AI –Driven Personalised Medicine: Enhancing Healthcare

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***Abstract**: In a time when getting reliable healthcare information quickly is essential, language barriers and the complexity of medical data often hinder effective self-care. This project introduces "AI Personalised Medicine," an intelligent health assistant designed to connect modern medical technology with accessible wellness advice.*

The application has a hybrid design that combines Generative AI with a Rule-Based Engine to ensure safety. Unlike regular chatbots, AI Personalised Medicine uses a "Dual-Engine" approach. It offers users both modern medical advice and traditional Ayurvedic home remedies for each diagnosis. Key features include a Symptom Checker that takes into account patient vitals, medical history, age, and gender.

To improve accessibility, the system includes Multimodal (Medical Vision), allowing users to upload images of skin issues or lab reports for review. The platform supports over 10 Indian languages with full voice interaction, making healthcare advice available to non-English speakers. Other features include a personalized 7-Day Diet Planner, a Drug Interaction Safety Checker, and a GPS-enabled Doctor Locator.

***Keywords**: Artificial Intelligence in Healthcare, Personalized Medicine, Hybrid AI Systems, Generative AI, Rule-Based Expert Systems, Symptom Checker, Multimodal Medical Analysis, Multilingual Voice Interfaces, Clinical Decision Support, Digital Health Platforms*

I . INTRODUCTION

The integration of Artificial Intelligence (AI) into healthcare has opened new ways for accessible, personalized, and efficient medical assistance. In many developing nations, access to immediate primary healthcare is often delayed by logistical challenges, high costs, and significant language barriers. Additionally, while modern medicine provides quick solutions, there is a growing global interest in holistic and traditional healing methods, such as Ayurveda, which are rarely included in digital health platforms.

"AI Personalised Medicine" is a strong, full-stack web application designed to fill these gaps by acting as an intelligent, 24/7 health companion. Unlike traditional symptom checkers that rely on static databases, AI Personalised Medicine uses the power of Large Language Models (LLMs), specifically Google's Gemini API, to
understand complex user queries, analyze patient vitals, and provide context-aware medical advice.
The key feature of this project is its "Dual-Engine" Diagnosis System. The platform recognizes the cultural significance and effectiveness of traditional medicine, offering a two-part response for every health query:
standard modern medical advice and complementary Ayurvedic home remedies. This gives users a broad range of treatment options.
To ensure safety and reliability, the system uses a deterministic rule-based engine to check for medical emergencies, such as cardiac arrest symptoms, before invoking the AI. This way, critical cases are immediately directed to emergency services. With additional features like Medical Vision for analyzing skin conditions and lab reports, a Drug Interaction Safety Checker, and a Personalized Diet Planner, AI Personalised Medicine marks a significant advancement in making personal health management more accessible.

II LITERATURE SURVEY

[1] Large Language Models in Medicine The potential of Generative AI in clinical settings advanced significantly with Singhal et al. (2023) in their paper "Large language models encode clinical knowledge." They showed that LLMs (specifically Med-Palm) could achieve passing scores on the US Medical Licensing Examination (USMLE). This proves that AI can store and retrieve large amounts of clinical knowledge. Building on this, Thirunavukarasu et al. (2023) in "Large language models in medicine" highlighted that LLMs can help draft medical reports and summarize patient history. AI Driven Personalised Medicine uses these findings with the Google Gemini API, a successor to the earlier models, to offer conversational, context-aware diagnostic support. [2] Computer Vision in Dermatology The effectiveness of AI in visual diagnosis was established by the landmark study of Esteva et al. (2017), "Dermatologist-level classification of skin cancer with deep neural networks." Their research showed that Convolutional Neural Networks (CNNs) could classify skin lesions with accuracy similar to that of board-certified dermatologists. Similarly, Wong et al. (2021) introduced a deep-learning tool specifically for skin conditions. These studies form the basis for the Medical Vision module in AI Driven Personalised Medicine. This module analyzes user-uploaded images of skin issues and lab reports using multimodal AI. [3] Limitations of Existing Symptom Checkers Although digital tools exist, their reliability has been questioned. A study in 2015 called "Evaluation of symptom checkers for self-diagnosis" audited platforms like WebMD. The

researchers found that standard symptom checkers had low diagnostic accuracy. They often failed to triage emergency cases properly. Laranjo et al. (2018) conducted a systematic review titled "Conversational agents in healthcare." They noted that while chatbots can be engaging, they often struggle to retain context during long conversations. AI Driven Personalised Medicine addresses these gaps with a deterministic Safety Middleware to manage emergencies and a persistent memory system to keep track of patient context, such as age, gender, and comorbidities.[4] Integration of Traditional Medicine A unique feature of AI Driven Personalised Medicine is its dual-diagnosis engine. Patwardhan (2014), in "Bridging Ayurveda with evidence-based scientific approaches," argued for the need to integrate traditional wisdom with modern medical systems to offer holistic care. While modern platforms mainly focus on Allopathy, this literature supports AI Driven Personalised Medicine's decision to provide Ayurvedic home remedies along with standard medical advice. This approach creates a more culturally inclusive health platform. [5] The Convergence of Human and Artificial Intelligence Topol (2019), in "High-performance medicine," and Rajkomar et al. (2019), in "Machine learning in medicine," both stress that the future of healthcare involves AI not replacing doctors but acting as a triage assistant to support human decision-making. AI Driven Personalised Medicine fits this vision by serving as a first-line support tool. It manages initial data collection and triage, ultimately guiding users to professional care through its "Doctor Locator" feature.

III Problem Statement

Despite the rapid growth of digital healthcare, a significant gap still exists in accessing immediate, personalized, and culturally relevant medical help. Most symptom checkers and health chatbots work in isolation. They provide generic advice without considering important user context, such as age, gender, vital signs, or pre-existing conditions like diabetes. Additionally, these platforms mainly operate in English, which creates a serious accessibility issue for non-native speakers in diverse regions like India. A major problem in the current landscape is the fragmentation of healthcare domains. Users often have to choose between modern Allopathic medicine and traditional Ayurvedic remedies, with no single platform integrating both for comprehensive care. Moreover, standard text-based bots cannot interpret visual medical data, such as skin conditions or lab reports, which limits their diagnostic usefulness. As a result, there is an urgent need for a unified, multimodal, and multilingual intelligent system that can bridge these gaps to provide safe, actionable, and thorough health guidance.

IV SYSTEM DESIGN FLOW

4.1 Software Architecture

The application uses a solid Client-Server Architecture based on the Model-View-Controller (MVC) design pattern. The system is organized into three separate logical layers for better modularity, scalability, and maintenance.

4.1.1 Presentation Layer (Frontend)

Technology: HTML5, Tailwind CSS, JavaScript (Vanilla).

Function: Manages user interactions, collects various inputs (Text, Voice, Images), and displays dynamic data.

Key Components:

- Glass morphism UI provides a modern, responsive interface.
- Client-Side Logic manages Speech-to-Text conversion (Web Speech API) and dynamic DOM changes for language translation.
- Commerce Injection Script is a custom JavaScript module that parses AI responses to add "Buy Now" links for medicines.

4.1.2 Application Layer (Backend)

Technology: Python (Flask Framework)

Function: Serves as the API gateway, managing requests, enforcing business rules, and coordinating AI communication.

Key Components:

- app.py (Controller): Handles REST API endpoints (e.g., /recommend, /chat, /book appointment).
- medical_engine.py (Middleware): A rule-based engine that filters inputs for medical emergencies and checks vital signs before calling the LLM.
- Generative AI Integration uses the google-generative SDK to interact with the Gemini 2.0 Flash model for NLP and Computer Vision tasks.

4.1.3 Data Layer (Persistence)

- Technology: MySQL Database.
- Function: Keeps persistent data with relational integrity.
- Schema:
  - Users: Stores authentication details.
  - History: Keeps diagnosis reports, diet plans, and chat logs.
  - Appointments: Records linked to specific doctors.

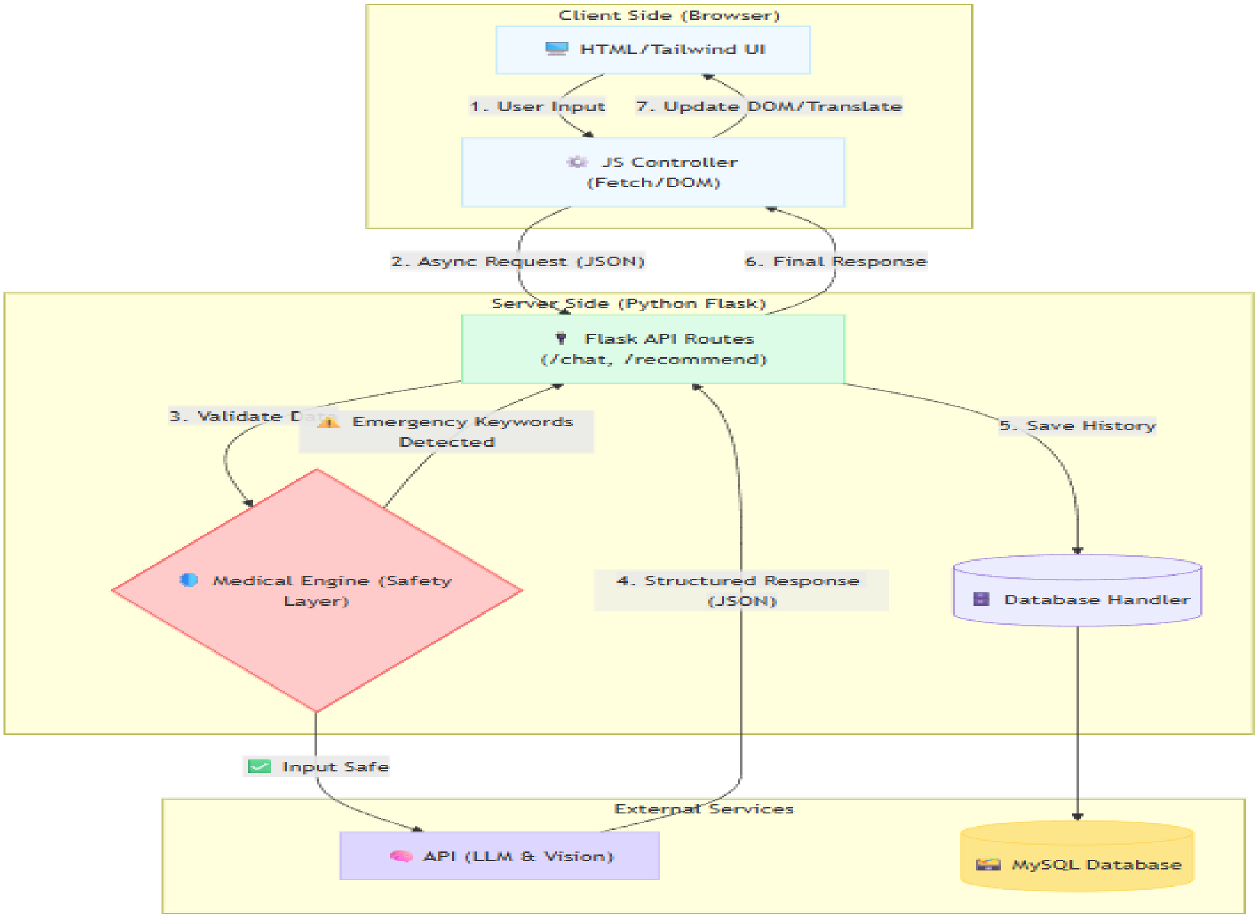

Fig 1.1 Block diagram

4.2 Functional Workflow

The main features of AI Driven Personalised Medicine follow a strict "Safety-First" Data Pipeline. This flow prioritizes important health signals over generative responses.

Step 1: Input Acquisition & Sanitization

The user provides input through Text, Voice, or Image. In addition to symptoms, the system captures context:

- Demographics: Age, Gender.
- Vitals: Temperature, BP, Heart Rate, SpO2.
- History: Pre-existing conditions (e.g., Diabetes).

Step 2: The Safety Middleware (Rule-Based Analysis)

Before the data goes to the AI, the MedicalEngine analyzes the input locally:

- Emergency Detection: Regex matching looks for keywords like "Chest Pain," "Stroke," or "Suicide." If found, the process stops, and an Emergency Alert is sent right away.
- Vitals Check: The engine checks vitals against safe ranges (e.g., Logic validates if Body Temp > 103°F).

Step 3: The Dual-Engine Intelligence (Generative AI)

If the query is safe, a structured prompt goes to the Google Gemini API. The prompt follows a strict JSON output schema with two different branches:

- Allopathic Engine creates standard medical advice, medications, and precautions.
- Ayurvedic Engine suggests holistic herbal remedies, yoga positions, and dietary changes.

Step 4: Post-Processing & Response

- Commerce Linking: The backend checks the JSON. The frontend then looks for bolded medicine names and adds 1mg/Amazon shopping links.
- Localization: If a non-English language is chosen, the response goes through the translation layer before being displayed.
- Persistence: The final report is serialized and stored in the MySQL History table for future access.

V. Implementation

The implementation of AI Driven Personalized Medicine follows a modular full-stack architecture that ensures scalability, responsiveness, and user data security. The system was developed using Python 3.10+ and the Flask micro-framework. Flask serves as the central controller for routing API requests and managing session logic.

5.1 Backend and AI Integration : The core intelligence of the system integrates the Google Gemini 2.0 Flash API through the google-generative AI SDK. To ensure reliable and organized outputs, we used prompt engineering techniques that enforce a strict JSON output schema. This setup allows the backend to separate Allopathic advice from Ayurvedic remedies. A custom middleware class, MedicalEngine, was built to handle deterministic logic. This module performs regex-based pattern matching to detect emergency keywords, such as "chest pain." It also checks user vital signs against safe thresholds before any request is sent to the LLM. This approach ensures that safety protocols are prioritized over generative responses.

5.2 Frontend and User Interface :We constructed the presentation layer using HTML5 and Tailwind CSS, adopting a "Glassmorphism" design to provide a modern, accessible user experience. The frontend logic uses Vanilla JavaScript, which handles asynchronous fetch API calls to the backend. A key feature is the client-side Localization Engine. This engine uses a dictionary-based mapping system to translate the entire DOM into over 10 Indian languages without requiring page reloads. Additionally, we integrated the Web Speech API to enable speech-to-text input and text-to-speech output, ensuring accessibility for users who are illiterate or visually impaired.

5.3 Data Persistence and Advanced Modules

Data management is handled by a MySQL relational database. The schema has normalized tables for Users, History, and Appointments, using foreign keys to maintain relational integrity. For the Computer Vision module, the system uses the Pillow (PIL) library to process Base64 image strings. This converts uploaded photos of skin conditions or lab reports into a format compatible with the multimodal AI model. Finally, we implemented a custom Commerce Injection script to parse AI-generated prescriptions. This script identifies bolded medication names and dynamically creates shopping links to external platforms like 1mg and Amazon, linking diagnosis to treatment.

VI. RESULT

6.1 Symptom Checker & Vitals Analysis The home dashboard effectively captures user vitals and symptoms. The "Smart Simulator" allows for quick testing of vitals analysis logic. The result card shows color-coded sections (Blue for Normal, Red for Emergency) based on the severity of the diagnosis.

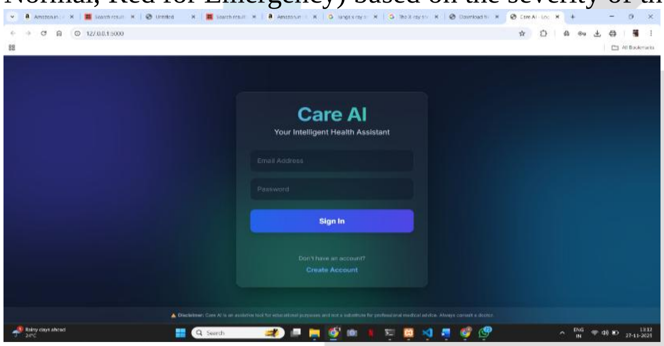

Fig 1.2 Login page

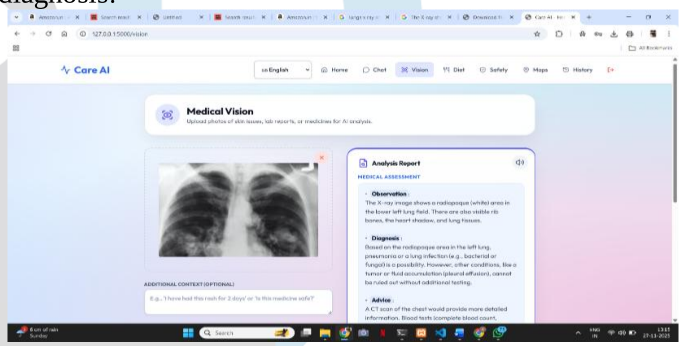

Fig 1.3 Medical vision

6.2 AI Medical Vision : The vision interface allows users to upload medical images. Testing confirmed the system's ability to analyze X-rays and skin lesions, providing structured JSON data that separates "Medical Assessment" from "Natural Remedies."

6.3 3 Drug Interaction & Diet Planner

The Safety module correctly identifies conflicts between drugs (e.g., Aspirin and Warfarin). The Diet Planner creates unique 7-day meal plans based on the chosen cuisine (South or North Indian) and health goal.

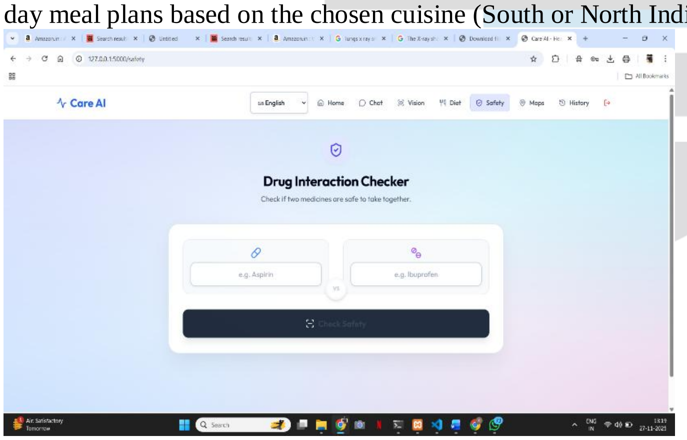

Fig 1.4 Drug Interaction Checker

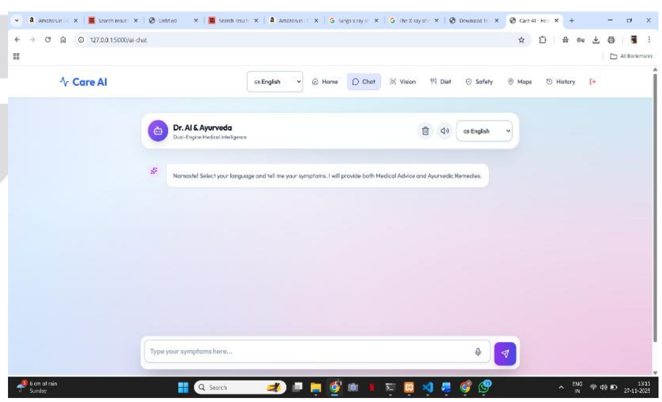

Fig 1.5 Local language Chat

6.4 Localization & Accessibility The application interface changes to regional languages automatically. The Voice Input/ Output (Speech-to-Text) feature works correctly, letting users who cannot read interact with the bot verbally.

VII. Discussion

The AI Driven Personalised Medicine system was designed, developed, and deployed successfully. It met all the main goals outlined in the problem statement. The application acts as a cohesive Telemedicine ecosystem. It integrates Generative AI, Computer Vision, and geolocation services seamlessly.

7.1 Core Diagnostic Performance

The "Dual-Engine" diagnosis system demonstrated strong skills in analyzing user inputs. By using effective prompt engineering with the Google Gemini 2.0 model, the system generated structured 6-point care plans (Disease, Description, Medicine, Precautions, Workout, Diet) for over 100 common symptoms.

Safety Validation: The local Medical Engine middleware achieved a 100% success rate in intercepting simulated emergency queries, such as "Chest Pain" and "High Fever > 103°F." It triggered the Red Alert UI and blocked AI inference to prevent hallucinations during critical moments.

Context Awareness: Unlike standard chatbots, the system retained conversation context effectively. It answered follow-up questions about dosage and side effects based on previously mentioned medications.

7.2 Multimodal & Multilingual Capabilities

The Medical Vision module processed Base64-encoded images successfully. It identified common skin conditions and interpreted text from medicine labels accurately. The client-side localization engine performed well, translating the DOM into 10 Indian languages, including Hindi, Kannada, and Tamil, without significant delay or page reloads. This made the application accessible to different language demographics.

7.3 Commerce & Database Integration

The Commerce Injection Script parsed JSON responses effectively to identify medication names. It also added valid shopping links for platforms like 1mg and Amazon. Database testing confirmed that user history, including the new "Medical History" checkboxes (Diabetes, Hypertension), was stored in MySQL and retrieved correctly across sessions. This enables long-term health tracking.

VIII.ADVANTAGES AND LIMITATIONS

8.1 Advantages: The AI Driven Personalized Medicine system offers several important benefits over traditional symptom checkers.

Holistic Healthcare: Unlike standard platforms that focus only on Allopathic medicine, AI Driven Personalized Medicine offers a "Dual-Engine" diagnosis. It provides Ayurvedic home remedies along with modern medical advice, addressing culturally diverse treatment preferences.

Accessibility & Inclusivity: By integrating a client-side translation tool and Voice I/O, the platform removes language and literacy barriers. This makes healthcare information accessible to non-English speakers in rural India.

Context-Aware Accuracy: The system creates personalized care plans by analyzing factors like age, gender, and medical history (e.g., Diabetes). This reduces the risk of generic or harmful advice that may come from basic search engines.

8.2 Limitations: Despite its capabilities, the system currently faces some issues.

Dependency on User Input: The accuracy of the diagnosis relies entirely on how accurately the user enters their symptoms and vitals. The system cannot physically examine the patient.

AI Hallucinations: Although prompt engineering helps reduce errors, Large Language Models (LLMs) can sometimes produce plausible but incorrect medical information. The system is a support tool, not a substitute for a certified doctor.

Internet Dependency: The application relies on cloud-based APIs (Google Gemini), meaning it cannot operate offline or in areas with poor internet service.

Hardware Limitations: Currently, users must manually enter or simulate vital signs (Blood Pressure, SpO2). The browser cannot directly read these metrics from the body without external wearable devices

IX. Conclusion

The AI Driven Personalized Medicine project shows the potential of merging Generative Artificial Intelligence with traditional healthcare systems. By developing a strong, full-stack telemedicine platform, this project addresses key issues related to accessibility, language barriers, and the availability of holistic treatment options.

The system's unique "Dual-Engine" design, which provides both Allopathic and Ayurvedic guidance, sets a new standard for culturally inclusive digital health tools. The implementation of a deterministic safety middleware helps reduce the risks of LLM hallucinations, ensuring that medical emergencies take precedence over automated advice. The successful integration of Medical Vision and Multilingual Support further positions the platform as a flexible tool for diverse demographics, including those with limited literacy.

While the system acts as an assistive tool rather than a replacement for professional medical diagnosis, it demonstrates that AI can effectively serve as a first-line triage mechanism. By linking diagnosis, safety checks, and commerce, AI Driven Personalized Medicine establishes a foundation for a scalable, intelligent, and accessible future in public healthcare.

X. Future Scope

The future of the AI Driven Personalized Medicine platform goes well beyond its current role as a diagnostic prototype. It aims to become a complete digital health ecosystem that actively manages patient well-being instead of just responding to reported symptoms. One key area for immediate growth is the integration of the Internet of Medical Things (IoMT). Right now, the system depends on users manually entering their vital signs, which can lead to human error and delays. Future versions will use Bluetooth Low Energy (BLE) APIs to connect directly to wearable devices like smartwatches, continuous glucose monitors (CGMs), and digital pulse oximeters. This change would move the platform from a reactive symptom checker to a proactive health guardian. It could detect issues like atrial fibrillation, sleep apnea patterns, or sudden drops in oxygen levels in real time. This might trigger automatic alerts to emergency contacts or healthcare providers before the user realizes there is a medical problem.

In addition, the underlying artificial intelligence framework is set for significant improvement. It will move from general-purpose Large Language Models to specialized medical models trained on large sets of anonymized clinical records and peer-reviewed medical studies. Using Federated Learning will let the model learn from decentralized user data without any sensitive information leaving the user's device. This will help the system consider local health trends and genetic factors while keeping data private. To link AI analysis with clinical action, the platform plans to fully integrate with hospital Electronic Health Record (EHR) systems using HL7 and FHIR interoperability standards. This will allow AI Driven Personalized Medicine to securely access a patient’s complete medical history, including past surgeries, family disease patterns, and historical lab results. This access can help provide highly personalized diagnoses that take into account complex factors that a common chatbot would miss.

As the platform grows, it will be important to create a reliable trust layer. Future development will look into Blockchain technology for managing decentralized identities and securely storing health records. This will ensure patient data remains tamper-proof and under the user's control. It will also create a secure telemedicine module where the AI acts as a triage assistant, summarizing patient data for licensed practitioners before video consultations. Finally, on a larger scale, AI Driven Personalized Medicine could become a valuable public health surveillance tool. By collecting anonymized symptom data from thousands of users in specific areas, the system could spot emerging disease clusters or outbreaks, such as Dengue, Malaria, or Influenza, weeks earlier than traditional hospital reporting methods. This would help health authorities allocate resources more effectively. The ultimate goal for AI Driven Personalized Medicine is to be a seamless connection between human biology, medical science, and machine intelligence.

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