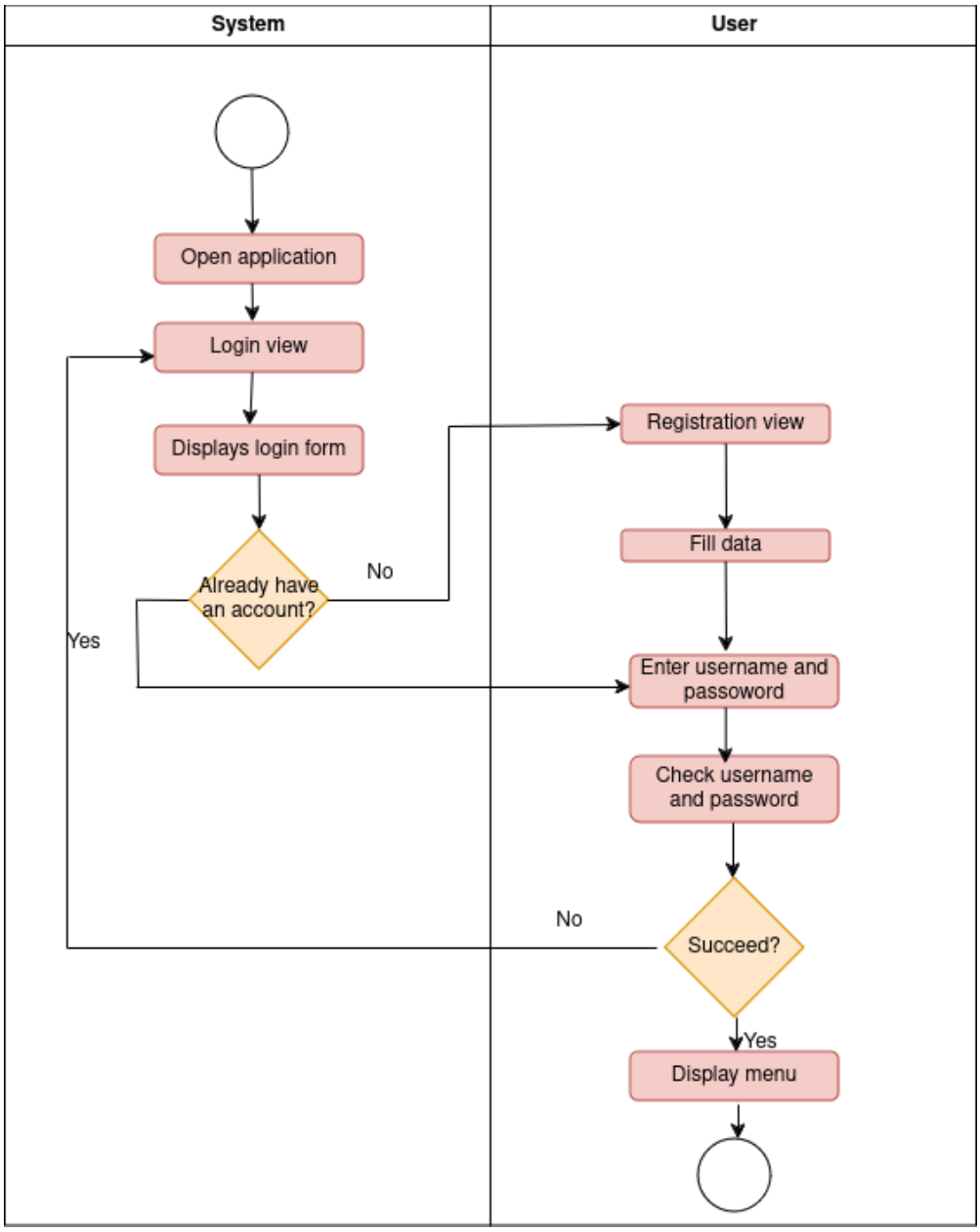
SWIMLANE DIAGRAM

A swimlane diagram is a type of flowchart. Like a flowchart, it diagrams a process from start to finish, but it also divides these steps into categories to help distinguish which departments or employees are responsible for each set of actions. It is based on the analogy of lanes in a pool, as it places process steps within the horizontal or vertical “swimlanes” of a particular department, work group or employee, thus ensuring clarity and accountability.

Level 1.1:

Name: Account management

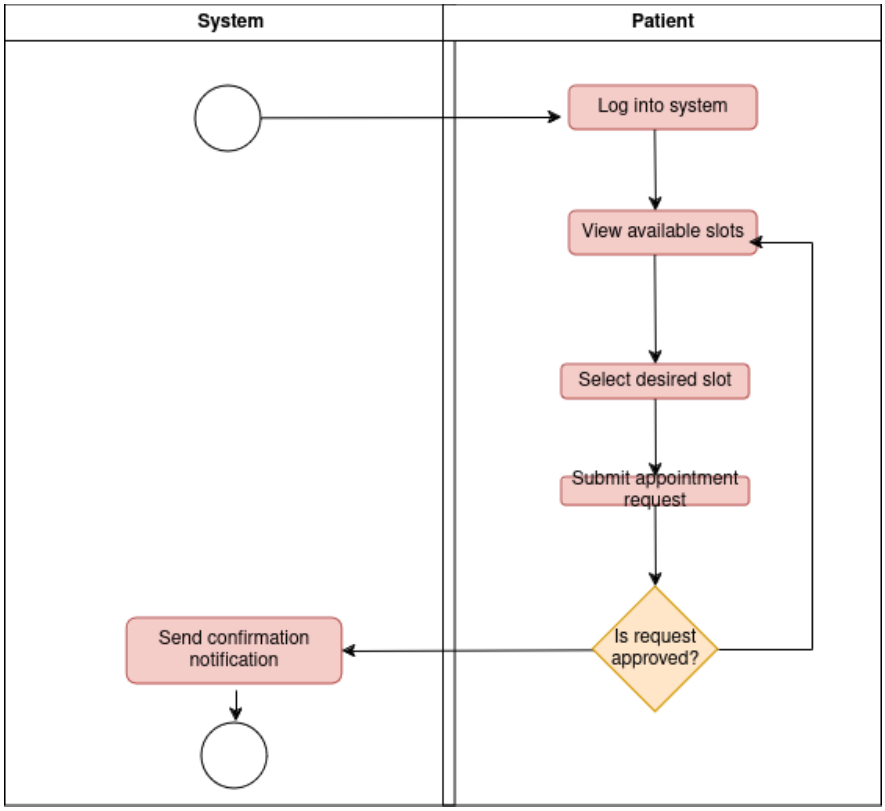
Reference: Use case & Activity diagram "Level 1.1"



Level 1.2:

Name: Appointment management

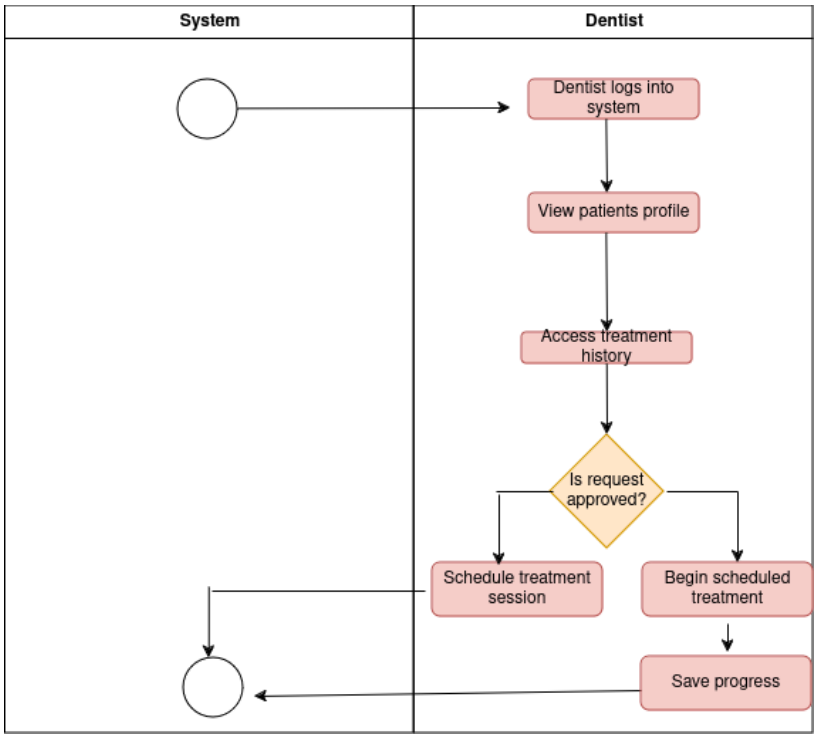
Reference: Use case & activity diagram "Level 1.2"



Level 1.3:

Name: Appointment management

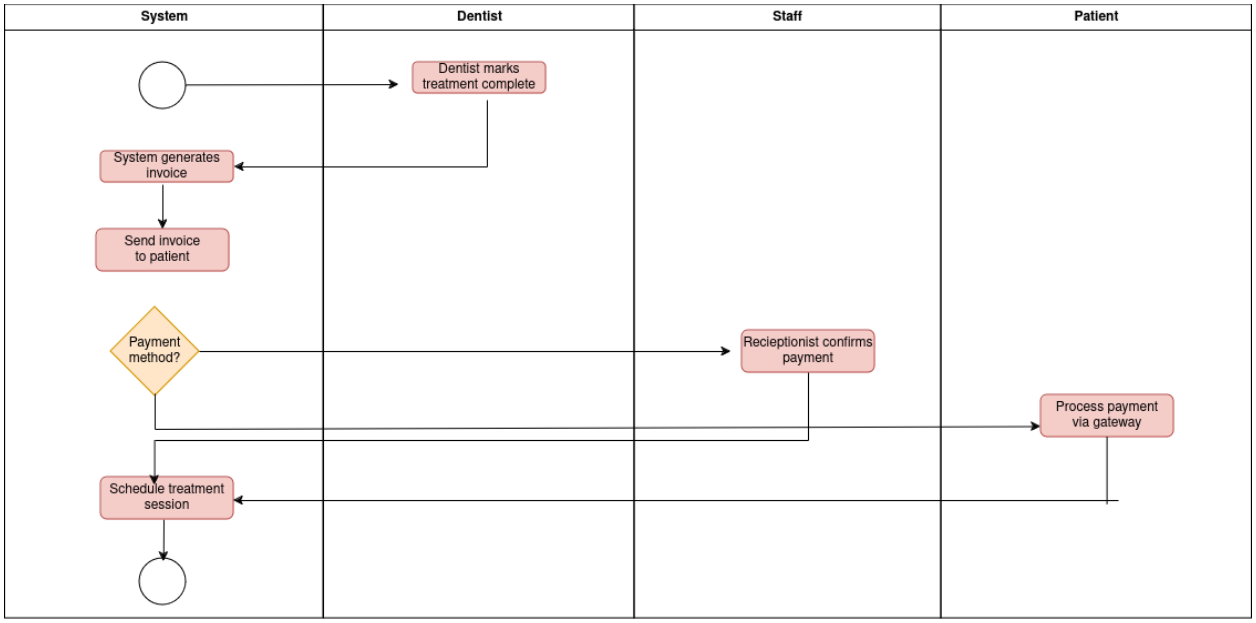
Reference: Use case & activity diagram "Level 1.3"



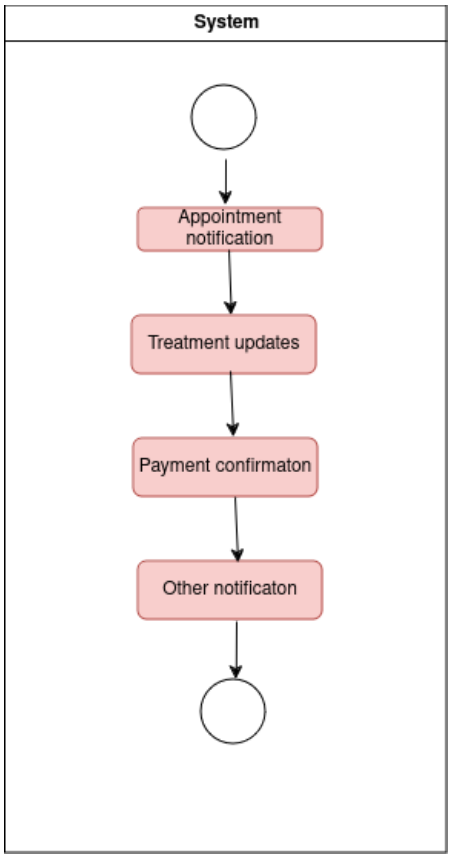
Level 1.4:

Name: Payment management

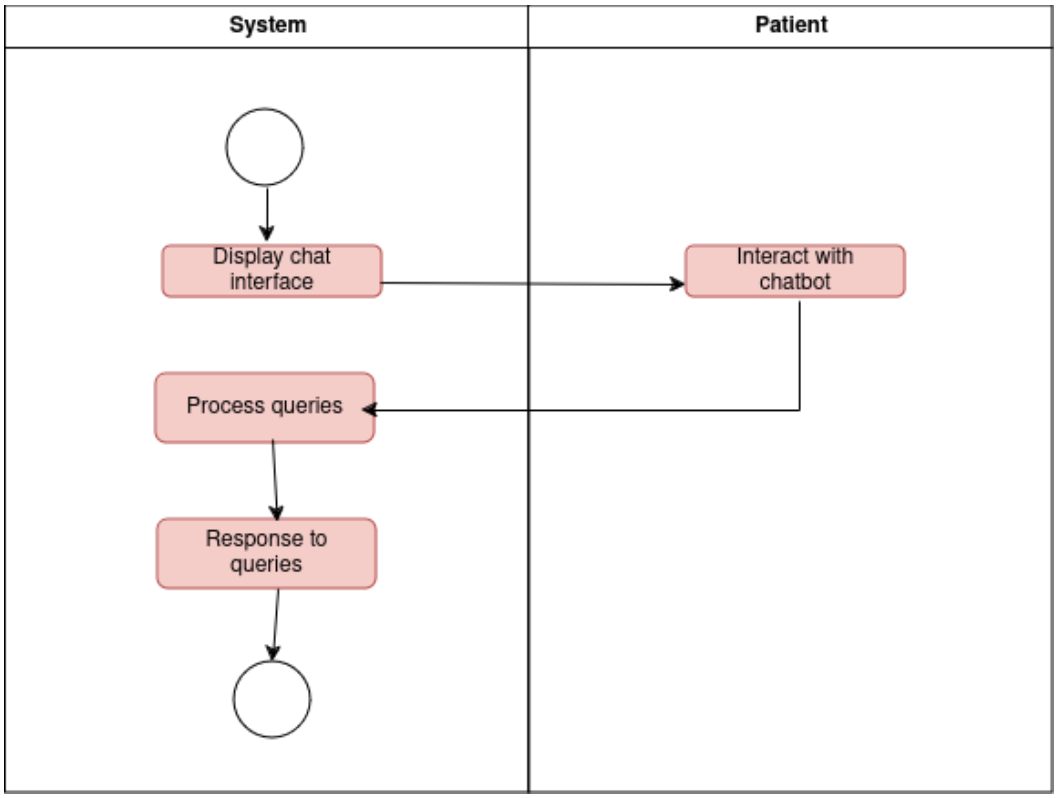
Reference: Use case & activity diagram "Level 1.4"



Level 1.6:
Name: Notification management
Reference: Use case & activity diagram "Level 1.6"



Level 1.7:
Name: AI chatbot
Reference: Use case & activity diagram "Level 1.7"



Data Modeling

Data Modeling Concept

Data Modeling is the process of abstracting, defining and visualizing the data requirements for a software. It is like drawing a blueprint for how information will be organized and stored in a system. It’s a way to plan out how data will flow through the software, what types of data will be used, and how they will relate to each other. Data modeling involves identifying and structuring the data objects (entities) that the software will manage, along with their attributes and the relationships that exist between them.The ER (Entity-Relationship) model defines all data objects that are processed within the system, the relationships between the data objects and the information about how the data objects are entered, stored, transformed and produced within the system.

Data Objects

A data object is a fundamental unit of information that needs to be stored, processed, or manipulated by the software. Each data object typically has attributes that describes its characteristics, and it can also have relationships with other data objects, forming a structured model of the information the system will work with. A data object can be an external entity, a thing, an occurrence, a role, an organizational unit, a place or a structure.

Identification of Data Objects

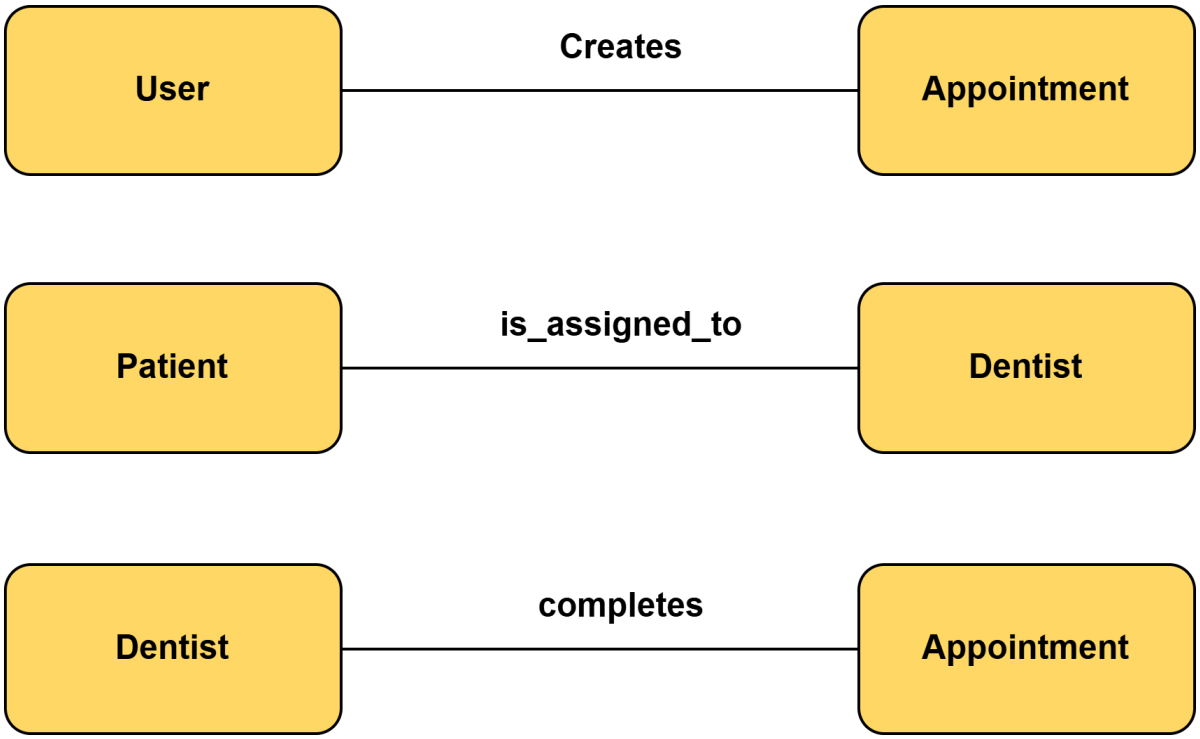
SL.NO	Noun	Problem(P)/ Solution(S) space	Attribute
1	User	s	3,4,5,6,7,8,9
2	Account	p	
3	System	p	
4	Information	p	
5	Full Name	s	
6	Phone Number	s	
7	Email Address	s	
8	Username	s	
9	Password	s	
10	Admin	s	11,12
11	Admin ID	s	
12	Employee	s	13,14,15
13	Employee ID	s	
14	Designation	s	
15	Dentist	s	16,17,18
16	Appointment Schedule	s	

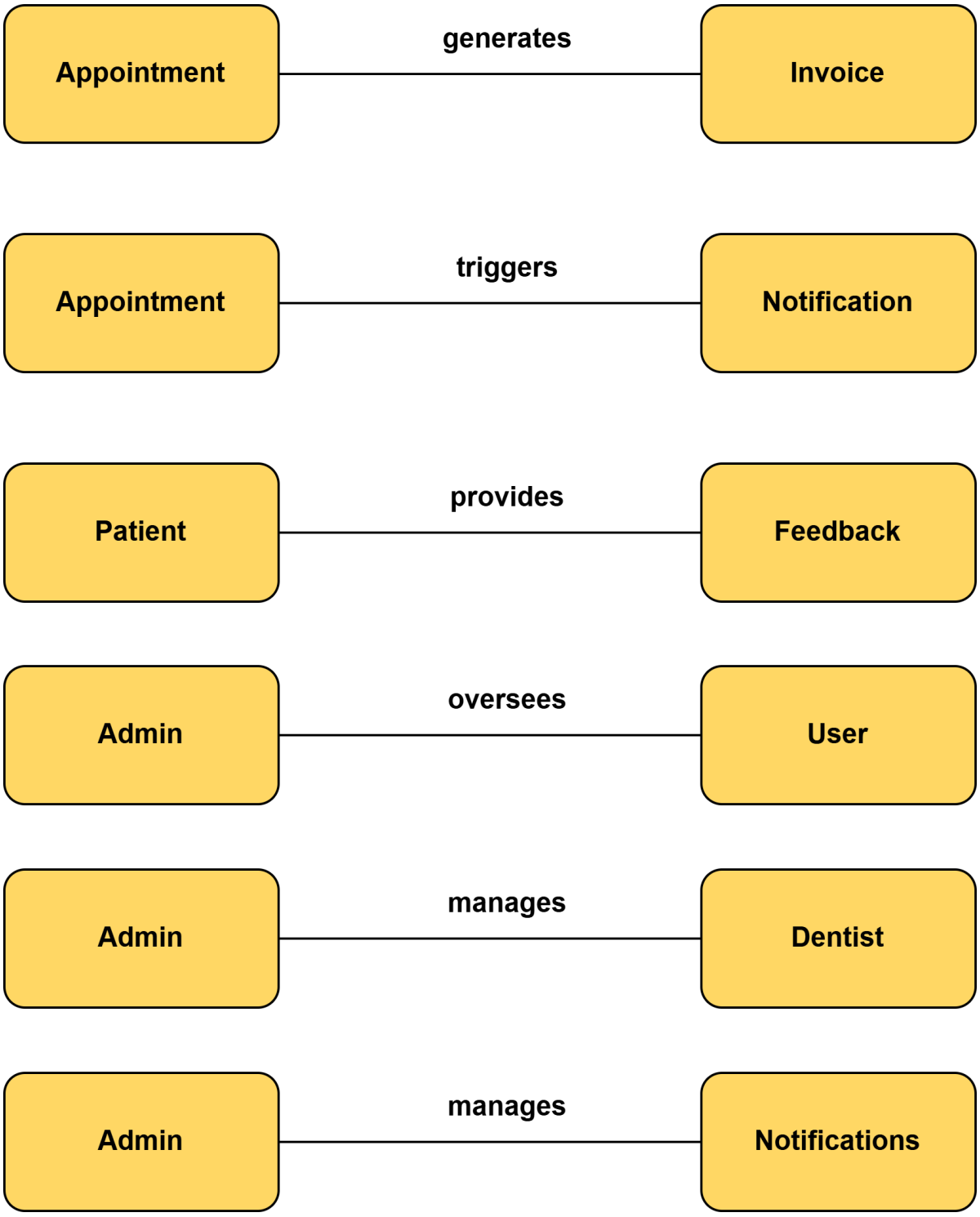
17	Treatment History	s	
18	Qualifications	s	
19	Patient	s	20,21,22
20	Patient ID	s	
21	Medical history	s	
22	Feedback	s	
23	Appointment	s	24,25,26
24	Appointment ID	s	
25	Appointment Date	s	
26	Appointment Status	s	
27	Billing	p	
28	Invoice	s	29,30,31
29	Invoice ID	s	
30	Payment Amount	s	
31	Payment Date	s	
32	Notification	p	
33	Feedback	s	34
34	Feedback ID	s	
35	Chatbot	p	
36	Dental Record	p	

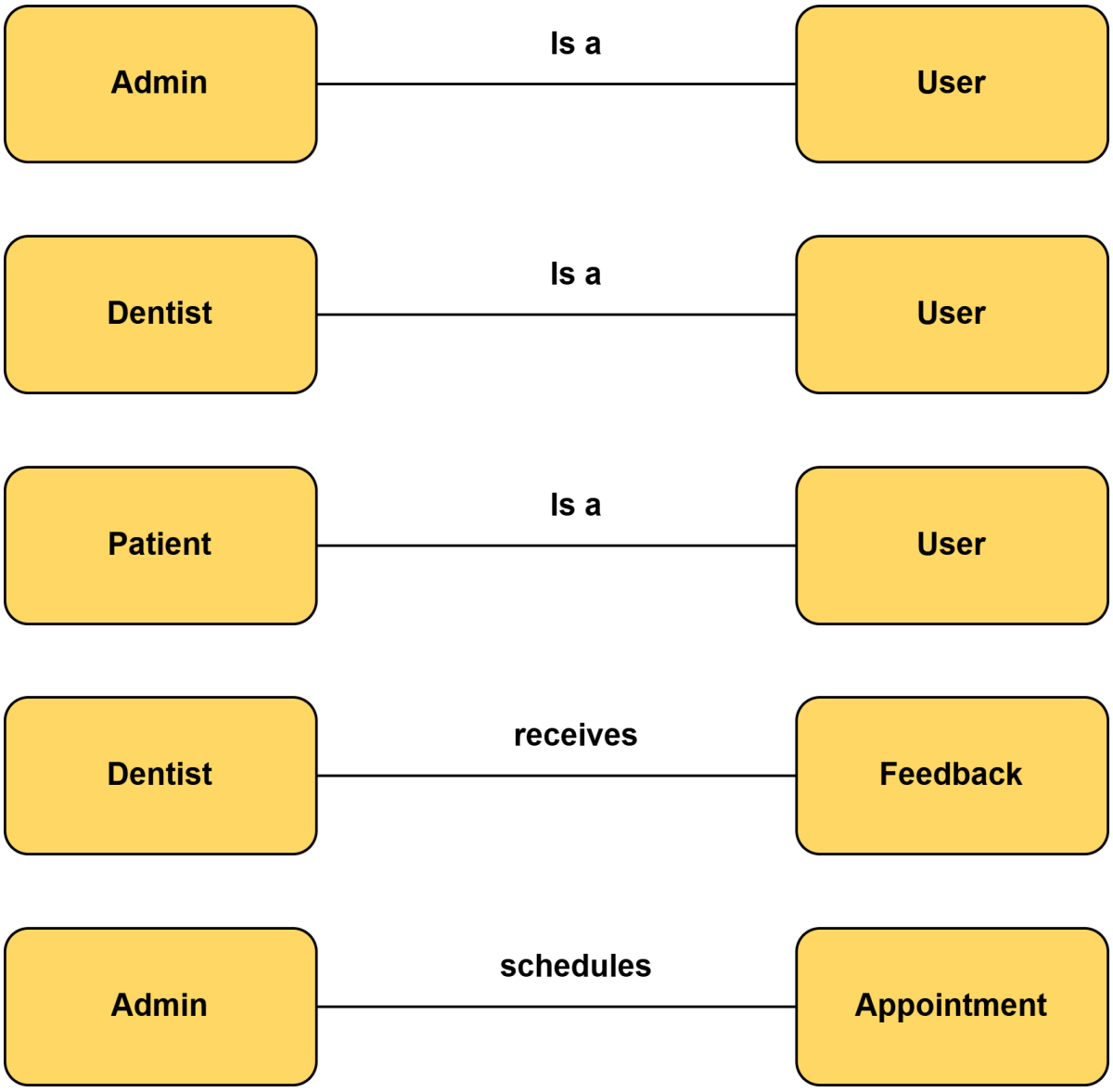
Final Data Objects

1. User
2. Admin
3. Dentist
4. Patient
5. Appointment
6. Invoice
7. Feedback
8. Notification

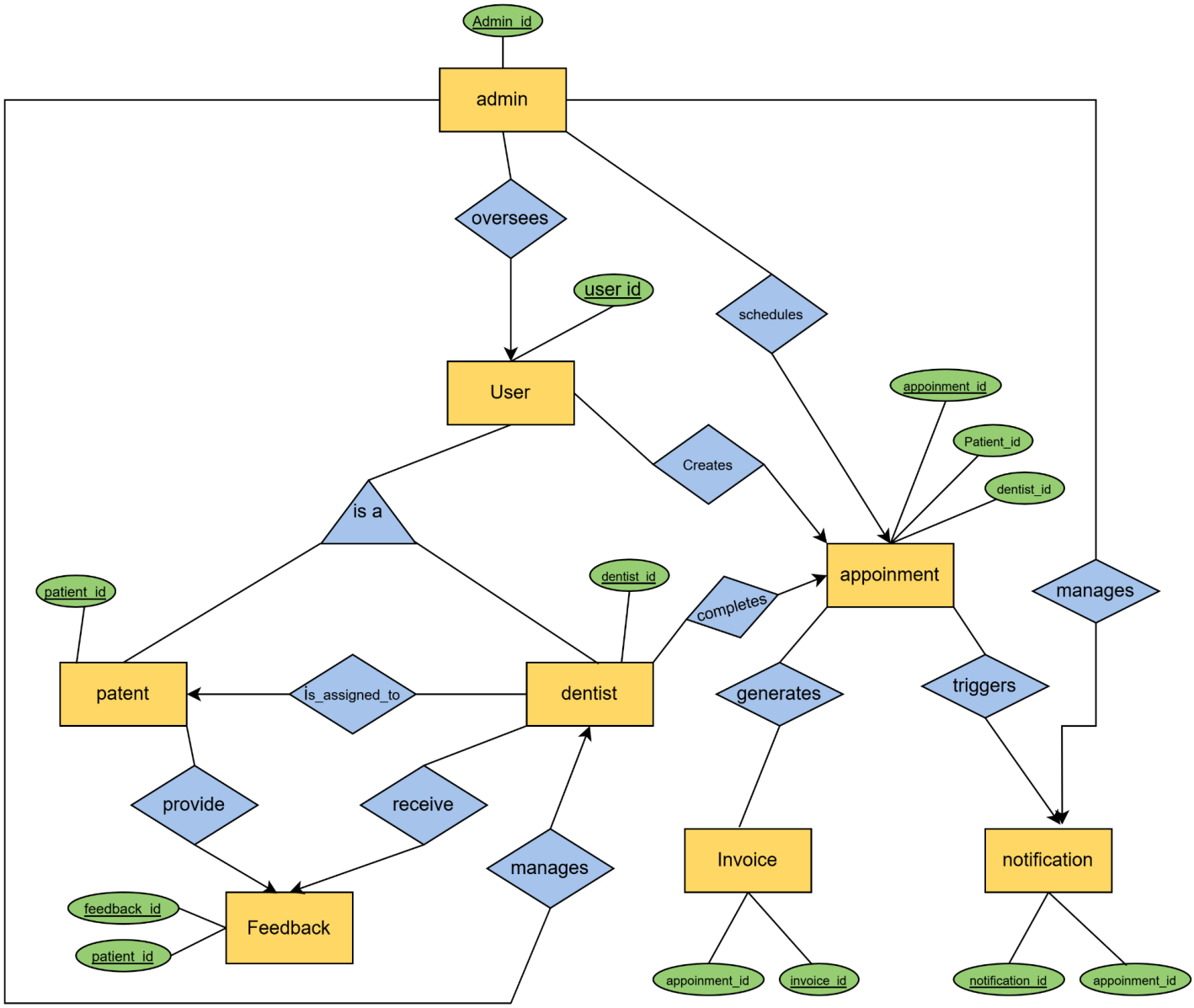
Relationship Between Data Objects




Appointment
generates
Invoice
Appointment
triggers
Notification
Patient
provides
Feedback
Admin
oversees
User
Admin
manages
Dentist
Admin
manages
Notifications


Admin
Is a
User
Dentist
Is a
User
Patient
Is a
User
Dentist
receives
Feedback
Admin
schedules
Appointment

ER DIAGRAM


Admin_id
admin
oversees
user id
schedules
User
appoinment_id
Patient_id
dentist_id
Creates
is a
appoinment
manages
patient_id
dentist_id
completes
patent
Is_assigned_to
dentist
generates
triggers
provide
receive
manages
Invoice
notification
feedback_id
patient_id
Feedback
appoinment_id
invoice_id
notification_id
appoinment_id

Schema

Data Objects	Variables
User	user_id VARCHAR2(15) [PRIMARY KEY] username VARCHAR2(40) email VARCHAR2(40) password VARCHAR2(50)
Admin	admin_id VARCHAR2(15) [PRIMARY KEY] name VARCHAR2(40) email VARCHAR2(40) password VARCHAR2(50)
Dentist	dentist_id VARCHAR2(15) [PRIMARY KEY] name VARCHAR2(40) specialization VARCHAR2(50) email VARCHAR2(40) phone_number VARCHAR2(15)
Patient	patient_id VARCHAR2(15) [PRIMARY KEY] name VARCHAR2(40) age NUMBER email VARCHAR2(40) phone_number VARCHAR2(15)
Appointment	appointment_id VARCHAR2(15)[PRIMARY KEY] appointment_date DATE time_slot VARCHAR2(20) status VARCHAR2(20) patient_id VARCHAR2(15) [Foreign key fromPatient] dentist_id VARCHAR2(15) [Foreign key from Dentist]
Invoice	invoice_id VARCHAR2(15)[PRIMARY KEY] amount NUMBER payment_status VARCHAR2(20) appointment_id VARCHAR2(15) [Foreign key from Appointment]

Feedback	feedback_id VARCHAR2(15) [PRIMARY KEY] content VARCHAR2(255) rating NUMBER patient_id VARCHAR2(15) [Foreign key from Patient]
Notification	notification_id VARCHAR2(15) [PRIMARY KEY] message VARCHAR2(255) appointment_id VARCHAR2(15) [Foreign key from Appointment]

Class-Based Modeling

Class-based modeling defines the structure of the entire system by identifying the static structure of objects in that system. A class model defines attributes and operations for the objects of each class and also the relationship between the objects, and the collaborations that occur between the classes of the systems. The elements of a class-based model include Classes and objects, Attributes, operations, class-responsibility-collaborator (CRC) models, collaboration diagrams, and packages.

General Classification:
In this section, we'll include those classes that are in the solution space. These candidate classes are categorized based on the seven general classifications. The analysis classes manifest themselves in one of the following ways:

1. External entities
2. Things
3. Events
4. Roles
5. Organizational units
6. Places
7. Structures

A candidate class is selected for special classification if it fulfills two- three or more Characteristics.

SL. No	Noun	General Classification
1.	User	4, 5, 7
2.	Admin	4,5,7

3.	Employee	4,5,7
4.	Dentist	4,5,7
5.	Patient	4,5,7
6.	Appointment	3
7.	Invoice	3,7
8.	Feedback	3
9.	Notification	3
10.	Biling	2,3
11.	Chatbot	1,2
12.	Appointment Schedule	2,3
13.	Appointment Status	2,3
14.	Medical History	2,7
15.	Treatment History	2,7
16.	Qualifications	2,7
17.	Payment Process	2,3,6
18.	Payment method	3,4

19.	Payment Gateway	1,3
20.	Admin Account	2,7
21.	User Dashboard	2,7
22.	Appointment Detail	2,7
23.	Digital Invoice	2,7
24.	Transaction ID	2
25.	Admin ID	2
26.	Dentist ID	2
27.	Patient ID	2
28.	Medical Records	2,7
29.	Prescription	2,3
30.	Dental Records	2,7
31.	User ID	2
32.	Feedback ID	2
33.	Appointment ID	2
34.	Treatment Plan	2

35.	Notification System	2,7
36.	Appointment Management	2,3
37.	Payment History	2,7
38.	Payment Confirmation	3,7
39.	Invoice ID	2
40.	Chatbot Support	2,7
41.	Verification Process	2,6
42.	Secure Login	3
43.	Password	2
44.	Email Address	1,2
45.	OTP Authentication	3
46.	Two-Factor Authentication	3
47.	AI Chatbot	1,2
48.	Resource Type	2,3
49.	Resource Management	2,7
50.	Professional Profile	2,7

51.	Dental Treatment	2
52,	Session	3,7
53	Cancellation Policy	3,6
54.	Rescheduling Policy	3,6
55.	Notification ID	2
56.	Feedback Mechanism	2,7
57.	Admin Panel	2,7
58.	System	7
59.	Database	1

Potential Classes

1. User
2. Admin
3. Dentist
4. Patient
5. Appointment
6. Invoice
7. Feedback
8. Notification System
9. Billing
10. Chatbot
11. Medical History
12. Dental Records
13. Payment Process
14. Database

Selection Criteria

The candidate classes are then selected as classes by six Selection Criteria.

1. Retain information
2. Needed services
3. Multiple attributes
4. Common attributes
5. Common operations
6. Essential requirements

Potential general classified nouns to become a class after selection criteria :

SL No.	Noun	Selection Criteria
1.	User	1,6
2.	Admin	1,2,3,4,5
3.	Dentist	1,2,3,4,5
4.	Patient	1,2,3,4,5
5.	Appointment	1,2,3,4,5
6.	Invoice	1,2,3,4,5
7.	Feedback	1,2,3,4

8.	Notification System	1,2,4,6
9.	Biling	1,2,3,4,5
10.	Chatbot	1,2,3,6
11.	Medical Record	1,2,3,6
12.	Dental record	1,2,3,4,5
13.	Payment process	1,2,3,4,6
14.	Database	6

Identification of Attributes and Methods

Class Name	Attributes	Method
User	-user id -Full Name -Phone Number -Email Address -Username -Password -Address (Present, Permanent)	• +create_account() • +login() • +update_profile_information() • +reset_password() • +logout()
Admin	-Admin ID -Email Address -Phone Number -Designation -Access Level	+verify_user_information() +manage_roles() +send_notifications() +generate_reports() +reset_system_settings()

Dentist	-Dentist ID -Full Name -Specialization -Phone Number -Email Address -Qualifications	• +schedule_appointments() • +view_patient_history() • +update_dental_records() • +provide_feedback() • +manage_availability()
Patient	-Patient ID -Full Name -Phone Number -Email Address -Medical History -Dental Records	• +book_appointment() • +cancel_appointment() • +view_dental_records() • +update_medical_history() • +provide_feedback()
Appointment	-Appointment ID -Date and Time -Status (Pending, Confirmed, Completed) -Dentist ID -Patient ID	• +schedule_appointment() • +cancel_appointment() • +reschedule_appointment() • +notify_parties() • +track_appointment_status()

Invoice	-Invoice ID -Patient ID -Appointment ID -Total Amount -Payment Status -Payment Date	+generate_invoice() +update_payment_status() +view_invoice_details()
Feedback	-Feedback ID -Patient ID -Dentist ID -Feedback Content -Rating (1-5)	+submit_feedback() +view_feedback() +analyze_feedback()
Notification System	-Notification ID -User ID -Notification Content -Status (Unread/Read)	+send_notification() +track_notification_status() +update_notification_preferences()

Billing	-Billing ID -Invoice ID -Payment Method -Payment Date -Payment Amount	+process_payment() +validate_payment_details() +generate_billing_summary()
Chatbot	- query - responses	+provide_recommendations() +answer_queries() +learn_from_interactions()
Medical History	-History ID -Patient ID -Conditions -Medications	+update_medical_history() +retrieve_medical_history() +analyze_health_trends()
Dental Records	-Record ID -Patient ID -Dentist ID -Treatment Details -Treatment Date	+add_dental_record() +retrieve_dental_records() +analyze_dental_health()

Payment Process	-Payment ID -Patient ID -Appointment ID -Payment Method -Transaction Status	+process_transaction() +validate_payment() +generate_receipt() +track_transaction_status()
Database	- connection_URI	+ write_data() + read_data() + update_data() + remove_data() + connect_db() + disconnect_db()

Class Cards

Class : User	
Responsibilities	**Collaborators**
Creating an account	Admin, Notification System
Logging in as a user	Admin
Updating profile information	Notification System
Resetting passwords	Notification System

Class : Admin	
Responsibilities	**Collaborator**
Verifying user credentials	User
Managing roles and permissions	Dentist, Patient
Sending system notifications	Notification System
Generating reports	Appointment, Feedback

Class : Dentist	
Responsibilities	**Collaborator**
Managing schedules and appointments	Appointment, Patient
Viewing and updating dental records	Dental Records, Patient
Providing feedback to patients	Feedback, Patient

Class : Patient	
Responsibilities	**Collaborator**
Booking and canceling appointments	Appointment, Notification System
Providing feedback on services	Feedback, Dentist
Viewing personal records	Medical History, Dental Records

Class : Appointment	
Responsibilities	**Collaborator**
Scheduling appointments	Patient, Dentist, Notification System
Rescheduling appointments	Dentist, Patient
Canceling appointments	Patient
Notifying users	Notification System

Class : Invoice	
Responsibilities	**Collaborator**
Generating invoices	Billing, Payment Process
Updating payment status	Payment Process
Providing invoice details	Patient

Class : Feedback	
Responsibilities	**Collaborator**
Collecting feedback from patients	Patient
Analyzing feedback	Admin, Dentist
Storing feedback	Admin

Class : Notification System	
Responsibilities	**Collaborator**
Sending notifications	Admin, Appointment, Patient
Tracking notification status	Appointment
Updating notification preferences	User

Class : Billing	
Responsibilities	**Collaborator**
Processing payments	Payment Process, Patient
Validating payment details	Payment Process
Generating billing summaries	Invoice

Class : Chatbot	
Responsibilities	**Collaborator**
Answering user queries	User
Providing recommendations for care	User

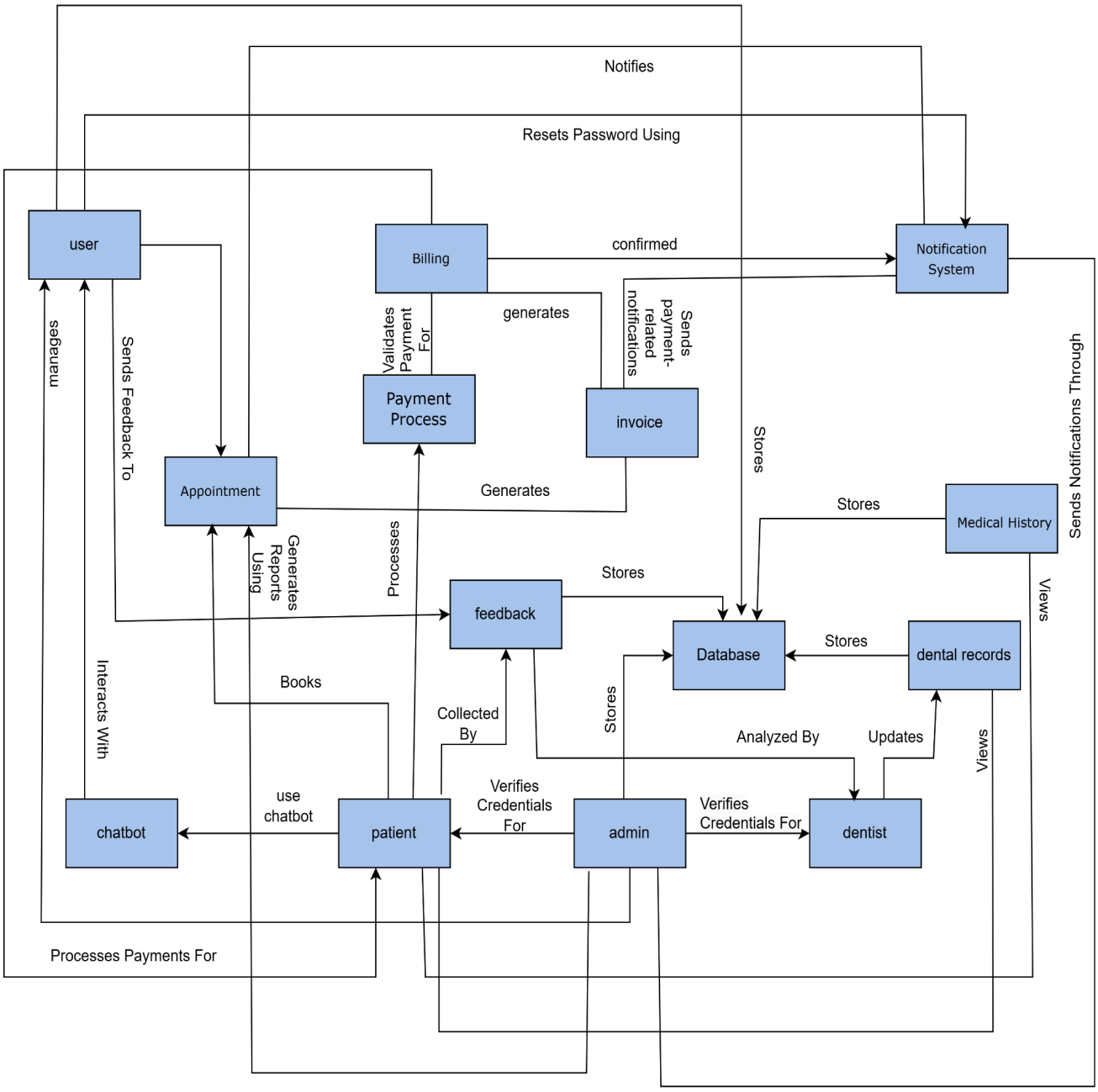
Class : Medical History	
Responsibilities	**Collaborator**
Storing medical history	Patient
Updating medical conditions	Patient, Dentist
Providing data for analysis	Dentist

Class : Dental Records	
Responsibilities	**Collaborator**
Storing dental records	Patient
Updating dental records	Dentist
Accessing data for treatment	Dentist, Patient

Class : Payment Process	
Responsibilities	**Collaborator**
Processing payments	Patient, Billing
Validating payment methods	Billing
Recording transaction details	Invoice

Class : Database	
Responsibilities	**Collaborator**
Store Information	
Store resources	

CRC Diagram


Notifies
Resets Password Using
user
Billing
confirmed
Notification System
manages
Sends Feedback To
Validates Payment For
generates
Sends payment-related notifications
Payment Process
invoice
Stores
Sends Notifications Through
Appointment
Generates
Stores
Medical History
Generates Reports Using
Processes
Stores
Views
feedback
Database
Stores
dental records
Books
Collected By
Stores
Analyzed By
Updates
Views
Interacts With
use chatbot
Verifies Credentials For
Verifies Credentials For
chatbot
patient
admin
dentist
Processes Payments For

BEHAVIORAL MODELING

The behavioral model indicates how software will respond to external events or stimuli. In the context of behavioral modeling, two different characterizations of states must be considered: (1) the state of each class as the system performs its function and (2) the state of the system as observed from the outside as the system performs its function.

State Transition Diagram

One component of a behavioral model is a UML state diagram that represents active states for each class and the events (triggers) that cause changes between these active states.

Event Table

SL	Event	Event Name	Initiator	Collaborator
1	App Launch	Launch_App	User	Notification System
2	Choose to Log In	Login_To_System	User	Notification System
3	Choose to Sign Up	Sign_Up_To_System	User	Notification System
4	Log In	Launch_Dashboard	User	chatbot
5	Recover Password	Recover_Password	User	Notification System
6	Schedule Appointment	Schedule_Appointment	Patient	Dentist, Appointment
7	Confirm Appointment	Confirm_Appointment	Dentist	Appointment

8	Cancel Appointment	Cancel_Appointment	Patient	Dentist, Appointment
9	Generate Invoice	Generate_Invoice	Appointment	invoice
10	Make Payment	Make_Payment	Patient	Invoice, Payment Gateway
11	Provide Feedback	Provide_Feedback	Patient	Feedback
12	Send Notification	Send_Notification	Notification System	User
13	Update Patient Profile	Update_Profile	Patient	Medical History
14	Notify Appointment Reminder	Notify_Reminder	Notification System	Patient
15	Manage Dentist Availability	Manage_Availability	Dentist	Appointment
16	Assign Dentist	Assign_Dentist	Admin	Dentist, Patient
17	Update System Records	Update_Records	Admin	Medical History
18	Add New User	Add_New_User	Admin	user
19	Delete User Account	Delete_User	Admin	user
20	View medical history	View_Medical_History	Dentist	Patient, Medical History

21	Update Dental Records	Update_Dental_Records	Dentist	Dental Records
22	Notify Payment Confirmation	Notify_Payment	Notification System	Billing
23	Access Chatbot Assistance	Access_Chatbot_Assistance	User	Chatbot