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FPT INTERNATIONAL TRAINING INSTITUTE FPT – APTECH COMPUTER EDUCATION

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Sunshine Dental Care

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Month

11

Year

2025

ACKNOWLEDGEMENT

We would like to extend our heartfelt appreciation to all those who have provided valuable support during the development of our **Sunshine Dental Care** project.

First and foremost, we would like to express our sincere gratitude to our dedicated instructor, **Mr. Tran Phuoc Sinh**. His insightful suggestions and words of encouragement helped us overcome technical challenges regarding the **complex system logic** and provided us with the confidence to tackle obstacles. Without **his** guidance, our project would not have achieved the level of success it has today.

Secondly, we would like to express our deep appreciation to the Project Team at the Head Office. Their unwavering support and the opportunity they provided us to apply our learning into practical implementation have been invaluable. We are confident that the experiences gained from developing this **Dental Clinic Management System** will greatly benefit our future careers in the software development field.

Thirdly, we would like to acknowledge and thank all the staff members of our center. Their collaboration, not only in allowing us to work with them on this project but also for their continuous support and encouragement throughout the process, has been instrumental in our success.

Lastly, we would like to express our personal gratitude to our fellow classmates and team members of **Group 03**. Their open and enthusiastic support has been truly invaluable. Their willingness to lend a helping hand and work together has made this journey enjoyable and rewarding.

Building the **Sunshine Dental Care** project has been a collaborative effort, and we would like to express our sincere appreciation to everyone involved. The unwavering support, guidance, and encouragement we received have helped us overcome technological challenges and bring this project to fruition. We are grateful for the opportunity to apply our knowledge and skills to create a successful **comprehensive Dental Management platform**.

SYNOPSIS

The **Sunshine Dental Care** project, built using **Java Spring Boot, ReactJS**, and

Flutter, is a modern and flexible platform designed to meet the complex operational needs of dental clinics. Leveraging the robust **Spring Boot** framework for the backend, **ReactJS** for the administration portal, and **Flutter** for the patient mobile application, Sunshine Dental Care offers a seamless and synchronized ecosystem.

This platform allows administrators, doctors, and patients to engage in efficient appointment scheduling, secure medical record management, and intelligent human resource operations. Furthermore, by **integrating multiple advanced AI technologies to automate various operational stages**, the system ensures an efficient and professional healthcare experience, combining robust performance with an intuitive design tailored to enhance the overall user experience in the digital medical marketplace.

Chapter 1. PROBLEM DEFINITION

Sunshine Dental Care is a comprehensive ecosystem for dental clinic management, designed to streamline operations for administrators, medical staff, and patients. Built with **Java Spring Boot**, **ReactJS**, and **Flutter**, it combines advanced AI features with robust database integration, offering a seamless healthcare experience with high-level security and cross-platform accessibility.

1. Modern and Cross-Platform Interface: Sunshine Dental Care features a modern, user-friendly design tailored for different users. The **ReactJS** web portal provides a powerful dashboard for administrators and doctors, while the **Flutter** mobile app offers an intuitive experience for patients to book appointments and view medical history on the go.

2. Smart Scheduling & HR Management: Unlike traditional systems, Sunshine Dental Care leverages AI technologies. The system enables AI-driven scheduling via Natural Language Processing (NLP (Natural Language Processing - công nghệ xử lý ngôn ngữ tự nhiên)) to automate appointment booking. Additionally, it offers advanced HR management with biometric attendance, utilizing ArcFace (Thuật toán nhận diện khuôn mặt tiên tiến) for FaceID verification and Wi-Fi geolocation to ensure accurate staff tracking.

3. Clinical & Patient Management: The platform enables efficient management of Electronic Medical Records (EMR (Electronic Medical Records - hồ sơ bệnh án điện tử)). Doctors can easily add diagnoses, update treatment plans, and upload X-ray images. This feature ensures that patient history is organized, accessible, and secure, enhancing the quality of care provided.

4. SQL Server Database & Security: Sunshine Dental Care is backed by a robust **SQL Server database**, ensuring the secure and efficient storage of sensitive medical data and high-volume transaction records. This guarantees data consistency, integrity, and reliability in managing critical clinic information.

5. Inventory & Financial Analytics: The system offers comprehensive financial tools, allowing the clinic to manage **invoices, payments, and product inventory** efficiently. Integrated analytics features enable the monitoring of revenue, salary calculations based on attendance, and supply usage, helping owners make strategic, data-driven decisions.

6. CRM & Patient Engagement: Replacing traditional communication methods, the system includes a **CRM and Notification module**. This features an **AI Chatbot** for instant patient support and automated appointment reminders. It helps build a strong relationship with patients, reduces no-show rates, and keeps customers informed about their dental health status.

Chapter 2. CUSTOMER'S REQUIREMENTS SPECIFICATIONS

2.1. Business/Project Objective:

Main Objective of the Sunshine Dental Care System:

The primary goal of the Sunshine Dental Care system is to provide a comprehensive and intelligent platform for modernizing dental clinic operations. This platform aims to streamline workflows for administrators, medical staff, and patients by integrating advanced technologies. It covers all aspects of clinic management, including patient records, smart scheduling, human resources, and financial tracking.

Here are the specific objectives:

- 2.1.1. **Patient & Medical Management:** Effectively manage patient profiles, medical histories, and Electronic Medical Records (EMR (Electronic Medical Records - hồ sơ bệnh án điện tử)). This includes storing diagnosis details, treatment plans, and digital X-ray images to enhance the quality of care and ensure data accessibility for doctors.
- 2.1.2. **Smart Scheduling & HR Operations:** Leverage AI and Natural Language Processing (NLP (Natural Language Processing - công nghệ xử lý ngôn ngữ tự nhiên)) to automate staff scheduling and validate appointment slots. Implement Biometric Attendance (FaceID & Geo-fencing) to accurately track employee work hours, ensuring efficient human resource management.
- 2.1.3. **Appointment & Financial Management:** Seamlessly process appointment bookings across multiple clinics and doctors. The system must also handle invoicing, payment processing, and inventory management for dental supplies, ensuring accurate financial reporting and stock control.
- 2.1.4. **CRM & Patient Engagement:** Enhance patient interaction through an **AI Chatbot** and automated notification system. This feature aims to provide instant support, send appointment reminders to reduce no-show rates, and foster long-term relationships with patients.
- 2.1.5. **User Experience (Cross-Platform):** Ensure an intuitive and consistent user experience across different platforms: a powerful **ReactJS Web Portal** for clinic staff and a user-friendly **Flutter Mobile App** for patients to book services and view their health records on the go.

2.2. Hardware/ Software Requirements:

Software & Tools:

- **Operating System:** Windows 10 / 11 or macOS.
- **Database:** Microsoft SQL Server.
- **Backend Development:** Java Development Kit (JDK) 17+, Spring Boot Framework.
- **Frontend Development:** Node.js, ReactJS (for Admin Web), Flutter SDK (for Mobile App).
- **IDE / Code Editors:** IntelliJ IDEA, Visual Studio Code, Android Studio.
- **API Testing:** Postman.
- **Version Control:** Git & GitHub.
- **Design & Modeling:** Draw.io (for Diagrams), Figma (for UI Design).

Technology Stack: Java Spring Boot / ReactJS / Flutter / SQL Server

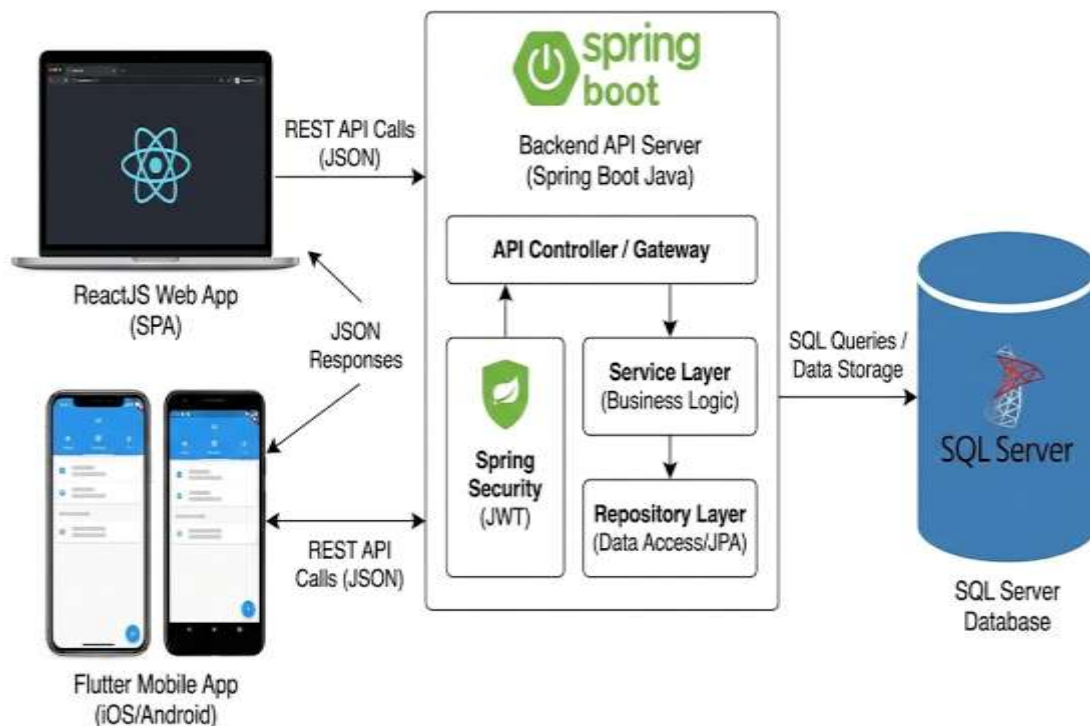
2.3. ARCHITECTURE AND DESIGN OF THE PROJECT

The Sunshine Dental Care system is built upon a robust **Multi-Tier Client-Server Architecture**,

utilizing **Java Spring Boot** as the core backend framework. Unlike traditional monolithic applications, this project adopts a **RESTful API-first design**, which decouples the frontend user interfaces from the backend logic.

- **Backend (Server-Side):** Powered by Spring Boot, the server acts as a centralized API hub. It handles complex business logic, AI data processing (NLP (Natural Language Processing - công nghệ xử lý ngôn ngữ tự nhiên) & ArcFace (Thuật toán nhận diện khuôn mặt tiên tiến)), security (Spring Security with JWT (JSON Web Token - chuẩn bảo mật cho xác thực)), and database interactions via Hibernate/JPA.
- **Frontend (Client-Side):** The system supports cross-platform clients:
 - **ReactJS:** Provides a dynamic and responsive Web Admin Dashboard for clinic staff.
 - **Flutter:** Delivers a high-performance native Mobile Application for patients.

This architecture ensures high scalability, maintainability, and security, allowing different client platforms (Web & Mobile) to communicate seamlessly with the server through standardized JSON data exchange.



Chapter 3. SCOPE OF THE WORK (IN BRIEF)

The scope of work for the **Sunshine Dental Care** project includes the following key components:

1. Multi-Platform Application Development:

- Design and develop a robust backend system using **Java Spring Boot**.
- Create a responsive **ReactJS** Web Admin Portal for clinic staff and a cross-platform **Flutter** Mobile App for patients.

2. Smart Scheduling & HR Management:

- Implement AI-driven scheduling using Natural Language Processing (NLP (Natural Language Processing - công nghệ xử lý ngôn ngữ tự nhiên)) to automate appointment creation and conflict resolution.
- Develop a Biometric Attendance System utilizing ArcFace (Thuật toán nhận diện khuôn mặt tiên tiến) (FaceID) and Geolocation (WiFi) for accurate staff tracking.

3. Patient & Clinical Management:

- Develop comprehensive Electronic Medical Records (EMR (Electronic Medical Records - hồ sơ bệnh án điện tử)) to track diagnosis, treatment plans, and digital X-ray images.
- Implement patient profile management with secure access to medical history via the mobile app.

4. Financial & Inventory Control:

- Enable automated invoicing, payment processing, and revenue tracking.
- Create functionalities for managing dental product inventory, including stock tracking and categorization.

5. AI & CRM Integration:

- Integrate an **AI Chatbot** to assist patients with inquiries and booking.
- Implement a **CRM system** for automated appointment reminders and customer engagement campaigns.

6. Database & Security:

- Set up a robust **SQL Server** database to securely store complex medical and transaction data.
- Ensure high-level security with Spring Security (JWT (JSON Web Token - chuẩn bảo mật cho xác thực)) and Role-Based Access Control (RBAC (Role-Based Access Control - kiểm soát truy cập theo vai trò)) across all platforms.

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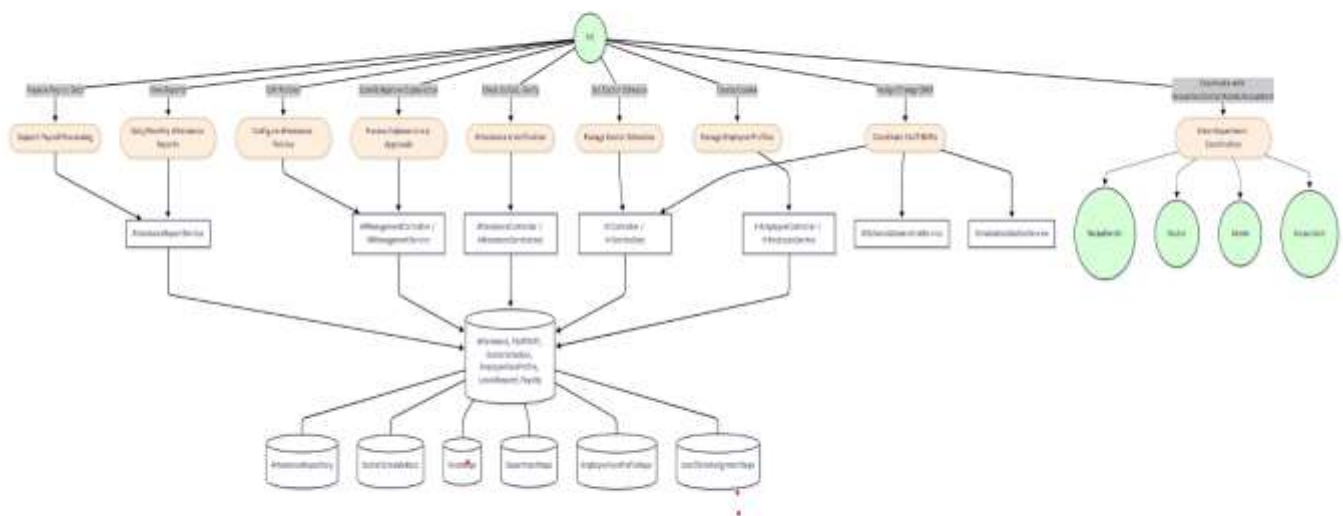
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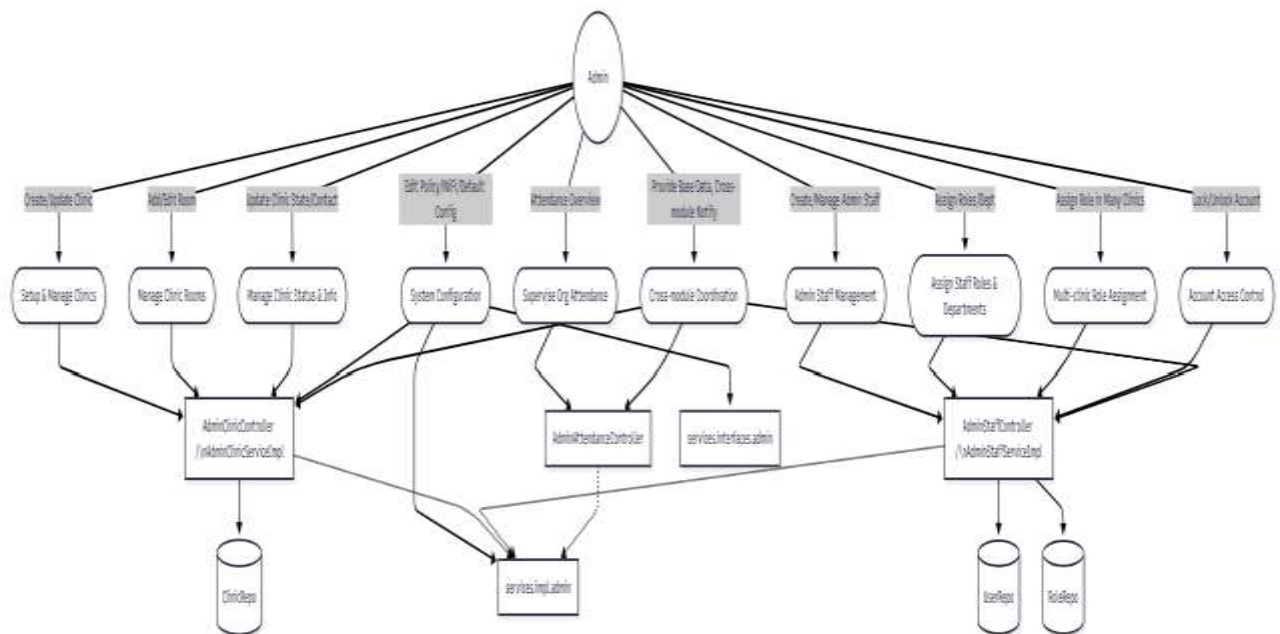
Sr. No.	Task Title	Assigned By	Actual Start Date	Actual Days	Teammate Names	Status
1	Authentication & User Profile(Login, Register, Security)	Tuan	24-November-2025	7	Ngô Minh Tuấn	Completed
2	HR Management & Admin Management	Long	24-November-2025	10	Sơn Phi Long	Completed
3	Doctor & Clinical Operations(Medical Records, Diagnosis)	Hoang (Nho)	24-November-2025	10	Nguyễn Hữu Hoàng	Completed

4	Reception & CRM System(Booking Mgmt, Invoices)	Hoang (Lon)	24-November-2025	10	Nguyễn Minh Hoàng	Completed
5	Accounting & Inventory(Products, Salary, Revenue)	Huy	24-November-2025	8	Nguyễn Quốc Huy	Completed
6	System Documentation(CRS, SRS, Slide Prep)	All Team	24-November-2025	4	Group 03	Completed

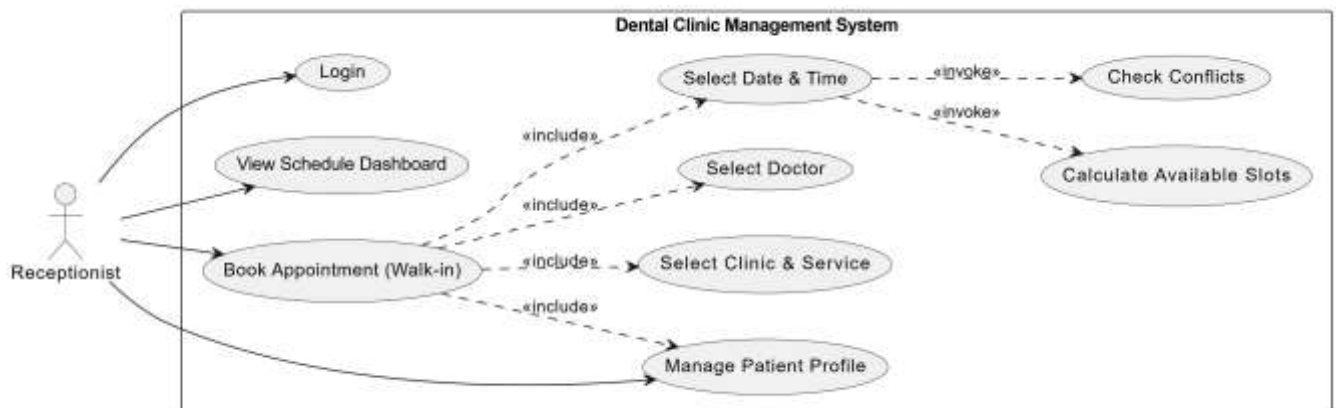
Chapter 4. DATABASE DESIGN

4.1. Relational model of the database

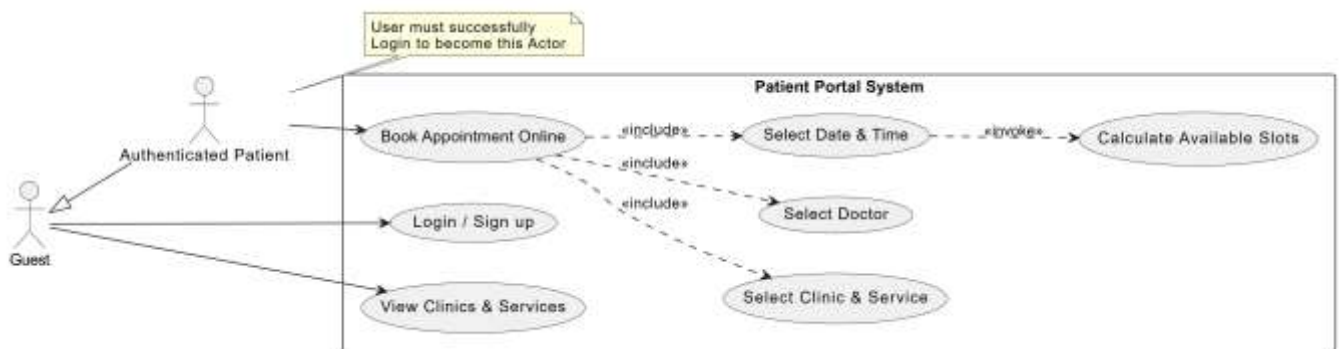




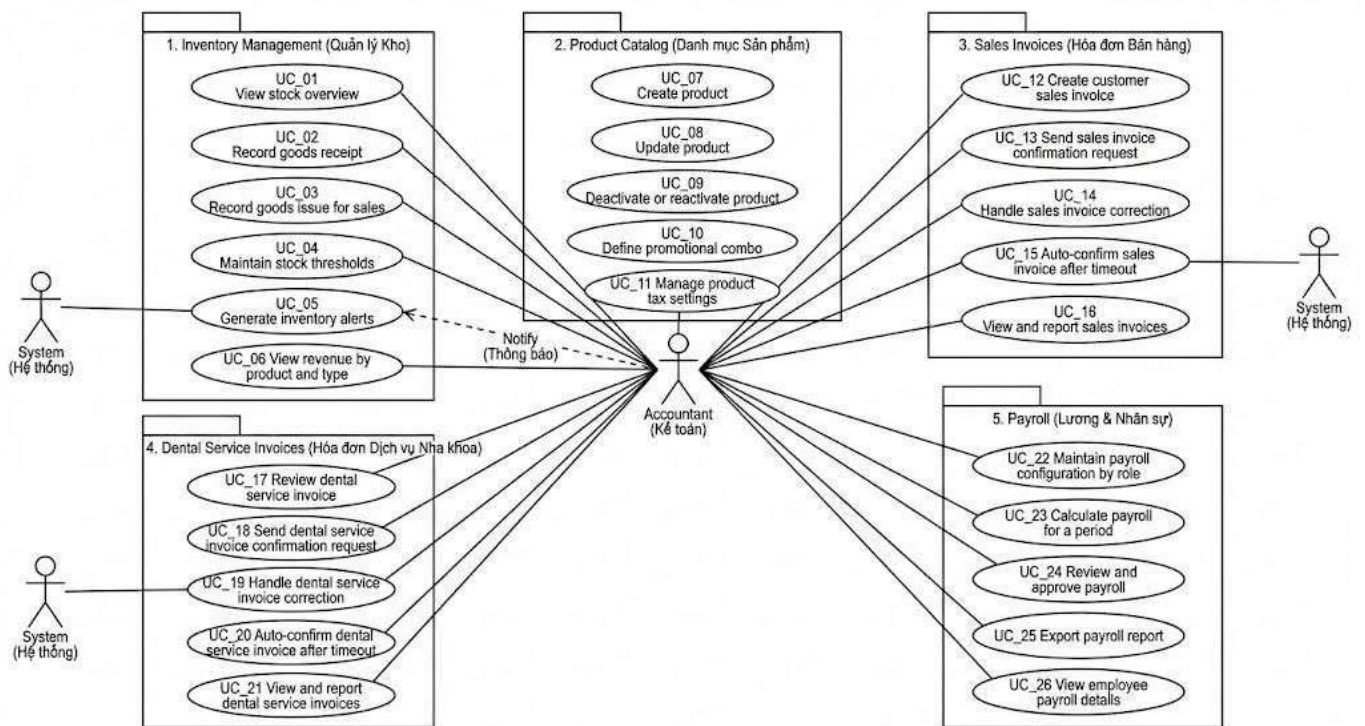
Usecase Admin



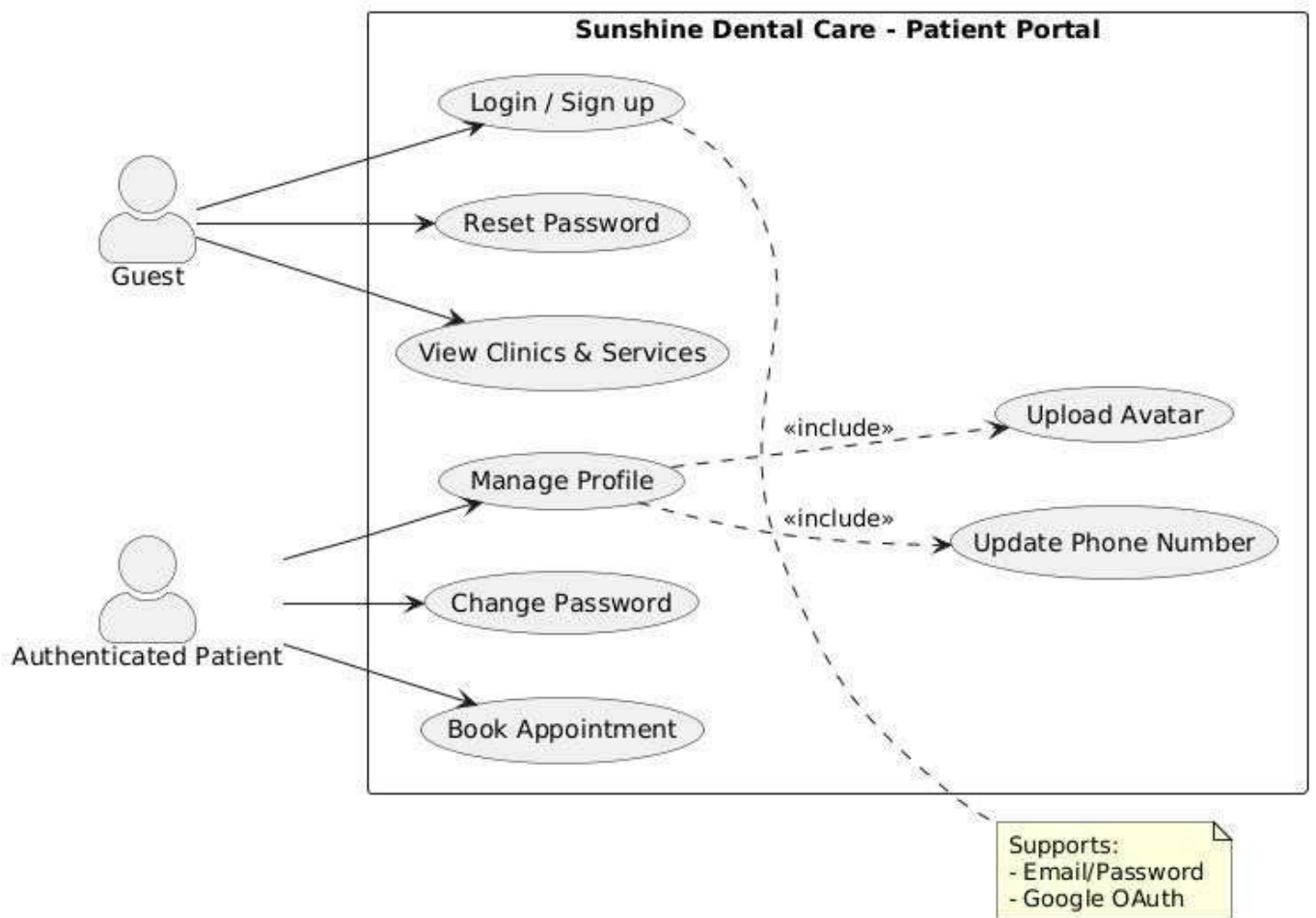
Usecase Recception



Usecase Patientbooking



Usecase Accountant



Usecase

Auth

&

Patient

Function Description

Funtion for HR

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
1	Employee Profile & Lifecycle Management	<p>1. Onboarding:</p> <ul style="list-style-type: none"> - Auto-Staff Code: Generate preview code, validate unique emails, create new Staff profiles. <p>2. Bio-Data Setup:</p> <ul style="list-style-type: none"> - Upload high-res Avatars. - Register Face Embeddings for biometric attendance. <p>3. Assignments:</p> <ul style="list-style-type: none"> - Map Staff to specific Clinics, Departments, and Roles (UserClinicAssignment). <p>4. Status Control:</p> <ul style="list-style-type: none"> - Hard Delete: Permanent removal. - Toggle: Active/Inactive status for resignations. 	<p>Controller: HrEmployeeController</p> <p>Services: HrEmployeeService, AvatarStorageService</p> <p>Entities: User, EmployeeFaceProfile, UserClinicAssignment</p>	<p>Centralized Registry:</p> <p>Secure staff registry ensuring every employee has the correct credentials, access rights, and biometric data for operations.</p>
2	Shift Coordination & Doctor Scheduling	<p>1. Shift Configuration:</p> <ul style="list-style-type: none"> - Define working shifts 	<p>Controller: HrController (Schedule)</p>	<p>Resource Optimization:</p>

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>(Morning/Afternoon/Night) in StaffShift.</p> <p>2. Clinical Rostering:</p> <ul style="list-style-type: none"> - Map Doctors to Treatment Rooms. - Conflict Detection: Ensures no double-booking of doctors or rooms. 3. Automation: - AI Suggestions: Recommend staffing levels based on historical appointment density. 4. Publishing: - Finalize and Push schedules to staff apps. 	<p>Services: AiScheduleGenerationService</p> <p>Entities: DoctorSchedule, StaffShift</p>	Optimize workforce distribution to meet patient demand while preventing resource conflicts.
3	Leave & Absence Management	<p>1. Request Workflow:</p> <ul style="list-style-type: none"> - Staff submit LeaveRequest (Sick, Annual, Unpaid). 2. Approval Chain: - HR/Admin views "Pending" queue, reviews quota/history. 	<p>Controller: LeaveRequestController</p> <p>Services: LeaveRequestService</p> <p>Entities: LeaveRequest</p>	<p>Formalized Process:</p> <p>Formalized absence handling to ensure transparency and allow proactive restaffing during gaps.</p>

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>- Performs Approve/Reject actions.</p> <p>3. Impact Analysis:</p> <p>- Approved leaves automatically block the schedule to prevent assigning shifts to absent staff.</p> <p>4. Tracking:</p> <p>- View history and balance of leave days.</p>		
4	Attendance Operations & Verification	<p>1. Multi-Factor Check-in:</p> <p>- Face Match: Real-time embedding comparison.</p> <p>- Location Lock: Validate WiFi SSID/BSSID against allowed SystemConfig.</p> <p>2. Time Tracking:</p> <p>- Capture exact entry/exit times.</p> <p>- Auto-calculate Late In, Early Out, and Overtime duration based on Shift rules.</p> <p>3. History:</p>	<p>Controller: AttendanceController, FaceProfileController</p> <p>Services: AttendanceService, FaceRecognitionService</p> <p>Entities: Attendance, SystemConfig (WiFi Limits)</p>	<p>Fraud Prevention:</p> <p>Eliminate time-fraud ("buddy punching") and generate precision data for payroll.</p>

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		- Staff can view their own daily/monthly logs.		
5	Explanations & Discipline Compliance	<p>1. Exception Handling:</p> <p>- Staff file AttendanceExplanation (e.g., "Forgot ID", "External Meeting") with proof for abnormal logs.</p> <p>2. Adjudication:</p> <p>- HR reviews explanations -> Updates Attendance Status (e.g., converts "Absent" to "Present" or "Valid Leave").</p> <p>3. Policy Enforcement:</p> <p>- Auto-flag check-ins exceeding grace periods (Late Penalty).</p>	<p>Controller: HRManagementController</p> <p>Services: HRManagementService</p> <p>Entities: AttendanceExplanation</p>	<p>Fairness:</p> <p>Fair and audible process to handle legitimate anomalies without breaking strict attendance rules.</p>
6	Reporting & Payroll Data Support	<p>1. Operational Dashboards:</p> <p>- Real-time view of "Who is here", "Who is missing".</p> <p>2. Payroll Export:</p> <p>- Generate MonthlySummaryResponse containing finalized Total Hours, OT Hours, and Deductions for the</p>	<p>Controller: AttendanceController (Stats endpoints)</p> <p>DTOs: DailySummaryResponse, MonthlySummaryResponse</p> <p>Integration: Data feeder for Payroll Module.</p>	<p>Data Accuracy:</p> <p>Provide actionable insights for management and clean, finalized data for accurate salary processing.</p>

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>Accountant.</p> <p>3. Demographics:</p> <p>- Statistics on staff distribution by Department/Clinic/Gender (/statistics endpoint).</p>		
7	Smart Notification System	<p>1. Real-time Alerts:</p> <p>- Trigger WebSocket (Web) & FCM Push (Mobile) for: <i>Leave Approved, New Schedule, Payslip Ready, Check-in Warning.</i></p> <p>2. Device Management:</p> <p>- Register/Update FCM Tokens (/device endpoint).</p> <p>3. Synchronization:</p> <p>- Sync "Read" status across multiple devices via Firestore/DB to avoid duplicate alerts.</p> <p>4. Inbox:</p> <p>- Centralized list of notifications with filtering and deep-linking.</p>	<p>Controller: NotificationController</p> <p>Services: NotificationService, NotificationAsyncService</p> <p>Entities: Log (Notification History), UserDevice</p>	<p>Responsiveness :</p> <p>Keep the entire workforce connected and responsive to critical operational updates instantly.</p>

Funtion for Admin

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
1	Clinic Infrastructure Management	<p>1. Network Management:</p> <p>- Listing: Retrieve comprehensive list of all branches with status indicators.</p> <p>- Onboarding: Add new facility records when expanding the business.</p> <p>2. Operational Control:</p> <p>- Emergency Shutdown: Instant toggle (isActive = false) to suspend all bookings/operations for a specific clinic (e.g., renovations, incidents).</p> <p>- Data Accuracy: Maintain single-source-of-truth for contact info (Hotline, Address) on Public Apps.</p> <p>3. Modification Workflow:</p> <p>- Validate input -> Update DB -> Sync changes to Client Apps instantly.</p>	<p>Controller: AdminClinicController</p> <p>Service: AdminClinicService</p> <p>DTOs: AdminClinicDto, ClinicActivationRequestDt o</p> <p>Entities: Clinic</p>	<p>Business Continuity:</p> <p>Ensure the physical network of clinics is digitalized accurately and can be centrally controlled.</p>

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
2	System Configuration & Security Audit	<p>1. Global Settings Engine:</p> <ul style="list-style-type: none"> - Configure runtime parameters (e.g., MAX_LOGIN_ATTEMPTS, SESSION_TIMEOUT) in SystemConfig. - Dynamic Updates: Apply changes immediately without server restart. <p>2. Calendar Rules (Holidays):</p> <ul style="list-style-type: none"> - Define Non-working days via "Repeat Yearly" logic. - Impact: Automatically blocks Schedule Generation and Appointment Booking. <p>3. Forensic Logging (Audit):</p> <ul style="list-style-type: none"> - Traceability: Track Who did What, When, and Affected Which Record. 	<p>Controller: AdminSystemController</p> <p>Services: SystemConfigService, AuditLogService</p> <p>Entities: SystemConfig, Holiday, Log (Audit)</p>	<p>Governance & Stability:</p> <p>Maintain a configurable, secure, and legally compliant system environment.</p>

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		- Search/Filter: Investigate suspicious activities.		
3	Customer Account Administration	<p>1. User Base Oversight:</p> <p>- Centralized view of all 10,000+ patient accounts.</p> <p>- Advanced Filter: Find by Phone, Email, or Registration Date.</p> <p>2. Security Actions:</p> <p>- Ban/Unban: Administrative override to block abusive users (CustomerStatusRequest).</p> <p>- Data Correction: Assist in fixing critical profile errors.</p> <p>3. Privacy & Compliance:</p> <p>- Ensure customer data handling meets deletion/retention policies.</p>	<p>Controller: AdminCustomerController</p> <p>Service: AdminCustomerService</p> <p>Entities: User (Role: CUSTOMER)</p>	<p>User Safety:</p> <p>Protect the platform integrity by managing the customer community and handling security exceptions.</p>
4	Workforce Overview (Read-Only)	1. Staff Directory:	Controller: AdminStaffController	Supervision:

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<ul style="list-style-type: none"> - View complete hierarchy: Who reports to whom, Doctor-Department mapping. - Cross-check: Verify HR assignments. <p>2. Separation of Duties:</p> <ul style="list-style-type: none"> - View Only: Admin sees staff data but cannot edit sensitive HR fields (Salary, Evaluation) - preserving HR autonomy. - Search: Quick lookup for IT support tickets. 	<p>Service: AdminStaffService</p> <p>DTO: AdminStaffDto</p>	High-level transparency into personnel without violating departmental boundaries.
5	Executive Intelligence & Reporting	<p>1. Command Center (Dashboard):</p> <ul style="list-style-type: none"> - Live Pulse: "Revenue today?", "Active patients?". - Visual Widgets: Graphs for Revenue trends, Appointment Completion rates. <p>2. Financial Reporting:</p>	<p>Controllers: AdminDashboardController , AdminReportController, AdminInventoryController</p> <p>DTOs: DashboardStatisticsDto, RevenueReportDto</p> <p>Logic: Aggregation Queries in Repositories.</p>	<p>Strategic Decision Making:</p> <p>Provide the Business Owner/Admin with "Big Picture" metrics to steer company strategy.</p>

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>- Revenue Analysis: Aggregated income reports by Clinic or Period (VND/USD).</p> <p>3. Inventory Intelligence:</p> <p>- Stock Health: High-level valuation of inventory assets.</p> <p>- Alerts: Identify categories with low turnover or high wastage risk.</p>		

Funtion for Doctor

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
1	Doctor Appointment Management	<p>1. Appointment Visibility:</p> <p>- View all appointments assigned to the specific Doctor ID.</p> <p>- Filter: By Date Range (ISO format),</p>	<p>- Controller: DoctorController (GET by day/week)</p> <p>- Services: DoctorAppointmentService</p>	Ensure doctors know their daily caseload and room allocations efficiently.

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>By Status (SCHEDULED, PROCESSING, COMPLETED, CANCELED).</p> <p>2. Detailed View:</p> <ul style="list-style-type: none"> - Access comprehensive info: Patient profile, Clinic location, Room, Service type, and Notes. <p>3. Status Transition Logic (Business Rules):</p> <ul style="list-style-type: none"> - To Processing: Only allowed near start time. - To Completed: Only from PROCESSING & requires at least one Medical Record created. - To Canceled: Only from SCHEDULED/CONFIRMED & strict Grace Time rules apply. 	<p>- Entities: Appointments, DoctorSchedule, Rooms</p>	
2	Doctor Weekly Schedule (My Schedule)	<p>1. Personal Schedule View:</p> <ul style="list-style-type: none"> - Logged-in doctor views their specific roster for the week (Start/End 	<p>- Controller:</p> <p>PatientMedicalRecordController → PatientMedicalRecordServiceImpl</p>	Maintain comprehensive , digital, and accessible health records

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>times, assigned Clinic).</p> <p>2. Security & Context:</p> <p>- Authentication: Strict check against <code>CurrentUser</code> context to prevent viewing other doctors' schedules unauthorized.</p> <p>- Input: <code>weekStart</code> date to navigate weeks.</p>	<p>- Entities: <code>MedicalRecord</code>, <code>MedicalRecordImage</code>, <code>Patient</code></p>	<p>for better treatment quality.</p>
3	Medical Record PDF Export	<p>1. Document Generation:</p> <p>- Create a printable "Dental Treatment Record" from a <code>MedicalRecord</code>.</p> <p>2. Branding & Content:</p> <p>- Header: Clinic Name, Address, Hotline, Logo.</p> <p>- Body: Patient/Doctor Info, Service Details (Price, Discount, Duration), Clinical Notes (Diagnosis, Rx, Plan).</p> <p>3. Visual Evidence:</p>	<p>- Entities: <code>Prescription</code>, <code>PrescriptionItem</code>, <code>AppointmentService</code>, <code>Medicines</code></p> <p>- Integration: Data flows to Invoice/Payment module</p>	<p>Provide accurate treatment (medicines) and ensure precise billing for services rendered.</p>

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>- Image Handling: Embed X-rays/Dental photos from URLs into a 2-column grid, auto-scaled.</p> <p>- Error Handling: Fallback for broken image links.</p>		
4	AI Assistant for Doctors (Chatbot)	<p>1. Natural Language Query:</p> <p>- Doctors ask clinical or operational questions (e.g., "History of patient X?", "Notes on last visit?").</p> <p>2. RAG (Retrieval-Augmented Generation):</p> <p>- Context Building: System fetches related Patient, Medical Record, and Appointment data based on filters (patientId, recordId).</p> <p>- AI Processing: Send [Question + Context] to Gemini AI API.</p> <p>3. Response Handling:</p>	<p>- Services: AttendanceService</p> <p>- Entities: Attendance, LeaveRequest</p> <p>- Logic: Shift-based check-in</p>	Compliance with clinic work regulations; basis for salary calculation.

No .	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		- Return structured answer with success/error flags.		
No .	Function Group	Detailed Tasks & Processes	<p>- Flow: Doctor → Reception/Accountant/HR</p> <p>- Data: Status updates, Service Lists</p>	Ensure a smooth patient journey from examination to payment and aftercare.

Function for auth + patient

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
1	Authentication (Login/Signup)	<p>- Login (Local): Verify credentials (username/password), check active status, generate JWT (Access + Refresh).</p> <p>- Signup: Validate input (email/username duplication), hash password, assign default</p>	<p>- Controller: AuthController</p> <p>- Service: AuthService, JwtService</p> <p>- Security: SecurityConfig, JwtAuthFilter, GoogleOAuth2UserService</p>	Secure entry point for all users; issue tokens for stateless session management.

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>role (ROLE_USER), create User entity.</p> <p>- Google OAuth2: Redirect to Google, map Google user to system user via OAuth2SuccessHandler, auto-register if new.</p> <p>- Refresh Token: Validate refresh token and issue new access token.</p>	<p>- DTOs: LoginRequest, LoginResponse, SignUpRequest</p>	
2	User Profile Management	<p>- View Profile: Retrieve current user details (CurrentUser).</p> <p>- Update Profile: Edit personal info (Name, Email, Phone).</p> <p>- Change Password: Verify old password, hash and save new password.</p> <p>- Avatar Upload: Upload image to Cloudinary, update avatarUrl and avatarPublicId in DB.</p>	<p>- Controller: UserController</p> <p>- Service: UserService, UserAvatarService, CloudinaryUploadService</p> <p>- Entities: User, UserRole</p>	Allow users to manage their personal identity and account security.
3	Authorization	- Role Assignment: Assign	- Repository:	Ensure users

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
	& Role Management	<p>default roles upon signup; Admin/HR can assign advanced roles (DOCTOR, HR, ADMIN).</p> <p>- Permission Check: JwtAuthFilter extracts roles from token to populate SecurityContext.</p> <p>- Access Control: Protect endpoints based on roles (e.g., only HR can access /api/hr/**).</p>	<p>UserRoleRepo, RoleRepo</p> <p>- Security: SecurityConfig (Filter Chain)</p> <p>- Logic: RBAC (Role-Based Access Control)</p>	can only access resources permitted by their assigned roles.
4	System Integrations (Mail/Utils)	<p>- Email Notifications: Send welcome emails, password reset links via MailService using templates.</p> <p>- Patient Code Gen: Generate unique patient codes (PatientCodeService + PatientSequence).</p> <p>- Cloudinary: Integration for storing user avatars.</p>	<p>- Service: MailService, PatientCodeService</p> <p>- Utils: EmailTemplate</p> <p>- External: SMTP Server, Cloudinary API</p>	Enhance user experience with notifications and handle file/data generation logic.

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
1	Identity & Security Management	<p>1. Authentication:</p> <p>- Register/Login: Support Email, Phone (OTP), Google OAuth2.</p> <p>2. QR Login Handover:</p> <p>- Web generates short-lived Token (2 mins).</p> <p>- Mobile App scans to auto-login on Web without typing password.</p> <p>3. Security Logic:</p> <p>- Lockout: Auto-lock account after 5 failed password attempts.</p> <p>- Session: JWT Token & Refresh Token mechanism.</p>	<p>Controller: AuthController</p> <p>Service: AuthService, JwtService</p> <p>Entities: User, Role, UserRole, Patient</p>	<p>Access Control:</p> <p>Diversify access methods, ensure seamless Web/Mobile experience and user data security.</p>
2	Patient Portal	1. Dashboard:	Controller:	Retention:

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
	Experience	<ul style="list-style-type: none"> - Real-time calculation of total spending. - Membership: Automated ranking (Silver, Gold, Diamond). 2. Health Record: - Display medical history, prescriptions, treatment images. 3. Synchronization: - Updating User info automatically syncs to Patient profile (Data Consistency). 	PatientDashboardController, PatientProfileController Entities: Patient, MedicalRecord, Invoice, AIRecommendation	Personalize customer experience, increase retention rate through membership program and health monitoring.
3	Booking Engine Management	1. Smart Booking: <ul style="list-style-type: none"> - Conflict Check: Real-time check for Doctor availability & Dental Chair schedules. 	Controller: PatientAppointmentController Service: BookingServiceImpl, MailService	Capacity Optimization: Optimize clinic capacity, reduce No-show rate via automated

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>2. Cancellation Handling:</p> <p>- Prevent cancellation if status is 'Processing' or overdue.</p> <p>3. Automation:</p> <p>- Auto-send Confirmation Emails (Booking Success) and Reminders.</p>	<p>Entities: Appointment, AppointmentService, ServiceVariant</p>	<p>reminder workflows.</p>
4	AI Virtual Assistant (Gemini Integration)	<p>1. Contextual Consultation:</p> <p>- Chatbot uses Gemini 2.5 Flash model.</p> <p>- RAG (Retrieval-Augmented Generation): Prompt injected with real-time data (Doctors, Service Prices, Working Hours).</p> <p>2. Recommendation:</p>	<p>Controller: AIChatController</p> <p>Service: AIChatService, DentalAIClient</p> <p>Entities: ServiceVariant, DoctorSpecialty</p>	<p>24/7 Availability:</p> <p>Support 24/7 Q&A, reduce workload for receptionists, and stimulate service demand (Up-sale).</p>

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<ul style="list-style-type: none"> - Analyze customer needs to suggest suitable Doctors and Services with specific pricing. 		
5	Operations & HR (Monitoring)	<p>1. Discipline Monitoring:</p> <ul style="list-style-type: none"> - Cron Job: Background task runs every 10m. - Logic: Detects Doctors missing Check-in 30m into shift -> Notify Reception/HR. <p>2. Authorization:</p> <ul style="list-style-type: none"> - Role-based system (Reception, Doctor, HR, Admin). 	<p>Scheduler: DoctorMissingCheckInTask</p> <p>Entities: DoctorSchedule, Attendance, Notification, UserClinicAssignment</p>	<p>Operational Stability:</p> <p>Automate monitoring processes, ensure smooth clinic operations, and handle HR incidents instantly.</p>
6	Infrastructure & Utilities	<p>1. Storage:</p> <ul style="list-style-type: none"> - Integrate Cloudinary for storing and optimizing images (Avatars, X-rays). 	<p>Service: CloudinaryUploadService, MailService</p> <p>Entities: EmailLog, EmailTemplate</p>	<p>Resource Efficiency:</p> <p>Manage resources efficiently,</p>

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		2. Notifications: - Dynamic multi-language Email Template system (Vi/En).		optimize server storage costs, and professionalize customer communication.

Function for Reception

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
1	Reception Appointment Operations	1. Schedule Management: - View/Filter appointments by status/doctor. 2. Check-in Logic: - Map DoctorSchedule to Appointment.	Controller: ReceptionAppointmentController Mappers: AppointmentMapper, DoctorScheduleMapper Entities: Appointment, AppointmentService, DoctorSchedule, Room	Flow Control: Streamline patient flow at the front desk, ensuring patients are checked in and assigned rooms efficiently.

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<ul style="list-style-type: none"> - Update status (WAITING, PROCESSING). - Assign Rooms to optimize flow. 		
2	Walk-in Patient Registration	<p>1. Onboarding:</p> <ul style="list-style-type: none"> - Register new walk-in patients. - Patient Code: Auto-generate unique ID. <p>2. Account Creation:</p> <ul style="list-style-type: none"> - Create User & UserRole. <p>3. Communication:</p> <ul style="list-style-type: none"> - Trigger MailService to send credentials. 	<p>Controller: ReceptionAppointmentController</p> <p>Service: ReceptionServiceImpl, PatientCodeService, MailService</p> <p>Entities: Patient, User, UserRole</p>	<p>Fast Onboarding:</p> <p>Quickly digitalize offline customers into the system ensuring data consistency with online users.</p>
3	Service Finalization & Pre-Billing	<p>1. Service Recording:</p>	<p>Service: ReceptionServiceImpl</p>	<p>Billing Accuracy:</p>

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>- Finalize list of ServiceVariant used.</p> <p>2. Invoice Prep:</p> <p>- Calculate costs, apply discounts.</p> <p>- Map data to BillInvoiceDTO for checkout.</p> <p>- Generate AppointmentResponse.</p>	<p>DTO: BillInvoiceDTO, AppointmentResponse</p> <p>Entities: AppointmentService, ServiceVariant</p>	<p>Ensure all services are correctly recorded and priced before generating the final invoice.</p>
4	Public Booking Portal	<p>1. Public Data Access:</p> <p>- Provide active clinic, doctor, service lists for booking.</p> <p>2. Patient Self-Booking:</p> <p>- Allow registered users to book via website.</p>	<p>Controllers: PatientBookingController, PublicController</p> <p>Service: BookingService, PublicService</p>	<p>Accessibility:</p> <p>Maximize conversion by making booking easy and accessible publicly while maintaining schedule integrity.</p>

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>3. Logic:</p> <p>- Time Slot Generation: Calculate available slots based on duration.</p> <p>- Session Validation: Prevent double booking.</p>		
5	Payment Gateway Integration	<p>1. Payment Processing:</p> <p>- Handle deposit/payment transactions.</p> <p>2. Integration:</p> <p>- Connect with Third-party Payment SDKs.</p> <p>3. Status Sync:</p> <p>- Update booking status upon successful payment callback.</p>	<p>Controller: BookingPaymentController</p> <p>Service: BookingPaymentServiceImpl</p> <p>Utility: Third-party Payment SDKs/APIs</p>	<p>Revenue Capture:</p> <p>Secure and automate financial transactions to reduce manual cash handling.</p>

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
6	AI Support for Reception	1. Virtual Assistant: - Assist receptionists with quick information lookup. 2. Integration: - Connect to Google Gemini AI to answer operational queries.	Controller: ReceptionAiController Service: ReceptionAiService Engine: Google Gemini AI Integration	Productivity: Empower receptionists with instant access to information, reducing response time to patients.

Funtion for product+accountant

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
1	Product Management (Catalog)	1. Create & Setup: - Create product	Controller: ProductController	Data Integrity: Enforce data

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>profile (Initial Unit = 0).</p> <p>- Upload & Optimize images.</p> <p>2. Access Control (Read):</p> <p>- Guest/Customer: View Active products + Discount %.</p> <p>- Accountant: View All products + Cost Price/Profit Margin.</p> <p>3. Updates:</p> <p>- Update info/images.</p> <p>- Disable Logic: Block deactivation if Stock > 0.</p>	<p>Entities: Product, ProductImage, ProductType</p>	<p>segregation (Sales vs. Accounting) and ensure catalog consistency.</p>
2	Inventory Management	<p>1. Import Logic:</p> <p>- Stock Receipt: Import goods -> Auto-</p>	<p>Controller: InventoryController</p> <p>Entities: ProductInventory,</p>	<p>Stock Control:</p> <p>Control operational flow of</p>

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>calculate suggestions for Retail Price.</p> <p>2. Visibility:</p> <p>- View multi-branch stock levels and Import History.</p> <p>3. Adjustment:</p> <p>- Correct quantity discrepancies.</p> <p>- Update Retail Price.</p> <p>4. Synchronization:</p> <p>- Sync total inventory count to Product entity for quick lookup.</p>	ProductStockReceipt, Clinic	goods and automate pricing strategies based on input costs.
3	Order Engine & Shopping Cart	<p>1. Cart Processing:</p> <p>- InMemory/Session: No DB writes for cart to boost speed.</p>	<p>Controller: CartController, CheckoutInvoiceController</p> <p>Entities: ProductInvoice, ProductInvoiceItem, ProductInventory</p>	<p>Transactional Integrity:</p> <p>Optimize cart performance and ensure physical</p>

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<p>- Instant Validation: Real-time stock check.</p> <p>2. Order Creation:</p> <p>- Persist Invoice to DB.</p> <p>- Deduct Stock: Move items from Stock (Q9) - > Sold.</p> <p>3. Lifecycle:</p> <p>- Update Status/Payment.</p> <p>- Cancellation: Auto-refund stock to inventory.</p>		stock matches digital records during transactions.
4	Payroll Management	<p>1. Configuration:</p> <p>- Setup Salary Structure and Monthly Payslips.</p> <p>2. Detailed View:</p>	<p>Controller: PayrollController</p> <p>Entities: SalaryProfile, PayslipsSnapshot, Attendance</p>	<p>Compliance:</p> <p>Automate complex salary calculations and ensure tax compliance with auditable snapshots.</p>

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		<ul style="list-style-type: none"> - Breakdown of Basic Salary, Personal Income Tax (PIT), and Overtime. <p>3. Adjustments:</p> <ul style="list-style-type: none"> - Handle Salary Advances and Manual Allowances. <p>4. Finalization:</p> <ul style="list-style-type: none"> - Lock Data: Snapshot payroll for the period (Immutable). 		
5	AI Integration (Gemini)	<p>1. Content Moderation:</p> <ul style="list-style-type: none"> - Auto-block images violating safety policies. <p>2. OCR & Analysis:</p> <ul style="list-style-type: none"> - Analyze product packaging images to 	Service: GeminiApiClient	<p>Automation:</p> <p>Accelerate data entry and ensure safe content for the public catalog.</p>

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		auto-fill Product Name/Brand.		
6	Financial Utilities	1. Exchange Rates: - Real-time USD/VND conversion. 2. Formatting: - Display currency formatted by locale/region.	Service: CurrencyRateInternalService Utils: FormatCurrencyCart	Accuracy: Support accurate multi-currency transactions and display.
7	Payment Gateway	1. PayPal: - Secure Capture Flow. 2. VNPay: - Implementation of SHA512 Checksum for security integrity.	Service: PaypalCheckoutService, VnpayCheckoutService	Security: Diversify payment methods while maintaining strict transaction security.
8	Location Services (Map)	1. User Experience: - Address Autocomplete suggestions.	Service: GoongMapServiceImpl	UX Optimization: Simplify the checkout process and ensure

No.	Function Group	Detailed Tasks & Processes	Technical Components & Data	Objective / Outcome
		2. Geocoding: - Convert address to GPS coordinates for delivery logic.		accurate delivery addresses.

Progress review2

No.	Student Name	Role in Project	Main Responsibilities (Review 1)	Contribution (%)
1	Sơn Phi Long	HR&Admin	- HR & Admin Modules - AI Integration (Schedule/FaceID) - Notification realtime - Project Management	80%
2	Ngô Minh Tuấn	Auth& Patient	- Authentication System - Patient Mobile App (Flutter)	70%

No.	Student Name	Role in Project	Main Responsibilities (Review 1)	Contribution (%)
			- Security Configuration	
Value 60%	Nguyễn Hữu Hoàng	Doctor	- Doctor Module - Medical Records Logic - Image Handling	70%
4	Nguyễn Minh Hoàng	Reception	- Reception Module - Booking Logic - CRM Integration	80%
5	Nguyễn Quốc Huy	Accountant & Product	- Accounting Module - Inventory & Products - Reporting Logic	80%

Summary review 2:

Task / Feature	Description / Status
Core Functions Optimization	Completed: Finalized Auth, User Profile, and Basic CRUD APIs for all roles.
AI Integration (Ongoing)	In Progress: Integrating advanced AI models (ArcFace for Attendance, NLP

Task / Feature	Description / Status
	for Smart Scheduling) to automate operational workflows.
Advanced Logic Implementation	In Progress: Developing complex flows for Medical Records, Prescriptions, and Payment Gateways.
System Status	Transition Phase: Moving from backend foundation to full-stack AI integration.

CHAPTER 5. CONCLUSION & FUTURE DEVELOPMENT

5.1. Project Outcomes

The **Sunshine Dental Care** project has successfully achieved its primary objectives:

1. **Core Functionality:** Delivered a comprehensive management ecosystem covering 4 key roles: Admin, Doctor, Receptionist, and Patient.
2. **Cross-Platform Availability:** Successfully deployed a robust Web Portal (ReactJS) for clinic staff and a high-performance Mobile App (Flutter) for patients.
3. **AI Implementation:** Integrated advanced AI features including **ArcFace** for biometric attendance and **Gemini AI/NLP** for smart scheduling and patient support.
4. **Security:** Implemented high-level security standards using Spring Security, JWT, and Role-Based Access Control (RBAC).

5.2. Limitations

- **Payment Gateways:** Online payment integration is currently operating in a Sandbox (Test) environment.
- **AI Latency:** The AI Chatbot may experience slight latency when processing highly complex medical context queries.

5.3. Future Scope

- **Blockchain Records:** Implement Blockchain technology to store immutable and transparent Electronic Medical Records (EMR).
- **Telehealth Integration:** Develop a Telemedicine module allowing Video Consultations directly within the Patient App.
- **Predictive Analytics:** Utilize Big Data to forecast revenue trends and inventory consumption for better strategic planning.