

# Efficient Fruit Calorie Measurement using Machine Learning

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**Abstract:** *Food is undeniably a fundamental necessity for all living organisms on Earth. Humans, in particular, seek freshness, purity, and standard quality in their food. To ensure these standards are met, the food processing industry has implemented rigorous standards and automation processes. With a growing global awareness of the impact of diet on health, individuals are increasingly mindful of their dietary choices. An imbalanced diet can lead to various health issues such as weight gain, obesity, and diabetes. Consequently, there has been a surge in the development of systems aimed at analyzing food images to determine calorie and nutrition levels. In this paper, a food portion recognition system is employed to accurately measure calorie and nutrition values. Users simply need to capture a picture of the food, which is then analyzed to detect the type of food portion. This is achieved through segmentation techniques, including skull stripping, followed by classification using support vector machine algorithms. This comprehensive approach ensures precise determination of calorie content, as well as identification of the type of energy present in the food. Overall, this system represents a significant advancement in the field of dietary assessment, offering a seamless and accurate means of monitoring food intake and nutritional values*

**Keywords:** Fruit Calorie Measurement

## I. INTRODUCTION

A calorie serves as a unit of measurement, defined as the amount of heat energy required to raise the temperature of one gram of water by one degree Celsius. Nutrition, on the other hand, encompasses the process of providing or obtaining the essential food necessary for health and growth. This unit is commonly employed to quantify the overall energy content in any food portion, comprising the primary food components of Carbohydrate, Protein, and Fat. Calories play a vital role in the body, serving as a source of energy. However, as with many things, excess calorie intake can lead to adverse effects. When the body accumulates excess calories, they are stored in the form of fat, contributing to weight gain and potentially leading to obesity

It is essential to acknowledge that calorie requirements vary among individuals based on factors such as age, gender, activity level, and metabolic rate. Children, for instance, have distinct calorie needs compared to adults. Additionally, an individual's Body Mass Index (BMI), which is calculated as a person's weight in kilograms divided by the square of their height in meters, influences their daily calorie requirements. Maintaining a balanced intake of calories relative to one's energy expenditure is crucial for sustaining optimal health and well-being.

## II. LITERATURE SURVEY

Image-Based Estimation of Real Food Size for Accurate Food Calorie Estimation Takumi Ege;Yoshikazu Ando; Ryosuke Tanno; Wataru Shimoda; Keiji Yanai IEEE 2023.

Estimating Food Calories for Multiple-Dish Food Photos Takumi Ege; Keiji Yanai IEEE 2023. A food photo generally includes several kinds of food dishes. In order to recognize food images including multiple dishes, we need to detect

each dish in food images. Meanwhile, in recent years, the accuracy of object detection has improved drastically by the appearance of CNN. In this paper, we apply Faster R-CNN [10], a major object detection method, to food photos of multiple dishes. In the experiments we verify by using two kinds of food photo datasets. In addition, this food detector is applied to food calorie estimation for food photos of multiple dishes.

We use Faster R-CNN as a food detector to detect each dish in a food image, and the food calorie of each detected dish are estimated by image-based food calorie estimation [2]. In this way, we estimate food calories from a food photo of multiple dishes. In this experiment, we collect food photos of multiple dishes with total food calorie of multiple dishes. Then we estimate food calories from food photos of multiple dishes by combining the food detector and image based food calorie estimation.

The Design and Implementation of an Ingredient-Based Food Calorie Estimation System Using Nutrition Knowledge and Fusion of Brightness and Heat Information Sirichai Turmchokkasam; Kosin Chamnongthai IEEE 2023. To measure the calorie of food, which are varied depending on its ingredients and volume in each cooking time, it is required to calculate calories of food before consuming. Based on nutrition knowledge, ingredients that are components of food naturally have different calories.

This paper proposes a method of ingredient-based food calorie estimation using nutrition knowledge and thermal information. In this method, an image of the food is first recognized as a type of food, and ingredients of the recognized food are retrieved from the database with their nutrition knowledge and pattern of brightness and thermal images. Simultaneously, the image is segmented into boundaries of ingredient candidates, and all boundaries are then classified into ingredients using fuzzy logic based on their heat pattern and intensities. The classified ingredients from all boundaries are finally calculated for total calories based on area ratio and nutrition knowledge. The performance of our proposed method shows acceptable results comparing with the calories set up by the conventional destructive method.

## II. METHODOLOGY SECTION

The methodology for efficient fruit calorie measurement using machine learning involves several key steps aimed at accurately quantifying the calorie content of various fruits.

Firstly, a comprehensive dataset of fruit images is collected, covering a wide range of fruit types and variations in size, shape, and color. These images serve as the foundation for training and testing machine learning algorithms.

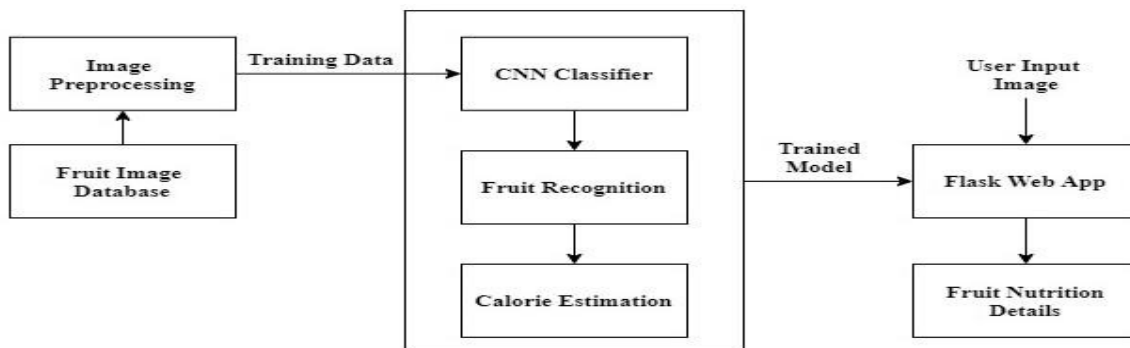


Fig1. Block Diagram

**Image Preprocessing:** image preprocessing techniques are applied to enhance the quality of the images and standardize them for analysis. This may include tasks such as resizing, normalization, and noise reduction to ensure consistency across the dataset.

**Fruit Segmentation:** The fruit item is distinguished with the assistance of the CNN model. In the subsequent stage, we do image segmentation with the assistance of morphological functions of OpenCV. A combination of techniques including canny edge detection and morphological operators are utilized to segment the fruit item to obtain the contour of the fruit as shown in Fig2.

A mixture of techniques like canny edge detection and morphological operators like dilation were used to segment the food item to obtain the contour of the fruit. A Contour based segmentation is done by calculating the number of contours and by finding the biggest fruit contour. For different foods different sets of morphological operations need to be performed multiple times in order to get the food region.

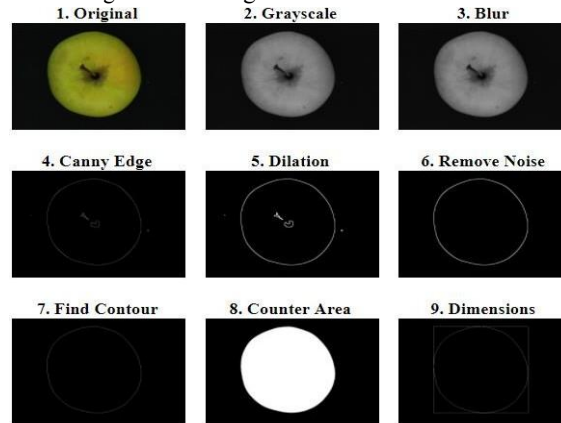


Fig2. Segmentation and contour detection processes

Subsequently, feature extraction is performed to capture relevant characteristics of the fruit images. This step involves identifying key attributes such as texture, shape, and color distribution, which can contribute to accurate calorie estimation.

Machine learning algorithms, such as convolutional neural networks (CNNs) or support vector machines (SVMs), are then trained using the preprocessed image data and extracted features. During the training process, the algorithms learn to associate specific image patterns with corresponding calorie values, enabling them to make predictions on unseen data.

Once the models are trained, they undergo rigorous testing and evaluation to assess their performance and accuracy in predicting fruit calorie content. This involves partitioning the dataset into training and testing sets, with the latter used to evaluate the model's ability to generalize to new data.

Finally, the trained machine learning model is deployed into a practical application, such as a mobile app or web platform, where users can upload images of fruits to receive instant calorie measurements. Continuous monitoring and updates to the model may be necessary to ensure its effectiveness and adaptability to new fruit varieties or environmental conditions.

Overall, the methodology for efficient fruit calorie measurement using machine learning offers a systematic approach to accurately estimate calorie content from fruit images, leveraging the power of data-driven techniques to enhance dietary assessment and nutritional guidance.

### III. RESULTS

A simple flask-based application is created for calorie detection so any patient can monitor their daily intake of nutrition.

Fig 3 shows Calories and nutrition results for orange class. Input images are passed through a progression of put images are passed through a series of image segmentation operations to ascertain calories.

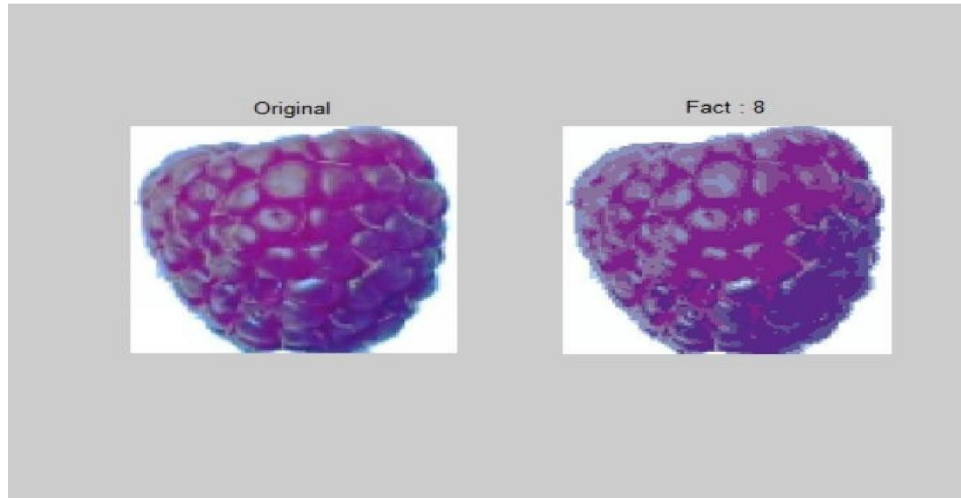


Fig 3: Calorie Result for fruit

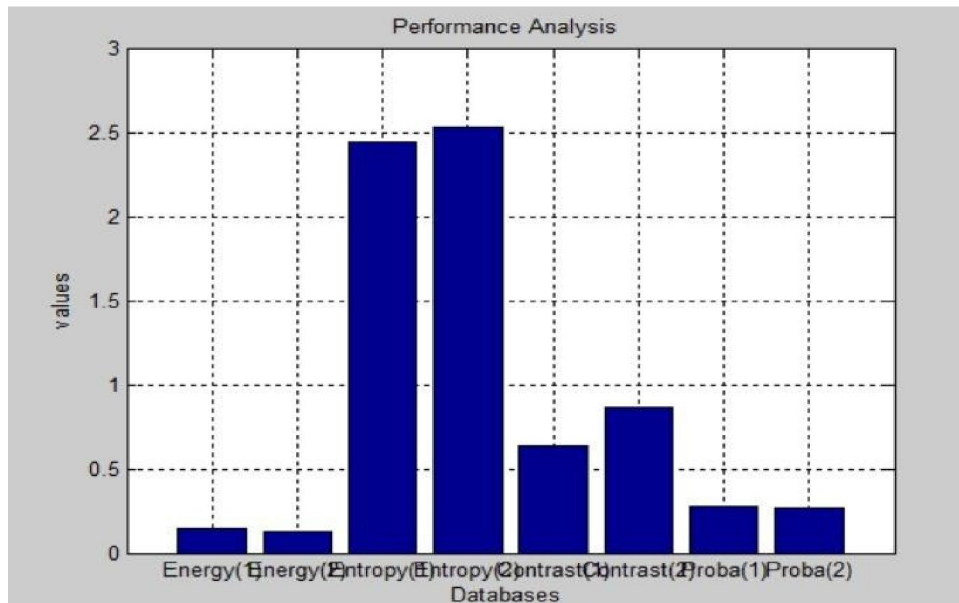


Fig4.Performance Analysis

#### IV. CONCLUSION

In the implementation of a food recognition system based on image processing, a comprehensive comparative study of various software schemes was conducted. The proposed method involves estimating the calorie content of a food item from its image by measuring the area of the food portions depicted and referencing nutritional facts tables to determine the calorie and nutrition levels. The calorie value is then approximated and presented in the final results. This innovative project is specifically designed to assist dieticians in treating individuals who are obese or overweight. However, it also holds potential benefits for the general population, allowing for closer monitoring of daily food intake without concerns of overeating and subsequent weight gain. The system's simplicity and user-friendliness make it accessible to a wide range of users. As a result, this system holds significant importance in the biomedical field, offering a clear and straightforward solution to addressing issues such as False Negative (FN) occurrences, where low-energy foods are inaccurately interpreted.

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