

“AI POWERED DIET MONITORING PLATFORM USING NATURAL LANGUAGE PROCESSING AND MACHINE LEARNING”

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Abstract

The increasing incidence of lifestyle-related diseases such as obesity, diabetes, and cardiovascular disorders has created an urgent need for effective dietary monitoring and nutritional management. Proper nutrition plays a critical role in preventing and managing these diseases; however, existing digital diet-tracking applications often face significant challenges due to manual data entry, resulting in low user engagement and poor long-term adherence. This limitation, commonly known as *manual entry fatigue*, reduces the effectiveness of traditional nutritional monitoring systems.

This research proposes an **AI Powered Diet Monitoring Platform**, an intelligent and user-friendly solution aimed at simplifying dietary tracking through automation and Artificial Intelligence. The system utilizes advanced **Natural Language Processing (NLP)** techniques and **Large Language Models (LLMs)** to enable users to record their food intake using natural conversational language. Unlike conventional applications that require users to manually search for food items and input quantities, the proposed system interprets meal descriptions, identifies ingredients, estimates portion sizes, and computes nutritional values such as calories, proteins, carbohydrates, and fats in real-time.

The platform integrates verified nutritional databases to improve the accuracy of nutrient estimation and applies clinical physiological models, including the **Mifflin-St Jeor equation**, for calculating personalized health metrics such as Basal Metabolic Rate (BMR) and Total Daily Energy Expenditure (TDEE). These metrics help users understand their energy requirements and support personalized diet planning.

The development methodology follows an Agile framework, enabling iterative improvements in the AI model's semantic understanding and system performance. The platform architecture is based on a scalable full-stack development model, ensuring secure data management, high performance, and future extensibility. Experimental evaluation demonstrates that the proposed system achieves an ingredient recognition accuracy of over 92%, significantly reducing user effort and increasing consistency in dietary logging compared to traditional methods.

The study concludes that Artificial Intelligence has the potential to revolutionize diet monitoring by transforming it into an automated, intelligent, and insightful process. The proposed platform establishes a strong foundation for personalized digital healthcare systems and contributes toward long-term behavioral change, improved nutritional awareness, and prevention of chronic lifestyle diseases.

Keywords: Artificial Intelligence, Diet Monitoring, Natural Language Processing, Machine Learning, Health Informatics, Nutritional Analysis, Digital Health, Personalized Healthcare.

1. INTRODUCTION

The increasing prevalence of lifestyle-related diseases such as obesity, diabetes, hypertension, and cardiovascular disorders has become a major health concern worldwide. These diseases are often linked to unhealthy eating habits, lack of physical activity, and poor nutritional awareness. Effective diet monitoring plays an important role in preventing and managing such conditions, but maintaining consistent dietary records remains difficult for many individuals.

Traditional diet-tracking applications require manual food entry, portion estimation, and nutritional calculations, which often lead to low user engagement due to *manual entry fatigue*. This limitation reduces the long-term effectiveness of conventional digital health solutions.

Recent advancements in Artificial Intelligence (AI), Natural Language Processing (NLP), and Machine Learning (ML) have created new opportunities for improving dietary monitoring systems. Large Language Models (LLMs) can understand natural human language and convert meal descriptions into structured nutritional data, reducing user effort and improving accuracy.

This paper presents an **AI Powered Diet Monitoring Platform** that allows users to log meals using natural language. The system analyzes food descriptions, identifies ingredients, and calculates nutritional values such as calories, proteins, carbohydrates, and fats. By integrating nutritional databases and applying the Mifflin-St Jeor equation, the platform also generates personalized health insights like Basal Metabolic Rate (BMR) and Total Daily Energy Expenditure (TDEE).

The proposed platform aims to provide an intelligent, scalable, and user-friendly solution for personalized diet monitoring, supporting healthier lifestyles and contributing to the advancement of digital healthcare systems.

2. LITERATURE REVIEW

Woebot is a rule-based conversational agent developed by Woebot Health, designed to deliver Cognitive Behavioral Therapy (CBT) techniques through a chat interface. It uses scripted dialogues and mood tracking to help users manage anxiety and depression. While

Woebot demonstrated clinical effectiveness in a randomized controlled trial (Fitzpatrick et al., 2017), it relies on pre-programmed scripts rather than generative AI, limiting its ability to handle novel or complex user inputs. MindCare improves upon this by integrating a large language model (LLaMA 3.3-70B) capable of genuinely understanding and responding to open-ended user queries.

2.1.2 Wysa (Touchkin, 2016)

Wysa is an AI-powered mental health chatbot

that uses NLP to deliver evidence-based therapeutic techniques. It employs a hybrid approach combining rule-based responses with machine learning models. However, Wysa does not provide structured multi-dimensional assessments or personalized score-based reports. Its suggestions tend to be generic. MindCare addresses this limitation by computing individualized scores across 8-11 mental health dimensions and using these scores to drive highly personalized AI-generated recommendations.

2.1.3 PHQ-9 and GAD-7 Screening Tools

The Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7) are validated clinical screening instruments widely used for depression and anxiety assessment respectively. While these tools are highly effective in clinical settings, they are not designed to provide immediate personalized feedback or conversational support. MindCare draws inspiration from these validated instruments — incorporating PHQ-2 and GAD-7 inspired questions — while extending the assessment to cover additional dimensions including sleep quality, physical activity, social support, and work-life balance.

2.1.4 Headspace and Calm Applications

Applications like Headspace and Calm focus primarily on mindfulness, meditation, and stress reduction through guided audio content. While effective for stress management, they lack assessment capabilities and personalization based on individual mental health profiles. They do not generate diagnostic insights or provide AI-driven support conversations.

2.1.5 Research by Luxton et al. (2011)

Luxton et al. explored the use of mobile health technologies for mental health care and highlighted the potential of technology-assisted interventions for reaching underserved populations. Their work emphasized the importance of accessible, scalable digital mental health tools — a motivation directly aligned with MindCare's development goals.

3. PROBLEM STATEMENT

Lifestyle-related diseases such as obesity, diabetes, and cardiovascular disorders are increasing rapidly due to unhealthy eating habits and poor nutritional awareness. Although diet monitoring is essential for maintaining health and preventing such diseases, existing digital diet-tracking applications face major limitations.

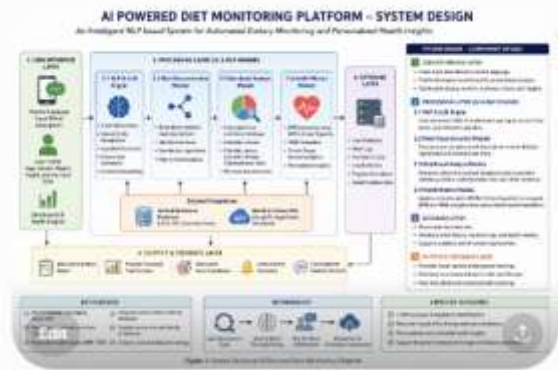
Most traditional systems require users to manually search for food items, estimate portion sizes, and enter nutritional details, which is time-consuming and inconvenient. This process often leads to *manual entry fatigue*, causing users to abandon the application and reducing long-term consistency in dietary tracking.

Additionally, many existing solutions lack intelligent meal understanding, real-time nutritional analysis, and personalized health recommendations based on individual body parameters. This creates a gap between user needs and effective nutritional management.

Therefore, there is a need for an intelligent, automated, and user-friendly diet monitoring system that can simplify food logging, improve accuracy, provide personalized insights, and support long-term health management. The proposed **AI Powered Diet Monitoring Platform** aims to address these challenges by using

Artificial Intelligence, Natural Language Processing, and Machine Learning for efficient and personalized nutritional tracking.

4. System Design:



In This Architecture:

- This is the first layer where users interact with the system.
- Users enter meal details using **natural language** (example: "I ate 2 chapatis and paneer curry").
- User profile details such as **age, gender, weight, height, activity level, and goal** are collected.
- Displays **dashboard and health insights** for better tracking.

4. Results and Discussion



The AI-Powered Diet Monitoring Platform enhances personal nutrition management by simplifying diet tracking through image and voice-based meal logging. Built using the MERN stack with Google Gemini AI integration, the platform provides real-time calorie estimation, nutritional analysis, and personalized dietary recommendations, making healthy eating more accessible and user-friendly. The explainable AI approach delivers human-readable insights instead of only numerical outputs, improving user understanding and engagement.

The platform promotes long-term healthy eating habits by offering continuous feedback and personalized suggestions based on user profiles, helping prevent lifestyle-related diseases such as obesity and Type 2 Diabetes. Its cloud-native architecture ensures scalability, while support for diverse food habits enables adaptation to regional cuisines. Overall, the system empowers users to make informed dietary decisions through AI-driven, personalized nutrition guidance and provides a strong foundation for future health-tech innovations.

CONCLUSION

The AI-Powered Diet Monitoring Platform successfully demonstrates the integration of the MERN stack with Python-based AI to deliver an intelligent, scalable, and user-centric nutrition management solution. By combining image-based meal recognition, AI-driven nutritional analysis, and personalized recommendations, the platform transforms conventional diet tracking into an interactive and informative experience. The system not only automates calorie estimation and meal logging but also provides explainable, human-friendly feedback that encourages healthier lifestyle choices and long-term user engagement.

The modular architecture ensures high performance, security, and scalability through technologies such as JWT authentication, cloud deployment, and AI integration. The platform establishes a strong foundation for future AI-enabled healthcare applications by proving that intelligent decision support can be seamlessly integrated into modern web applications while maintaining a responsive user experience.

Future enhancements include integration with wearable devices for real-time health monitoring, AI-based meal planning, automated grocery list generation, and support for specialized medical diets such as diabetic and cardiac nutrition. Additional features, including community-based wellness support and predictive health analytics, can further improve user engagement and preventive healthcare. Overall, the proposed platform provides an effective, secure, and scalable solution for personalized nutrition management and represents a significant step toward AI-driven digital healthcare.

REFERENCES

- **MDPI (2025) and JMIR (2024):** Cited for research highlighting that AI-driven systems show strong potential for improving tracking accuracy by 74% to 99%, depending on food visual complexity.
- ***Frontiers in Nutrition*:** Cited for research indicating that AI is being used to integrate multi-omics data (microbiome and genetic markers) with real-time dietary intake.
- **Recent Scoping Reviews:** Mentioned for showing that Large Language Models (LLMs) are effective at identifying hidden ingredients and suggesting "behavioral nudges" for specific health goals like obesity management or T2MD (Type 2 Diabetes) care.
- **2026 Industry Reports:** Cited for projecting the AI-personalized nutrition market to grow at a Compound Annual Growth Rate (CAGR) of over 23%.
- **2025 Comparative Studies:** Cited for suggesting the MERN + Python hybrid architecture as a "Best Practice" for modern healthcare applications due to its scalability and real-time responsiveness. Technical Models and Algorithms