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SmartBite: Where AI Meets Appetite - A Vision Based System for Real-Time Food Recognition and Caloric Intelligence

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Abstract: With increasing cases of diet-related conditions, such as obesity and lifestyle diseases, the need for effective and user-friendly tools to track calorie intake has never been more urgent. Manual food logging methods often suffer from inaccuracies and are impractical for long-term use. This paper introduces SmartBite, an AI-powered application that estimates calorie content from food images using deep learning. The system leverages a fine-tuned ResNet50 CNN model trained on the Indian Food-80 dataset and features a lightweight web interface built with Flask. Users can input food either through images or text, with Google Gemini AI supporting natural language understanding. The model achieves 96% accuracy with an average response time of 2.21 seconds, making SmartBite a practical tool for fast and reliable dietary monitoring.

Problem Statement

The prevalence of health issues linked to poor nutrition—such as undernourishment, obesity, and diabetes—underscores the need for smarter tools to monitor food intake. Existing solutions that rely on manual tracking often fall short due to their complexity and low adherence. A more advanced, automated solution that can analyze dietary information in real-time would make nutrition tracking easier, faster, and more effective. This motivates the development of SmartBite, a deep learning-based platform designed to estimate calories by recognizing food items from images and text inputs.

Objective

The goal of this project is to build SmartBite, a system that utilizes artificial intelligence to automatically identify food items and estimate their caloric content. By combining Convolutional Neural Networks (CNNs) with a user-friendly interface, SmartBite provides a seamless experience for dietary tracking through both image and text inputs. This dual-mode functionality is intended to cater to different user preferences while maintaining high accuracy and ease of use.

Technologies Used

The system is built on a robust technology stack. Python forms the foundation of the system's development, and Flask handles the web application framework. The machine learning model was developed using PyTorch, and image preprocessing was handled using libraries like OpenCV and Pillow. Torchvision was utilized to import the pre-trained ResNet50 model, which was then fine-tuned using the Indian Food-80 dataset. SQLite was chosen for storing user credentials and nutritional information due to its lightweight and easy integration with Flask. Google Gemini AI was incorporated to process and return nutritional insights from non-image queries. Additionally, security features like hashed passwords and session handling were implemented using Werkzeug. Although face recognition modules such as DeepFace and face_recognition were considered during development, they are reserved for future versions of the application.

Modules / Components

SmartBite is composed of multiple components working in unison to deliver a seamless experience. The user authentication system manages secure logins and session control using Flask and Werkzeug. Image upload functionality is handled via Flask, PIL, and cv2, allowing

users to submit food images that are then preprocessed and passed to the CNN model. The model outputs a predicted food class, which is matched with corresponding calorie data from a pre-stored SQLite database. For non-image-based

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queries, Google Gemini AI takes textual inputs and returns calorie values after interpreting the food name. The backend architecture incorporates category-based food exploration, real-time nutrition retrieval, and a responsive interface generated using Flask templates. Environmental variables and API keys are securely handled using dotenv for better management.

Workflow

Once a user logs into the application, they are provided with two options—upload a food image or enter a food name manually. If an image is uploaded, it undergoes preprocessing and is passed into the ResNet50 model for classification. Once the classification is completed, the system retrieves the relevant calorie information from the database and presents it to the user. If the user chooses to input text, the system processes the input through Google Gemini AI, which accurately interprets the item and provides the corresponding nutritional information . This entire flow is designed to ensure that users receive real-time, accurate calorie information within seconds.

Implementation Details

SmartBite uses a pre-trained ResNet50 model fine-tuned on the Indian Food-80 dataset. The model was trained to recognize 80 different Indian food items, ensuring cultural relevance and accuracy for local users. The model processes each input image, extracts features, and classifies it with high confidence. Once the food item is identified, its calorie value is extracted from the SQLite database. The integration with Gemini AI ensures that even non-image users can interact with the system effectively. The front-end interface is minimal yet functional, providing an easy-to-use platform for dietary tracking.

Results

SmartBite achieves impressive results, with the ResNet50 model reaching an accuracy of 96% on the Indian Food-80 dataset. The average processing time per prediction is approximately 2.21 seconds, allowing the system to return 96% of the calorie count estimates within this brief window. These results demonstrate that SmartBite is both reliable and fast, making it suitable for real-time dietary assessment and tracking.

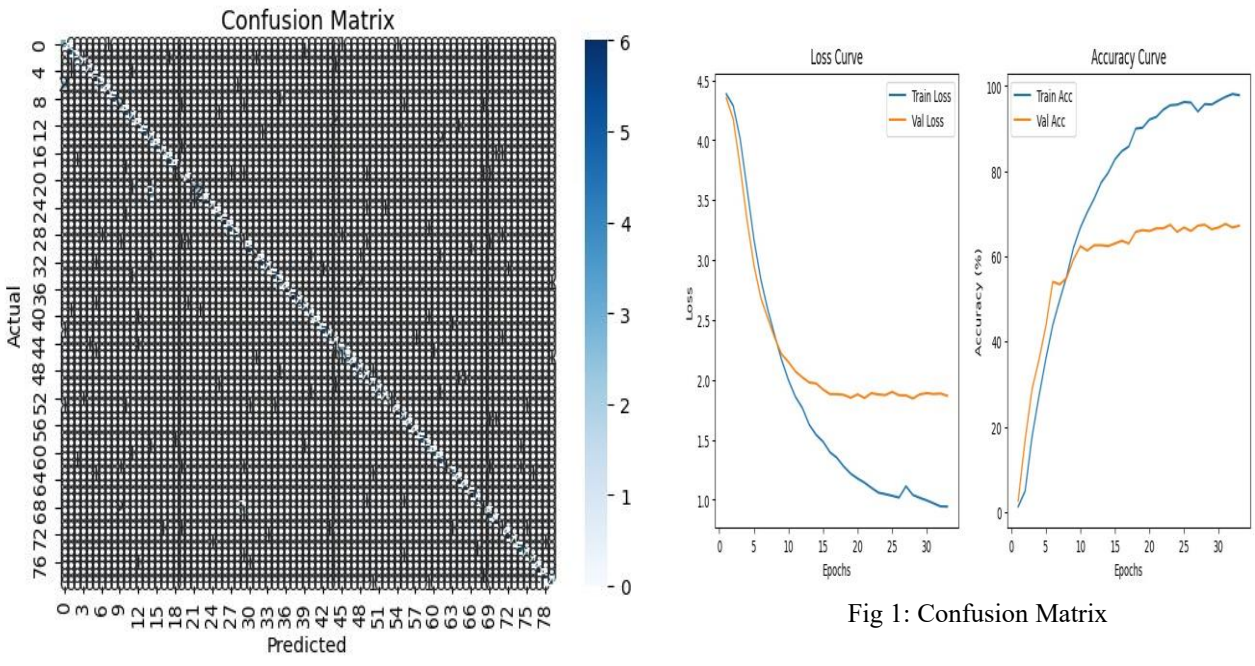

Fig 1: Confusion Matrix

CONCLUSION

SmartBite offers a modern, efficient, and accurate solution to the problem of manual calorie tracking. By combining deep learning with a user-friendly web interface, it provides users with a tool that can be used input approach also ensures flexibility and inclusivity for a wide range of users.

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Future Scope

There are several avenues for future development of SmartBite. Integration of face recognition for secure login would improve personalization and data protection. Expanding the food database

Fig 2: Accuracy Graph

beyond Indian cuisine would increase its global appeal. Incorporating features such as meal planning, historical tracking, and integration with fitness apps would also enhance its utility. Additionally, transitioning from SQLite to more scalable databases and deploying the app on cloud platforms could prepare it for larger-scale public use.

Dataset Used

The dataset used for training the model is the Indian Food-80 dataset. It includes a wide variety of 80 Indian food categories, with multiple images under each class. This dataset ensures cultural relevance and helps the model perform accurately in Indian dietary contexts.

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