Dental AI Hospital System

Project Documentation

https://github.com/Yahia-mahmoud21/DentAI-Hospital-System

or

https://github.com/O0VIP0O/Dental-AI-Hospital

01 Project Proposal

Dental AI Hospital System Project Proposal

Executive Summary

The Dental AI Hospital System is an intelligent, comprehensive healthcare management platform designed to revolutionize dental education and patient care within the Faculty of Dentistry. By integrating artificial intelligence, modern web technologies, and robust data management, the system creates a seamless ecosystem that enhances learning outcomes, streamlines clinical workflows, and improves patient experience.

1. Project Overview

1.1 Vision Statement

To create an integrated digital ecosystem that transforms dental education and clinical practice by leveraging AIpowered diagnostic assistance, streamlined case management, and datadriven insights.

1.2 Mission

Provide all stakeholders—dental interns students, faculty doctors, patients, and college administration—with an intuitive, efficient, and intelligent platform that facilitates learning, improves clinical decisionmaking, and enhances patient care quality.

2. Project Description

2.1 Core Functionality

For Students Dental Interns

Case Management Dashboard: View assigned patients, track treatment progress, and manage case documentation

AIPowered Classification: Upload dental images for instant disease classification

Learning Analytics: Access performance metrics, receive feedback on case analyses, and track improvement over time

Assignment System: Claim unassigned cases from their department, upload before/after photos, and submit diagnosis and treatment plans

Feedback Integration: Receive structured feedback from supervising doctors with notes and approval status

For Doctors Faculty Members
Review & Approval Workflow: Efficiently review studentsubmitted cases with AIassisted classification
Student Performance Monitoring: Track students' diagnostic accuracy and treatment planning quality
Bulk Review Interface: Process multiple cases simultaneously with filtering and sorting capabilities
AI Diagnostic Assistant: Access Hugging Face medical LLM SciReasonLFM22.6B for diagnosis suggestions and treatment planning support
Analytics Dashboard: View department statistics, student performance trends, and case volume metrics
Quality Assurance: Approve or reject student analyses with detailed notes and recommendations

For Patients
Easy Appointment Online and Offline Booking: Simple registration interface requiring only name, age, gender, and phone number
Case Access Portal: Login with Case ID and Name to view treatment history, medical reports, and appointment details
Treatment Tracking: Monitor progress through the treatment lifecycle from initial booking to completion
Digital Medical Records: Access complete case documentation including images, diagnosis, and treatment plans

For College Administration
Comprehensive System Management: Full control over users, departments, batches, and system configuration
User Management: Create, update, and delete students, doctors, departments, batches, and rounds
Analytical Insights: Access systemwide analytics including:
  Department performance metrics
  Student enrollment and progress statistics
  Case volume and treatment completion rates
  AI model usage and accuracy metrics
Customization: Configure system settings, department capacities, batch structures, and academic rounds

For Secretary/Administrative Staff
Patient Registration: Register new patients and assign them to appropriate departments
Case Management: Edit patient information and manage appointments
Queue Management: View and manage patient queues across departments

3. Enhanced Technical Architecture

3.1 Frontend Technologies

HTML5: Semantic markup for accessibility and SEO
CSS3: Modern styling with responsive design principles
JavaScript ES6+: Interactive user interfaces and dynamic content
UI/UX Best Practices: Intuitive navigation, clear visual hierarchy, and consistent design language

3.2 Backend Technologies

FastAPI: Modern, highperformance Python web framework
Python 3.x: Core backend programming language
SQLite3: Lightweight, efficient relational database
Jinja2 Templates: Serverside rendering for dynamic HTML pages
RESTful API: Wellstructured API endpoints following REST principles
CORS Middleware: Crossorigin resource sharing for frontendbackend communication

3.3 Database Architecture

SQLite Database: Singlefile database with WAL WriteAhead Logging mode for concurrent access
Relational Design: Normalized schema with proper foreign key constraints
Core Tables:
- collage: College/Institution information
- batch: Academic batch management
- rounds: Academic rounds within batches
- department: Department information with managers and capacity
- facultymembers: Doctor/Faculty member profiles
- student: Student/intern profiles
- cases: Patient case records
- studentdepartmentcases: Junction table linking students to cases with treatment details
- batchdepartment: Batchdepartment relationships
- batchfacultymembers: Batchfaculty assignments

- secertary: Review, Registration and Edit patient`s Book

3.4 AI/ML Components

Classification Model
Architecture: ResNet50based deep learning classifier
Training Accuracy: 94.17%
Validation Accuracy: 90.83%
Classes: 6 dental condition categories

Features:
Image preprocessing and normalization
Transfer learning from ImageNet
Regularization techniques Dropout, BatchNorm
Model persistence and caching for performance
Repository: https://github.com/O0VIP0O/dental_classifier_model

AI Assistant LLM
Model: SciReasonLFM22.6B Hugging Face
Purpose: Diagnostic suggestions and treatment planning assistance
Integration: Medical domainspecific reasoning capabilities
Repository: https://huggingface.co/yasserrmd/SciReason-LFM2-2.6B

4. Enhanced Objectives & Success Criteria

4.1 Primary Objectives

For Students
1. ✓ Streamline case assignment and tracking processes
2. ✓ Provide instant AI feedback on diagnostic images
3. ✓ Enable efficient submission and revision of case analyses
4. ✓ Track learning progress through analytics dashboard
5. ✓ Reduce time spent on administrative tasks

For Doctors
1. ✓ Reduce case review time through AIassisted classification
2. ✓ Improve grading accuracy and consistency
3. ✓ Enable bulk review operations for efficiency
4. ✓ Access AIpowered diagnostic assistance
5. ✓ Monitor student performance trends effectively

For Patients
1. ✓ Simplify appointment booking process registration
2. ✓ Provide transparent access to medical records
3. ✓ Enable treatment progress tracking
4. ✓ Reduce waiting times through better queue management

For Administration
1. ✓ Centralize user and resource management
2. ✓ Generate comprehensive analytics and reports

3. ✓ Maintain flexible system configuration
4. ✓ Ensure scalability for future growth

4.2 Success Metrics KPIs

AI Model Performance
✅ Classification Model Accuracy: 90.83% Validation
✅ Training Accuracy: 94.17%

5. Features & Capabilities

5.1 Security Features
Passwordbased authentication for students and doctors
Casebased authentication for patients ID + Name
Input validation and sanitization
SQL injection prevention through parameterized queries

5.2 Data Management
Automatic case assignment to current batch
Departmentbased case routing
Appointment scheduling with date/time tracking
Before/after photo management for treatment documentation
Comprehensive case notes and feedback system

5.3 Analytics & Reporting
Departmentlevel statistics
Student performance dashboards
Case volume analytics
Treatment completion rates
AI model usage metrics
Batch and round management statistics

5.4 File Handling
Secure image upload JPG, PNG, JPEG
File validation and error handling

Upload Excel files and exports

6. Team Structure & Contributions

6.1 Team Leader

Abdelrahman Ali Abdelrahman
Overall project coordination
Classification model development and data processing
Patient, college, and home page frontend customization
Database schema design and DDL scripts
Data visualization for model performance
UX improvement initiatives

6.2 Team Members

Yahia Mahmoud
Doctor and student page frontend customization
Frontend and backend integration
Database schema and ERD contribution
Model data research and collection
Hugging Face medical LLM deployment and integration

Yahya Mohamed
Analytical system visualizations
ERD and database schema design
DDL script optimization
File visualization improvements for model

David
Database ERD design contribution
User stories research and development

Ahmed Saad
Analytical visualizations for stakeholder decisionmaking
ERD development contribution
Process flow clarification

Collage backend integration

7. Technology Stack Summary

Category	Technology
Frontend	HTML5, CSS3, JavaScript ES6+
Backend	Python 3.x, FastAPI
Database	SQLite3 with WAL mode
Templating	Jinja2
ML Framework	PyTorch, Transformers
Model Architecture	ResNet50 Transfer Learning
AI Assistant	SciReasonLFM22.6B Hugging Face
Image Processing	PIL/Pillow, torchvision
Server	Uvicorn ASGI server
API Architecture	RESTful API

8. Deliverables

8.1 Documentation

- ✅ Upgraded Project Proposal this document
- ✅ Project Planning Document
- ✅ Stakeholder Analysis
- ✅ Database Design Documentation
- ✅ UI/UX Design Documentation
- ✅ API Documentation
- ✅ User Manuals for each stakeholder group

8.2 Technical Deliverables

- ✅ Fully functional web application
- ✅ Trained classification model dentalclassifierbalanced.pth
- ✅ Database schema and DDL scripts
- ✅ RESTful API endpoints
- ✅ Frontend templates and static assets
- ✅ Deployment documentation

10. Conclusion

The Dental AI Hospital System represents a significant advancement in dental education and clinical practice management. By combining cuttingedge AI technology with intuitive user interfaces and robust data management, the system addresses the critical needs of all stakeholders while providing a foundation for future enhancements.

With a validation accuracy of 90.83% and comprehensive features covering case management, AIassisted diagnosis, and analytical insights, the system is wellpositioned to transform the dental education and practice landscape.

11. References & Resources

Classification Model Repository: https://github.com/O0VIP0O/dental_classifier_model
AI Assistant Model: https://huggingface.co/yasserrmd/SciReason-LFM2-2.6B
FastAPI Documentation: https://fastapi.tiangolo.com/
PyTorch Documentation: https://pytorch.org/docs/
SQLite Documentation: https://www.sqlite.org/docs.html

02 Project Planning

Dental AI Hospital System Project Planning Document

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1. Project Scope

1.1 InScope Features

Core Functionality

- ✅ User authentication for all stakeholder types
- ✅ Patient registration and case management
- ✅ Student case assignment and submission system
- ✅ Doctor case review and approval workflow
- ✅ AIpowered dental image classification 6 classes
- ✅ Medical LLM integration for diagnostic assistance
- ✅ Administrative management dashboard
- ✅ Analytics and reporting capabilities
- ✅ File upload and management system

Technical Components

- ✅ FastAPI backend with RESTful API
- ✅ SQLite database with relational schema
- ✅ ResNet50based classification model
- ✅ Hugging Face LLM integration
- ✅ Responsive web frontend
- ✅ Static file serving for uploads
- ✅ CORSenabled API endpoints

2. Work Breakdown Structure WBS

1.1 Level 1: Project Phases

1.0 Dental AI Hospital System
├── 1.1 Planning & Design
├── 1.2 Backend Development
├── 1.3 AI/ML Development
├── 1.4 Frontend Development
├── 1.5 Integration & Testing
└── 1.6 Documentation & Deployment

2.2 Level 2: Detailed Tasks

1.1 Planning & Design
1.1.1 Requirements Analysis
1.1.2 Database Schema Design
1.1.3 ERD Creation
1.1.4 API Endpoint Design

1.2 Backend Development
1.2.1 Database Setup SQLite + DDL
1.2.2 FastAPI Application Structure
1.2.3 Authentication Endpoints
1.2.4 Student API Endpoints
1.2.5 Doctor API Endpoints
1.2.6 Patient API Endpoints
1.2.7 College Admin API Endpoints
1.2.8 File Upload System
1.2.9 Database Query Functions

1.3 AI/ML Development
1.3.1 Data Collection & Preparation
1.3.2 Model Architecture Design ResNet50
1.3.3 Model Evaluation & Validation
1.3.4 Model Integration API
1.3.5 Hugging Face LLM Integration

1.3.6 Model Deployment

1.4 Frontend Development
1.4.1 HTML Templates Jinja2
1.4.2 CSS Styling & Responsive Design
1.4.3 JavaScript Functionality
1.4.4 Student Dashboard
1.4.5 Doctor Dashboard
1.4.6 Patient Portal
1.4.7 College Admin Interface
1.4.8 Home & Landing Pages

1.5 Integration & Testing
1.5.1 API Frontend Integration
1.5.2 Bug Fixes & Refinements

1.6 Documentation & Deployment
1.6.1 API Documentation
1.6.2 User Manuals
1.6.3 Technical Documentation
1.6.4 Deployment Guide
1.6.5 Training Materials

4. Resource Allocation

4.1 Team Roles & Responsibilities

Team Member Primary Role Secondary Responsibilities

Abdelrahman Ali Team Leader Project Management, ML Model Development Database Design, Frontend Patient/College, Data Visualization
Yahya Mahmoud Frontend Development Doctor/Student, Backend Integration Database Schema, Model Data Collection, LLM Integration
Yahya Mohamed Analytics & Visualization, Database Design DDL Optimization, File Visualization
David Database ERD, User Stories Requirements Analysis
Ahmed Saad Analytics & Visualization ERD Development, Process Flow

4.2 Skillset Requirements

Technical Skills
Python Programming Advanced
FastAPI Framework IntermediateAdvanced
SQLite Database Management Intermediate
PyTorch/Deep Learning Intermediate
Frontend HTML/CSS/JavaScript Intermediate
Git Version Control BasicIntermediate

Domain Knowledge
Dental/Medical Terminology Basic
Healthcare System Workflows Intermediate
Educational Institution Processes Basic
AI/ML Model Deployment Intermediate

04 Database Design

Dental AI Hospital System Database Design Document

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1. Overview

1.1 Database Purpose

The Dental AI Hospital System uses a SQLite relational database to manage:

User accounts students, doctors, administrators, patients

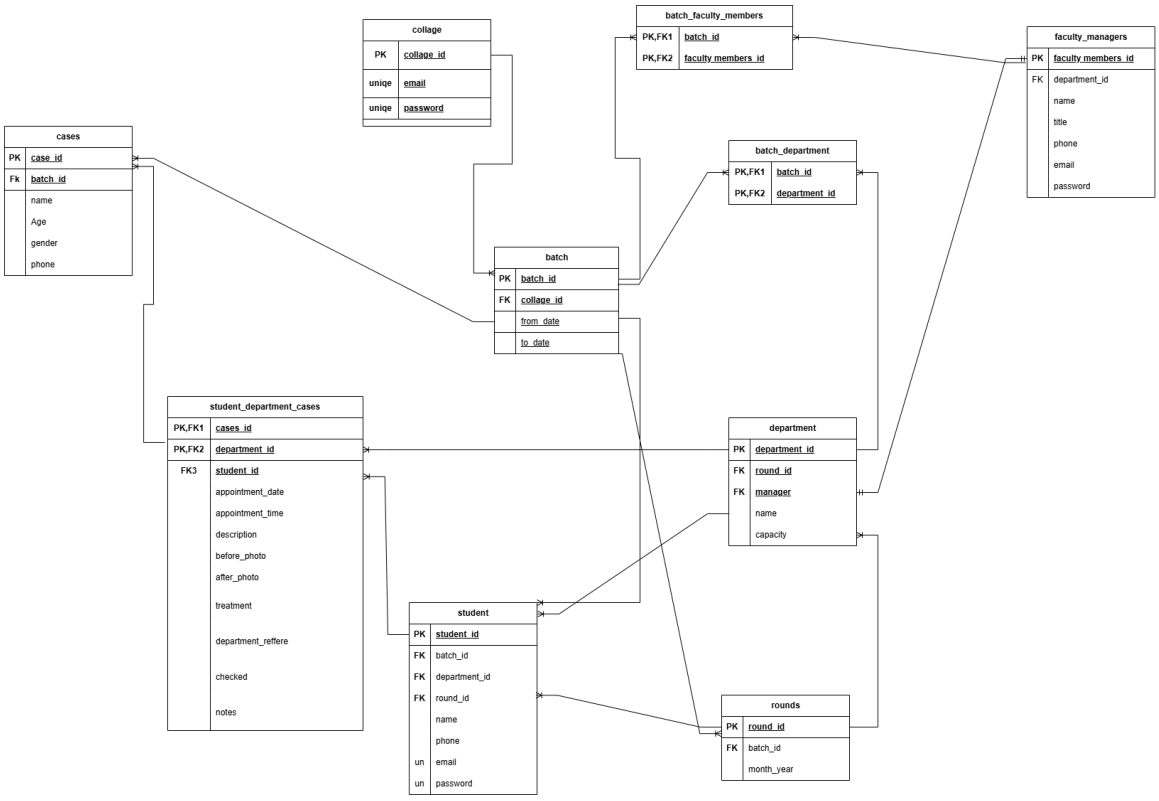
Academic structure batches, departments, rounds

Patient cases and medical records

Treatment tracking and student doctor workflows

Department assignments and case routing

2.Schema



5. Table Definitions

```
CREATE table collage
(
collage_id text PRIMARY KEY,
email text UNIQUE NOT NULL,
password text UNIQUE not NULL
);

CREATE TABLE batch
(
batch_id text PRIMARY key, -- (batch25 = 2025)
collage_id TEXT,
from_date text,
to_date text,
FOREIGN key (collage_id) REFERENCES collage (collage_id)
);

CREATE table rounds
(
round_id text primary key ,
batch_id text ,
month_year TEXT,
FOREIGN key (batch_id) REFERENCES batch (batch_id) on delete cascade
```

```
);

create table department
(
department_id text PRIMARY KEY ,
round_id text,
capacity INTEGER not null,
name text,
manager text,
description text,
FOREIGN KEY (manager) REFERENCES faculty_members(faculty_members_id) on delete set null,
FOREIGN KEY (round_id) REFERENCES rounds(round_id) on delete set null
);

CREATE TABLE batch_department
(
batch_id TEXT ,
department_id text ,
PRIMARY KEY (batch_id ,department_id),
FOREIGN key (batch_id) REFERENCES batch (batch_id) on delete cascade ,
FOREIGN key (department_id) REFERENCES department(department_id) on delete set null
);

CREATE TABLE faculty_members
```

```
(
faculty_members_id text PRIMARY KEY,
department_id  TEXT, -- need Fk
name text not null,
title text,
email text UNIQUE not null ,
password text UNIQUE not null,
phone text,
FOREIGN KEY (department_id) REFERENCES department(department_id) on delete set null
);


CREATE TABLE batch_faculty_members
(
batch_id TEXT ,
faculty_members_id text ,
PRIMARY KEY (batch_id ,faculty_members_id),
FOREIGN key (batch_id) REFERENCES batch (batch_id ) on delete cascade,
FOREIGN key (faculty_members_id) REFERENCES faculty_members(faculty_members_id)
on delete set null
);


CREATE TABLE student
(
student_id text primary key ,
```

```
batch_id text ,
department_id TEXT,
name text not null ,
phone text,
email text UNIQUE NOT NULL,
password text UNIQUE not NULL,
FOREIGN key (batch_id) REFERENCES batch (batch_id) on delete cascade ,
FOREIGN key (department_id) REFERENCES department (department_id) on delete set null
);

CREATE table cases
(
case_id INTEGER PRIMARY KEY AUTOINCREMENT,
batch_id TEXT,
name text not NULL,
age INTEGER,
gender char CHECK(gender in ('M','F')),
phone text UNIQUE,
FOREIGN key (batch_id) REFERENCES batch (batch_id) on delete cascade
);


CREATE TABLE student_department_cases
(
student_id text,
department_id TEXT,
```

```
case_id INTEGER,
appointment_date date,
appointment_time time,
description TEXT DEFAULT 'Unkown',
before_photo TEXT,
after_photo TEXT,
treatment text DEFAULT 'Unkown',
department_refferal text DEFAULT 'Unkown',
checked TEXT
   CHECK (checked IN ('0','1','-1'))
   DEFAULT '-1',
notes text,
PRIMARY KEY (department_id,case_id),
FOREIGN key (student_id) REFERENCES student(student_id) on delete set null,
FOREIGN key (department_id) REFERENCES department(department_id) on delete set null,
FOREIGN KEY (case_id) REFERENCES cases(case_id) on delete set null
);



CREATE table secertary(
secertary_id text PRIMARY key,
name text,
email text,
password text );
```

05 UI UX Design

Dental AI Hospital System UI/UX Design Document

1. Design System

1.1 Color Palette

Primary Colors
Primary Blue: 2563eb Main actions, links, headers
Primary Dark: 1e40af Hover states, emphasis
Primary Light: 60a5fa Secondary actions, highlights

Semantic Colors
Success: 10b981 Approvals, positive actions
Warning: f59e0b Alerts, pending items
Error: ef4444 Rejections, critical alerts
Info: 3b82f6 Informational messages

Neutral Colors
Background: ffffff, f9fafb light gray
Text Primary: 111827 dark gray
Text Secondary: 6b7280 medium gray
Borders: e5e7eb light gray

1.2 Typography

Font Families
Primary: System fonts sansserif stack
  applesystem, BlinkMacSystemFont, "Segoe UI", Roboto, "Helvetica Neue", Arial, sansserif
Code/Monospace: "Courier New", Courier, monospace for IDs, codes

Font Sizes
Heading 1 H1: 2.5rem 40px Page titles
Heading 2 H2: 2rem 32px Section titles
Heading 3 H3: 1.5rem 24px Subsection titles
Body: 1rem 16px Main content
Small: 0.875rem 14px Secondary text, captions
Tiny: 0.75rem 12px Labels, timestamps

Font Weights
Regular: 400 Body text
Medium: 500 Emphasis, buttons

SemiBold: 600 Headings, important text
Bold: 700 Strong emphasis

1.3 Spacing System

8px Grid System:
4px Tight spacing icon padding
8px Small spacing button padding
16px Medium spacing card padding
24px Large spacing section spacing
32px Extra large spacing page margins

1.4 Component Library

Buttons
Primary Button: Blue background, white text, rounded corners
Secondary Button: White background, blue border, blue text
Danger Button: Red background, white text
Icon Buttons: Square, icononly buttons for actions

Forms
Input Fields: White background, gray border, rounded corners
Labels: Above inputs, medium gray text
Error States: Red border, error message below
Success States: Green border, checkmark icon

Cards
Default Card: White background, subtle shadow, rounded corners
Hover State: Slight shadow elevation
Clickable Cards: Cursor pointer, hover effect

Tables
Header Row: Light gray background, bold text
Data Rows: Alternating row colors for readability
Hover State: Highlighted row on hover
Action Buttons: Inline actions per row

2. User Interface Design

2.1 Home Page

Purpose
Landing page for all users, patient registration entry point

Key Elements
Hero Section:
- Welcome message
- System overview
- Quick navigation links

Patient Registration Form:
- Name input
- Age input
- Gender selection radio buttons
- Phone number input
- Submit button

Navigation Bar:
- Links to student, doctor, patient, college, AI assistant pages
- Login links for each user type

Design Specifications
Clean, welcoming layout
Centered registration form
Clear calltoaction buttons
Medical imagery optional, professional
Responsive grid layout

2.2 Student Dashboard

Purpose
Main interface for dental interns to manage cases

Key Sections

1. Header
Student name and ID
Department information
Logout button

2. Case Assignment Section
List of available unassigned cases
Filter by department
"Claim Case" button per case

Case details patient name, age, appointment date

3. My Cases Table
Columns: Case ID, Patient Name, Status, Actions
Status indicators Pending, Under Review, Approved, Rejected
Action buttons: View, Edit, Submit for Review

4. Case Detail View
Patient information
Before/after photo upload
Diagnosis text area
Treatment plan text area
Department referral dropdown
AI Classification button for images
Submit/Update buttons

Design Specifications
Twocolumn layout list + detail
Colorcoded status badges
Large file upload areas
Realtime validation feedback
Loading states for AI classification

2.3 Doctor Dashboard

Purpose
Interface for doctors to review student cases and provide feedback

Key Sections

1. Header
Doctor name and title
Department information
Analytics link

2. Pending Reviews Queue
List of cases awaiting review
Filter by student, department, date
Priority indicators overdue, urgent
"Review Case" button

3. Case Review Interface
Patient information panel
Student submission details
Diagnosis
Treatment plan
Before/after photos
AI Classification result if available
Doctor feedback section:
Approve/Reject toggle
Notes text area
Department referral
Update description/treatment
Save/Submit buttons

4. Approved Cases History
List of reviewed cases
Search and filter options
Export options

Design Specifications
Splitscreen layout list + review panel
Clear visual distinction between student input and doctor feedback
Highlighted AI recommendations
Oneclick approve/reject actions
Comprehensive feedback forms

2.4 Patient Portal

Purpose
Simple interface for patients to access their medical records

Key Sections

1. Login
Case ID input
Patient name input
Simple, nonintimidating design

2. Patient Dashboard
Patient information card
Active cases list

Appointment history
Treatment progress indicators

3. Case Details
Diagnosis information
Treatment plan
Before/after photos if available
Appointment dates
Doctor notes approved information only

Design Specifications
Minimal design, easy to understand
Large, readable text
Clear visual hierarchy
Mobilefriendly layout
No medical jargon userfriendly language

3.5 College Administration Dashboard

Purpose
Comprehensive management interface for system administrators

Key Sections

1. Navigation Sidebar
Dashboard
Students Management
Doctors Management
Departments Management
Batches Management
Rounds Management
Analytics

2. Dashboard Overview
System statistics total cases, students, doctors
Recent activities
Quick action buttons

3. Management Tables
CRUD operations Create, Read, Update, Delete
Search and filter capabilities

Bulk actions
Export functionality

4. Analytics Dashboard
Charts and visualizations
Department performance
Student statistics
Case volume trends

Design Specifications
Professional admin interface
Data tables with sorting
Modal forms for create/edit
Confirmation dialogs for deletions
Responsive charts and graphs

Visual feedback during processing
Clear presentation of AI results
Confidence indicators
Export options for results

4. User Experience Flows

4.1 Student Case Submission Flow

1. Login Email + Password
↓
2. View Available Cases
↓
3. Select & Claim Case
↓
4. Fill Case Details Form
Upload before photo
Enter diagnosis
Enter treatment plan
Optional Upload after photo
↓
5. Optional Use AI Classification

Upload image
View AI prediction
Incorporate into diagnosis
↓
6. Submit for Review
↓
7. Wait for Doctor Feedback
↓
8. View Feedback & Revise if needed

UX Considerations:
Autosave drafts
Clear progress indicators
Validation before submission
Success confirmation

4.2 Doctor Review Flow

1. Login Email + Password
↓
2. View Pending Cases Queue
↓
3. Select Case to Review
↓
4. Review Student Submission
Read diagnosis
Review treatment plan
View before/after photos
Check AI classification if available
↓
5. Optional Use AI Assistant
Get diagnostic suggestions
Review treatment recommendations
↓
6. Provide Feedback
Approve/Reject decision
Add notes
Optional Update description/treatment
Optional Refer to another department

↓
7. Submit Review
↓
8. Case Moved to History

UX Considerations:
Quick navigation between cases
Keyboard shortcuts for common actions
Bulk approval option
Clear approval/rejection indicators

4.3 Patient Registration Flow

1. Visit Home Page
↓
2. Fill online Registration Form
Name
Age
Gender
Phone
↓
3. Submit Registration
↓
4. Receive Case ID
↓
5. Optional Login to Patient Portal
Enter Case ID
Enter Name
↓
6. View Case Status

UX Considerations:
Minimal form fields
Instant validation
Clear success message with Case ID
Simple login process

4.4 Case Assignment Flow

1. Secretary Logs In
↓
2. View Unassigned Cases
↓
3. Select Case
↓
4. Assign to Department
↓
5. Case Appears in Department Queue
↓
6. Student Claims Case
↓
7. Case Status: Assigned