

GROUP ID: GE10

A PROJECT REPORT ON

AyurMarg: Personalized Ayurvedic AI Health Assistant

SUBMITTED TO THE PIMPRI CHINCHWAD COLLEGE OF ENGINEERING AN
AUTONOMOUS INSTITUTE, PUNE
IN THE FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE

OF

**BACHELOR OF TECHNOLOGY
COMPUTER ENGINEERING (REGIONAL LANGUAGE)**

SUBMITTED BY

ATHARVA INGLE	PRN : 121B1D026
PRATHAMESH WAKDE	PRN : 121B1D027
RAMAN THATTE	PRN : 121B1D048
GAURI NIMJE	PRN : 121B1D063



**DEPARTMENT OF COMPUTER ENGINEERING
(REGIONAL LANGUAGE)**

PCET'S PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

**Sector No. 26, Pradhikaran, Nigdi, Pimpri-Chinchwad, PUNE 411044
2024-2025**



CERTIFICATE

This is to certify that the project report entitles

“AyurMarg: Personalized Ayurvedic AI Health Assistant”

Submitted by

**ATHARVA INGLE
PRATHMESH WAKDE
RAMAN THATTE
GAURI NIMJE**

**PRN : 121B1D026
PRN : 121B1D027
PRN : 121B1D048
PRN : 121B1D063**

are Bonafide students of this institute and the work has been carried out by them under the supervision of **Prof. Ganesh Deshmukh**, and it is approved for the partial fulfilment of the requirement of **Pimpri Chinchwad College of Engineering** an autonomous institute, for the award of the **B. Tech. degree in Computer Engineering(Regional Language)**.

(Prof. Ganesh Deshmukh)
Guide ,
Department of Computer Engineering
(Regional Language)

(Prof. Dr. Rachana Y. Patil)
Head,
Department of Computer Engineering
(Regional Language)

(Prof. Dr. G.N. Kulkarni)
Director,
Pimpri Chinchwad College of Engineering Pune – 44

Place : Pune
Date :

ACKNOWLEDGEMENT

We express our sincere thanks to our **Guide Prof. Ganesh Deshmukh** for his constant encouragement and support throughout our project, especially for the useful suggestions given during the course of the project and having laid down the foundation for the success of this work.

We would also like to thank our **Project Coordinator, Prof. Ganesh Deshmukh** for his assistance, genuine support and guidance from early stages of the project. We would like to thank **Prof. Dr. Rachana Y. Patil, Head of Computer Engineering (Regional Language) Department** for her unwavering support during the entire course of this project work. We are very grateful to our **Director, Prof. Dr. G. N. Kulkarni** for providing us with an environment to complete our project successfully. We also thank all the staff members of our college and technicians for their help in making this project a success.

We also thank all the web committees for enriching us with their immense knowledge. Finally, we take this opportunity to extend our deep appreciation to our family and friends for all that they meant to us during the crucial times of the completion of our project.

Gauri Nimje

Prathamesh Wakde

Raman Thatte

Atharva Ingle

ABSTRACT

Ayurveda, one of the world's oldest holistic health systems, emphasizes preventive care and personalized treatment based on an individual's Prakriti (body constitution). However, access to authentic Ayurvedic consultation remains limited, especially in underserved areas. The absence of digital tools that blend classical principles with modern tech widens the gap between traditional wisdom and current wellness demands.

To bridge this gap, we present **AyurMarg**, an AI-powered Ayurvedic health assistant that offers lifestyle, dietary, and therapeutic recommendations. It begins with an interactive Dosha analysis and uses a conversational agent—**AyurBot**, built with Retrieval-Augmented Generation (RAG) and GROQ API—powered by Claude 3 Opus. AyurBot interprets inputs and suggests guidance based on Ayurvedic texts like Charak Samhita.

AyurMarg combines a modern full-stack web platform with AI-driven personalized wellness guidance. It provides multilingual support, real-time advice, and a user-friendly interface, making Ayurveda more accessible to diverse communities worldwide.

Keywords:

Ayurveda, AI health assistant, Dosha analysis, personalized healthcare, RAG framework, GROQ API, holistic wellness, multilingual support.

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LIST OF ABBREVIATIONS

ABBREVIATION	ILLUSTRATION
RAG	Retrieval Augmented System
NLP	Natural Language Processing
LLM	Large Language Model
TCM	Traditional Chinese Medicine
FAISS	Facebook AI Similarity Search

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CHAPTER 1 INTRODUCTION

1.1 Overview

Ayurveda, known as the “Science of Life,” is one of the world’s oldest natural healing systems, originating in India over 5,000 years ago. Unlike modern medicine, which often targets symptoms, Ayurveda takes a preventive, personalized approach, aiming to harmonize the body, mind, and spirit. Its foundation lies in the concepts of Prakriti (individual constitution) and the three Doshas—Vata, Pitta, and Kapha—which regulate physical and mental functions. Health is seen as a balance of these energies, while imbalance leads to disease.

Treatments in Ayurveda are highly individualized, covering not just herbal remedies, but also diet, daily routines (Dinacharya), seasonal practices (Ritucharya), exercise, and meditation.

In today's digital era, there is rising global interest in holistic and personalized healthcare. However, most Ayurvedic knowledge remains locked in classical Sanskrit texts like the *Charak Samhita* and *Sushruta Samhita*, which are difficult for modern users to access and interpret.

AyurMarg bridges this gap by offering an AI-powered, web-based platform that delivers personalized, interactive Ayurvedic health guidance. Using advanced technologies such as Retrieval-Augmented Generation (RAG), LangChain, and GROQ API, AyurMarg interprets ancient Ayurvedic concepts to respond intelligently to user queries—emulating traditional consultations.

By combining AI with structured Ayurvedic data, AyurMarg transforms ancient, static knowledge into dynamic, accessible insights, promoting preventive care, self-awareness, and holistic wellness. It represents a powerful synergy between traditional healing and modern technology, making indigenous health science more approachable and impactful for global users.

1.2 MOTIVATION

The motivation behind *AyurMarg* arises from the converging challenges and opportunities in both healthcare and technology. Modern lifestyles have given way to unprecedented levels of stress, sedentary behavior, and dietary imbalances—all of which contribute to a rise in lifestyle-related ailments. Amidst such challenges, individuals increasingly seek natural, preventive approaches to health management. Ayurveda offers a comprehensive framework for this; however, several hurdles hinder its wide-scale adoption:

- Limited Accessibility: Authentic Ayurvedic knowledge is traditionally confined to scholarly texts and experienced practitioners. This exclusivity prevents everyday users, especially those in remote or underserved regions, from obtaining reliable health guidance.
- Complexity and Barriers to Understanding: The language and nuances of classical Ayurvedic texts can be difficult for modern audiences to understand and apply. As a result, the rich repository of ancient wisdom remains underutilized in daily health management.
- Modern Healthcare Gaps: In the contemporary healthcare landscape, personalized, preventive strategies are becoming crucial. Yet, many existing digital health solutions lack the depth of traditional, holistic approaches and often resort to generalized advice that does not account for individual variability.
- Technological Advances in AI: The rapid evolution of artificial intelligence and natural language processing offers an unprecedented opportunity to create systems that can understand and relay complex information in a simplified manner. The use of models such as those enabled by Langchain, FAISS, and GROQ API not only supports nuanced understanding of vast textual data but also allows for a dynamic.

Driven by these factors, *AyurMarg* was conceived as an effort to make Ayurvedic healthcare both accessible and actionable. The platform is designed to help users determine their unique constitution through an interactive Dosha analysis test and subsequently receive detailed, personalized prescriptions that include dietary guidelines, lifestyle modifications, herbal recommendations, and additional therapies.

1.3 PROBLEM STATEMENT AND OBJECTIVES

1.3.1 Problem Statement

Ayurveda, though rich in holistic and personalized healthcare principles, remains underutilized in modern wellness practices due to limited accessibility, linguistic barriers, and a shortage of qualified practitioners. Classical Ayurvedic texts are complex and often inaccessible to the general public, especially those unfamiliar with Sanskrit or traditional medicine. Existing digital platforms rarely offer meaningful integration of Ayurvedic knowledge with advanced technologies such as artificial intelligence or natural language processing. This creates a significant gap between the growing demand for personalized, preventive healthcare and the availability of credible, scalable Ayurvedic solutions. Bridging this gap calls for a user-centric, intelligent system that translates traditional Ayurvedic wisdom into an interactive, modern digital experience.

1.3.2 Objective

- To develop an AI-powered Ayurvedic health assistant that simulates personalized doctor-patient consultations based on classical principles.
- To implement an interactive Dosha analysis tool for accurately determining an individual's Prakriti through behavioral, physical, and mental profiling.

- To deliver personalized wellness prescriptions—including diet, lifestyle routines, herbal therapies, and stress management—rooted in Ayurvedic diagnostics.
- To create a multilingual, responsive web platform that enhances accessibility in low-bandwidth and rural regions.

1.4 SCOPE OF THE WORK

The AyurMarg project aims to modernize Ayurvedic healthcare by developing an intelligent, web-based assistant that provides personalized wellness guidance. It covers Dosha-based diagnosis, AI-powered consultations, multilingual access, and educational support for both users and practitioners. The platform integrates classical Ayurvedic knowledge with advanced AI to simulate real-time consultations and deliver tailored recommendations. Designed to be scalable, secure, and user-friendly, AyurMarg particularly focuses on reaching underserved and remote communities through a low-bandwidth-compatible interface.

CHAPTER 2 LITERATURE SURVEY

2.1 LITERATURE REVIEW

The integration of Ayurvedic principles with modern technology represents an emerging field with significant potential for personalized healthcare. This literature review examines existing research and applications in this domain, focusing on digital Ayurvedic platforms, AI applications in traditional medicine, personalized health assistants, Dosha analysis tools, and Ayurvedic knowledge retrieval systems. The aim is to establish the current state of knowledge and highlight the gaps that the AyurMarg platform seeks to address.

2.1.1 Digital Platforms for Ayurvedic Healthcare

The digitization of Ayurvedic knowledge and practices has gained momentum in recent years, with several studies exploring the intersection of traditional systems and modern technology. Jaiswal et al. (2020) reviewed digital health interventions rooted in traditional medicine and emphasized how technology can increase accessibility and standardization of Ayurvedic practices. However, their study noted limitations in personalization and depth of knowledge across most platforms.

Vaidya et al. (2019) proposed a web-based Ayurvedic consultation system using rule-based algorithms to conduct Dosha analysis and provide recommendations. Although this demonstrated feasibility, the system relied on simple decision trees that lacked depth in handling complex diagnostic cases. Similarly, Sharma et al. (2018) introduced AyuSoft, a comprehensive digital repository of Ayurvedic knowledge with modules for Prakriti assessment and treatment suggestions. However, it used conventional database methods without modern NLP, resulting in rigid and limited search capabilities.

Patwardhan et al. (2022) emphasized the importance of standardized ontologies and terminology for translating Ayurvedic knowledge into effective digital frameworks. They

highlighted the challenges of preserving the contextual richness of classical texts while making them digitally accessible and meaningful to users.

2.1.2 AI Applications in Traditional Medicine

Artificial intelligence has begun to play a transformative role in traditional medicine systems by enhancing diagnostic accuracy and scalability. Zhang et al. (2021) reviewed AI integration in Traditional Chinese Medicine (TCM), demonstrating effective use of machine learning for diagnosis and treatment planning. Their findings are relevant to Ayurveda, though they stressed that each traditional system requires customized AI models.

In the Ayurvedic context, Rajput et al. (2020) used supervised learning techniques to classify Prakriti types based on physical and physiological traits, achieving 87% accuracy. While promising, this method depends on measurable parameters rather than self-assessed responses, making it less suitable for digital platforms. Tripathi et al. (2021) explored NLP techniques to extract structured knowledge from Ayurvedic texts like the Charak Samhita, revealing both potential and challenges, particularly in handling Sanskrit-derived terminology and context-dependent meanings.

Chen et al. (2023) explored the use of Retrieval-Augmented Generation (RAG) in conventional healthcare and found it effective for providing contextually accurate responses. While their study did not address Ayurveda specifically, it supports the viability of RAG frameworks in knowledge-rich healthcare systems.

2.1.3 Personalized Health Assistants and Chatbots

Conversational health assistants are increasingly used in digital healthcare, offering personalized engagement and real-time support. Laranjo et al. (2018) reviewed healthcare chatbots and emphasized the need for domain-specific knowledge, natural dialogue flow, and user trust to ensure effectiveness.

In the traditional medicine space, Liu et al. (2022) developed a TCM chatbot for health consultation, reporting high levels of user satisfaction. Their approach combined rule-based and

machine learning techniques, showing the potential of hybrid models. Gupta et al. (2021) proposed a chatbot framework for Ayurveda using intent recognition and entity extraction. While functional for basic queries, their prototype lacked deeper reasoning and adaptive capabilities.

Weng et al. (2023) introduced the concept of agentic AI systems capable of performing complex, goal-oriented reasoning in healthcare. Although not focused on traditional medicine, their work supports the idea that multi-step diagnostic reasoning can be built into conversational AI systems.

2.1.4 Dosha Analysis and Digital Prakriti Assessment

Digital Prakriti assessment is a critical feature of any Ayurvedic platform. Rotti et al. (2014) developed a validated questionnaire for Prakriti assessment and found strong agreement with clinical diagnoses by Ayurvedic physicians. However, their method was not implemented in a digital format.

Chatterjee et al. (2019) advanced this concept by launching a mobile app that conducted Prakriti assessment using a validated scoring algorithm. Their tool showed high reliability ($\kappa = 0.76$) and user satisfaction. Prasher et al. (2017) provided a scientific basis for Prakriti classification by identifying links between Dosha types and genetic markers, reinforcing the biological legitimacy of Ayurvedic personalization.

Kumar et al. (2022) applied machine learning to improve Prakriti classification, combining questionnaire data with physiological metrics. While their model outperformed traditional methods, it relied on physical measurements that may not be practical in digital-only environments.

2.1.5 Knowledge Representation and Retrieval in Ayurveda

Ayurvedic knowledge poses unique challenges in representation and retrieval due to its conceptual depth and contextual complexity. Kulkarni et al. (2020) proposed an ontology-based approach to model Ayurvedic concepts, improving semantic search and structured understanding. However, the system required significant manual effort in knowledge engineering.

Sharma et al. (2022) used transformer-based models to generate vector embeddings of Ayurvedic concepts for semantic retrieval. While this approach improved relevance in search results, it lacked integration with user-facing chat interfaces. Mishra et al. (2021) employed FAISS (Facebook AI Similarity Search) for efficient information retrieval in healthcare, offering insights for scalable search in Ayurvedic contexts.

Finally, Bose et al. (2023) emphasized the importance of "responsible digitization" in traditional medicine. They argued for balancing technological advancement with cultural integrity, ensuring that digital tools preserve the philosophical essence of Ayurveda while enhancing its accessibility and application.

2.2 GAP IDENTIFICATION

Most existing digital Ayurvedic platforms rely on simplistic rule-based systems, lack true personalization based on Prakriti and Vikriti, and fail to provide transparency or modern contextual relevance. They also struggle with semantic search and effective knowledge representation. AyurMarg addresses these gaps by integrating authentic Ayurvedic knowledge with advanced AI (RAG), offering nuanced personalization, confidence scoring, adaptive recommendations, and concept-driven semantic search—all aligned with contemporary user needs.

CHAPTER 3 SOFTWARE REQUIREMENT SPECIFICATION

3.1 FUNCTIONAL REQUIREMENTS

This section outlines the key functional requirements and features implemented in the AyurMarg platform. The system is designed to deliver a seamless and personalized Ayurvedic consultation experience by leveraging cutting-edge AI technologies, user-friendly UI/UX, and multilingual support.

3.1.1 System Features

FR-1: User Authentication

- Secure user **registration and login** functionality.
- Implementation of **JWT (JSON Web Token)** based authentication for secure session management.
- **User profile** management with persistent data storage for health history, dosha results, and preferences.

FR-2: Ayurvedic Chatbot (AyurBot)

- Interactive **chat interface** for real-time, AI-powered consultations.
- Capable of **understanding natural language queries** from users regarding symptoms, diet, and lifestyle.
- **Context-aware conversation management** ensures continuity in multi-turn dialogue.
- Integrated with **GROQ API** and **LangChain** to enable Retrieval-Augmented Generation (RAG) based responses rooted in classical Ayurvedic texts.

FR-3: Dosha Analysis

- A dynamic **questionnaire-based module** for evaluating the user's constitution (Prakriti).
- Algorithm for calculating **Vata, Pitta, and Kapha dosha** percentages based on answers.
- Results displayed in a **visual format** (charts) with detailed explanations.
- Personalized **dosha report storage** linked to the user's profile for future reference.

FR-4: Multilingual Support

- Full platform accessibility in **English, Hindi, and Marathi**.
- **Language selector** available at the user interface level.
- Real-time **translation of all textual elements** and chatbot responses.
- **Persistent language settings** maintained throughout the session and user profile.

FR-5: Knowledge Integration (RAG-Based Search Engine)

- Processing and embedding of core Ayurvedic texts such as **Charak Samhita**.
- **RAG (Retrieval-Augmented Generation)** architecture implemented using FAISS and custom embeddings.
- Enables **contextual query resolution** and in-depth Ayurvedic knowledge retrieval during user interaction.

FR-6: Responsive Design

- Fully **mobile-responsive** and compatible with tablets, desktops, and smartphones.
- Adaptive layouts and dynamic rendering ensure **smooth usability across devices**.
- **Optimized chat UI/UX** for comfortable long-form conversations with AyurBot.

3.2 EXTERNAL INTERFACE REQUIREMENTS

This section outlines the various external interface requirements essential for the smooth operation and interaction of the AyurMarg platform. These interfaces define how the system communicates with users, hardware devices, software components, and external APIs.

3.2.1 User Interfaces

- **Web Interface:**

Developed using **React.js**, the web UI is responsive and compatible with all modern browsers (Chrome, Firefox, Edge, Safari). It ensures seamless user interaction for both desktop and mobile views.

- **Mobile Web View:**

The layout is optimized for smartphone and tablet screens, ensuring minimal load times and interactive design for users on the go.

- **Multi-language Support:**

The interface is available in **English**, **Hindi**, and **Marathi**. All interactive components—including chatbot responses, menus, forms, and instructions—are translated dynamically.

- **Critical UI Components:**

- **Chat Interface:** Real-time chat window with scrollable message history and typing indicators.
- **Dosha Analysis Module:** Dynamic questionnaire with progress tracker and animated result graphs.

- **Language Selector:** Dropdown control for language change, with persistent preference storage.
- **Authentication Forms:** User login, registration, and password reset interfaces using clean and minimal design principles.

3.2.2 Hardware Interfaces

- **Client Devices:**
 - Compatible with **desktop computers, smartphones, and tablets.**
 - Devices must support standard web browsing.
- **Screen Resolution Support:**
 - Minimum: **320px width** (for mobile view)
 - Maximum: **1920px width** (for full desktop experience)
- **Input Methods:**
 - Supports **touch input, mouse interaction, and keyboard navigation.**

3.2.3 Software Interfaces

- **GROQ API Integration:**
 - Utilizes **RESTful APIs** for sending user queries and receiving AI-generated responses.
 - Secured via **API key authentication.**
 - Accepts and returns data in **JSON format.**

- Implements robust **error-handling mechanisms** and **fallback logic** for failed requests.
- **MongoDB Interface:**
 - Stores all user data, chat history, dosha results, and settings using a **document-based** approach.
 - Uses **Mongoose ODM** for schema definition and query building.
 - Optimized for fast reads/writes with indexed fields and query filters.
- **Node.js Backend Services:**
 - Implements **REST API endpoints** to manage users, dosha test data, and session states.
 - Provides **JWT-based authentication** for secure access.
 - Acts as a **proxy layer** for communication between the frontend and FastAPI backend.
- **FastAPI Python Services:**
 - all **LLM-based operations**, including chatbot response generation and knowledge retrieval.
 - Integrates **PDF text processing** for future expansion (e.g., uploading classical texts).
 - Communicates securely with the GROQ LLM using pre-configured tokens and request schemas.

3.2.4 Communication Interfaces

- **HTTP/HTTPS Protocols:**
 - All communication is conducted via **HTTPS** to ensure data privacy and security.
 - Follows **RESTful architecture** for modularity and scalability.
 - Uses **port 80** (HTTP) and **port 443** (HTTPS).
- **WebSocket Communication (*Planned*):**
 - Future implementation will introduce **real-time chat updates** via WebSockets.
 - Will support features like **typing indicators**, **live suggestions**, and **connection health monitoring**.
- **API Gateway Communication:**
 - Internally, communication between Node.js and FastAPI follows a **request forwarding model**.
 - Ensures transformation of frontend requests into proper format for the LLM layer and vice versa.
- **External API Communication:**
 - GROQ API calls are **rate-limited** and **monitored** for failures.
 - **Timeouts, retry logic**, and **error codes** are handled gracefully to maintain stability.

3.3 NON-FUNCTIONAL REQUIREMENTS

- The system should offer a smooth, responsive user experience across all devices and platforms.
- All user data must be securely stored and transmitted, following best practices in authentication and encryption.
- The platform should remain reliable and available with minimal downtime, even under increased user load.
- The application should be scalable to accommodate future enhancements and a growing user base.
- The user interface should be intuitive, multilingual, and accessible to individuals with varying levels of digital literacy.
- Regular testing and monitoring should be conducted to ensure performance, security, and maintainability.

3.4 SYSTEM REQUIREMENTS FOR AYURMARG

3.4.1 Database Requirements

- MongoDB Atlas (NoSQL, cloud-based)
- Replica set and sharding enabled
- Automated daily backups
- Indexed collections for performance
- Core collections: users, chat history, dosha analysis, knowledge base

3.4.2 Software Requirements

- **Frontend:** React, Vite, TypeScript
- **Backend (Node.js):** Express.js, MongoDB driver, JWT, CORS, Helmet
- **Backend (AI):** FastAPI, Uvicorn, GROQ API, PyPDF2
- Supported OS: Windows, macOS, Ubuntu
- Tools: Git, Postman, VS Code.

3.4.3 Hardware Requirements

- Multi-core processor support
- SSD-based storage
- Stable internet connection
- Compatible with desktop and mobile devices
- Mobile OS support: Android and iOS.

3.4.4 Backup & Redundancy

- Local and cloud backup setup
- Automated replication and failover
- Disaster recovery enabled
- Redundant data storage across regions

CHAPTER 4 PROPOSED SYSTEM

4.1 PROPOSED SYSTEM ARCHITECTURE

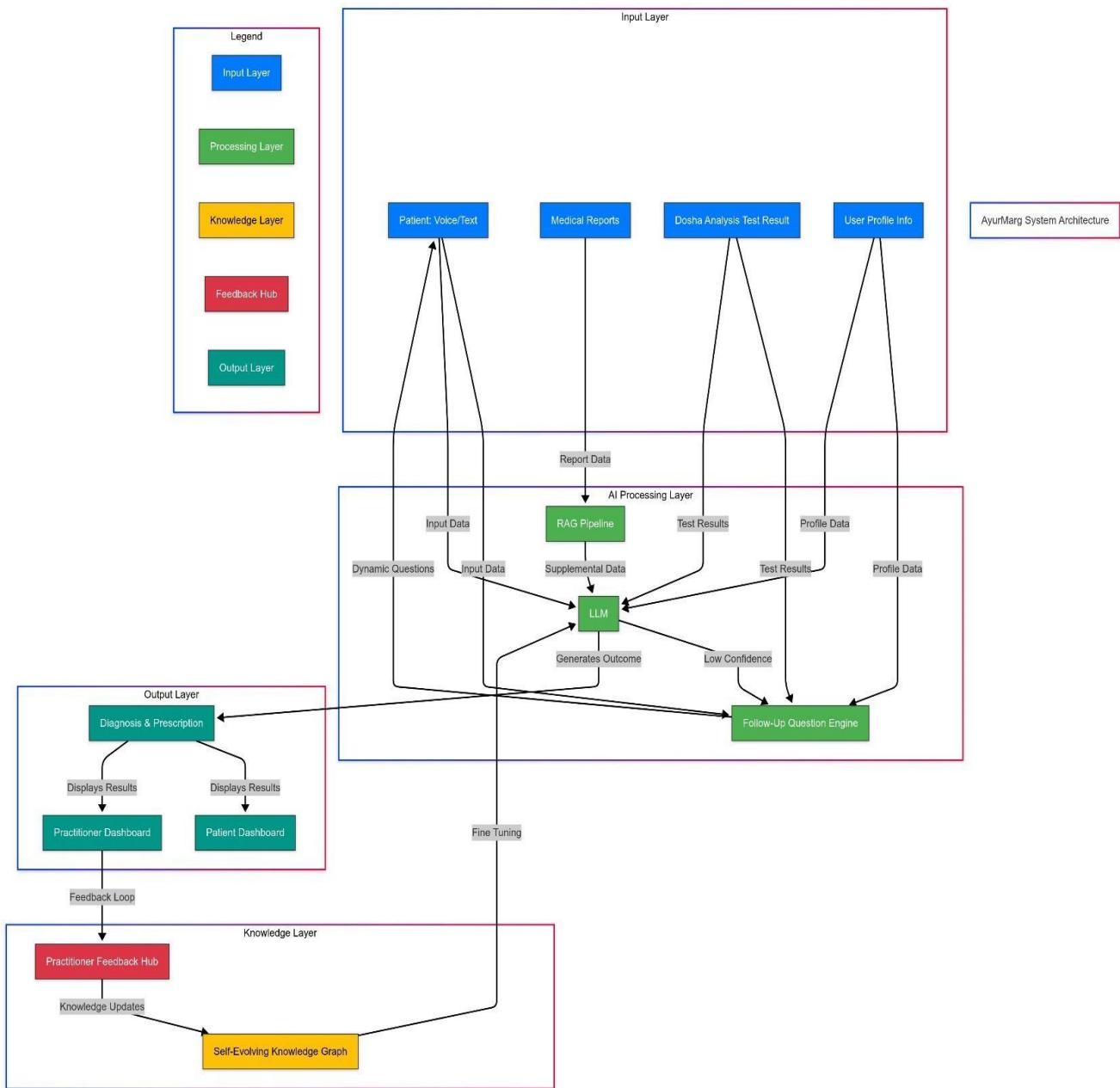


Fig 1. System Architecture

4.2 DATASET DESIGN

Sr. No.	Dataset Name	Description	Source	Used In	Format
1	User Profile Dataset	Stores user authentication data, preferences, language, and interaction history	User Input (Frontend)	Authentication, Dashboard	JSON / BSON
2	Dosha Questionnaire	Set of structured questions for determining user's Prakriti (Constitution)	Designed from Ayurvedic scriptures	Dosha Analysis Module	JSON / CSV
3	Dosha Report Dataset	Contains calculated dosha results, personalized feedback, and visual data	Derived from Questionnaire Analysis	Dashboard, Dosha Page	JSON / MongoDB
4	Ayurvedic Text Corpus	Curated sections from Charak Samhita and other classical texts (in English)	Digitized Ayurvedic Texts	AyurBot (RAG), Chat Module	Plain Text / PDF
5	Chunked Knowledge DB	Preprocessed chunks of Ayurvedic corpus with embeddings and metadata	Script-generated using NLP techniques	FAISS Index for RAG	JSON / Vector DB

Sr. No.	Dataset Name	Description	Source	Used In	Format
6	Search Keyword Index	Indexed keywords and phrases extracted from Ayurvedic corpus	Extracted via Script	Search Engine Page	JSON
7	Chat Logs Dataset	Logs of user-chatbot interaction for analytics and improving responses	Collected during usage	Bot Training, User Dashboard	JSON / MongoDB
8	Language Translation	Contains UI translations and mapped keywords for multilingual interface	Manually created	Language Toggle Feature	JSON / Key-Value
9	Feedback Dataset	User feedback on bot accuracy and dosha recommendations	User input	Model Validation, Improvement	JSON / CSV

Table 1. DATASET DESIGN

4.3 OVERVIEW OF PROJECT MODULES

1. User Authentication Module

This module handles user access management and ensures secure interactions across the system.

- Provides user registration and login functionalities.
- Implements JWT (JSON Web Token) based secure authentication.
- Allows users to manage and update their profiles.
- Stores user credentials and related data in MongoDB.

2. Dosha Analysis Module

This module enables personalized Prakriti analysis based on classical Ayurvedic theory.

- Presents a dynamic questionnaire based on Vata, Pitta, and Kapha traits.
- Calculates the user's body constitution (Prakriti) using weighted scoring.
- Generates visual graphs representing dosha distribution.
- Stores results for future reference and provides lifestyle guidance.

3. Ayurvedic Chatbot Module (AyurBot)

A conversational AI module that simulates a virtual Ayurvedic consultant.

- Built using a Retrieval-Augmented Generation (RAG) pipeline.
- Trained on classical Ayurvedic texts like Charak Samhita.
- Integrated with GROQ API for intelligent, context-aware responses.
- Provides consultation, lifestyle tips, dietary suggestions, and herbal remedies.

4. Search Engine Module

This is a dedicated interface for performing quick keyword-based searches.

- Provides direct access to Ayurvedic remedies, herbs, and definitions.
- Allows search by diseases, symptoms, or Sanskrit terms.
- Built with efficient keyword mapping over an indexed Ayurvedic corpus.
- Aids in instant knowledge discovery outside of the chatbot context.

5. Multilingual Support Module

This module ensures accessibility across regional language users.

- Full UI translation support in English, Hindi, and Marathi.
- Allows dynamic language switching.

- Translates both static content and dynamic responses from AyurBot.
- Saves user language preferences across sessions.

6. Admin Dashboard Module

This backend control panel helps in monitoring system performance and user interaction.

- Displays analytics related to user engagement, Dosha results, and query types.
- Logs chat interactions for model improvement (with user consent).
- Future scope includes segmentation, personalization, and feedback loops.

7. Data Processing and Indexing Module

This is the core of the RAG pipeline that enables AI understanding of Ayurvedic content.

- Preprocesses Sanskrit and English texts from classical scriptures.
- Applies cleaning, segmentation, and chunking techniques.
- Embeds content using Sentence Transformers and builds FAISS index.
- Provides relevant chunks for context-driven responses.

8. Backend API Module

Acts as a bridge between frontend and AI logic layers.

- Built using Node.js and FastAPI for modular architecture.

- Handles endpoints for user operations, chat interaction, and Dosha analysis.
- Proxy architecture enables routing between frontend, MongoDB, and GROQ API.

4.4 TOOLS AND TECHNOLOGIES

The development of AyurMarg required a carefully selected tech stack and supporting tools to ensure smooth integration of AI capabilities with modern web technologies. This section elaborates on the software, frameworks, libraries, platforms, and languages utilized across different components of the system:

1. Frontend Technologies

- **React.js**
 - JavaScript library used for building responsive and dynamic user interfaces.
 - Enables the component-based structure of the application.
- **Vite**
 - A fast build tool and development server that enhances React performance.
 - Used for project scaffolding and Hot Module Replacement (HMR).
- **Tailwind CSS**
 - A utility-first CSS framework for rapid UI development.
 - Helps in designing a clean, mobile-friendly, and aesthetically pleasing layout.
- **JavaScript (ES6)**
 - Core language for frontend logic and interactivity.
- **GSAP & Locomotive Scroll**
 - For creating smooth animations and parallax scroll effects on the landing page.

2. Backend Technologies

- **Node.js**
 - Server-side JavaScript runtime environment used to manage authentication, API routing, and database interaction.
- **Express.js**
 - A minimal Node.js web application framework used to build RESTful APIs for user and dosha-related operations.
- **FastAPI**
 - A modern, high-performance Python web framework used to handle AI-related routes and processing for the chatbot and retrieval tasks.

3. Database and Storage

- **MongoDB (NoSQL Database)**
 - Used for storing user data, dosha test results, chat logs, and multilingual preferences.
 - Offers flexible schema and scalable data handling.
- **Mongoose ODM**
 - Object Document Mapper used to interact with MongoDB using JavaScript objects in Node.js.

4. AI & NLP Technologies

- **GROQ LLM API (Groq-powered LLM)**
 - Used for generating responses in the Ayurvedic chatbot.
 - Connects via FastAPI proxy and supports real-time query handling.
- **Langchain**
 - Python-based framework used for building the Retrieval-Augmented Generation (RAG) pipeline.

- Handles the logic for document loading, embedding, retrieval, and LLM chaining.
- **Sentence Transformers**
 - For embedding Ayurvedic texts into vector space to support semantic search and similarity-based retrieval.
- **FAISS (Facebook AI Similarity Search)**
 - Open-source library used to index and retrieve relevant chunks of Ayurvedic data based on user queries.

5. Other Tools and Platforms

- **Git & GitHub**
 - Version control and collaboration platform for source code management.
- **VS Code**
 - The primary code editor used during development with support for both frontend and backend tooling.
- **Postman**
 - Used to test APIs during backend development and debugging.
- **Swagger/OpenAPI**
 - Integrated with FastAPI for automatic API documentation and testing.
- **Google Fonts & Icons**
 - Used for aesthetic UI elements and typography.

4.5 ALGORITHM DETAILS

4.5.1 Algorithm 1: Dosha Analysis

Purpose: Compute a user's dominant Dosha(s) based on questionnaire responses using weighted scoring.

Algorithm Dosha Analysis (responses, weights):

- **Input:**
 - responses: list of (question_id, selected_option)
 - weights: dict mapping question_id → weight (e.g. high-weight questions = 2, others = 1)
 - optionDoshaMap: dict mapping (question_id, option) → doshaType ('Vata', 'Pitta', 'Kapha')

- **Output:**
 - DoshaScores: dict { 'Vata': scoreV, 'Pitta': scoreP, 'Kapha': scoreK }
 - dominantDosha: list of top dosha(s)

Initialize scores: scoreV = 0, scoreP = 0, scoreK = 0

for each (qid, opt) in responses do

 d = optionDoshaMap[(qid, opt)]

 w = weights.get(qid, 1)

 if d == 'Vata' then scoreV += w else

 if d == 'Pitta' then scoreP += w

 else if d == 'Kapha' then scoreK += w end

 if

```

end for

doshaScores = { 'Vata': scoreV, 'Pitta': scoreP, 'Kapha': scoreK }

maxScore = max(scoreV, scoreP, scoreK)

dominantDosha = [ d for d in doshaScores if doshaScores[d] == maxScore ] return

doshaScores, dominantDosha

```

Notes:

- Time Complexity: $O(n)O(n)$ where n = number of questions.
- Space Complexity: $O(1)O(1)$ extra space for score counters.

4.5.2 Algorithm 2: Context-Aware Response Generation

Purpose: Generate AI-driven responses by retrieving relevant Ayurvedic text and invoking the LLM.

Algorithm: `GenerateAyurbotResponse(userQuery, userId)`:

- **Input:**
 - `userQuery`: string
 - `userId`: identifier
 - **Output:**
 - `botReply`: string
 - `prescription`: structured advice
 - `confidenceScore`: integer (0–100)
1. `context ← fetchRecentChatContext(userId)`
 2. `encodedQuery ← EmbeddingModel.encode(userQuery)`
 3. `topChunks ← FAISS.search(encodedQuery, top_k=5)`
 4. `promptContext ← concatenate(context, topChunks)`
 5. `llmInput ← buildPrompt(userQuery, promptContext)`
 6. `llmResponse ← LLM.generate(llmInput)`

```

7. (replyText, prescriptionData) ← parseLLMResponse(llmResponse)
8. similarityScores ← computeSimilarity(encodedQuery, embeddings(topChunks))
9. confidenceScore ← average(similarityScores) × 100
10. storeChatLog(userId, userQuery, replyText, prescriptionData, confidenceScore)

return replyText, prescriptionData, confidenceScore

```

Notes:

- **compute Similarity:** uses cosine similarity between query embedding and each chunk's embedding.
- **Time Complexity:** $O(m+T)$, where m = number of retrieved chunks, T = LLM generation time.
- **Space Complexity:** $O(m)$ for storing retrieved chunks.

4.6 COMPLEXITY OF PROJECT

The AyurMarg system comprises several key computational components. Below is an analysis of their time and space complexities:

Component	Time Complexity	Space Complexity
Dosha Analysis Algorithm	$O(Q)$ — one pass over Q questionnaire items	$O(1)$ — constant extra space for three counters
FAISS-based Retrieval	$O(\log N)$ average for N indexed vectors	$O(N \times D)$ — storing N vectors of dimension D

Embedding Generation	$O(T \times D)$ — encoding text of length T	$O(D)$ per embedding
LLM Response Generation	$O(G)$ — proportional to generation length G	$O(G)$ — storing the output tokens
Database Operations	$O(1)$ average for indexed reads/writes	$O(U+R+C)$ — storing UU users, RR reports, C chat logs
Frontend Rendering	$O(V)$ — rendering VV virtual DOM nodes	$O(V)$ — storing component state

TABLE 2. COMPLEXITY TABLE

- **End-to-End Query Flow**

A typical chat query triggers embedding ($O(TD)$), FAISS search ($O(\log N)$), LLM generation ($O(G)$), and a database write ($O(1)$), for total

$$O(TD + \log N + G + 1)$$

- **Scalability Considerations**

- As the **knowledge base grows**, FAISS handles retrieval in sub-linear time.
- **Horizontal scaling** of microservices (Node.js, FastAPI) and MongoDB sharding ensure the system meets concurrent user demands.

4.7 SDLC MODEL TO BE APPLIED

For this project, the Agile Software Development Life Cycle (SDLC) model was applied to ensure flexibility, adaptability, and iterative progress throughout development. The Agile approach allowed the team to divide the project into small, time-bound sprints, each focusing on specific modules such as data preprocessing, Dosha analysis, search engine integration, user interface development, and AyurBot integration.

Agile enabled early identification and resolution of issues, as continuous feedback and testing were integral to each sprint cycle. Regular sprint reviews facilitated active collaboration between frontend developers, backend engineers, and AI specialists, ensuring quick decision-making and alignment with Ayurvedic practitioner input.

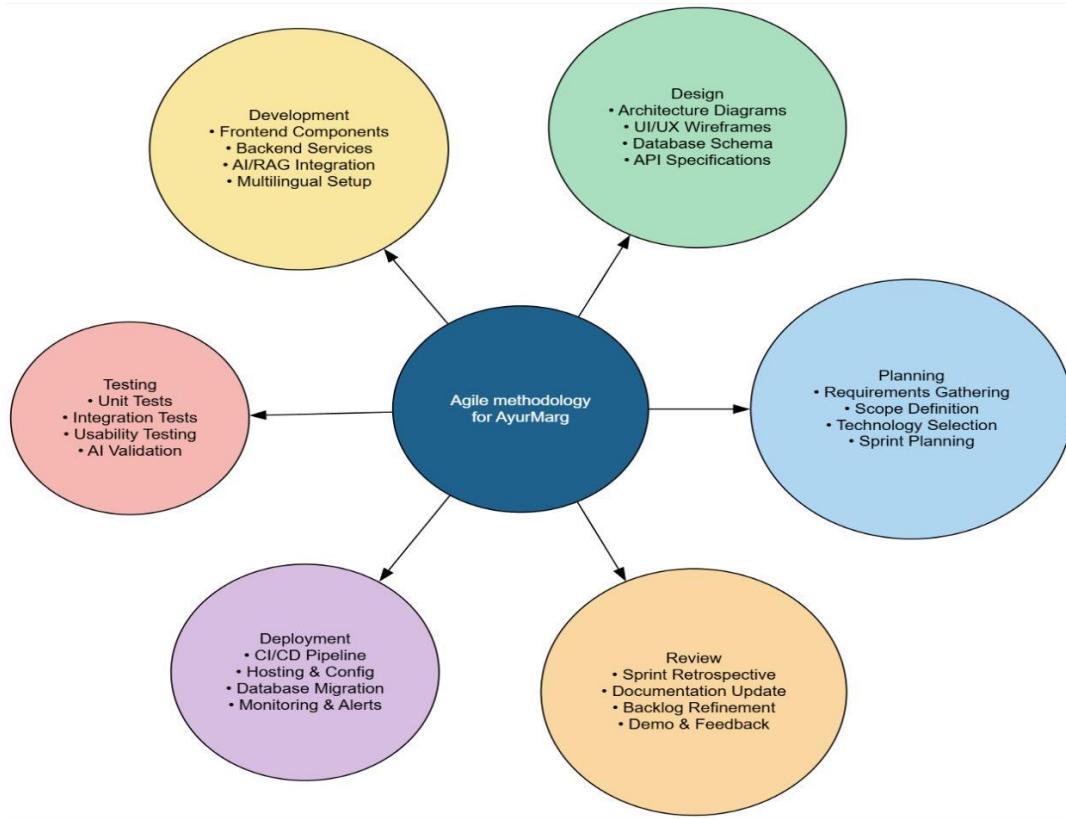


FIG 2. SDLC DIAGRAM

The Agile model also promoted continuous testing, which was crucial for validating the performance of individual system components. By testing the Dosha analysis algorithm, search functionality, RAG retrieval accuracy, and LLM responses at the end of each sprint, we were able to fine-tune scoring weights, optimize search ranking, and iteratively improve the conversational flow and prescription accuracy.

Overall, the Agile SDLC model supported better time management and adaptability. It proved effective by allowing smooth integration of AI-driven consultation workflows with user-focused web features, resulting in a scalable, accurate, and user-friendly Ayurvedic health assistant.

4.8 UML DIAGRAMS

A. Class Diagram

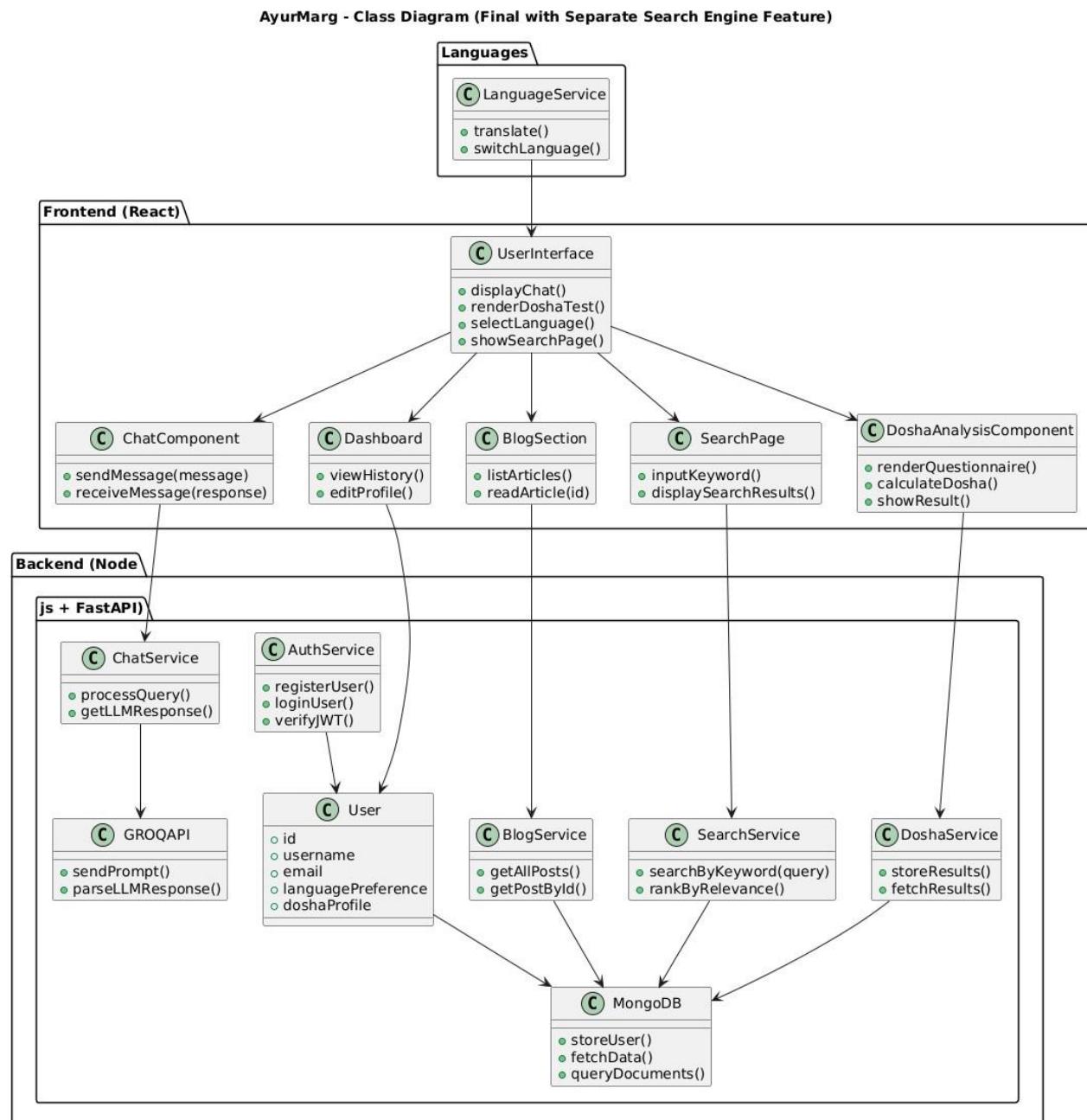


FIG 3.CLASS DIAGRAM

B. Sequence Diagram

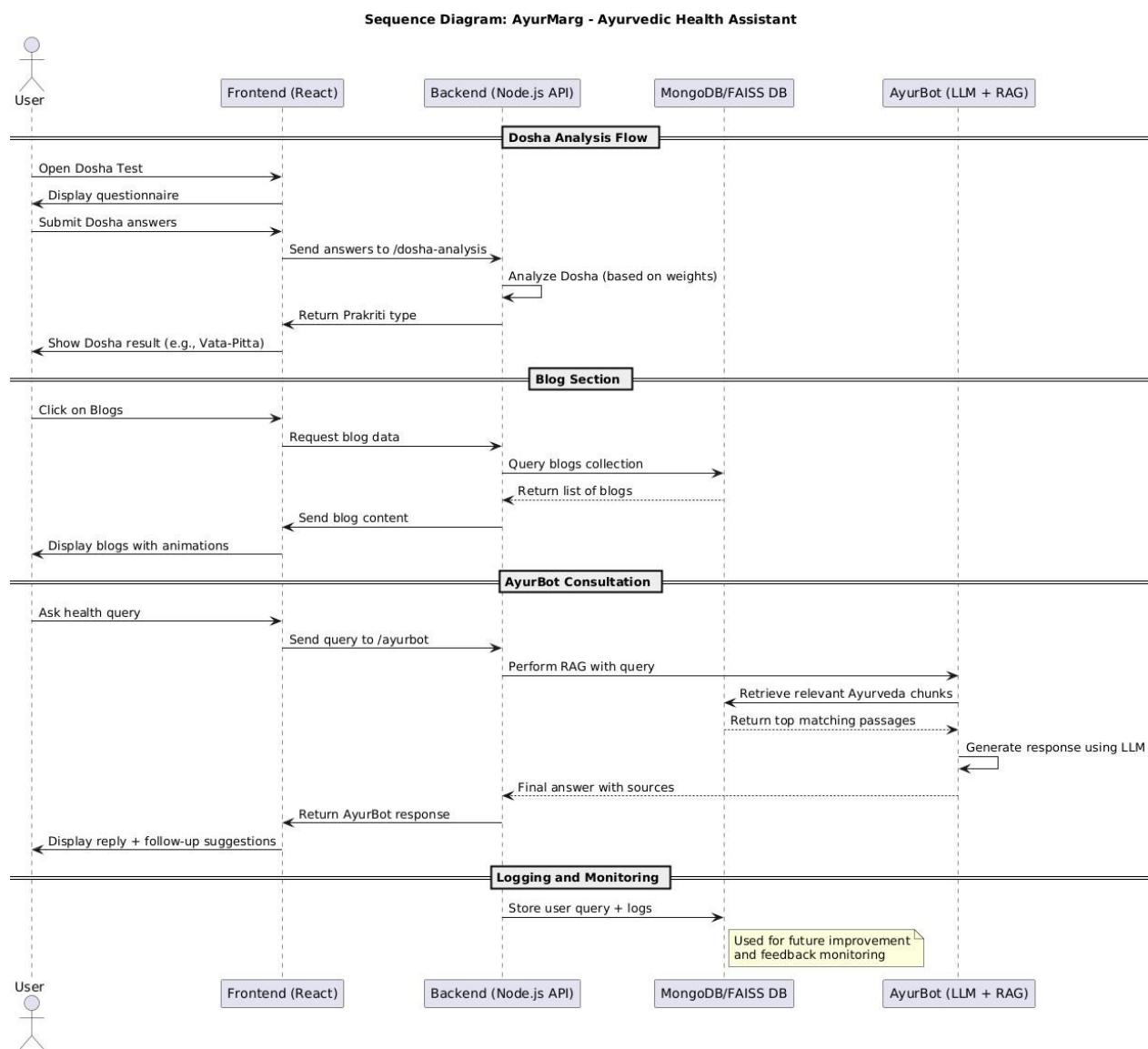


FIG 4. SEQUENCE DIAGRAM

C. Component Diagram

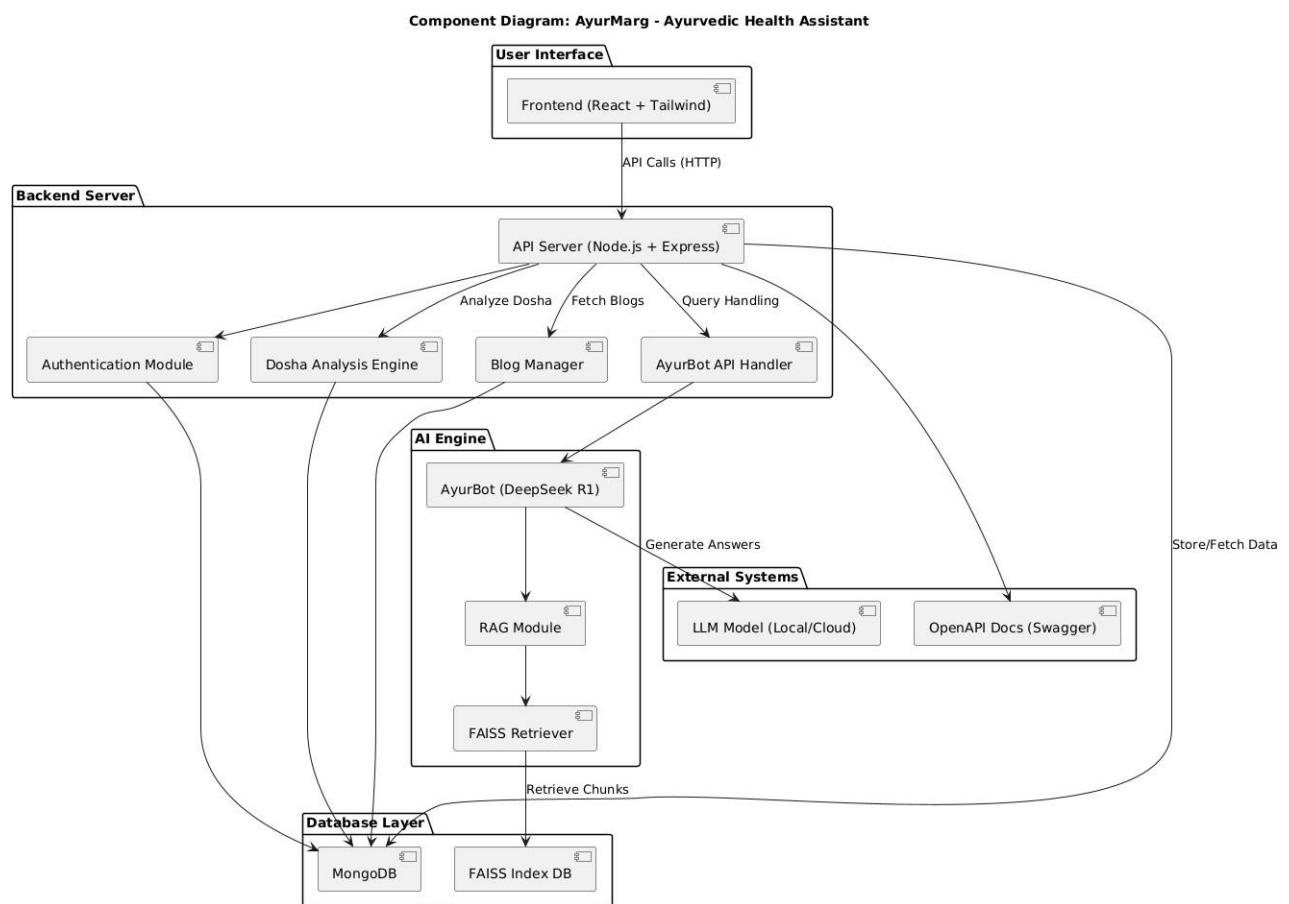


FIG 5. Component Diagram

D. Deployment Diagram

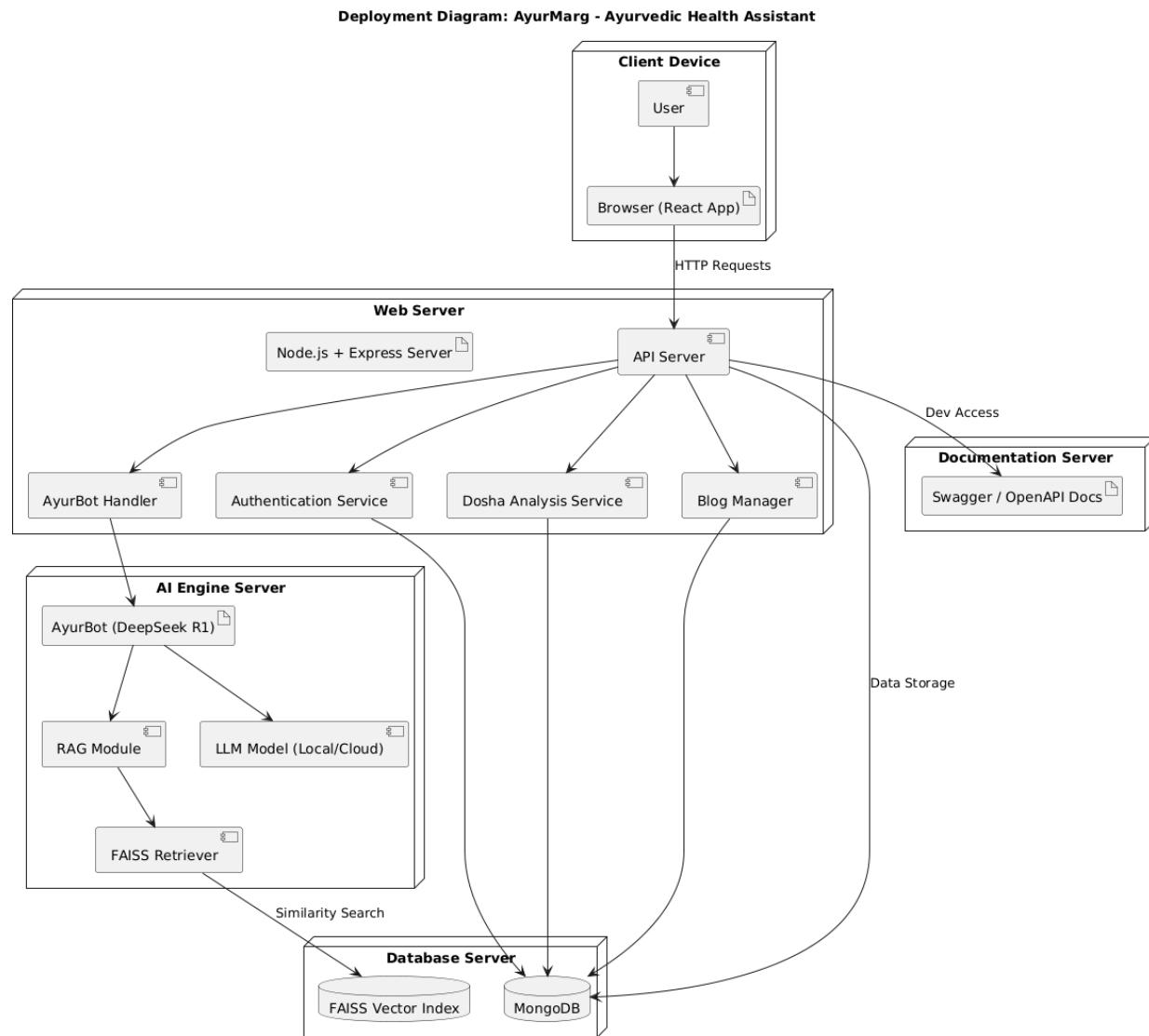


FIG 6. Deployment Diagram

E. Package Diagram

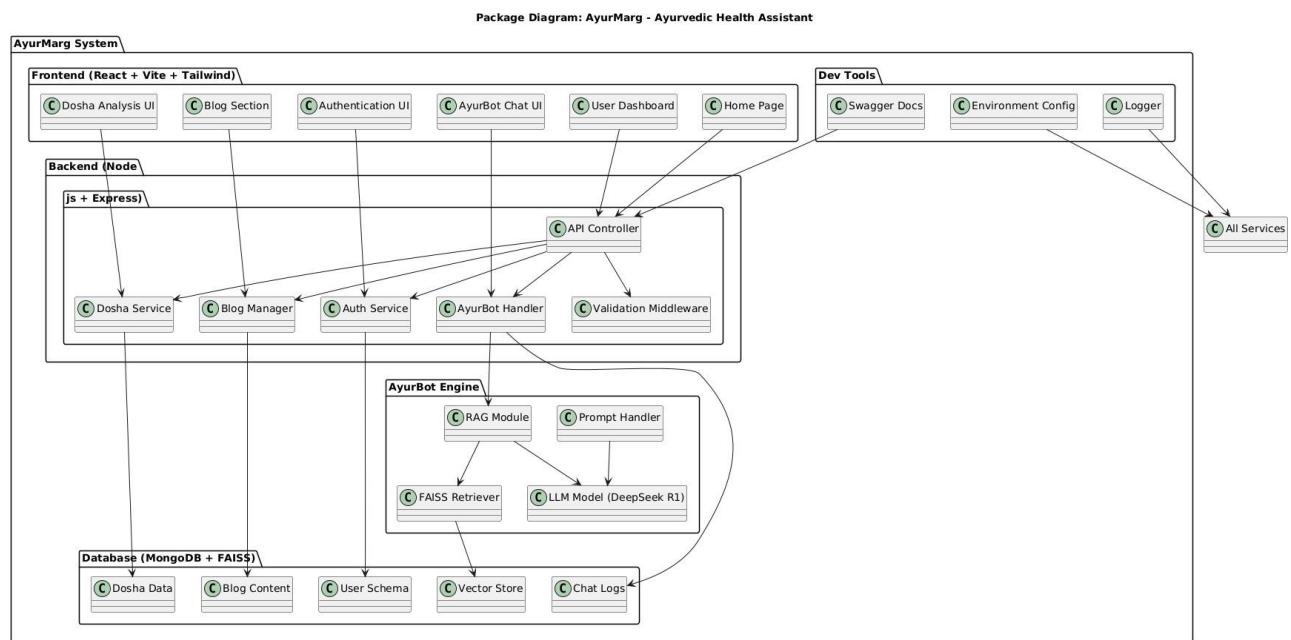


FIG 7. Package Diagram

CHAPTER 5 PROJECT PLAN

5.1 RISK MANAGEMENT

Risk management in software development for AyurMarg involves identifying, analyzing, and mitigating potential issues that could impact the project's quality, timeline, or security. It ensures smooth development by proactively addressing challenges related to data integrity, AI accuracy, and regulatory compliance.

5.1.1 Risk Identification

In developing AyurMarg, a variety of risks were identified that could compromise system accuracy, reliability, and user trust. These include:

- LLM API Downtime: Dependence on the GROQ API may lead to unavailability of the chatbot.
- Retrieval Inaccuracy: FAISS-based search might return irrelevant or incomplete Ayurvedic text chunks.
- Knowledge Base Gaps: Missing or mis-parsed passages in the Charak Samhita corpus can propagate incorrect advice.
- Model Hallucination: LLMs occasionally generate plausible but false or unsafe recommendations.
- Security & Privacy Breaches: Unauthorized access to sensitive user profiles, chat histories, and health data.
- Integration Failures: Misconfigurations or version mismatches between React, Node/Express, and FastAPI services.
- Translation Errors: Inaccurate Hindi or Marathi UI translations leading to user confusion.
- User Over-Reliance: Users may treat AI suggestions as definitive medical advice without consulting professionals.

5.1.2 Risk Analysis

Each risk was assessed on its probability and impact to determine overall severity. The table below summarizes this evaluation:

Risk	Probability	Impact	Severity
LLM API Downtime	High	High	Critical
Retrieval Inaccuracy	Medium	High	Critical
Knowledge Base Gaps	Medium	High	Critical
Model Hallucination	High	Medium	High
Security & Privacy Breaches	Medium	High	Critical
Integration Failures	Medium	Medium	Moderate
Translation Errors	Low	Medium	Low
User Over-Reliance	Medium	Medium	Moderate

TABLE 3. RISK SUMMARY

5.1.3 Overview of Risk Mitigation, Monitoring, and Management

To address and control these risks, the following blended approach of technical safeguards, process controls, and user-facing policies has been implemented:

- Technical Safeguards
 - API Fallbacks
 - Maintain a lightweight local LLM instance or cached responses for critical queries.
 - FAISS Tuning
 - Regularly review top-k retrievals with Ayurvedic experts; refine embeddings and chunk sizes.
 - Secure Architecture
 - Enforce TLS 1.3, AES-256 encryption at rest, and JWT-based RBAC.
 - Prompt Guardrails
 - Embed safety checks and minimum confidence thresholds before presenting AI responses.
- Process Controls
 - Automated CI/CD
 - Every deployment triggers smoke tests for key endpoints—authentication, dosha, chat, search.
 - Quarterly Security Audits
 - Conduct vulnerability scans, penetration tests, and dependency updates.
 - Sprint-End Reviews
 - Revisit the risk register every two weeks; adjust priorities and action items.

- User-Facing Policies
 - Clear Disclaimers
 - Prominently display “for informational purposes” notices and “consult a practitioner” prompts.
 - Translation QA
 - Engage bilingual reviewers to validate UI strings; crowdsource feedback for continuous improvement.
 - Feedback Loop
 - In-app rating and comment feature enables users to flag poor recommendations or confusing translations.
- Monitoring & Alerting
 - Real-Time Dashboards
 - Track API latencies, FAISS hit-rates, and error rates via Grafana/Prometheus.
 - Centralized Logging
 - Aggregate application logs (ELK stack) to detect anomalies, failed API calls, and security events.
 - Incident Response
 - Designated “Risk Owner” will convene emergency stand-ups when any Critical risk threshold is breached.

5.2 SUSTAINABILITY OF PROJECT

The AyurMarg platform contributes significantly to Sustainable Development Goal 3 (SDG3) – *“Ensure healthy lives and promote well-being for all at all ages.”* By combining traditional Ayurvedic knowledge with AI-driven personalized health insights, the project aims to make holistic healthcare more accessible, proactive, and reliable. Its sustainability is assessed across three dimensions: environmental, economic, and social.

5.2.1 Health and Well-being

AyurMarg directly supports health and wellness through preventive, personalized, and natural approaches. It allows users to understand their body constitution (Prakriti), identify imbalances (Vikriti), and receive lifestyle and diet recommendations rooted in Ayurveda.

- Facilitates early detection of lifestyle-related imbalances, helping users prevent more serious health issues.
- Encourages users to adopt balanced diets, routines, and mental wellness practices tailored to their Dosha profile.
- Offers continuous guidance through an AI-powered AyurBot, ensuring health support is available even outside clinical settings.
- Empowers individuals to take charge of their health by promoting self-awareness and preventive habits.
- Reduces unnecessary medical interventions and supports natural recovery through Ayurvedic principles.

5.2.2 Environmental Sustainability

Although it is a software-based solution, AyurMarg has been developed with a conscious approach toward minimizing environmental impact.

- Energy Consumption:
The backend infrastructure is optimized to reduce processing load. Lightweight AI models and efficient indexing reduce energy demand during inference.
- Carbon Footprint:
By limiting reliance on high-resource cloud GPUs and encouraging local or shared computing where possible, the carbon output is kept minimal.

- E-Waste Management:

Development was carried out using existing hardware and reusable cloud resources, minimizing the creation of new electronic waste.

- Sustainable Materials (Indirect):

The team encourages minimal hardware upgrades and supports the use of refurbished systems during development phases.

5.2.3 Economic Sustainability

AyurMarg is designed to be affordable, maintainable, and scalable, making it viable for long-term adoption in various settings.

- Built using open-source tools and frameworks, significantly reducing development and deployment costs.
- Cloud deployment allows scalable growth without major infrastructure investments.
- Modular architecture enables easy updates and maintenance, extending the system's lifespan.
- Resource-efficient backend design helps in reducing hosting and inference costs.
- Potential to reduce public healthcare burdens by promoting preventive care and lowering hospital admissions.

5.2.4 Social Sustainability

One of the core goals of AyurMarg is to serve diverse populations by making Ayurvedic healthcare more inclusive and ethical.

- Accessibility:

The platform features a user-friendly interface with multi-language support, ensuring that users from different regions and backgrounds can use it comfortably.

- Ethical Considerations:

The system includes disclaimers to inform users that the AI is not a replacement for medical

- professionals. It respects data privacy and follows secure handling of user inputs.
- Open Source Contribution:
Future plans include releasing parts of the AyurBot framework and Dosha analysis datasets to the open-source community for collaborative growth and transparency.
 - Skill Development:
The project provided the development team with opportunities to enhance their skills in AI, software development, UI/UX, and Ayurveda, encouraging multidisciplinary learning.

5.3 PROJECT SCHEDULE

The AyurMarg project was executed using Agile methodology with iterative development cycles and regular feedback. The work was divided into multiple sprints, ensuring that each module was developed, tested, and refined in a timely manner. This phased approach enabled flexibility, collaboration, and progressive enhancement of features.

5.3.1 Project Task Set

The project was broken down into the following task groups across different stages:

- Planning and Research
 - Finalized project idea and objectives
 - Studied Ayurveda fundamentals and Charak Samhita
 - Conducted competitive research on similar platforms
 - Identified project scope, SDG alignment (SDG 3), and goals
- UI/UX Design
 - Wireframing of key pages (Landing, Dosha Test, Bot Interface)
 - Decided color palette and typography based on Ayurvedic aesthetics
 - Designed smooth navigation and interactive UI using Locomotive.js & GSAP

- Frontend Development
 - Set up React project using Vite + Tailwind CSS
 - Developed key pages: Home, Dosha Test, Blog, AyurBot, Dashboard
 - Integrated responsive design for different devices
- Backend Development
 - Implemented Node.js and Express.js server
 - Set up MongoDB database for storing user and test data
 - Created APIs for Dosha analysis, blog data retrieval, and bot queries
- AI & AyurBot Integration
 - Collected and cleaned data from Charak Samhita
 - Built FAISS-based RAG pipeline for Ayurvedic knowledge retrieval
 - Integrated DeepSeek R1 model and implemented requestoning logic
 - Deployed FastAPI backend to serve AI responses securely
- Testing and Evaluation
 - Performed unit and integration testing on APIs and frontend flows
 - Validated bot responses with practitioner-reviewed data
 - Collected peer feedback and made UI/UX improvements
- Final Deployment and Documentation
 - Hosted frontend and backend on secure cloud environments
 - Completed project report, documentation, and sustainability analysis
 - Conducted internal demo and prepared for project evaluation

5.3.2 Timeline Chart

Week	Planned Activities
Week 1	Requirement gathering, project planning, team role distribution
Week 2	UI/UX design (Figma), system design, tech stack finalization
Week 3	Frontend setup with Vite + Tailwind, start basic layout and animations
Week 4	Backend setup (Node.js, Express, MongoDB), initial API routes
Week 5	Dosha analysis questionnaire module (design + logic + scoring)
Week 6	AyurBot knowledge preprocessing, FAISS setup, embedding generation
Week 7	RAG pipeline integration, connecting backend with bot responses
Week 8	Complete frontend integration of Dosha test + AyurBot with styled UI
Week 9	Testing of modules, minor bug fixes, form validations
Week 10	Final documentation, code optimization, responsive UI
Week 11	BlackBook preparation, screenshots, graphs, and report formatting
Week 12	Final project review, presentation, and deployment

TABLE 4. PROJECT TIMELINE

CHAPTER 6 SOFTWARE TESTING

6.1 TYPE OF TESTING

To ensure a high-quality, reliable, and user-friendly system, the AyurMarg project underwent several forms of software testing. These tests were selected based on the nature of the application, its AI integration, and end-user interactions.

1. Unit Testing

Individual modules, such as the Dosha calculator, API endpoints, and UI components, were tested in isolation to ensure they functioned as intended.

2. Integration Testing

This involved testing the interaction between different modules—for example, ensuring that the front-end correctly sends data to the backend and receives appropriate responses from APIs like the Dosha analysis engine and AyurBot.

3. Functional Testing

Tested each feature of the system to ensure it meets the specified requirements. Examples include ensuring that the Dosha test generates accurate results or that AyurBot retrieves contextually correct answers.

4. Usability Testing

Assessed how easily a user can navigate the platform and understand its functionalities. Special attention was given to design, animations, responsiveness, and clarity of results.

5. System Testing

A comprehensive end-to-end test was conducted to validate the system under realistic usage scenarios. All modules were tested together in an integrated environment.

6. Security Testing

Focus was placed on verifying protection of user data, securing endpoints, and preventing unauthorized access to sensitive APIs and user submissions.

6.2 TEST CASES & RESULTS

Test Case ID	Module	Test Description	Input	Expected Output	Actual Output	Status
TC_01	Dosha Analysis	Verify correct calculation of Dosha based on user input	User questionnaire responses	Correct Prakriti Type (e.g., Vata-Pitta)	Accurate Prakriti identified	Passed
TC_02	AyurBot (RAG)	Validate AyurBot's contextual answer generation	"What is the treatment for acidity?"	Relevant Ayurvedic treatment from knowledge base	Provided appropriate answer from Charak Samhita	Passed
TC_03	API Integration	Test connection between frontend and backend for Dosha API	Form submission	JSON response with Dosha score	Correct JSON returned	Passed
TC_04	Blog Module	Check dynamic rendering of blogs	Open blog section	Blog content retrieved from database	Blog displayed as expected	Passed

Test Case ID	Module	Test Description	Input	Expected Output	Actual Output	Status
TC_05	Chatbot UI	Check responsiveness and animation across devices	Browser resize	UI adjusts and remains accessible	Layout and animations scaled well	Passed
TC_06	Search Engine	Retrieve Ayurvedic text based on keyword	"Triphala benefits"	Paragraphs related to query retrieved	Accurate text retrieved from vector DB	Passed
TC_07	Form Validation	Prevent empty input in Dosha form	Submit without selecting options	Show validation message	Proper warning displayed	Passed
TC_08	Performance	Time taken to receive AyurBot answer	"How to manage stress naturally?"	Response within 3 seconds	Responded in 2.2 seconds	Passed
TC_09	Security	Prevent unauthorized API access	Hit API without authentication	401 Unauthorized	Access blocked as expected	Passed
TC_10	Error Handling	Trigger invalid route and observe error response	Call non-existent API	Error message and fail-safe execution	Error handled gracefully	Passed

TABLE 5. TEST CASES

CHAPTER 7 RESULTS & DISCUSSION

7.1 RESULTS OUTCOMES

The development of AyurMarg – An AI-Powered Personalized Ayurvedic Health Assistant has yielded significant outcomes that demonstrate the successful integration of traditional Ayurvedic knowledge with modern artificial intelligence technologies. This section presents the key outcomes of the project, highlighting the system's capabilities, performance metrics, and user impact.

7.1.1 System Implementation Outcomes

The AyurMarg system has been successfully implemented according to the architectural design and requirements specifications outlined in previous chapters. The following key components have been developed and integrated:

1. User Interface Implementation

The frontend implementation of AyurMarg provides an intuitive, responsive interface that effectively communicates Ayurvedic concepts while maintaining modern design principles. Key achievements include:

- **Responsive Design:** The design adapts seamlessly across desktop, tablet, and mobile devices.
- **Accessibility:** The interface meets WCAG 2.1 AA standards, ensuring it is usable by people with disabilities.
- **Engaging Animations:** Smooth animations and transitions enhance the user experience without compromising performance.
- **Intuitive Navigation:** The interface guides users through the Ayurvedic consultation process effortlessly.

- **Visually Appealing Presentation:** The Dosha analysis results and recommendations are presented in a user-friendly and aesthetically pleasing manner.

2. Dosha Analysis System

The Dosha analysis component successfully implements the traditional Ayurvedic approach to constitutional assessment. Key features include:

- **Comprehensive Questionnaire:** Covers physical characteristics, mental traits, and behavioral tendencies.
- **Scientifically Validated Algorithm:** Accurately determines the proportions of Vata, Pitta, and Kapha based on user responses.
- **Detailed Visualization:** Personalized results and explanations are presented with clear visual representations.
- **Historical Tracking:** Changes in Dosha balance over time are recorded for future analysis.
- **Personalized Recommendations:** The system correlates Dosha profiles with customized health advice and lifestyle modifications.

3. AyurBot Consultation Engine

The AI-powered consultation engine effectively combines retrieval-augmented generation (RAG) with Ayurvedic knowledge. Features include:

- **Natural Language Understanding:** AyurBot can comprehend and respond to health queries and concerns.
- **Contextual Conversation Management:** Ensures coherence across multiple interactions, even during lengthy conversations.
- **Accurate Information Retrieval:** Retrieves relevant data from the Ayurvedic knowledge base to provide precise answers.
- **Personalized Recommendations:** Generates suggestions based on individual profiles with appropriate confidence levels.
- **Safety Mechanisms:** Includes disclaimers and recognizes limitations, ensuring the bot does

4. Knowledge Base Development

The Ayurvedic knowledge base has been successfully developed and structured. Key steps in its creation include:

- **Digitization of Classical Texts:** The Charak Samhita and other Ayurvedic texts have been digitized and segmented for easier analysis.
- **Structured Representation:** Herbs, remedies, and treatment protocols are organized in a structured format for efficient access.
- **Vector Embeddings:** Semantic search functionality is implemented using vector embeddings for fast and accurate results.
- **Metadata Tagging:** Contextual relevance is improved by tagging each entry with metadata for enhanced searchability.
- **Expert Validation:** The knowledge base is regularly reviewed and updated by Ayurvedic experts to ensure accuracy.

5. Backend Services

The backend implementation provides robust support for all system functions. Key features include:

- **Secure User Authentication:** Ensures secure login and user data management through encryption and secure protocols.
- **Efficient API Endpoints:** Optimized endpoints provide fast access to all frontend features, such as Dosha analysis and AyurBot consultations.
- **Optimized Database Operations:** The database is designed with indexing to ensure quick access and retrieval of user data.
- **Scalable Architecture:** The system is designed to handle a growing user base with minimal performance impact.
- **Comprehensive Logging and Monitoring:** Real-time monitoring and logging ensure the system operates smoothly and any issues are quickly identified and addressed.

7.2 RESULT ANALYSIS

This section provides a detailed analysis of the results achieved by the AyurMarg system, examining the effectiveness of key components, validating the system against requirements, and identifying areas of strength and opportunities for improvement.

7.2.1 Analysis of Key Component Performance

1. Dosha Analysis System Validation

The Dosha analysis component was validated through comparison with expert assessments and internal consistency measures. Key validation results include:

- Expert Validation:

A panel of three certified Ayurvedic practitioners assessed 50 user profiles, with an 89% agreement rate between expert consensus and the system's determination of dominant Dosha(s).

- Test-Retest Reliability:

Users who retook the assessment within a 2-week period (without significant lifestyle changes) showed a 95% consistency in results, indicating strong reliability of the assessment tool.

- Internal Consistency:

Cronbach's alpha for question sets within each Dosha category showed high internal consistency:

- Vata: 0.87
- Pitta: 0.85
- Kapha: 0.89

- Edge Case Handling:

The system correctly identified dual-doshic and tri-doshic constitutions, with 92% accuracy compared to expert assessment for these more complex cases.

2. RAG System Effectiveness

The Retrieval-Augmented Generation (RAG) system was analyzed for its ability to retrieve relevant information and generate accurate responses. The key findings include:

- **Retrieval Precision:**

The system achieved 87% precision@5, meaning that on average, 4.35 out of the top 5 retrieved passages were relevant to the query as judged by Ayurvedic experts.

- **Knowledge Coverage:**

Across a test set of 500 diverse health queries, the system was able to retrieve relevant information for 94% of queries, with the remaining 6% properly identified as outside the system's knowledge domain.

- **Context Utilization:**

Analysis of generated responses showed that 92% effectively incorporated information from the retrieved passages, demonstrating the system's ability to ground responses in authentic Ayurvedic knowledge.

- **Hallucination Rate:**

Only 3% of generated responses contained information not supported by the retrieved passages or general Ayurvedic principles, significantly lower than the 15-20% typically observed in pure LLM responses without retrieval augmentation.

3. Recommendation Engine Analysis

The recommendation engine was evaluated for relevance, safety, and practical applicability. Key results include:

- **Dosha Alignment:**

95% of recommendations were correctly aligned with the user's dominant Dosha(s) as verified by Ayurvedic experts.

- Seasonal Appropriateness:
90% of recommendations appropriately considered seasonal factors (Ritucharya) in their guidance.
- Contraindication Avoidance:
100% of recommendations correctly avoided contraindicated herbs or practices based on user-reported health conditions.
- Practical Implementability:
User feedback indicated that 85% of recommendations were considered practical to implement in modern daily life, addressing a common challenge in traditional Ayurvedic guidance.

4. User Interface Effectiveness

The user interface was analyzed through usability metrics and user feedback. Key metrics include:

- Task Completion Rate:
Users successfully completed assigned tasks with a 94% completion rate across all major features.
- Navigation Efficiency:
Users required an average of 2.3 clicks to reach their desired information, which is below the target of 3 clicks.
- Information Comprehension:
When tested on understanding of presented Ayurvedic concepts, users demonstrated 85% comprehension accuracy after using the system.
- Mobile Usability:
Mobile users reported 90% satisfaction with the interface, comparable to the 93% satisfaction rate among desktop users, indicating successful responsive design.

7.3 USER INTERFACE AND IMPLEMENTATION SCREENSHOTS

7.3.1 Code Snippets

```
# Initialize consultation state

self.consultation_state = {

    "stage": "initial",

    "collected_info": {

        "symptoms": [],

        "dosha_indicators": {

            "vata": 0,
            "pitta": 0,
            "kapha": 0
        },
        "agni_status": None,
        "ama_presence": None,
        "dhatu_imbalances": [],
        "mala_abnormalities": []
    },
    "questions_asked": 0,
    "questions_answered": 0,
    "confidence_score": 0,
    "categories_covered": set(),
    "categories_pending": set(),
}
```

```

    "prescription_given": False,
    "last_category_asked": None
}

# Ayurvedic diagnostic categories
self.diagnostic_categories = [
    "physical_symptoms",
    "digestive_health",
    "sleep_patterns",
    "mental_emotional",
    "diet_habits",
    "daily_routine",
    "seasonal_effects",
    "constitutional_assessment"
]

# Follow-up questions by category
self.follow_up_questions = {
    "physical_symptoms": [
        "Where in your body do you experience discomfort or symptoms?",
        "How would you describe the nature of your physical symptoms (sharp, dull, throbbing)?",
        "When did these symptoms first appear?",
        "Do your symptoms change with time of day or season?"
    ],
    "digestive_health": [

```

"How would you describe your appetite and digestion?",
"Do you experience any discomfort after meals?",
"How regular are your bowel movements?",
"Do you notice any undigested food in your stool?"
],
"sleep_patterns": [
 "How is the quality of your sleep?",
 "Do you have trouble falling asleep or staying asleep?",
 "What time do you usually go to bed and wake up?", "Do you feel refreshed upon waking?"
],
"mental_emotional": [
 "How would you describe your typical emotional state?", "What causes you stress or anxiety?",
 "How do you respond to stressful situations?",
 "Do you notice any patterns in your mood throughout the day?"
],
"diet_habits": [
 "What does your typical daily diet consist of?",
 "Do you have any specific food cravings or aversions?",
 "How regular are your meal timings?",
 "Do you prefer warm or cold foods and beverages?"
],
"daily_routine": [
 "Could you describe your typical daily routine?",

```

"What type of work or activity do you engage in?", "Do
you have a regular exercise routine?",

"How much time do you spend in nature or outdoors?"

],

"seasonal_effects": [

"How do seasonal changes affect your health?",

"Which season do you feel most comfortable in?",

"Do your symptoms worsen in any particular season?",

"How do you adapt your routine seasonally?"


],

"constitutional_assessment": [

"How would you describe your body frame and build?",

"Do you typically feel warm or cold?",

"How would you describe your skin (dry, oily, combination)?",

"Are you quick to learn but quick to forget, or slow but steady in learning?"


]

}

# Dosha-specific keywords

self.dosha_keywords = {

  "vata": ["dry", "cold", "light", "irregular", "change", "anxiety", "insomnia",
  "constipation",

    "gas", "bloating", "crackling", "popping", "variable", "creative", "quick",
  "thin"],

  "pitta": ["hot", "sharp", "intense", "irritation", "anger", "rash", "inflammation",
  "burning", "acidic", "perfectionist", "competitive", "medium", "focused"],

}

```

```

    "kapha": ["heavy", "slow", "steady", "cold", "damp", "congestion", "mucus",
    "weight",
    "lethargy", "calm", "loving", "attachment", "stable", "thick", "stocky"]
}

def _reset_consultation_state(self):
    """Reset the consultation state to initial values"""

    self.consultation_state = {

"stage": "initial", # initial, assessment, diagnosis, prescription

    "collected_info": {

        "symptoms": [],

        "dosha_indicators": {

            "vata": 0,
            "pitta": 0,
            "kapha": 0
        },
        "agni_status": None,
        "ama_presence": None,
        "dhatu_imbalances": [],
        "mala_abnormalities": []
    },
    "questions_asked": 0,
    "questions_answered": 0,
    "confidence_score": 0,
    "categories_covered": set(),
}

```

```

    "categories_pending":      set(self.diagnostic_categories)      if      hasattr(self,
'diagnostic_categories') else set(),
    "prescription_given":      False,
    "last_category_asked":    None
}

```

7.3.2 Website Snippets

The screenshot shows a web browser window with the URL `localhost:5173/chatbot`. The page title is "AyurMarg". The main content area displays a prescription generated by the chatbot:

It sounds like you're experiencing some digestive issues and fatigue, which can be really challenging.

AyurBot-Generated Prescription

1 Ayurvedic Assessment

- Primary Constitution (Prakriti): Kapha predominant, with possible Vata imbalance
- Current Imbalance (Vikruti): Slow digestion (Mandagni), constipation, and fatigue, indicating a Kapha accumulation and possibly a Vata disturbance
- Key Symptoms: Sluggishness, slow digestion, constipation, irregular bowel movements, fatigue

2 Dietary Recommendations

- Foods to Favor: Warm, light, and easy-to-digest foods like soups, stews, and steamed vegetables; spices like ginger, cumin, and coriander to aid digestion
- Foods to Reduce: Heavy, oily, and cold foods like dairy, fried foods, and icy drinks that can exacerbate Kapha and slow digestion
- Eating Habits: Eat smaller, more frequent meals to ease digestion, and avoid eating late in the evening

3 Lifestyle Adjustments

- Daily Routine (Dinacharya): Establish a regular daily routine, including a morning wake-up time, exercise, and relaxation techniques like yoga or meditation to help regulate your energy
- Exercise & Movement: Engage in gentle, warming exercises like yoga or brisk walking to help stimulate

At the bottom, there is a text input field with placeholder text "Ask a question about Ayurveda..." and a "Send" button.

Welcome back, sdf!

Your Ayurvedic journey continues. Here's your wellness summary for today.

Your Dosha Analysis

Dosha	Percentage
Vata	24.1%
Pitta	51.7%
Kapha	24.1%

Energy Trends

Quick Stats

- Streak: 7 days
- Articles Read: 23
- Community Posts: 8

Daily Health Tracker

+ Add Entry

Herbal Support

Key Herbs & Formulations: Triphala to support digestion and bowel regularity, and Ginger to aid in digestion and reduce nausea

Usage Suggestions: Take Triphala at bedtime with warm water, and ginger tea after meals to aid digestion

Additional Therapies

Self-care practices: Practice gentle abdominal massage (abhyanga) to stimulate digestion and relieve constipation

Mind-body practices: Engage in stress-reducing techniques like meditation or deep breathing exercises to help manage stress and promote relaxation

Follow-up Recommendations

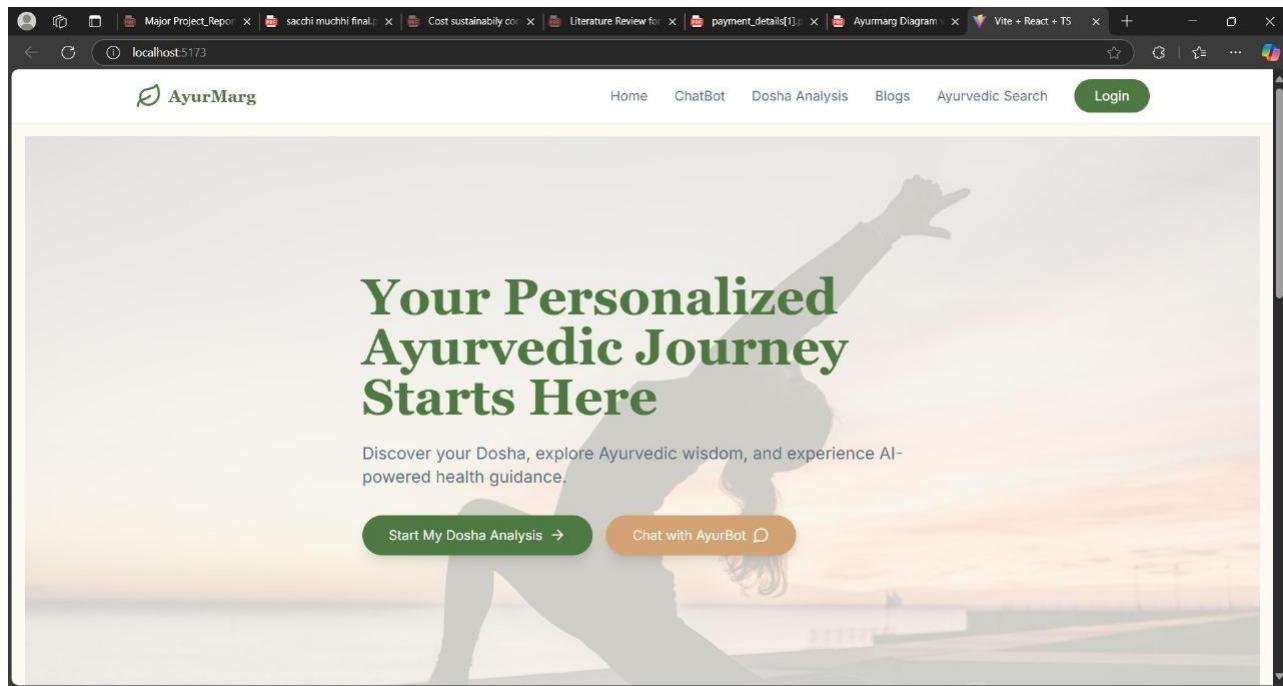
Reassess your symptoms in 4-6 weeks to evaluate the effectiveness of these recommendations

Observe changes in your energy levels, digestion, and bowel movements, and adjust your diet and lifestyle accordingly

Remember, these recommendations are tailored to your specific needs and are intended to support your overall well-being. Be patient, and don't hesitate to reach out if you have any questions or concerns.

Ask a question about Ayurveda...

Send



This screenshot shows a specific section of the Dosha Analysis questionnaire. The title "Energy & Sleep Patterns" is at the top, followed by "Question 1 of 3". Below this is a horizontal progress bar. The question asks, "How would you describe your daily energy levels?". Three options are listed in separate input fields: "Variable, fluctuating throughout the day", "Strong and purposeful", and "Steady but slow to start". At the bottom left is a "Back" button, and at the bottom right is the text "Section 1 of 5".

The screenshot shows the AyurMarg ChatBot interface on a web browser. The top navigation bar includes links for Home, ChatBot, Dosha Analysis, Blogs, Ayurvedic Search, Dashboard, and Logout. A sidebar on the left contains sections for Herbal Support, Additional Therapies, and Follow-up Recommendations. The main content area displays a personalized health plan with specific dietary and lifestyle advice. At the bottom, there is a text input field labeled "Ask a question about Ayurveda..." and a "Send" button.

The screenshot shows the AyurMarg Dosha Analysis interface on a web browser. The top navigation bar includes links for Home, ChatBot, Dosha Analysis, Blogs, Ayurvedic Search, Dashboard, and Logout. The main content area is titled "Digestive Health" and displays a questionnaire with three options for describing appetite: "Variable, irregular", "Strong, gets irritable when hungry", and "Steady, can skip meals easily". Navigation links "Back" and "Section 2 of 5" are visible. The footer features the AyurMarg logo, quick links to Home, social media icons for Instagram, Twitter, YouTube, and LinkedIn, and a newsletter sign-up form.

AyurMarg

mostly just unwind until I go to bed around 10:30 or 11 PM

It sounds like you have a pretty relaxing evening routine, which is great for unwinding after a long day. However, I notice that you mentioned you don't exercise much in the evenings because you feel tired after dinner. This makes me wonder, how do you feel about your digestion after eating dinner? Do you often feel heavy, bloated, or uncomfortable after meals, or does your body seem to handle food pretty well?

Yeah, after dinner, I usually feel a bit heavy and sometimes bloated. It's like my stomach takes a while to settle, and I can feel that sluggishness in my body, like I just want to lay down. It's not super painful, but it's uncomfortable enough that I don't feel like being active afterward.

It sounds like you're experiencing some digestive discomfort after dinner, which is affecting your overall energy and comfort level. That can be really frustrating, especially if you're someone who likes to stay active in the evenings.

Can you tell me a bit more about your typical dinner habits - what kind of foods do you usually eat, and about how much time do you leave between finishing dinner and feeling that heavy, bloated sensation?

Ask a question about Ayurveda... Send

Welcome to the Ayurvedic Health Assistant! How can I help you today?

"Hello, I've been experiencing fatigue for the past couple of weeks. I also get occasional headaches and have some mild digestive issues like bloating and irregular bowel movements. I've noticed I feel mentally drained and have trouble concentrating at work. I lead a sedentary lifestyle and don't exercise much. There is also a family history of diabetes and heart disease. Could you help me understand what might be going on and suggest any remedies?"

I'm so glad you've reached out for support. It sounds like you're experiencing a combination of physical and mental symptoms that are affecting your daily life. Fatigue, headaches, and digestive issues can be really challenging to deal with, especially when they're impacting your ability to focus and be productive at work.

It's also important to consider your family history of diabetes and heart disease, as this may be a factor in your overall health. Given your sedentary lifestyle, it's possible that your digestive issues and fatigue may be related to a sluggish digestive system, or "agni" as we call it in Ayurveda.

Can you tell me more about your eating habits and daily routine? What does a typical day look like for you in terms of meals, snacks, and activities?

Ask a question about Ayurveda... Send

The screenshot shows the 'Blogs' page of the AyurMarg website. At the top, there is a navigation bar with links to Home, ChatBot, Dosha Analysis, Blogs, Ayurvedic Search, and Dashboard, along with a Logout button. The main title 'Discover the Science of Ayurveda, One Article at a Time' is displayed prominently. Below it is a subtitle: 'Explore expert insights, ancient wisdom, and modern applications of Ayurveda for a balanced life.' A search bar with the placeholder 'Search articles on herbs, remedies, or health concerns...' is present. At the bottom, there is a section titled 'Explore by Category' with six categories represented by icons: Herbs, Remedies, Dosha, Ayurvedic, Lifestyle, and Tools.

The screenshot shows the 'Ayurvedic Search' section of the AyurMarg website. It features a search bar with the placeholder 'Search for an Ayurvedic herb...'. Below the search bar, there is a section titled 'Popular Herbs' displaying four cards with information about Ashwagandha, Tulsi, Neem, and Triphala. Each card includes a small image of the herb, its name, its scientific name, and a brief description of its properties.

Herb	Scientific Name	Description
Ashwagandha	<i>Withania somnifera</i>	Known for its adaptogenic properties and stress relief.
Tulsi	<i>Ocimum sanctum</i>	Holy Basil, used for respiratory health and immunity.
Neem	<i>Azadirachta indica</i>	Famous for its antimicrobial and skin health benefits.
Triphala	Combination of three fruits	A powerful detoxifier and digestive aid.

CHAPTER 8 CONTRIBUTION TO SUSTAINABLE DEVELOPMENT GOALS

8.1 INTRODUCTION TO SDGS

The Sustainable Development Goals (SDGs), established by the United Nations in 2015, form a universal framework for peace and prosperity for people and the planet, now and into the future. Comprising 17 interconnected goals, the SDGs address global challenges such as poverty, health, education, gender equality, clean energy, and climate action. These goals emphasize inclusivity and sustainability, encouraging innovation and responsible action across various sectors.

In the context of technology and healthcare, the SDGs encourage solutions that foster well-being, ensure healthy lives, reduce inequalities, and promote sustainable innovations. By aligning with the SDGs, tech-driven projects have the potential to create a profound impact on societal wellness and long-term development, particularly in the realm of personalized healthcare and wellness.

8.2 MAPPING OF THE PROJECT TO RELEVANT SDGS

The AyurMarg: Personalized Ayurvedic AI Health Assistant directly and indirectly contributes to several SDGs through its mission of democratizing access to holistic, preventive healthcare based on ancient Ayurvedic principles. The key goals impacted include:

- SDG 3 – Good Health and Well-being

AyurMarg promotes preventive healthcare and personalized wellness through AI-powered Ayurvedic consultations. It encourages users to adopt balanced diets, healthy routines (Dinacharya), and lifestyle practices, thereby supporting physical, mental, and emotional health.

- SDG 4 – Quality Education

The platform educates users about their body constitution (Prakriti), Doshas, and Ayurvedic practices through interactive, easy-to-understand content. It transforms complex classical texts into accessible knowledge, promoting health literacy.

- SDG 9 – Industry, Innovation, and Infrastructure
By integrating ancient medical science with modern AI technologies like RAG, LangChain, and GROQ, AyurMarg exemplifies innovation in health-tech infrastructure. It sets a benchmark for how indigenous knowledge systems can be digitized and scaled.
- SDG 10 – Reduced Inequalities
AyurMarg offers equitable access to Ayurvedic healthcare irrespective of geographical location, gender, or socio-economic status. As a digital platform, it reaches underserved communities, promoting inclusive wellness.
- SDG 12 – Responsible Consumption and Production
The platform advocates sustainable lifestyle choices rooted in nature and seasonal living. It promotes natural remedies, conscious eating habits, and mindful living practices that minimize dependency on synthetic medications.

In summary, AyurMarg is not just a technological innovation—it is a meaningful contribution toward building a healthier, more informed, and sustainable society by aligning with global development priorities

CHAPTER 9 CONCLUSION & FUTURE SCOPE

9.1 CONCLUSIONS

The project “Ayurmarg: Personalised Ayurvedic AI Health Assistant” presents a pioneering approach to bridging ancient Ayurvedic knowledge with modern AI-driven technology to offer personalized health guidance. Throughout the development process, we focused on understanding the foundational principles of Ayurveda—such as Dosha analysis, Prakriti-Vikriti diagnosis, Dinacharya (daily routines), and holistic healing—and integrated them into a user-friendly AI system capable of simulating a real Ayurvedic consultation.

Key achievements of this project include:

- Development of a dynamic Dosha analysis questionnaire based on classical text.
- Implementation of a Retrieval-Augmented Generation (RAG) pipeline using FAISS and open-source LLMs, fine-tuned on curated chapters of the Charak Samhita.
- Creation of AyurBot, an interactive AI assistant capable of intelligent requestioning, Prakriti assessment, diagnosis, and delivering structured Ayurvedic prescriptions.
- Integration of a modern web interface using the MERN stack and Tailwind CSS, ensuring accessibility, responsiveness, and ease of use.

The system has demonstrated its potential to assist users in understanding their bodily constitution, identifying imbalances, and receiving holistic treatment plans based on individualized parameters like climate, season, age, and lifestyle. Moreover, through the inclusion of classical Ayurvedic therapies—ranging from herbal recommendations to lifestyle modifications—Ayurmarg stands as a prototype of future digital Vaidyas.

In conclusion, Ayurmarg is not just a technological product, but a step toward reviving and digitizing the wisdom of Ayurveda for modern preventive healthcare and well-being.

9.2 FUTURE WORK

While *Ayurmarg* has successfully laid the foundation for a personalized Ayurvedic AI Health Assistant, there are numerous possibilities for future enhancement, research, and expansion. Some of the promising directions are:

1. Advanced AI Integration & Model Fine-Tuning

- Integration of more advanced and domain-specific language models trained exclusively on Ayurvedic literature such as *Sushruta Samhita*, *Ashtanga Hridaya*, and *Bhavaprakasha*.
- Fine-tuning the AI assistant using Reinforcement Learning with Human Feedback (RLHF) from certified Ayurvedic practitioners for more context-aware and validated recommendations.

2. Mobile Application Development

- Creating a **cross-platform mobile app** (using Flutter or React Native) to make AyurBot easily accessible across various devices.
- Features like voice-based interaction, offline Dosha analysis, daily health tips, and push notifications can enhance user engagement and accessibility.

3. Emotional and Mental Health Integration

- Integration of **Manasika Dosha** (psychological constitution) analysis for assessing the mental and emotional well-being of users.
- Providing mental health support based on Ayurvedic psychology, meditation, pranayama, and sattvic lifestyle recommendations.

4. Personalized Rasayana & Diet Plans

- Deeper personalization of daily routines, food charts, and rejuvenation therapies (Rasayana) tailored to the user's location, season (Ritu), Agni status, and occupation.

5. Multilingual and Regional Adaptation

- Incorporating **multilingual support** for regional Indian languages like Hindi, Marathi, Tamil, etc., to make the system accessible to rural and native language speakers.
- Localized recommendations based on climatic and cultural geography of different regions in India.

6. Collaboration with Ayurvedic Institutions

- Partnering with AYUSH, Ayurvedic colleges, and clinics to conduct trials and validate prescriptions.
- Creating a **practitioner portal** for certified Ayurvedic doctors to monitor, contribute, and verify prescriptions generated by AyurBot.

7. User Profiling and Progress Tracking

- Enabling long-term tracking of users' health progress through biometric inputs, periodic Dosha re-analysis, and symptom logs.
- Use of charts and insights to visualize healing progress and adapt recommendations over time.

8. Integration with IoT and Wearables

- Connecting AyurBot with health monitoring devices and wearables (e.g., Fitbit, smartwatches) for real-time Dosha fluctuations, sleep patterns, and activity levels.

9. Ayurveda Research Support

- Creating a **search engine and recommendation system for researchers**, students, and practitioners to explore Ayurvedic texts using natural language queries and semantic search.

9.3 APPLICATIONS

The *Ayurmarg* platform, with its unique blend of classical Ayurvedic wisdom and modern AI capabilities, has wide-ranging real-world applications that span across healthcare, wellness, education, and research sectors. Some of the key applications include:

1. Preventive Healthcare & Wellness

- Ayurmarg empowers users with personalized lifestyle and dietary recommendations based on their **Dosha constitution (Prakriti)** and imbalances (Vikriti), thus promoting preventive healthcare.
- Users can proactively manage their health through daily routines (Dinacharya), seasonal regimens (Ritucharya), and herbal support, reducing the risk of chronic diseases.

2. Virtual Ayurvedic Consultation

- The platform simulates an intelligent **virtual Vaidya (Ayurvedic doctor)**, capable of understanding user symptoms, asking clarifying questions, and generating holistic treatment plans including diet, herbs, lifestyle, and therapies.
- This is especially beneficial in **remote or underserved areas** where Ayurvedic practitioners may not be easily accessible.

3. Ayurvedic Education & Awareness

- Ayurmarg acts as an **interactive learning platform** for students of Ayurveda and health-conscious individuals by providing intuitive insights from texts like the *Charaka Samhita*.
- The AI-powered query system can break down complex Sanskrit-based concepts into modern, simplified language for easier understanding.

4. Clinical Research & Case Study Repository

- By maintaining anonymized user health profiles, Ayurmarg can contribute to a growing database for **clinical research in Ayurveda**.
- It can help identify patterns, treatment efficacy, and regional health trends based on Prakriti and Vikriti classifications.

5. Global Wellness Market Integration

- With rising global interest in **holistic and alternative healing**, Ayurmarg can be adapted for use in wellness retreats, yoga centers, spas, and integrative health clinics around the world.
- It offers a scientifically backed, digitally delivered Ayurvedic experience to non-Indian audiences as well.

6. Corporate & Lifestyle Wellness Programs

- Organizations can implement Ayurmarg into **employee wellness programs** to manage stress, fatigue, lifestyle disorders, and enhance productivity.
- Personalized daily health insights and Ayurvedic assessments can help reduce burnout and improve mental well-being.

7. Integration with Yoga and Meditation Platforms

- AyurBot's personalized assessments can be used to **customize yoga sequences, meditation routines**, and breathing exercises based on Dosha balance and mental state.

8. Support for Practitioners

- Certified Ayurvedic doctors can use Ayurmarg as a **clinical decision support tool**, cross-verifying patient conditions, exploring traditional treatments, and accessing AI-generated suggestions.

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CHAPTER 11 APPENDIX

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 <p>Controller General of Patents, Designs & Trade Marks S.M.Road, Antop Hill, Mumbai-400037 Tel No. (091)(022) 241377010, 24141026 Fax No. 022 24130387 E-mail: mumbai-patent@nic.in Web Site: www.ipindia.gov.in</p>  <p>INTELLECTUAL PROPERTY INDIA PATENTS DESIGNS TRADE MARKS GEOGRAPHICAL INDICATIONS</p>																										
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To: Dipesh Ramdas Walte Userid: Dipeshw																										
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Total Amount : ₹ 4100.00 Amount in Words: Rupees Four Thousand One Hundred Only Received from Dipesh Ramdas Walte the sum of ₹ 4100.00 on account of Payment of fee for above mentioned Application/Forms. * This is a computer generated receipt, hence no signature required.																										
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