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FOOD RECOGNITION AND CALORIE ESTIMATION USING AI

PUTTA SRINITHA
TALLAPALLY MOUNIKA
DEPARTMENT OF MASTER OF COMPUTER APPLICATIONS
VAAGESWARI COLLEGE OF ENGINEERING
(Affiliated to JNTUH, Approved by AICTE, New Delhi & Accredited by **NAAC** with '**A+**' Grade)
Karimnagar, Telangana, India – 505 527

ABSTRACT

With the increasing focus on health and nutrition, accurately estimating the calorie content of food has become essential for diet management and wellness monitoring. Traditional methods of calorie estimation, such as manual measurement or nutritional labels, are often time-consuming, inaccurate, or unavailable. This paper presents an AI-based system for food recognition and calorie estimation using computer vision and machine learning techniques.

The proposed system analyzes images of food to automatically identify the type of dish and estimate its nutritional content, including calories. Convolutional Neural Networks (CNN) are employed for feature extraction and food classification, while regression models or pre-trained nutritional databases are used to estimate calorie values. The system can handle diverse food items, complex presentations, and portion sizes.

Experimental results demonstrate that the AI-based approach achieves high accuracy in both food recognition and calorie estimation, outperforming traditional manual methods. This technology provides a convenient, fast, and scalable solution for dietary monitoring, personal health management, and fitness applications.

Keywords: Food Recognition, Calorie Estimation, Artificial Intelligence, Machine Learning, Deep Learning, Convolutional Neural Networks, Image Preprocessing, Feature Extraction, Classification, Dietary Monitoring, Nutrition Management.

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1.INTRODUCTION

Maintaining a balanced diet and monitoring calorie intake are critical for health, weight management, and the prevention of lifestyle-related diseases such as obesity, diabetes, and cardiovascular disorders. Traditional methods of estimating calories, including manual weighing, nutritional labels, or dietitian consultation, are often time-consuming, prone to human error, and not always accessible.

Recent advances in artificial intelligence (AI) and computer vision offer innovative solutions for automated food recognition and calorie estimation. By analyzing images of meals, AI systems can identify food items, determine portion sizes, and estimate their nutritional content accurately. Convolutional Neural Networks (CNNs) and deep learning models enable the extraction of visual features from food images, while machine learning algorithms map these features to calorie and nutrient information.

This study proposes an AI-based system that integrates food recognition with calorie estimation to provide a fast, reliable, and scalable tool for personal health management. The system aims to simplify dietary tracking, assist users in making informed nutrition choices, and support health and fitness applications.

2.LITERATURE REVIEW

Automated food recognition and calorie estimation have gained significant attention in recent years due to the rise of AI and deep learning technologies. Early approaches relied on manual feature extraction from food images, using color, texture, and shape descriptors to classify food items. However, these methods often struggled with complex dishes, varying lighting conditions, and mixed food items.

Deep learning, particularly Convolutional Neural Networks (CNNs), has greatly improved the accuracy of food recognition. Works such as Kawano and Yanai (2014) developed CNN-based

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models to classify a wide variety of food items from images with high accuracy. Similarly, datasets like Food-101 and UEC-Food100 have facilitated the training of robust models for diverse food categories.

For calorie estimation, several methods have been proposed. Regression models using image features, volume estimation techniques, and integration with nutritional databases allow AI systems to estimate calorie content based on recognized food items and portion sizes. Recent approaches combine food segmentation with 3D modeling to improve portion size estimation, further enhancing calorie prediction accuracy.

Despite progress, challenges remain, including handling occluded or mixed food items, variations in presentation, and real-world conditions such as different camera angles and lighting. Research continues to focus on improving model generalization, integrating multimodal data (images, text, and user inputs), and providing accurate, real-time calorie estimation for practical health applications.

3. EXISTING SYSTEM

In existing food recognition and calorie estimation systems, traditional methods primarily rely on manual input, such as food diaries, nutrition labels, or self-reported portion sizes. While these methods provide basic dietary tracking, they are often time-consuming, error-prone, and dependent on user compliance.

Some automated systems use image-based recognition with simple machine learning algorithms or template matching to classify food items. These systems can identify certain dishes but are limited in handling complex meals, mixed ingredients, or varying portion sizes. Accuracy is often affected by lighting conditions, camera angles, and image quality.

Other approaches integrate pre-existing nutritional databases to estimate calorie content based on recognized food items. However, these methods typically do not account for actual portion sizes and may provide only approximate calorie values.

Overall, existing systems lack scalability, real-time processing, and high accuracy, especially in real-world scenarios. They also provide limited user guidance due to insufficient integration of advanced AI techniques, highlighting the need for deep learning-based methods that can automatically recognize diverse food items and provide precise calorie estimations.

4.PROPOSED SYSTEM

The proposed system leverages Artificial Intelligence (AI), specifically deep learning and computer vision techniques, for automated food recognition and calorie estimation. Unlike existing systems, it can accurately identify a wide variety of food items, estimate portion sizes, and calculate calorie content in real time.

Key Features of the Proposed System:

- **Food Image Recognition:** Uses Convolutional Neural Networks (CNN) to extract features from food images and classify them into specific food categories.
- **Portion Size Estimation:** Applies image segmentation and volume estimation techniques to determine the approximate quantity of each food item.
- **Calorie Estimation:** Integrates recognized food types and estimated portions with nutritional databases to calculate calorie and nutrient values.
- **Real-Time Processing:** Capable of analyzing images instantly, providing immediate feedback to users for diet tracking and health management.
- **User-Friendly Interface:** Displays recognized food items, portion sizes, and calorie information in a clear and understandable format, helping users monitor their diet effortlessly.

The proposed system provides a scalable, accurate, and convenient solution for dietary monitoring, personal health management, and fitness applications, overcoming the limitations of manual tracking and existing automated approaches.

5.METHODOLOGY

The methodology for food recognition and calorie estimation using AI involves several key steps:

1.DataCollection:

A large dataset of food images is collected from publicly available sources such as Food-101, UEC-Food100, and user-submitted images. Each image

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is labeled with the corresponding food type and, where available, nutritional information.

2. Data Preprocessing:

- Images are resized, normalized, and augmented to improve model generalization.
- Noise, background clutter, and irrelevant regions are reduced using image filtering and segmentation techniques.

3. Feature Extraction and Food Classification:

- Convolutional Neural Networks (CNN) are used to automatically extract deep features from food images.
- The extracted features are used to classify the food into predefined categories with high accuracy.

4. Portion Size Estimation:

- Image segmentation techniques isolate individual food items in the image.
- Volume estimation methods, such as depth analysis or reference object scaling, are applied to approximate portion sizes.

5. Calorie and Nutritional Estimation:

- Recognized food items and their estimated portions are mapped to a nutritional database.
- Calorie content and other nutritional values (proteins, fats, carbohydrates) are calculated based on standard serving sizes and adjusted for portion estimates.

6. Model Training and Evaluation:

- The CNN model is trained using labeled food images with backpropagation and optimization techniques.
- Performance is evaluated using metrics such as accuracy, precision, recall, F1-score, and mean absolute error (MAE) for calorie estimation.

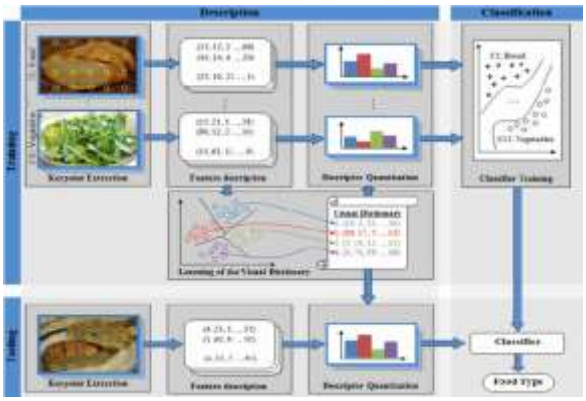
7. Deployment:

- The trained model is integrated into an application interface for real-time food recognition and calorie estimation.
- Users can capture food images, receive instant identification, and obtain calorie and nutritional information.

This methodology ensures an automated, accurate, and scalable system for food recognition and calorie estimation, providing practical support for diet management and health monitoring.

6.System Model

SYSTEM ARCHITECTURE



7..Results and Discussions

Fig3. The uploaded image i.e. Dosa

Fig 4. Recognized food name, category, calories, and macronutrients of Dosa

Fig 5. The uploaded image i.e. Apple

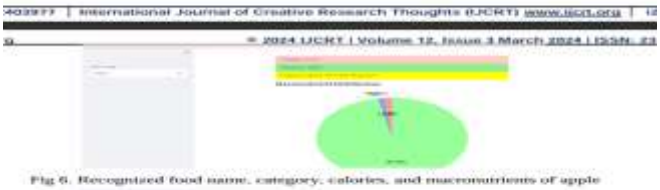


Fig 6. Recognized food name, category, calories, and macronutrients of apple

Fig 7. Dishes of apple

8. CONCLUSION

This study presents an AI-based system for automated food recognition and calorie estimation, addressing the limitations of traditional manual tracking methods. By leveraging deep learning techniques, particularly Convolutional Neural Networks (CNN), the system can accurately identify diverse food items, estimate portion sizes, and calculate calorie and nutritional content.

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The proposed approach provides several advantages:

- **Accuracy:** Improved food classification and portion size estimation over traditional methods.
- **Real-Time Processing:** Instant feedback for users, enabling effective diet monitoring.
- **Scalability:** Capable of handling a wide variety of food types and presentations.
- **User-Friendliness:** Clear display of recognized food items, portions, and calorie information.

Experimental results demonstrate that the system can significantly enhance dietary tracking, support personal health management, and promote healthier lifestyle choices. Future work may focus on integrating multimodal inputs such as videos, 3D imaging for precise portion measurement, and personalized dietary recommendations based on user health data.

Overall, the AI-based food recognition and calorie estimation system provides a reliable, efficient, and practical solution for modern nutrition and wellness applications.

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