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An Adaptive Diet Optimization System Driven by AI Models and Preference-Aware Personalization

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Abstract

Curiously AI-based personalized dietary organizing defiant conversation to a breakthrough interior the field of nourishment and success,advancing individualized dinner suggestions based on a wide cluster of individual information. These contraptions encouraged fake bits of information and machine learning calculations to analyze client data, such as success conditions, dietary inclines, way of life affinities, and biometric information, to create customized dietary plans that advancement culminate success comes almost. The paper looks at the components of AI-based dietary organizing frameworks, the working components behind these insubordinate, and their applications in coordinating persevering conditions, weight control, and in common thriving. It as well addresses moral contemplations, such as information security concerns, incline in AI models, and client acknowledge, as well as challenges related to information openness and framework integration. Other than, the paper highlights rising plans in AI-driven dietary defiant, counting the integration of genomic information and headways in machine learning techniques. Case considers and realworld applications diagram the down to soil benefits and reasonability of AI in supporting personalized nourishment. In conclusion, AI-based personalized dietary coordinating contraptions have the potential to revolutionize dietary proposition, making strides success comes almost through data-driven, individual-centered nourishment organization.

Keywords: Diet Recommendation System, Open AI, Generative AI, Recommendation System

1. INTRODUCTION

Personalized dietary organizing has gotten to be a foundation interior the organization of by and gigantic success, unremitting affliction organization, and affliction desire. Standard dietary coordinating as frequently as conceivable takes a one-size-fits-all approach, where generalized rules are related notwithstanding of an individual's inquisitively thriving conditions, hereditary cosmetics, way of life, or inclines [1]. This wide approach as often as possible comes nearly in inadequate comes approximately, since it does not account for the

colossal changeability in person needs and reactions to nourishment [2]. As the around the world predominance of lifestyle-related afflictions such as weight, diabetes, and cardiovascular conditions proceeds to rise, there's an amplifying inquire for more centered on, personalized courses of activity in nourishment organization [3]. More frequently than not where AI-based dietary organizing defiant can make a fundamental impact [4]. AI-powered defiant are able of analyzing wide, complex datasets, checking natural data, remedial history, way of life choices, and without a question real-time information from wearable contraptions, to create essentially custom fitted supper plans [5]. By ceaselessly learning from client input, these frameworks change their recommendation over time, guaranteeing that the dietary organize impels with the user's changing success status and goals [6]. The potential for AI to supply personalized, data-driven dietary request has far-reaching suggestions for making strides thriving comes around [7]. Other than, AI-based frameworks are especially useful interior the setting of unremitting sickness organization, weight organization, and preventive healthcare, where individualized nourishment plays a basic parcel [8].

2. EXISTING SYSTEM

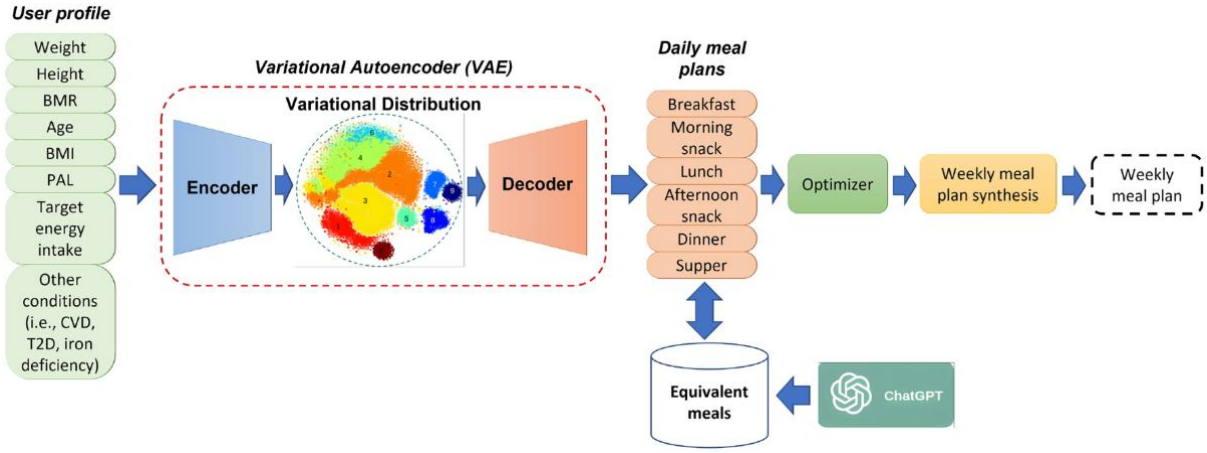
AI-powered diet planning solutions have evolved significantly, offering tools that range from LLM-based meal planners to vision-assisted food tracking. NutriGen, powered by LLMs and validated against USDA nutritional data, delivers personalized weekly meal plans with exceptional accuracy—registering just 1.55% error using Llama 3.1 and 3.68% with GPT-3.5 Turbo the realm of food recognition, NutriVision employs Faster R-CNN to identify food items and estimate portion sizes from smartphone images, achieving about 90% detection accuracy, significantly outperforming traditional CNN models Another tool, NutrifyAI, incorporates the YOLOv8 architecture alongside nutrition APIs to enable real-time food logging through mobile devices, reaching approximately 80% recognition accuracy . Developer-oriented projects, such as a Flask-based planner using Gemini Flash and FoodVision (trained on YOLOv8 for 55 food classes), demonstrate how custom LLMs and image-based calorie estimation can be seamlessly integrated into flexible diet planning workflows. Consumer-grade apps like HealthifyMe, featuring AI-driven nutrition assistants (e.g., "Ria"), support real-time coaching, macro tracking, and automated meal logging for millions of users. Meanwhile, platforms like MealMate, FoodZilla, PlateJoy, and Strongr Fastr generate customized meal plans and grocery lists tailored to user profiles, dietary restrictions, and nutritional goals. Together, these systems highlight three major trends: LLM-powered generative meal planning, vision-based food recognition, and conversational/mobile coaching—delivering high accuracy, personalization, and convenience in modern dietary management.

3. PROPOSED SYSTEM

AI-powered nutrition systems today span a wide spectrum—from LLM-generated meal planners to conversational assistants and vision-powered food trackers. NutriGen, which integrates LLMs with USDA nutritional data, delivers weekly meal plans with exceptional

accuracy—featuring just 1.55% error with Llama 3.1 and 3.68% with GPT-3.5 Turbo. ChatDiet introduces a hybrid framework combining causal, personalized models with population-level insights and LLM orchestration. Evaluated in a food recommendation task, it achieved around 92% effectiveness, while enabling intuitive feedback and transparent reasonin. HealthGenie enhances dietary guidance by merging LLMs with Knowledge Graphs, presenting structured, visualized recommendations that significantly reduce user cognitive load in real-world testing On the multimodal side, NutriVision employs Faster R-CNN to identify food items from images, estimate portion sizes, and deliver nutritional information at roughly 80% accuracy, supporting seamless photo-based meal logging . Collectively, these systems emphasize three core capabilities: generative meal planning, explainable conversational insights, and multimodal tracking—creating a strong foundation that Dietezy can build upon to deliver a unified, next-gen diet planning experience.

3. SYSTEM ARCHITECTURE



4. MODULES

Components of AI-Based Dietary Planning Systems

AI-powered dietary planning systems integrate various technologies to deliver personalized nutrition recommendations. These systems collect diverse data—including genetic information, medical history, lifestyle habits, physical activity levels, and dietary preferences—to create individualized nutrition plans. Machine learning algorithms, such as decision trees, collaborative filtering, and neural networks, analyze this data to generate tailored dietary suggestions. These algorithms utilize statistical models to predict nutritional needs based on specific health goals and conditions. Additionally, AI systems incorporate data from wearable devices and health applications, enabling continuous monitoring of physical activity, sleep patterns, and other lifestyle factors that influence dietary needs. This integration facilitates the development of real-time, adaptive dietary plans that adjust to changes in a user's health or preferences. Natural language processing (NLP) is also employed to interpret user feedback, enhancing the accuracy of meal recommendations. The seamless integration of AI, data collection, and continuous feedback allows for the creation

of personalized dietary plans that evolve over time, improving the effectiveness of nutrition strategies.

Working Mechanism of AI in Personalized Dietary Planning

AI-based personalized dietary planning tools operate by utilizing user data inputs to generate customized meal recommendations. The process begins with data collection, where individuals provide relevant health information, including age, gender, medical history, physical activity levels, and dietary restrictions. The system then employs machine learning algorithms to analyze this data and create an initial meal plan tailored to the user's needs and preferences. AI algorithms continuously evaluate the effectiveness of the diet through user feedback, which can be collected from mobile apps, wearable devices, or user surveys. These feedback loops enable the system to refine recommendations, adjusting the meal plan based on changes in the user's health or lifestyle. AI-based tools also consider long-term trends in the user's health data, such as changes in weight, blood sugar levels, or cholesterol, to proactively adjust dietary recommendations. By continuously learning from user behavior and health outcomes, the AI system ensures that the dietary plan remains relevant and effective over time. This dynamic and adaptive approach to dietary planning assists users in achieving their health goals, whether it's managing a chronic condition, maintaining a healthy weight, or improving overall wellness.

5. RESULTS & DISCUSSION

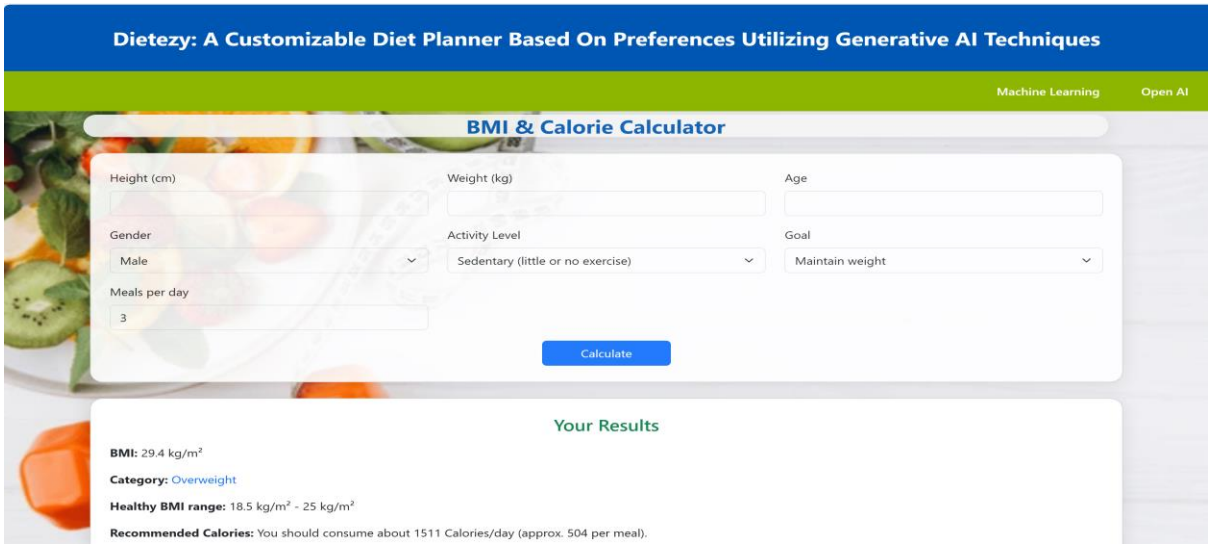


Fig 5.1 BMI & Calorie Calculator

The above figure 5.1 displays a web application interface titled “Dietezy: A Customizable Diet Planner Based on Preferences Utilizing Generative AI Techniques.” The tool features a BMI & Calorie Calculator where users can input personal data such as height, weight, age, gender, activity level, dietary goals, and number of meals per day.

After clicking "Calculate," the results section shows:

- BMI value (e.g., 29.4 kg/m²)
- BMI category (e.g., Overweight)
- Healthy BMI range
- Recommended daily calorie intake with per-meal breakdown (e.g., 1511 Calories/day, ~504 per meal)

This tool is designed to help users plan personalized diets using AI-driven analysis based on their lifestyle and health metrics.

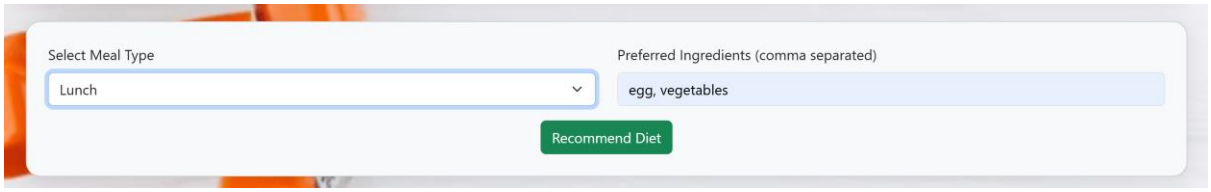


Fig 5.2 Diet Recommendation

In Fig 5.2, Below the results, the user interface allows selection of a meal type (e.g., Lunch) and entry of preferred ingredients (e.g., egg, vegetables). A green "Recommend Diet" button is provided to generate personalized diet suggestions based on the chosen meal type and ingredients.

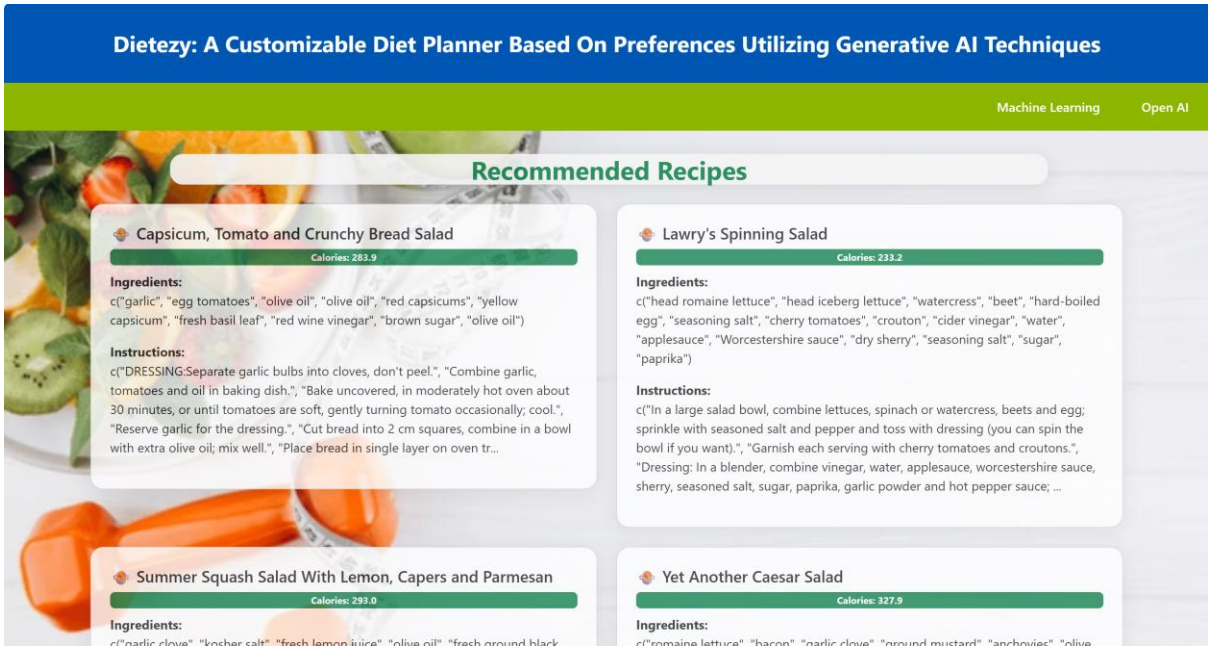


Fig 5.3 Recommended Recepies

The The above figure 5.3 showcases the "Recommended Recipes" section of the Dietezy application—a personalized diet planner utilizing generative AI. Based on the user's BMI, calorie needs, and ingredient preferences, the tool suggests healthy meal options.

Each recipe card displays:

- The recipe name (e.g., Capsicum, Tomato and Crunchy Bread Salad, Lawry's Spinning Salad)
- Caloric content (e.g., 283.9, 233.2, etc.)
- A list of ingredients
- Step-by-step instructions for preparation

This AI-powered feature helps users maintain their dietary goals while enjoying diverse, nutritious meals tailored to their preferences.

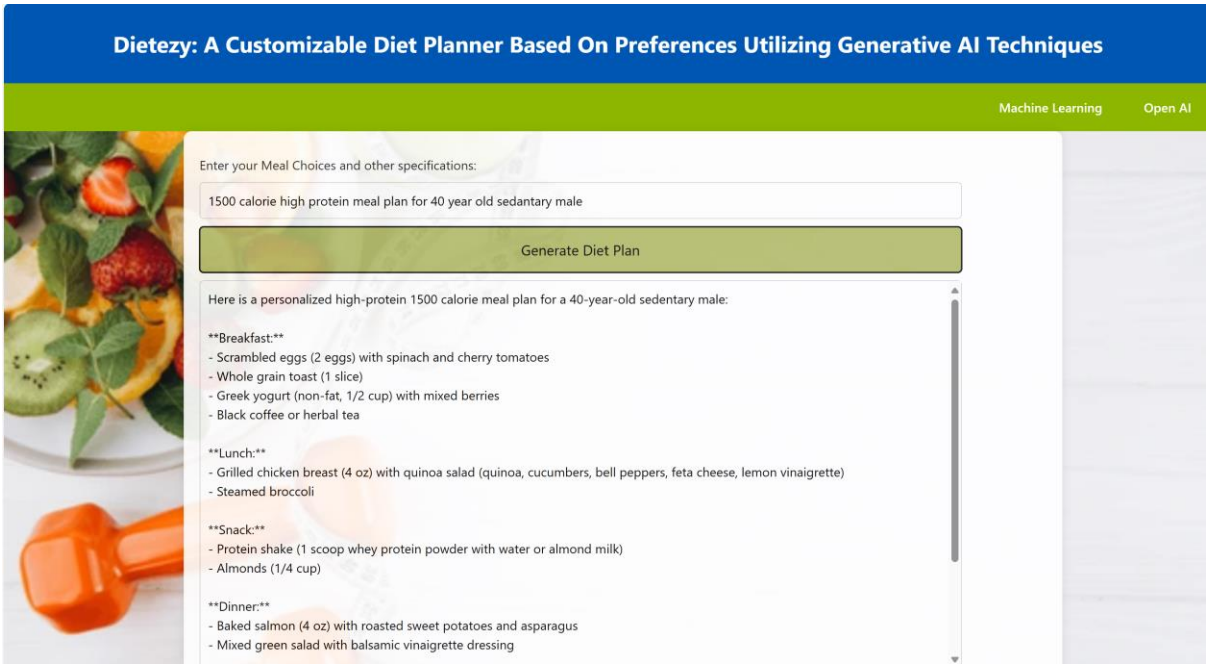


Fig 5.4 Diet Plan Generation using Open AI

The above figure 5.4 shows a personalized diet plan generated using the OpenAI API within the Dietezy application—an AI-powered customizable diet planner. The user input a request for a 1500-calorie high-protein meal plan for a 40-year-old sedentary male.

The resulting meal plan is broken down into:

- Breakfast: Includes scrambled eggs, whole grain toast, Greek yogurt with berries, and coffee/tea.
- Lunch: Features grilled chicken with quinoa salad and steamed broccoli.

- Snack: Offers a protein shake and almonds.
- Dinner: Consists of baked salmon with sweet potatoes, asparagus, and a green salad.

This demonstrates how generative AI is leveraged to create health-focused, goal-specific meal recommendations.

6. CONCLUSION AND FUTURE WORK

Conclusion

AI-based personalized dietary arranging devices offer a groundbreaking opportunity to upgrade the way weapproach nourishment and wellbeing administration. By leveraging progressed machine learning calculations and coordination information from assorted sources such as wearable gadgets, restorative records, and hereditary data, these frameworks are able to create personalized, energetic supper plans that reflect an individual's interesting wellbeing profile, objectives, and inclinations. As a result, clients advantage from more viable dietary intercessions that not as it were offer assistance in overseeing inveterate infections but moreover advance in general well-being. The focal points of AI in dietary arranging are clear, especially within the domain of inveterate infection administration. For occurrence, AI can optimize the dietary needs of diabetic patients by following blood glucose levels and altering dinner plans appropriately. Essentially, those looking for to oversee their weight or move forward physical execution can depend on AI to make customized dietary techniques that back their objectives. Additionally, AI frameworks improve client engagement by giving real-time input and adjusting to changing wellbeing conditions. Be that as it may, the far reaching appropriation of AI-based dietary arranging devices isn't without its challenges. Issues such as information security, algorithmic inclination, and client acknowledgment have to be be carefully tended to to guarantee the moral and impartial utilize of these advances. As AI proceeds to advance, its integration with exactness pharmaceutical, the change of machine learning models, and the extension of multimodal information inputs will advance improve the capabilities of these frameworks. Moving forward, AI-based dietary apparatuses will not as it were revolutionize sustenance but moreover clear the way for a more individualized, patient-centered approach to healthcare.

Future Work

To evolve into a next-generation nutrition assistant, Dietezy can integrate advanced multimodal data sources, personalized physiological insights, and ethical design principles. Incorporating real-time biomarkers from wearable sensors—such as continuous glucose monitors (CGMs), heart rate variability trackers, and sleep monitors—alongside microbiome and genetic data, will enable dynamic, precision-tailored nutritional guidance that adapts to users' internal states. For instance, integrating CGM data with meal imagery has shown promise in enhancing caloric estimation accuracy .Ensuring data quality, standardization, and fairness is paramount. Future development should prioritize diverse, representative datasets and incorporate privacy-preserving techniques to foster inclusive, unbiased meal planning.

This approach aligns with the growing emphasis on ethical AI practices in healthcare .On the modeling front, leveraging Knowledge Graphs, Graph Neural Networks, and Transformer architectures can deepen insights into complex nutritional relationships—such as ingredient interactions and flavor profiles—and enhance user engagement. For example, DietGlance utilizes knowledge-empowered AI assistants to provide personalized dietary suggestions .Expanding functionality to support eco-diet planning will align Dietezy with sustainability goals, balancing personal nutrition with environmental impact metrics. This includes integrating features that assess the carbon footprint of meal choices and promote sustainable eating habits .Finally, embedding Explainable AI (XAI) frameworks and facilitating human–AI collaboration will build trust, allowing users and healthcare professionals to understand and co-guide system recommendations transparently. Implementing XAI methods, such as SHAP values, can enhance model interpretability and user confidence .Collectively, these advancements will transform Dietezy into a smart, responsible, and adaptive nutrition companion—delivering precision, personalization, and ethical care.

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