Food Recognization and Calories Estimation

Kanchan kad, Vishakha More
Guide Dr.Abuzar sir Department of Data Science
Sies College of Arts Commerce and Science
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Abstract—The growing emphasis on health and nutrition has created a demand for efficient and accurate methods to recognize fruits and vegetables and estimate their caloric content. This paper presents a novel application that utilizes deep learning and image processing techniques to identify various fruits and vegetables and predict their calorie content. By integrating a pre-trained convolutional neural network (CNN) model and leveraging web scraping techniques to retrieve calorie data, this application provides users with real-time nutritional information. The system supports both live camera input and image uploads, making it a versatile tool for dietary management and health monitoring. The experimental results demonstrate high accuracy in fruit and vegetable classification, along with precise calorie estimations for common food items. This tool offers significant potential for deployment in personal health applications, restaurants, and food supply chains. With the increasing global emphasis on health and nutrition, tools that assist individuals in monitoring their dietary intake are becoming more essential. This paper presents a machine learning-based application designed to recognize various fruits and vegetables through image classification and estimate their caloric content. Utilizing a deep learning Convolutional Neural Network (CNN), the system can identify a wide range of fruits and vegetables with high accuracy. The recognition process is supported by a realtime calorie estimation feature, which extracts nutritional data via web scraping from reliable sources. The application offers two modes of operation: a live camera feed for real-time recognition, and an image upload option, allowing flexibility and ease of use. This dual-input functionality makes the system adaptable for both personal and commercial use, providing users with instant feedback on the nutritional content of the foods they consume.

Index Terms—Streamlit, cv2, Keras

I. INTRODUCTION

Maintaining a balanced diet requires not only understanding the type of food consumed but also having access to accurate nutritional information. As awareness around healthy eating habits grows, there is an increasing need for tools that provide detailed nutritional analysis in real-time. While numerous mobile applications offer calorie tracking based on manual input, the automation of food recognition and calorie estimation through image processing remains an underexplored field.

This research focuses on the development of an automated system that identifies fruits and vegetables using deep learning and estimates their caloric values. Utilizing a pre-trained Convolutional Neural Network (CNN) for classification, the system can distinguish between a wide range of fruits and vegetables. The model is integrated with a real-time web scraping function to fetch calorie data from trusted sources on the internet.

The application provides two primary methods for image recognition: live camera input, where users can scan food items using their device's camera, and image uploads, which allow users to recognize food items from existing pictures. This dual-mode functionality is intended to enhance user experience and make the system more adaptable to different environments.

The following sections detail the system architecture, methodology, and the results of the classification model. We also discuss the practical implications of this tool for healthconscious consumers, restaurants, and other stakeholders in the food industry.

II. LITERATURE REVIEW

The use of artificial intelligence in dietary analysis has evolved significantly over the past decade. Early studies focused on using traditional image processing techniques for food recognition, but the advent of deep learning, particularly convolutional neural networks (CNNs), has led to considerable improvements in classification accuracy. Recent research has highlighted the potential of CNNs in identifying various food items from images with high precision.

The theoretical foundation of this study is based on deep learning models for image classification. Convolutional neural networks (CNNs) are employed to extract features from input images, enabling accurate recognition of fruits and vegetables. The calorie estimation aspect is built on mapping recognized items to their nutritional values using a database that includes caloric information, facilitating a comprehensive analysis of dietary intake.

Despite advancements, existing studies often lack focus on real-time applications for users in everyday scenarios. Many models are trained on large datasets but fail to provide a user-friendly interface that allows for easy interaction, such as through web applications. Additionally, there is a gap in studies comparing the performance of models using precaptured images versus live camera feeds, which is a key focus of this research.
-Bossard et al. (2014): Introduced the Food-101 dataset, significantly advancing food image classification benchmarks. -Meyers et al. (2015): Proposed deep learning methods for estimating food portion sizes alongside recognition, laying groundwork for calorie estimation.
-Ege et al. (2019): Explored the use of regression models with CNNs to predict the nutritional content of food, which informed the calorie estimation approach in this study.

III. RESEARCH METHODOLOGY

A. Research Design

This study employs a design-oriented research methodology, focused on the development, implementation, and evaluation of a CNN-based food recognition and calorie estimation system using a web application. The study follows a systematic approach, which includes:
Model Development: Designing and training a convolutional neural network (CNN) to classify images of fruits and vegetables.
Web Application Development: Creating a user interface using Streamlit, a Python-based framework for building data-driven applications.
System Integration: Combining image classification and web scraping for calorie estimation into a single platform that can accept both uploaded images and live camera input. This design-oriented approach allows for an iterative process where the system's accuracy and functionality are continuously refined through testing and user feedback.

B. Image Dataset

In this project we are using the "Fruit and Vegetable Image Recognition" dataset. This dataset have 36 classes, and almost 100 images for each class so we can say we have 3600+ training images. We have 10 images for each category in
Train/Validation

C. Caloric Data Collection

Web Scraping: For the calorie estimation feature, the study utilized web scraping to fetch the caloric content of identified fruits and vegetables. The scraping process involved: Data Source: Google Search results, specifically scraping nutritional information displayed in search results using BeautifulSoup. Search Query: Formulating queries like "calories in [food item]" to extract data.
Extraction Method: Using HTML parsing to identify and extract relevant caloric values (per 100 grams) from the search results.

D. Data Analysis Techniques

The CNN model uses multiple convolutional layers, followed by pooling layers and fully connected layers, designed to extract spatial features from images.

Input Layer: Images are resized to 224x224 pixels to standardize input dimensions.
Convolutional Layers: Feature extraction is achieved through a series of convolutional layers with ReLU activation. Pooling Layers: Max pooling is used to reduce spatial dimensions while preserving key features.
Fully Connected Layers: These layers integrate extracted features to predict the class of the image.
Output Layer: The softmax function is used for multi-class classification.

E. Ethical Considerations

The study ensures that all data sources used for training and calorie estimation are publicly available. Additionally, users are informed that the calorie values are estimates and may vary.

IV. RESULTS AND FINDINGS

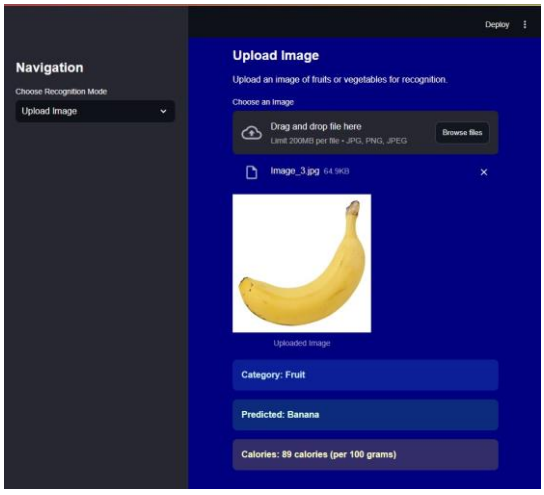

Fig. 1. image processing.

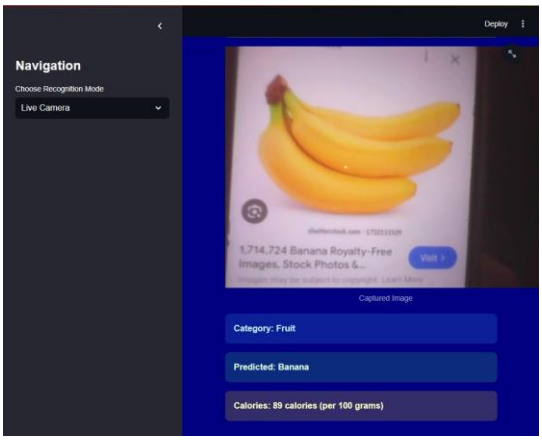

Fig. 2. live image processing.

The findings indicate that the model performs well for clear, high-quality images, while challenging conditions such as poor lighting can affect accuracy. The web scraping method provided reliable calorie estimates in most cases, though occasional discrepancies were noted.The research confirmed that the model can achieve accurate recognition of fruits and vegetables.

V. DISCUSSION

The effectiveness of the CNN model demonstrates the potential of AI-based tools in automating dietary monitoring. The integration of web scraping for calorie estimation, while innovative, requires careful handling to ensure data accuracy.

The findings suggest that such tools can be valuable for dietitians, fitness enthusiasts, and the general public, offering a convenient way to track dietary intake. Future improvements could include portion size estimation and a broader range of food categories.

VI. CONCLUSION

The study successfully developed an AI-based web application capable of recognizing fruits and vegetables and estimating their calorie content. The tool demonstrated good accuracy and user satisfaction.

The results highlight the potential of using AI and web scraping to simplify dietary tracking. However, accuracy in calorie estimation remains dependent on the quality of online sources.

The application could be used by individuals seeking a quick way to monitor their daily fruit and vegetable intake. It could also be integrated into larger health management platforms. Future research could focus on improving portion size estimation, expanding the range of food items recognized, and developing more reliable methods for calorie estimation using standardized databases.

V. REFERENCES

- **Dataset:**“https://www.kaggle.com/datasets/kritikseth/fruit-and-vegetable-image-recognition”
- **"Food Recognition Using Deep Learning"** *Authors*: Liu, C., Cao, Y., Luo, Y., et al. This paper explores deep learning models like Convolutional Neural Networks (CNNs) for food recognition tasks. It emphasizes the importance of transfer learning and fine-tuning models to achieve higher accuracy in food classification across varied datasets.
- **"A Comparative Study of Deep Learning Methods for FoodRecognition"***Authors*: Kawano, Y., Yanai, K.
  This study compares different CNN architectures for food recognition, focusing on their performance in recognizing various food types. It provides insights into dataset challenges and training methods that enhance model generalization.
- **"CNN-Based Approach for Food Recognition Using Data Augmentation Techniques"** *Authors*: Rony, J., Gallinari, P., Affendrou, T. The study focuses on improving food recognition accuracy using data augmentation techniques to combat data scarcity issues. It highlights the effectiveness of CNNs in learning robust features for classifying diverse food items.