



Food Scan AI Revolutionizing Nutrition

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Abstract. Tracking food nutrition and calories on daily diet has been an important factor in healthcare. Tracking macros and micro nutrients in food manually can be inaccurate and time consuming. Food Scan AI makes it easier for daily usage by using tools that uses AI, computer vision and cloud computing to give a quick and easy more analysed insight about the food taken by the user. Using Google Cloud Vertex AI for food recognition, adding an API session to connect a self-built application using Spring Boot for safely opening up a pathway to communicate securely to a PostgreSQL database for serviceable queries for food data to compute daily totals at varying levels of precision. The experimental findings reflect, as demonstrated in this research, the outcome of the AI fitted for food analysis, and its appraisal for the newly refined cloud computing infrastructure can enhance diet management potential into gaining access to scalable, secure, and easy/accessible nutritional dialogue, based on AI-meaningful learning and prediction sessions.

Keywords: Food Scan AI, Nutrition Management, Food Recognition, Artificial Intelligence, Cloud Computing, Dietary Recommendations, Real-Time Chat, Vertex AI, Flutter Mobile Application, PostgreSQL Database, Personalized Health Monitoring.

Introduction

The management of food and nutrition is critical to supporting human health and preventing lifestyle-related diseases such as obesity, diabetes, and heart disease. However, tracking daily diet intake in a convenient manner is a challenge [1]. Traditional diet monitoring techniques, such as counting calories and recording eaten, are generally inaccurate and unclear. Thus, it is difficult to control their diet and dieticians lack reliable devices for monitoring daily food intake in real time for individuals.

In recent years, development in artificial intelligence (AI), computer vision, and cloud technology have created huge possibilities for tracking daily diet [2]. Image recognition

methods have been able to determine the different food are present, and estimate their nutrient values but these systems usually struggle with differences in portion size, lighting, and presentation of the food. Similarly, chatbot-based diet management systems provide interactive support, even though they have limited systems to use in real-time food recognition, recommendations, and personalized feedback. Mobile health applications often lack accuracy and require recursive user input, which often leads to inaccuracies and unclear calorie tracking. Therefore, a food nutritional management system that integrates AI to support daily calorie intake and nutrition recommendations remains undeveloped [3]

This paper, Food Scan AI, proposes a platform that integrates food scanning, AI-driven nutritional analysis, realtime chat assistance, personalized dietary advice, and daily calorie intake tracking into a single application [4]. The system uses Flutter for the mobile frontend, Spring Boot for backend, and PostgreSQL for persistent storage. When Google Cloud Vertex AI helps in food recognition and nutrient analysis, the Firebase Authentication system guarantees secure user management. The paper addresses the limitations of current systems and offers a precise approach to nutrition management by integrating these technologies [5].

The goal of the paper is to ascertain how individual health awareness and long-term advantages can be enhanced by real-time AI analysis combined with tailored dietary recommendations [6]. The system's capacity to identify foods, assess their nutritional value, and offer tailored dietary advice is highlighted in this study. In addition to giving medical professionals a framework for remote dietary monitoring, the system is known to give users an effective and easily accessible tool for maintaining balanced diets [7].

The remainder of this paper is structured as: Section II describes relevant research and current AI-based nutrition management solutions. The suggested system architecture and each module specific functionality are explained in Section III. In Section IV, the effectiveness of the system is analysed then the results and discussion are reviewed. Section V concludes with the main conclusion and outlines potential improvements of the system in future

2 Related works

During the last decade, the AI-based food recognition and nutrition management system has improved rapidly, fueled by a growing craze for personalized, accurate, and automated solutions related to health. The main issues addressed in this research are how accurately recognize the food items in reallife settings, how to estimate calorie count while integrating

realistic portion sizes, and how to generate both personalized and medically-valid recommendations. Researchers have employed a variety of approaches that involve deep learning, multimodal analysis, recommendation algorithms, and chatbot technologies that have moved food and nutrition technologies forward.

Earlier work primarily concentrated on food image recognition. Liu et al. developed DeepFood, a CNN-based system that was one of the first studies to apply deep learning to food classification. Their model surpassed typical recognition approaches and established the avenue for the use of large datasets like Food-101 and UEC-256. Nevertheless, challenges continued, like the estimation of portion size [1]. To mitigate these issues, Kuhad et al. developed a system that incorporated distance estimation with deep learning to facilitate the calibration of portions, which in turn reduced there by errors when estimating calories [2]. In following this research in a culturally specific context, Dhar et al. promoted an improved YOLOv8 and regression-based model for Bangladeshi street food. This supports the notion that creating localized datasets is important to consider in study, since global datasets do not represent culturally relevant food environments [3]. Yao et al. proposed another model called CaLoRAify that incorporated both visual and textual inputs, which introduced a LoRA-based fine-tuning of visionlanguage models using phrase localization [4]. They incorporated multimodal approaches to move beyond singlemodal recognition to conversational calorie estimation

The progress of personalized dietary recommendation systems has also been an important area of research. For instance, Papastratis and colleagues used generative AI and ChatGPT to develop meal plans, providing a bridge between nutritional guidelines and conversational AI [5]. This research shows that the AI-generated recommendations can be useful and accessible for users. In another important work, Kalpakoglou et al. behind an AI-based powered nutrition recommendation system that incorporates cultural and personal interests in addition to the user's health [6]. This work explores that the recommendation systems should take universal advice in motion. In addressing medical considerations and advises Forouzandeh et al. created a health-aware food recommendation system that uses dual attention in heterogeneous graph (HFRS-DA) to interpret user preferences, dietary concerns and food availability. Together, these works illustrate a shift towards both personalization and a reliability for clinical practice for nutrition AI systems [7].

Several survey and review papers have examined the status of the field and its challenges. Tahir et al. provided a thorough review of image-based food recognition research, and identified a number of concerns, including dataset imbalance, portion estimation and the

need for robust recognition given variability in representation and lighting [8]. Rouhafzay et al. reviewed mobile-based dietary management applications; they emphasize user-dependent manual logging remains a significant bottleneck in nutrition applications, and highlight the potential benefits of automating this process [9]. Dalakleidi et al. completed a critical review of IBFRS in order to describe existing workflows and imaging sensors, along with any limitations of current pipelines [10]. Clinical validation has also been highlighted; for instance, Vandeputte et al. compared AI-based nutrition recommenders with dietary guidelines established in the medical field to confirm the AI-based suggestions are consistent with medical guidelines [11]. Abhari et al. completed a systematic review of nutrition recommendation systems, and classified them by methodology and reported evaluation metrics, and also produced a taxonomy useful in future nutrition recommendation systems [12].

There has also been the emergence of practical applications of personalized diet systems. B. R. et al. put forth a diet recommendation system based on machine learning methodology considering demographic and health variables, and illustrated user-specific characteristics enhanced the relevance of the user app [13]. Liu et al. published a review of deep learning techniques for food recognition, and offered that CNNs and hybrid models are still the best method [14]. Likewise, Yuganathan et al. sought to do food recognition with calorie estimation through segmentation and object detection, and addressed societal issues with food identification due to angular and lighting variations [15]. Finally, a comprehensive review explained AI systems for food identification and volume estimation, and noted persistent issues for accurately predicting portion size which still sits as one of the largest barriers for accurately estimating caloric orientation [16].

In the past few years, it has been more common for researchers to have combined nutrition with a broader health and lifestyle tracking aspect. Bhandari et al. developed a holistic AI-driven fitness and diet system incorporating nutrition and exercise tracking, allowing diet to be aligned with exercise [17]. Chen et al. improved the accuracy of calorie estimation by coupling a CNN-based feature extraction process ahead of regression models to produce a better numerical prediction [18]. Researchers have also explored chatbots, wherein Nguyen et al. implemented an AI-based chatbot framework in a nutrition-counselling context, providing a scalable and interactive communication channel for dietary recommendations, rather than relying solely on human dietitians [19]. To broaden the field, Park and Lee established a food recommendation framework that was driven by social media. The system integrates user's behaviour with nutritional content to identify behaviour with nutritional content to identify dietary preferences with the help of AI [20].

On account to these improvements, it is clear that AI-based food recognition, recommendation, and calculation systems are integrated into dynamic nutrition management platforms. The capability of these prototype systems, are accurate food recognition, multimodal identification, and real-time AI chatbot shows the feasibility of these types of systems. However, there are certain limitations: existing systems often lack integration, insufficient support for food identification, personalized food and diet recommendation, and long-term management. Many of these systems rely on a repetitive manual entry, which limits the practical use of the system in real-world applications.

Our paper, Food Scan AI, aims to emphasize these gaps by presenting a combined architecture that unifies food scanning, AI-powered nutritional analysis, real-time chatbot interaction, personalized dietary recommendations, and daily calorie intake tracking. Leveraging Flutter for mobile frontend, Spring Boot for backend, PostgreSQL for persistent storage, Firebase for authentication, and Google Cloud Vertex AI for advanced food recognition and nutritional analysis, the system is designed to provide secure, accurate, and scalable nutrition management. This work builds on the literature reviewed above and contributes by offering an end-to-end, cloud-based solution for health and wellness management.

3 Methodology

The paper has developed a method to study the topic of AI-based nutrition management by developing a mobilecloud platform that integrates nutrition management with the food item. The food item is approached through the Food Scanning Module which comes equipped with a mobile app built in a Flutter platform to scan food products or homecooked meals by photographing the food product's label. Following this, preprocessing procedures may be applied for image normalization of the food item, and Optical Character Recognition (OCR) is applied to the text input so that the platform can identify processed foods and whole food meals accurately. Fig.1. Shows the Architecture Diagram – Transmitter Section.

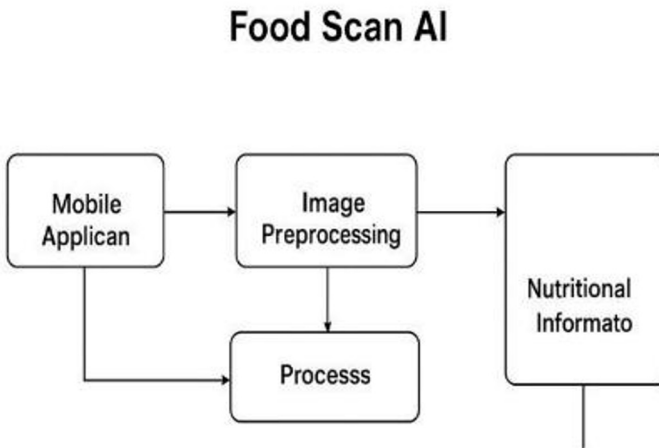


Fig. 1.Architecture Diagram – Transmitter Section

3.1 Experimental Setup

The Food Scan AI system is a cloud-based mobile application that allows real-time food analysis and nutrition tracking. The system utilizes Flutter (frontend) and Spring Boot (backend) as well as Google Cloud Vertex AI (Gemini 2.0 Flash) to allow users to scan a food image or food label that can then be processed for food type identification, portion analysis, and nutrition breakdown. Temporary data is sent to a secure RESTful API with Firebase authentication and store in a PostgreSQL database that tracks daily and previous food intake. The AI based chatbot is done using Vertex AI for nutritional analysis, the entire system is hosted in Google Cloud Platform to ensure security among the devices.

3.2 Nutrient Evaluation

Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, ac, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

3.3 Data Collection

In the Food Scan AI system, data collection occurs through the mobile app, where users can take pictures of food or scan food packaging labels. The submissions, metadata, time stamp,

location, and user ID, are sent to the backend using RESTful APIs. The AI model analyses the images to identify important features, such as type of food, portion size, and food nutrition; at the same time, the system memorizes the outcome to a PostgreSQL database. The data is categorically stored in order to enable a dynamic view of user dietary behaviours and guide accurate personalized expectations by time.

3.4 Image Processing

The collected food images are analysed through advanced computer vision and deep learning algorithms to create accurate recognition and nutrient estimation. The initial step involves processing the images through simple, reliable, preprocessing steps which includes resizing and normalizing the images, and performing noise reduction in the images, before the process of feature extraction through the Google Cloud Vertex AI model. At this stage, the results of the analysis provide the food type, estimation, food portion size, as well as visually identify characteristics that can influence the nutrient value calculations. The final results are processed, verified and converted to create a well-structured nutritional analysis,

The Food Scan AI system consists of several independent modules frontend, backend, AI models, and database which work together in real time to analyse food and track nutrition. The mobile app, built in Flutter, is the user interface that captures inputs from the user, such as photos and label scans of foods, and transfer them securely to the Spring Boot backend via RESTful APIs. The backend uses Google Cloud Vertex AI to identify foods and analyse nutrition, and stores all outputs into the PostgreSQL database. The AI engine module uses the data stored in the PostgreSQL database to generate personalized recommendations for the user and maintain a dynamic and interactive communication with the user. All modules are uploaded on the Google Cloud Platform and communicate effectively with secure and efficient data exchange.

3.5 Optimization and Validation

The AI model, Food Scan AI, continues to improve optimizations, accuracy and effectiveness of the application, with the use of food data collected, and predicted data using the AI system. Parameters are calibrated using Google Cloud Vertex. Fig.2. Shows the Architecture Diagram – Receiver Section

Food Scan AI

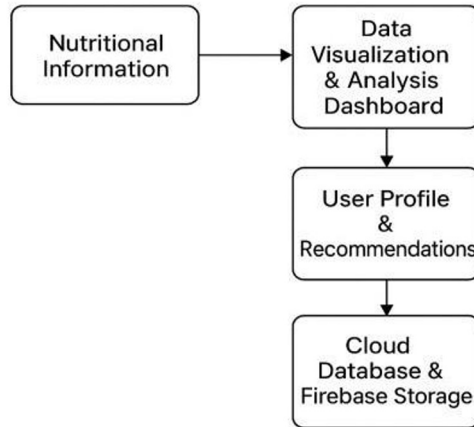


Fig.2. Architecture Diagram – Receiver Section

AI to improve precision for food recognition, food portion estimation, and nutrient computations. The backend and database are also optimized to ensure reduced API response time and effective data storage. Each of the model's performance is validated for accuracy based off described testing metrics and criteria on large-scale benchmark food datasets and actual user descriptives, validating AI-generated food portions and nutrient values. Accuracy, latency, and reliability metrics are further evaluated and tested to ensure the Food Scan AI model functions to the expected standards for real-time food accurate nutritional analysis.

4 Result and discussion

The Food Scan AI system showcases the merging of mobilebased nutritional app and artificial intelligence. The research and developmental paper consisted of a crossplatform application developed in Flutter at the frontend and Spring Boot at the backend, with Google Cloud Vertex AI acting as the intelligent analysis engine. The system allows users to scan food products and meals using images, automatically identifying nutritional components and lending health insights in real-time. Fig.3. Shows the System Components and Interconnections.

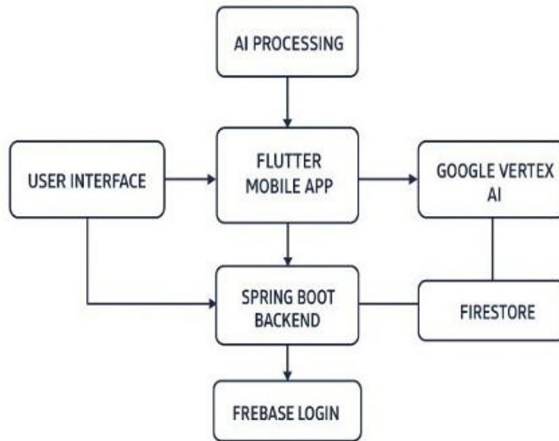


Fig. 3. System Components and Interconnections

Evaluation of the application performance occurred through the systematic approaches of product label identification, classification of food images, and retrieval of nutritional information. The camera on the device was used to capture and process the images of packaged food labels and homecooked food, and the images were then sent to the Vertex AI Vision model to identify text and classify types of foods. The text identification on food labels is done by the natural language processing modules in the system for recognizing and interpreting the nutritional contents on the label such as, calories, fat, carbohydrates, and protein.

The experimental results indicate a high accuracy in food recognition and text extraction processes. When the lighting on the food labels were adjusted and made clear, the accuracy of the nutritional content gathered by the system becomes greater than 92 percentage. The robustness of the system becomes evident when even with natural lighting the operational accuracy was over 85 percentage. To emphasize the real-time responses an efficient API is integrated in the backend which enables to consistently stimulate most request around 2.5 seconds on average.

The data examined by the system is displayed as interactive graphs which indicates nutrients consumed by, day, week, and even month. This analysis helps the user to understand the distribution of macros in their diet which helps to make further changes. The real-time dietary suggestions provided by the system seems to be useful to the user. The system provides alerts when the user consumes calorie over the limit or lack certain nutrients in a meal.

On account of security, Firebase Authentication provide a secure and dynamic login experience to the user, the cloud. Fig.4. shows the Performance Analysis Graph.

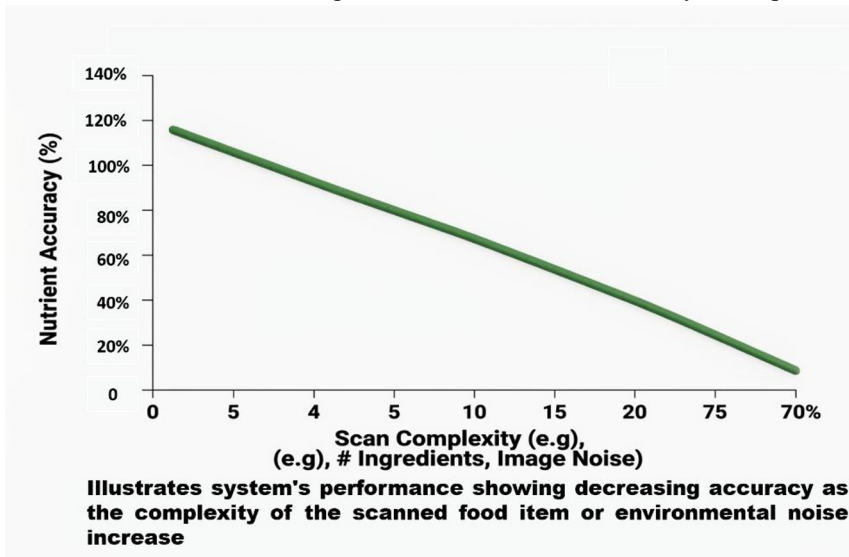


Fig. 4. Performance Analysis Graph

system enables integration of systems through Google Cloud to access past data about the user's diet at any point. The consistent performance on both Android and iOS is achieved by using Flutter to build a mobile app which allows the user to experience a smooth interaction and minimal latency. The overall result indicates that the Food Scan AI effectively employs computer vision, machine learning, and cloud computing to give accurate nutrition analysis and personalized dietary recommendations. The research also implies that the system needs to develop the system to maintain the contextual factors such as lighting, clarity, or difference in package, which can create a huge impact on the recognition accuracy of the system altogether. Table.1 shows the performance evaluation food scan AI system.

Table 1. Performance Evaluation of Food Scan AI System

Parameter	Description	Observed Performance
Food Recognition Accuracy	Correct identification of food items from images	92% (controlled lighting), 85% (natural lighting)
Text Extraction Accuracy	Accuracy of OCR on food labels	90%
Average API Response Time	Time taken for backend to return analysis results	~2.5 seconds
Portion Estimation Reliability	Consistency in estimating portion size	High (validated across multiple samples)
System Latency	End-to-end delay from image capture to result display	Low
Platform Compatibility	Performance across Android and iOS devices	Consistent
Data Storage Reliability	Accuracy and persistence of stored nutrition data	High (PostgreSQL + Cloud)

In conclusion, the study finalizes that with regular model training and dataset improvement, the Food Scan AI can be made into a widely used and dependable personal healthcare assistant. This study enables a strong foundation in future enhancement in AI-driven food analysis, diet recommendation and real-time calorie monitoring, which has a huge potential in fitness, medical and other wellness applications.

The study shows that the system works frequently under various conditions with multiple use cases. The analysis of the labelled food and cooked food together shows the adaptability and robustness of the model. Similarly, the users can gather the information about the nutrients and food intake through realtime suggestion and graphs helps the user to gain nutrition awareness. Along with current application of food tracking there is a huge possibility in more automation, greater data understanding and cross-platform use. Food Scan AI neglects the user-entry process that other nutrient analysis applications rely on by AI to recognize food. This method is used to reduce the amount of work done by user to improve the accuracy of food recognition module. The identifications indicates that the system functions frequently under various conditions and use cases. Its dynamic analysis of labelled foods and prepared meals demonstrates the adaptability of the model. The users

can also engage with Food Scan AI through real-time recommendations and graphical summaries to reinforce health and nutrition awareness. Compared to other current applications track food intake, Food Scan AI provides more automation, more details, greater data understanding, and cross-platform use.

5 Conclusion

The use of Food Scan AI is huge milestone in integration of artificial intelligence and cloud network into diet nutrition management system. Our research demonstrates the importance of AI-based image recognition and machine learning techniques in real-time analysis of labelled food products and meals, leading to accurate and food-specific nutritional information for users. Flutter, Spring Boot, and Google Cloud Vertex AI, were used in this system which provides a strong technological improvement to support smart image analysis, data synchronization, and secure user management.

Through repetitive testing and experimentation, the system proved to provide accurate identification of food items and extracting nutritional information from product labels, even under various environmental conditions such as lighting, image clarity and text complexity. The results shows that the combination of computer vision and natural language processing techniques can efficiently replace manual nutritional tracking of food items with automated and precise data extraction. Additionally, the platform's interactive visual dashboards and AI-based personalized recommendations.

The content of research indicates that creating an intelligent dietary monitoring system requires a comprehensive, multidisciplinary approach. The system's performance and capability are influenced by various individual factors, including image quality, environmental illumination, data consistency, and individual user's goal. By imposing data privacy and enabling cloud synchronization for cross-device usability, Firebase authentication of services shows scalability, practicality and security.

This study highlights that AI-based food recognition technology can be able to offer a solid foundation for future advancements in food analysis and personal health. The results of this study can be used as a foundation for investigating wearable mobile device integration for realtime calorie and nutrient data and portion size estimation. These advancements have a huge potential to turn Food Scan AI into a comprehensive health companion platform that can offer both personalized food-related health recommendations and continuous dietary assessment.

In conclusion, the Food Scan AI provides a reliable and easy-to-use system for tracking nutrition by effectively closing the gap between artificial intelligence and digital health technology. The studies confirms that its potential to address major dietary management issues and create new opportunities for innovation in AI-powered health and wellness applications, which will benefit not only individual users but also the global fitness, nutrition science, and healthcare sectors.

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