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NUTRI COACH AI

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Abstract - Nutri Coach AI is an innovative, AI-powered nutrition assistant that democratizes access to personalized, genetically informed health coaching. The system automates the interpretation of genetic testing reports (Nutri DNA PDFs) through a multi-stage pipeline: PDF extraction using `pdf plumber`, data cleaning & normalization, rule-based genetic interpretation via a YAML knowledge base, and integration of Large Language Models (LLM) for intelligent reasoning and contextual explanations. This hybrid approach combines the transparency of rule engines with LLMs' nuanced capabilities, generating four personalized outputs—Nutrition Plans, Fitness Recommendations, Supplement Protocols, and Lifestyle Modification. Nutri Coach AI empowers individuals, fitness coaches, and healthcare providers to translate complex genetic insights into actionable, evidence-based nutrition and lifestyle interventions—addressing limitations of generic apps and costly traditional services. The project delivers a fully functional web application, robust API, comprehensive documentation, and validation methodologies to guarantee clinical accuracy and user trust.

Key Words: Large Language Models (LLM), YAML

1.INTRODUCTION

Over the past decade, genetic testing has moved from specialized research laboratories into mainstream consumer health. Today, an individual can submit a simple saliva or cheek- swab sample and receive a detailed report describing how specific genetic variants influence nutrient metabolism, food sensitivities, exercise response, and risk of lifestyle- related diseases. Tests such as Nutri DNA and similar genomic wellness panels analyses dozens of genes associated with vitamin absorption, fat and carbohydrate processing, oxidative stress, appetite regulation, and fitness traits. These tests promise "personalized nutrition" based on DNA, aligning with the broader shift toward precision medicine and individualized health care.

2.PROBLEM STATEMENT

Personalized nutrition and health optimization are critical in combating rising lifestyle diseases, but millions lack access to science-based guidance due to complex genetic reports, scarce expert nutritionists, and static testing services. Existing solutions fail to provide continuous, adaptive support, increasing the risk of poor health outcomes.

The motivation behind Nutri Coach AI is to bridge the gap between genetic science and practical health decisions, making personalized nutrition guidance accessible to everyone. With the rise of lifestyle diseases and limited access to expert nutrition advice, there's a pressing need for innovative solutions that provide tailored health recommendations. qualified nutritionists or genetic counsellors, making it difficult to interpret genetic reports and make informed health decisions. Generic solutions often fail to account for individual genetic variations, leading to ineffective or even harmful recommendations. Nutri Coach AI aims to democratize access to personalized nutrition guidance, empower individuals to take control of their health, provide actionable, evidence-based recommendations, and bridge the gap between genetic science and practical health decisions, ultimately making a positive impact on public health.

3. LITERATURE REVIEW

Nutrigenomics and personalized nutrition science and concept, journal of nutrition issue in 2008. lay the scientific foundation of nutrigenomics, investigating how genetic variations affect nutrient metabolism and influence health outcomes like obesity or diabetes. They emphasize translating genetic insights into practical, individualized dietary recommendations. The studies use genomic analysis and epidemiological data to link specific gene-nutrient interactions with personalized nutrition strategies. Their findings highlight the need for actionable, genetically informed nutrition plans to optimize health [1].

AI in Precision Medicine. discusses the integration of artificial intelligence with human expertise to advance high-performance medicine, focusing on data-driven diagnostics and treatment and explores machine-learning techniques applied to precision medicine for individualized

patient care. examines AI's role in patient-specific drug design. The methodologies involve advanced AI algorithms and large medical datasets to improve predictive health models and personalized interventions [2].

Extracting information from textual documents in the health record. review NLP methods for extracting structured information from unstructured textual documents in electronic health records and describe NLP's evolution from bedside applications to broader medical text analysis, enabling automated interpretation of clinical narratives. The semantic analysis to process medical reports and derive techniques include text mining, entity recognition, and actionable insights to process medical reports and derive actionable insights [3].

Large Language models in medicine. it investigates how large language models redefine diagnostic support by processing complex medical queries and generating clinical insights. technical report outlines the use of LLMs to accelerate precision medicine through sophisticated language understanding and reasoning. The approach leverages transformer-based models to interpret medical data and provide contextual explanations for clinical decisions [4].

Automated Medical Report Generation present a conditioned transformer model for automatically generating radiology reports from imaging data. And introduce a cross-modal augmented transformer for medical report generation, combining visual and textual data. The methods employ deep learning architectures to synthesize structured medical reports, inspiring similar techniques for personalized nutrition report generation [5]

Clinical Decision Support Systems (CDSS) and their role in improving modern healthcare delivery. CDSS are intelligent systems designed to assist healthcare professionals in making accurate, evidence-based clinical decisions by analyzing patient data and medical knowledge. The literature highlights that CDSS significantly enhances diagnostic accuracy, treatment planning, and patient safety by providing real-time recommendations. These systems integrate electronic health records (EHR), clinical guidelines, and predictive analytics to support physicians in identifying diseases early and suggesting appropriate interventions. As a result, CDSS helps reduce medical errors and improves overall healthcare outcomes [6].

Artificial intelligence in delivering personalized dietary recommendations. The paper emphasizes how AI techniques such as machine learning and data-driven models can analyse individual health data, dietary patterns, and lifestyle factors to generate customized nutrition plans. It highlights the effectiveness of AI in improving dietary adherence and health outcomes by offering precise, real-time recommendations tailored to user needs. Additionally, the study discusses the integration of large datasets and predictive analytics to enhance decision-making in nutrition systems. However, it also identifies challenges such as data privacy concerns, model accuracy, and the need for high-quality datasets. Overall, the research demonstrates that AI-driven personalized nutrition systems have strong potential to transform traditional dietary practices into more adaptive and individualized healthcare solutions [7].

Modern application development frameworks used for deploying healthcare 1solutions. The literature highlights how tools like Fast API and Pedantic enable the creation of high-performance, scalable, and efficient APIs for healthcare applications. It emphasizes the importance of rapid development, data validation, and seamless integration when building systems such as personalized nutrition platforms. The study also discusses how these technologies support real-time data processing, secure handling of medical information, and easy deployment across platforms. Furthermore, it underlines the role of developer-friendly frameworks in accelerating innovation and improving the reliability of digital health systems. Overall, the paper demonstrates that leveraging modern backend technologies is essential for building robust, scalable, and efficient AI-driven healthcare applications [8].

Machine learning and genomic data analysis in personalized medicine and nutrition. The literature highlights how advanced computational models can analyze large-scale genomic datasets to identify individual genetic variations that influence dietary responses and health outcomes. It emphasizes the role of AI in enabling precise, data-driven dietary recommendations tailored to an individual's genetic profile. Additionally, the studies discuss the growing importance of predictive analytics in early disease detection and prevention. However, challenges such as data complexity, need for large and diverse datasets, and integration into clinical practice are also noted. Overall, the research demonstrates that combining nutrigenomics with machine learning has significant potential to enhance personalized healthcare and optimize nutrition strategies [9].

Ethical and legal considerations in nutritional genomics and personalized nutrition. The literature highlights key concerns such as data privacy, informed consent, and the responsible use of genetic information, especially in direct-to-consumer genetic testing services. It emphasizes the risks of misinterpretation of genetic data and the potential for misuse or discrimination if proper regulations are not followed. The authors also discuss the need for clear guidelines, transparency, and regulatory frameworks to ensure safe and ethical implementation of personalized nutrition technologies. Furthermore, the importance of educating consumers and healthcare professionals about the limitations and implications of genetic-based dietary recommendations is stressed. Overall, the paper underscores that while nutritional genomics offers significant benefits, ethical and legal safeguards are essential for its trustworthy and effective application [10].

4.METHODOLOGY

The system follows a structured pipeline to convert genetic data into a personalized nutrition plan using artificial intelligence. It begins with a Nutri DNA report provided in PDF format, which contains raw genetic information about an individual. This data is unstructured and not directly usable, so the first step involves extracting meaningful information from it. A specialized component reads the PDF, processes its contents, and identifies the most important genes related to nutrition and health. Typically, around ten priority genes are

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selected based on their impact on metabolism, nutrient absorption, and potential health risks. Each of these genes is then associated with specific traits and categorized into risk levels such as low, medium, or high. Once the relevant genetic information is identified, it is converted into a structured format like JSON. This structured data makes it easier for the system to process and ensures compatibility with AI models. The JSON file acts as a bridge between the data extraction phase and the intelligent processing phase. The. In the next stage, the structured genetic data is analyzed using an AI-based system. A dedicated client module reads the JSON file and sends the gene-related information to an advanced AI model.

The model interprets the genetic traits and risk factors using its knowledge of nutrition science and health analytics. Based on this analysis, it generates a highly personalized nutrition plan tailored to the individual's genetic profile. This plan may include dietary recommendations, suggested foods, nutrient intake guidelines, and lifestyle advice. Finally, the generated nutrition plan is delivered trousers through different platforms such as command-line tools, web applications, or mobile applications. It can also be deployed using frameworks that allow interactive and scalable usage. This ensures that the system is flexible and accessible to both developers and general users.

Overall, this methodology demonstrates how raw genetic data can be transformed into meaningful, personalized health recommendations through data extraction, structured processing, and AI-driven analysis.

Freemium Layer:

The freemium AI coaching layer provides basic nutrition guidance by processing the extracted genetic data and generating simple, generalized recommendations. It uses a lightweight AI model to analyses key gene traits and present easy-to-understand diet and lifestyle suggestions. To improve accessibility, this layer also supports multiple Indian languages, allowing users to view insights in their preferred regional language. This layer is designed to give users an initial understanding of their health insights, but the level of personalization and depth remains limited.

Premium Layer & Payment Gateway:

The premium AI coaching layer offers advanced and highly personalized recommendations using a more powerful AI model. It performs deeper analysis of genetic data and generates detailed, customized daily meal plans and exercise routines tailored to the user's health profile and goals. The platform also supports multiple Indian languages in the premium layer, ensuring a more inclusive and user-friendly experience. Access to this layer is controlled through a payment gateway, where users can upgrade from freemium to premium by selecting flexible subscription plans such as 1-month, 3-month, 6-month, or 12-month options. Once the payment is completed, the system grants access to enhanced features and routes the user's requests to the premium AI model, enabling continuous, personalized guidance and dynamic health recommendations.

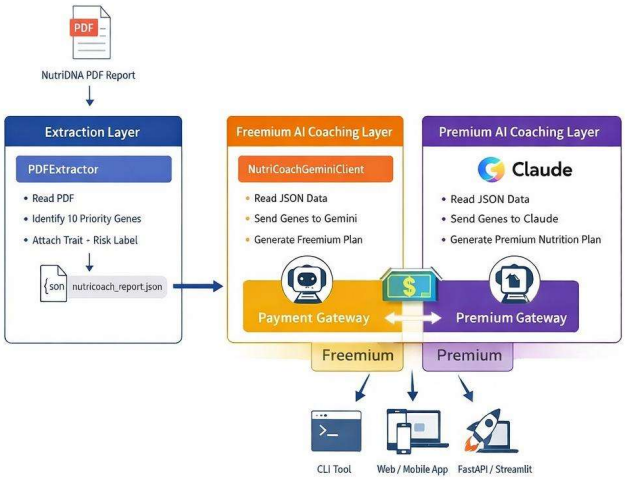

Fig 1: Block diagram

5. IMPLEMENTATION

1.Dataset Requirements

The Nutri Coach AI system depends on multiple datasets to generate accurate and personalized health recommendations. These datasets act as the core knowledge base of the system.

a) Genetic Dataset

This is the primary input to the system. Users upload their genetic reports in PDF format. These reports contain important biological information such as gene names, SNPs (Single Nucleotide Polymorphisms), and genetic variations.

The system extracts this data using a PDF extraction module. This dataset is essential because all recommendations (diet, fitness, supplements) are based on the user's genetic profile. For example, a gene related to metabolism may indicate how a person processes fats or carbohydrates.

b) Food and Nutrition Dataset

This dataset contains detailed information about different food items and their nutritional values. It is usually stored in JSON or CSV format.

Each food item includes attributes such as calories, protein, carbohydrates, fats, vitamins, and minerals. This dataset helps the system generate personalized meal plans based on the user's genetic needs. For instance, if a user has a vitamin deficiency, the system recommends foods rich in that nutrient.

c) Rule-Based Dataset

The rule dataset is stored in a YAML file (rules') and contains predefined mappings between genes and health recommendations. Each rule defines a relationship such as: If a specific gene variant is present → suggest a dietary change or lifestyle modification.

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d) Fitness Dataset

This dataset includes information about various exercises, such as:

Type of exercise (cardio, strength training) Calories burned

Difficulty level Duration: It helps generate customized fitness plans based on the user's genetic traits, such as endurance, muscle strength, or injury risk.

e) Supplement Dataset

This dataset includes details about vitamins, minerals, and dietary supplements. It contains:

Supplement names Recommended dosage Health benefits

The system uses this dataset to recommend supplements when genetic analysis indicates deficiencies or health risks.

2. Models Used

Nutri Coach AI uses a combination of simple logic-based models and advanced AI models to provide intelligent outputs.

a) Rule-Based Model

This is a deterministic model that uses predefined "if-then" rules stored in the YAML file. Example:

IF gene = "FTO variant" → THEN recommend low-fat diet This model ensures reliability and accuracy because it follows scientifically defined relationships. It is fast and does not require training like machine learning models.

b) Large Language Model (LLM)

An LLM (such as GPT-based models) is used to enhance the system with human-like understanding and explanation.

Functions of LLM:

Interprets genetic results in simple language

Generates personalized diet and lifestyle explanations Acts as a chatbot to answer user queries This makes the system interactive and user-friendly.

c) Recommendation System

The recommendation system combines outputs from: Genetic data

Rule engine

Food and fitness datasets It generate:

Meal plans Workout routines

Supplement suggestions

This system is mostly logic-based but can be enhanced with AI Techniques for better personalization.

Nutri Coach AI follows a freemium–premium architecture for personalized nutrigenomic guidance. The freemium module employs Gemini to interpret genetic reports and generate basic recommendations regarding supplements, food choices, exercise, and lifestyle modifications. The premium module integrates Claude Sonnet 4.6 to deliver comprehensive daily diet and exercise plans, accessible through paid subscription options of 1 month, 3 months, 6 months, and 1 year. In addition, the platform is being extended with support for multiple Indian local languages to improve usability and regional accessibility.

3.Python Libraries

Python libraries play a crucial role in implementing different modules of the project.

a) Data Processing Libraries

pandas: Used for handling structured data such as food datasets and user data. It allows filtering, sorting, and analysis.

NumPy: Used for numerical computations and efficient data manipulation.

b) PDF Processing Libraries

PyMuPDF (fits): Extracts text from PDF genetic reports quickly. Pflaumer: Alternative library for reading and extracting structured text from PDFs.

c) Frontend Development

Stream lit: Used to build a simple and interactive web interface. Allows users to upload reports Displays results and recommendations Provides chatbot interaction

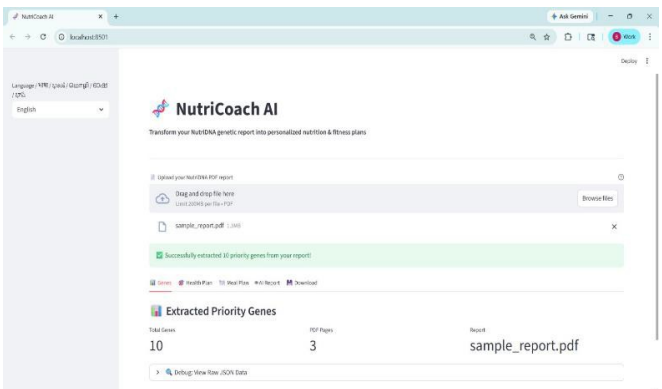
d) File Handling Libraries

Json: Used to read and write food datasets.

pyyaml: Used to load and process rule-based datasets (rules.yml).

6.RESULT

The system successfully extracts and analyzes genetic data from uploaded reports to understand the user's health profile.



It generates personalized recommendations such as meal plans, fitness routines, supplements, and lifestyle advice

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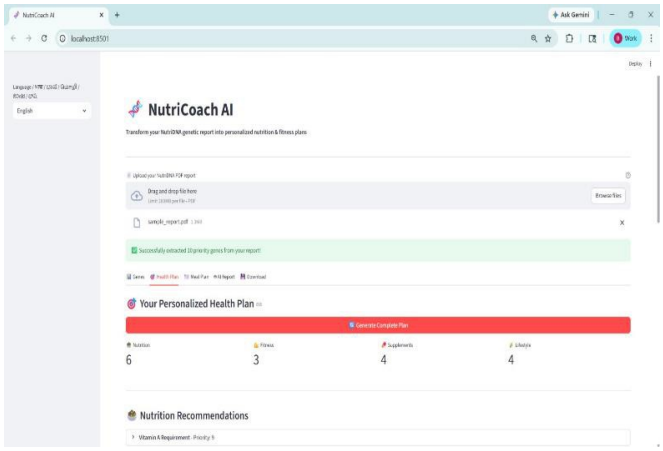
Fig 2: Nutri Coach AI Interface for Nutri DNA Report Processing and Gene Extraction

This figure illustrates the Nutri Coach AI user interface where a Nutri DNA genetic report is uploaded and processed to generate personalized health insights. The system allows users to upload a PDF file through a drag-and-drop or browse option, after which it successfully extracts key genetic information, confirmed by a status message. The interface includes multiple tabs such as Genes, Health Plan, Meal Plan, AI Report, and Download, indicating different stages of analysis and output generation. In the Genes section, the system displays a summary of extracted data, including the total number of priority genes (10), the number of PDF pages analyzed (3), and the uploaded file name. Additionally, a debug option is available to view raw JSON data, highlighting backend processing. Overall, the figure represents the data input and gene extraction stage, which serves as the foundation



for generating personalized nutrition and fitness recommendations.

Fig 3: Nutri Coach AI Interface for Personalized Health Plan Generation

This figure illustrates the Nutri Coach AI system interface after processing a Nutri DNA genetic report and transitioning to the personalized health planning stage. Once the report is uploaded and key genes are extracted, the system provides a dedicated "Health Plan" section where users can generate a complete personalized plan. The interface displays categorized recommendations including nutrition, fitness, supplements, and lifestyle, along with their respective counts, indicating the breadth of suggestions generated from genetic insights. A prominent "Generate Complete Plan" option enables users to produce a comprehensive health strategy. Below this, detailed nutrition recommendations are presented, such as vitamin requirements with priority levels, reflecting how genetic data is translated into actionable health guidance. Overall, the figure represents the transformation of extracted genetic information into structured, personalized health recommendations within the Nutri Coach AI workflow.

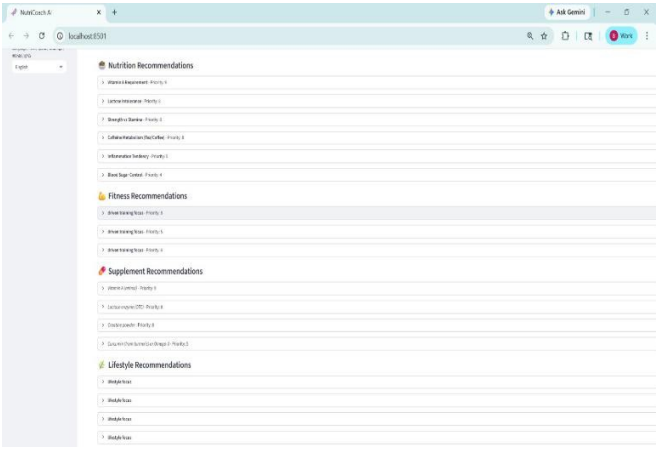


Fig 4: Nutri Coach AI Detailed Personalized Recommendations Interface

This figure presents the detailed recommendation output of the Nutri Coach AI system, where personalized health insights are categorized into nutrition, fitness, supplements, and lifestyle sections based on the user's genetic data. Each category contains specific recommendations such as vitamin requirements, lactose intolerance, caffeine metabolism, training focus, and supplement suggestions like vitamins and creatine, all assigned with priority levels to indicate their importance. The structured layout allows users to easily navigate through different health aspects and understand which areas require more attention. Additionally, lifestyle suggestions are included to provide a holistic approach to health improvement. Overall, the figure demonstrates how the system translates extracted genetic information into comprehensive, prioritized, and actionable recommendations for personalized wellness planning.

7.CONCLUSION

The Nutri Coach AI project integrates multiple datasets, models, and libraries to create a complete intelligent system. The datasets provide the necessary knowledge, models process and interpret the data, and Python libraries help implement and deploy the system efficiently. Together, they enable personalized nutrition, fitness, and lifestyle recommendations based on genetic information. Nutri Coach AI system, where personalized health insights are categorized into nutrition, fitness, supplements, and lifestyle sections based on the user's genetic data. Each category contains specific recommendations such as vitamin requirements, lactose intolerance, caffeine metabolism, training focus, and supplement suggestions like vitamins and creatine, all assigned with priority levels to indicate their importance. The structured layout allows users to easily navigate through different health aspects and understand which areas require more attention. Additionally, lifestyle suggestions are included to provide a holistic approach to health improvement. Overall, the figure demonstrates how the system translates extracted genetic information into

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