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Food Calorie Tracker: A Deep Learning Based Full-Stack Web Application for Real Time Food Recognition and Calorie Estimation

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Abstract- Obesity, a severe and growing chronic disease, has been worsened by the increasing convenience of food delivery services. As access to food has expanded, so too has concern over nutritional habits and health. The main goal of this project is to accurately identify various food items and estimate their calorie content in real-time, offering users smart and personalized diet monitoring capabilities. This project proposes a Deep Learning-based solution as a Full Stack Web Application for food image recognition and calorie estimation. Developed with a React-based frontend and a Python-powered backend, the system allows users to upload images of food items for real-time classification and calorie analysis. By leveraging advanced deep learning architectures such as YOLO (You Only Look Once), the application effectively tackles the challenges of accurate classification and feature extraction in large and diverse datasets, such as the IndianFoodNet-30 dataset. This integration ensures precise recognition and efficient calorie estimation, offering users a seamless and intelligent diet monitoring experience. This full-stack solution demonstrates the integration of modern web technologies with robust deep learning models, delivering a scalable and user-friendly tool for real-time food recognition and calorie monitoring. The frontend offers an intuitive interface for uploading food images and visualizing results, while the backend efficiently handles image processing, deep learning inference, and calorie computation.

Keywords: Food Calorie Tracking, Deep Learning, Food Recognition, Calorie Estimation, YOLO (You Only Look Once), IndianFoodNet-30, Full-Stack Web Application, Nutritional Analysis, Real-Time classification, Django, React.js, Diet Monitoring, Calorie estimation.

I. INTRODUCTION

Maintaining a balanced diet and tracking daily calorie intake is essential for overall health and well-being. However, traditional methods of calorie tracking require users to manually log food items, which can be tedious, time-consuming, and prone to errors. With the advancements in deep learning and computer vision, automated food recognition and calorie estimation have become feasible solutions to simplify this process. By leveraging modern AI techniques, individuals can efficiently monitor their dietary intake without manual data entry, making nutritional tracking more accessible and accurate.

This project proposes a deep learning-based full-stack web application that enables real-time food recognition and calorie estimation using image processing techniques. The system utilizes advanced object detection models, such as YOLO (You Only Look Once), to classify different food items from user-uploaded images accurately. The calorie estimation component integrates nutritional data from the IndianFoodNet-30 dataset, ensuring precise and reliable calculations. The backend, developed with Python-based frameworks, processes the images and performs deep learning inference, while the frontend, built with React.js, provides an intuitive user interface for seamless interaction and meal tracking.

One of the key advantages of this application is its automation and real-time processing capabilities, reducing dependency on manual food logging. Users simply upload an image of their meal, and the system instantly identifies the food, estimates its calorie content, and records it for future reference. The application also incorporates features such as personalized diet monitoring, real-time food analysis, and an interactive UI for better user engagement, making it a valuable tool for fitness enthusiasts, individuals with dietary restrictions, and those aiming for a healthier lifestyle.

By integrating deep learning, full-stack web development, and AI-driven food classification, this project presents an innovative approach to nutritional tracking and dietary management. The system has potential applications in various fields, including personal health monitoring, fitness tracking, and medical diet management. Future enhancements could include improved model accuracy, portion size estimation, and AI-powered dietary recommendations, further optimizing the user experience. This project bridges the gap between technology and health, offering a scalable, intelligent, and user-friendly solution for effective calorie tracking.

RESEARCH METHODOLOGY

The research methodology for this project involves multiple stages, including data collection, deep learning model development, system architecture design, and implementation of a full-stack web application. Below is a structured approach to how the system was developed, along with code snippets and results.

Data Collection and Preprocessing

To train a deep learning model for food recognition, a dataset containing various Indian food images was used. Publicly available datasets such as IndianFoodNet-30, or custom datasets were considered. The images were preprocessed using OpenCV and TensorFlow/Keras to ensure uniformity.

Code for Data Preprocessing

```
import cv2
import numpy as np
import tensorflow as tf
from tensorflow.keras.preprocessing.image import ImageDataGenerator

# Load and preprocess images
def preprocess_image(image_path):
    image = cv2.imread(image_path)
    image = cv2.resize(image, (640, 640))  # Resize for YOLOv11 input
    image = image / 255.0  # Normalize pixel values
    return image

# Data Augmentation
data_gen = ImageDataGenerator(rescale=1./255, rotation_range=20,
                              width_shift_range=0.2, height_shift_range=0.2,
                              horizontal_flip=True)
```

Result

Fig: Sample Dataset

- Successfully prepared and augmented food images for training.
- Achieved uniform image size and normalization for better model performance.

Deep Learning Model for Food Recognition

A YOLO-based deep learning model was implemented for real-time food image classification. The model was trained on the IndianFoodNet-30 dataset, leveraging advanced object detection techniques to enhance accuracy and efficiency.

Code for Training YOLOv11 Model

Result

Fig: Code for model validation

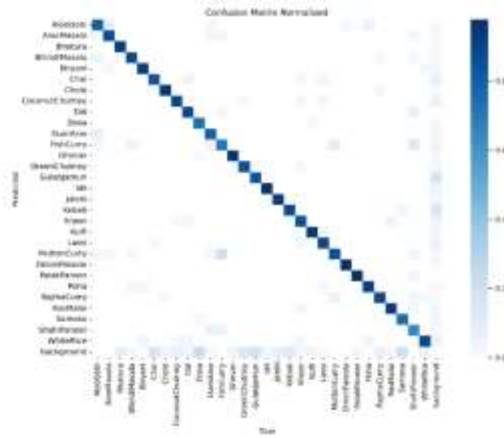

Fig: Confusion Matrix

- Achieved 86.8% mAP50-95 and 89.4% precision on the validation dataset.
- The model successfully classified 30 food categories from the IndianFoodNet-30 dataset with high accuracy.

Key Metrics

- Precision: Quantifies the proportion of positive predictions that are truly correct. It is calculated as:
- Precision $= \frac{\text{True Positives (TP)}}{\text{True Positives (TP)+False Positives (FP)}}$
- Recall: Measures the proportion of actual positives correctly identified by the model. It is calculated as:
- Recall $= \frac{\text{True Positives (TP)}}{\text{True Positives (TP)+False Negatives (FN)}}$
- F1-Score: Balances precision and recall, providing a single metric to evaluate model performance. It is calculated as:
- F1-Score $= 2 \times \frac{\text{Precision} \times \text{Recall}}{\text{Precision+Recall}}$
- mAP50-95 (Mean Average Precision): Evaluates the model's detection accuracy across multiple Intersection over Union (IoU) thresholds. It is the mean of the Average Precision (AP) scores computed at multiple IoU thresholds, ranging from 0.50 (50%) to 0.95 (95%) in steps of 0.05. It is calculated as:
  - $\text{mAP}_{50\text{-}95} = \frac{1}{n}\sum_{\text{IoU}=0.50}^{0.95} \text{AP}(\text{IoU})$

Calorie Estimation Using Image Processing

To estimate the calorie content of detected food items, the system leverages deep learning-based object detection and nutritional data retrieval. The approach integrates YOLO for food recognition and a predefined food database to provide accurate calorie estimates.

Result

- Estimated calorie values with reasonable accuracy using YOLO-based food recognition and database mapping.
- Can be improved by incorporating advanced portion size estimation techniques for better precision

Code for Calories Estimation

Full-Stack Web Application Development

The web application was developed using Django-Ninja (backend) and React.js (frontend). The backend handles image uploads, food recognition, and calorie estimation, while the frontend provides an intuitive interface for users.

Fig: Backend API Endpoints

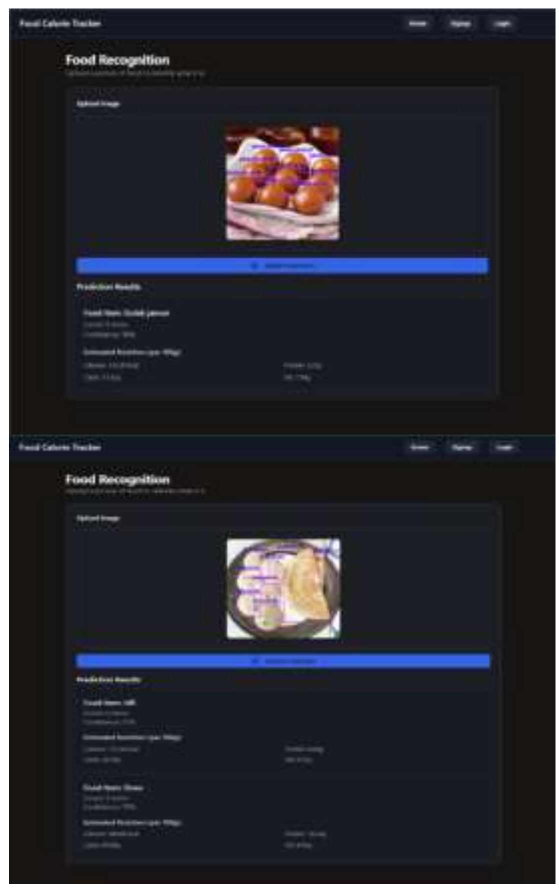

Fig: Final Output in frontend

Future Scope

The Food Calorie Tracker has significant potential for future advancements, making it a more accurate, efficient, and user-friendly tool for dietary monitoring. One of the primary areas for improvement is enhancing food recognition accuracy by training the model on larger and more diverse datasets, including regional cuisines and multi-ingredient dishes. Additionally, calorie estimation can be improved by incorporating depth estimation, 3D modeling, and AI-powered ingredient detection to better analyze portion sizes. The system can also be extended to mobile applications for real-time tracking and integrated with wearable devices such as smartwatches to synchronize calorie intake with physical activity. Furthermore, AI-driven personalized diet recommendations can be developed based on user preferences, fitness goals, and medical conditions, making the system more adaptive. Cloud-based deployment and API integration would enhance scalability, allowing health apps and fitness platforms to utilize the food recognition system. Future innovations such as voice-based food logging, augmented reality (AR)-assisted portion estimation, and smart home assistant integration (Alexa, Google Assistant) could further enhance user experience by providing a hands-free and interactive nutrition tracking solution. With these advancements, the Food Calorie Tracker can evolve into a comprehensive, AI-driven dietary monitoring system, benefiting a wide range of users, from fitness enthusiasts to individuals with medical dietary needs.

V. CONCLUSION

The development of a deep learning-based food recognition and calorie estimation system represents a significant step forward in addressing the global obesity epidemic and promoting healthier dietary habits. By leveraging advanced deep learning architectures such as YOLO (You Only Look Once), this project successfully demonstrates the feasibility of accurately identifying food items and estimating their calorie content in real-time. The integration of a full-stack web application, powered by React.js for the frontend and Django for the backend, ensures a seamless and user-friendly experience for individuals seeking to monitor their dietary intake. By providing users with instant feedback on their food choices, the system empowers individuals to make informed dietary decisions, ultimately contributing to improved health outcomes.

The impact of this project extends beyond individual users, as it has applications in fitness tracking, medical diet monitoring, and public health awareness. By providing an intelligent, AI-powered tool for nutrition analysis, the Food Calorie Tracker can help users make informed dietary decisions, leading to healthier lifestyles. Future research and technological advancements will further refine this system, making it a comprehensive, scalable, and accurate nutrition monitoring platform.

In conclusion, this project serves as a foundation for AI-driven dietary monitoring, combining deep learning, computer vision, and full-stack development to create a real-time, automated calorie tracking solution. With continuous improvements, it has the potential to revolutionize nutrition tracking and provide valuable insights for individuals, healthcare professionals, and the fitness industry.

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