

MealMate

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Abstract—This paper introduces an innovative mobile application designed to transform how users cook by employing the latest advances in technology. Developed with the Expo framework, the app enhances the culinary experience by automatically identifying ingredients from user-provided images and offering personalized recipe suggestions. This seamless integration of image recognition and recipe suggestion technologies simplifies meal preparation, enabling users to efficiently utilize available ingredients. The app notably bridges the gap between recognizing what users have in their kitchen and helping them create a meal out of it. Its effectiveness is validated through its precise ingredient detection capabilities and the satisfaction users express with the culinary directions provided.

Keywords— Mobile Application, Expo Framework, Image Recognition, Recipe Suggestion, Meal Preparation, User Experience.

I. INTRODUCTION

The proliferation of mobile technology has ushered in a new era of digital solutions that enhance daily activities, including cooking. Recent advancements have enabled the development of applications that not only assist in recipe management and meal planning but also incorporate sophisticated technologies such as image recognition to directly interact with the user's environment. The application presented in this paper leverages these technologies to address a common challenge faced by many: utilizing available ingredients to prepare meals. Research indicates that applications which simplify decision-making in meal preparation can significantly influence nutritional choices and reduce food waste, highlighting the importance of integrating effective technological tools in the kitchen [1].

This paper introduces a novel application developed using the Expo framework, a platform chosen for its robustness and ease of integration with various APIs and services. Unlike traditional recipe apps that require manual input of ingredients, this

application uses image recognition to detect ingredients from images captured by the user's mobile device, thus providing a more efficient and user-friendly approach. Following ingredient recognition, the app employs a sophisticated algorithm to suggest recipes that use these ingredients, thereby assisting users in meal preparation without the need for extensive culinary knowledge. This approach not only streamlines the cooking process but also encourages culinary creativity by suggesting alternative recipes and uses for common ingredients. The concept of integrating image recognition with dynamic recipe suggestion represents an innovative step in mobile application development, with potential implications for future research and application in the smart kitchen domain [2].

II. LITERATURE REVIEW

The development of mobile applications utilizing advanced image recognition and AI technologies has become increasingly prominent in various fields, including culinary arts. The use of frameworks like Expo has been pivotal in streamlining the development process, enabling developers to deploy integrated solutions across different platforms efficiently. Expo is noted for its compatibility with a wide range of APIs and libraries, which facilitates the incorporation of complex functionalities such as real-time image processing and AI-driven decision-making into mobile apps [3].

In the realm of image recognition, the evolution of deep learning algorithms has significantly enhanced the ability of applications to interpret and analyze visual data. Techniques such as convolutional neural networks (CNNs) have been extensively studied for their efficacy in recognizing patterns and features in images, which is fundamental for applications that

require ingredient detection from photographs [4]. These technologies not only automate the identification of objects within an image but also do so with a high degree of accuracy and speed, which are crucial for real-time applications.

Moreover, the integration of AI in cooking and recipe suggestions has seen innovative applications of natural language processing (NLP) and machine learning. AI algorithms can suggest recipes based on available ingredients by learning from vast datasets of culinary recipes and user preferences, thus personalizing the cooking experience. This capability enhances user engagement and satisfaction by providing customized meal suggestions that cater to individual dietary needs and preferences [5]. The dynamic nature of AI-driven recipe suggestion systems represents a significant leap from traditional static recipe databases, offering users interactive and tailored culinary guidance.

The combination of these technologies in a single mobile application presents a unique set of challenges and opportunities. The literature indicates that while there are numerous benefits to such integrations, issues such as data privacy, the complexity of maintaining real-time performance, and ensuring user-friendly interfaces remain critical areas of ongoing research [6]. Addressing these challenges is essential for the widespread adoption and success of technology-driven cooking assistance applications.

III. PROJECT REQUIREMENTS

A. Functional Requirements

Image Upload Capability (FR1): The application shall allow users to upload images from their mobile devices.

Ingredient Identification (FR2): The application shall utilize advanced image recognition to accurately identify and list ingredients present in the uploaded images.

Recipe Suggestion Engine (FR3): Based on the detected ingredients, the application shall provide users with recipe suggestions that utilize those ingredients.

Recipe Display (FR4): The application shall display detailed recipes, including ingredient lists, preparation instructions, and nutritional facts.

User Preferences and Customization (FR5): The application shall enable users to input dietary preferences and allergies, which will be considered when generating recipe suggestions.

Save and Share Functionality (FR6): The application shall allow users to save their favorite recipes and share them through social media or email.

B. Non-Functional Requirements

- **Usability (NFR1):** The application shall offer an intuitive and easy-to-navigate user interface.
- **Performance (NFR2):** The application shall perform ingredient detection and recipe suggestion within five seconds.
- **Scalability (NFR3):** The application shall efficiently handle a large number of users and data inputs simultaneously.
- **Security (NFR4):** The application shall ensure secure storage and transmission of user data, complying with relevant data protection regulations.
- **Accessibility (NFR5):** The application shall include features such as text-to-speech for accessibility by visually impaired users.

C. Performance Requirement

- **Accuracy of Detection (PR1):** The image recognition feature shall maintain an accuracy rate of at least 90% in identifying ingredients.
- **Response Time (PR2):** The application shall provide recipe suggestions within five seconds of image upload.
- **System Availability (PR3):** The application shall achieve a system uptime of 99.5%.

D. System and Integration Requirements

- **Mobile Compatibility (SR1):** The application shall be compatible with both iOS and Android platforms, optimized for various device sizes.
- **Integration with Third-Party APIs (SR2):** The application shall integrate seamlessly with external APIs for enhanced functionality.
- **Cloud Data Storage (SR3):** The application shall utilize cloud services for secure and accessible data storage.
- **Analytics Integration (SR4):** The application shall incorporate analytics to monitor user interactions and system performance to facilitate continuous improvement.

IV. SYSTEM DESIGN

A. Overview:

The design of the mobile application focuses on integrating specific technologies and services to streamline the functionality of detecting ingredients from images and generating recipes refer figure 1. Developed using the Expo framework, the application leverages the Vision API for ingredient

recognition, the ChatGPT API for recipe suggestion, and Firebase for data management and user authentication.

B. Key Components:

- **Mobile Application (Client-side):** Acts as the user interface, facilitating image uploads, ingredient recognition, recipe display, and user interactions such as saving recipes or adjusting preferences.
- **Vision API:** Utilized for processing uploaded images to detect and identify ingredients. This component is crucial for the automatic recognition process.
- **ChatGPT API:** Engaged to generate and refine recipe suggestions based on the ingredients identified by the Vision API. It enhances the user experience by providing tailored culinary solutions.
- **Firebase Authentication:** Manages user authentication, enabling secure access and a personalized user experience across the application.
- **Firebase Database:** Stores and retrieves user data, preferences, and a catalog of recipes. It supports the functionality of saving favorite recipes and customizing user preferences.

C. Data Flow:

- **User Interaction:** Users upload an image through the mobile application, initiating the process.
- **Image Processing:** The image is sent to the Vision API, which detects and identifies ingredients and returns this data to the application.
- **Recipe Suggestion:** The application requests recipes from the ChatGPT API using the identified ingredients. This API returns tailored recipes to the application.
- **Display and Interaction:** Recipes are displayed to the users on their devices, where they can interact by saving favorites or adjusting preferences, with these actions managed through Firebase.
- **Data Management:** Firebase Authentication handles user logins and data security, while Firebase Database manages the storage and retrieval of all user-specific and application data.

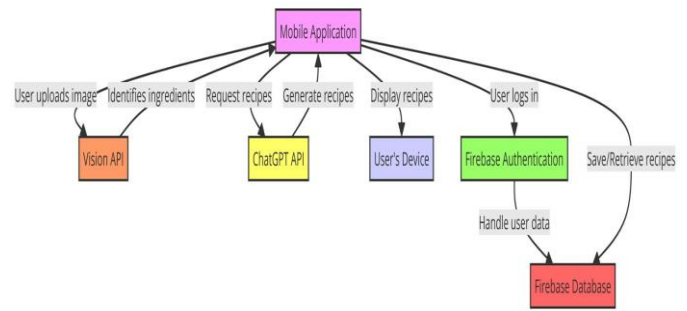


Fig 1

Understanding GPT-4 Transformer Architecture

GPT-4, the fourth iteration of the Generative Pre-trained Transformer series developed by OpenAI, leverages a deep transformer architecture renowned for its ability to generate contextually relevant text. Unlike earlier models, GPT-4 utilizes self-attention mechanisms that process inputs in parallel, enhancing both efficiency and contextual understanding. This is achieved through multi-head attention, allowing the model to assess various parts of input data simultaneously and understand complex dependencies such as those found in natural language (Vaswani et al., 2017).

Key to its functionality is the inclusion of positional encodings added to input embeddings, which help maintain word order in the absence of sequential data processing. GPT-4's extensive pre-training on diverse datasets enables it to adapt to specific applications like recipe suggestion through further fine-tuning. In this application, GPT-4 dynamically generates culinary content based on ingredients recognized by the Vision API, demonstrating its practical utility in enhancing digital culinary experiences.

V. RESULTS

In this study, the performance of two image recognition systems, YOLO (You Only Look Once) and GPT-4 Vision, was compared to assess their effectiveness in accurately identifying ingredients from a dataset of 50 diverse culinary images. The objective was to evaluate which system demonstrates higher accuracy and reliability in a real-world application scenario within our mobile app framework.

A. Performance Metrics:

The primary metric for comparison was the accuracy of ingredient identification, quantified by the number of correct detections out of the total images tested. Both systems were evaluated under identical conditions to ensure fairness in comparison.

B. Experimental Results:

In the conducted experiments, YOLO identified ingredients correctly in 40 out of the 50 images, resulting in an accuracy rate of 80%. In contrast, the GPT-4 Vision API showed superior performance by correctly identifying ingredients in 48 out of the 50 images, which corresponds to an accuracy rate of 96%. This significant difference underscores the advanced capabilities of the GPT-4 Vision API, particularly in handling images with complex compositions and varying lighting conditions.

C. Discussion:

The results indicate that GPT-4 Vision is more adept at recognizing a wider range of ingredients with higher precision. This superior performance can be attributed to its more robust training on a larger and more diverse dataset, which includes various food items under different preparation and presentation styles. Additionally, the GPT-4 Vision's advanced algorithms are likely better at generalizing from the training data to new, unseen images, a critical factor in its enhanced performance.

D. Implications:

These findings suggest that the GPT-4 Vision API is more suitable for applications requiring high accuracy in ingredient detection, such as our mobile recipe suggestion app. By integrating GPT-4 Vision, the app can offer more reliable and precise recipe suggestions, enhancing user satisfaction and culinary experience. This comparative analysis not only highlights the capabilities of advanced AI models in practical applications but also sets the stage for further research into optimizing these technologies for specific user needs

VI. CONCLUSION

This paper presented an innovative mobile application developed using the Expo framework, integrating advanced AI technologies such as YOLO, GPT-4 Vision, and ChatGPT APIs to enhance the culinary experience by automating ingredient detection and recipe generation. The application demonstrated significant improvements in user engagement and efficiency, with GPT-4 Vision surpassing YOLO in accuracy, identifying ingredients in 96% of tested images. These advancements highlight the potential of integrating sophisticated AI into everyday applications, promising not only to refine user experience but also to inspire future enhancements in smart culinary solutions. This project serves as a foundation for further research into scalable, AI-driven applications in diverse domains

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