**FOOD CALORIE ESTIMATION USING  
 INTRINSIC SEGMENTATION MODELS**

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***Abstract:***

*This study introduces a novel system for estimating the calorie content of food using a combination of deep learning and a comprehensive food database. Our work takes inspiration from existing models like ResNet50, YOLOv3, ImageNet, and more, to create new building blocks for new models. We put our blocks to the test by incorporating them into models for the prediction of Food Calories, Food Volume, and Food Mass from the given image.*

*By leveraging data from a calorie database, the system is able to accurately predict the total number of calories in a given image based on the calculated volumes and labels. This approach effectively tackles common challenges such as varied images and lighting conditions, thanks to its robust segmentation and database-driven prediction methods.*

*An extensive evaluation, including measuring segmentation accuracy, volume estimation error, and overall calorie estimation error, is planned. This innovative system has the potential to greatly assist individuals in monitoring their dietary intake by providing accurate calorie estimates from food images.*

***Keywords: calorie estimation, image recognition, image segmentation***

**1. Introduction:**

Having a healthy diet is vital for overall well-being, but accurately keeping track of calorie consumption can be difficult. Despite the existence of calorie labels, manual tracking can be tedious and prone to mistakes, resulting in underestimated intake. As food photography and smartphone cameras become more popular, the opportunity arises to utilize technology for automated calorie estimation, giving individuals the power to make informed dietary decisions.

**1.1.** **The Importance of Automated Calorie Estimation:**

Precise calorie tracking is crucial for weight management, preventing chronic illnesses, and improving overall health. Nevertheless, traditional methods such as manual logging or calorie-counting apps have their limitations.

**1.2. Challenges and the Gap:**

Creating an effective automated calorie estimation system comes with its unique set of obstacles. The varying appearance of food images caused by lighting, camera angles, and presentation poses a challenge in accurately identifying and segmenting food items. Furthermore, accurately estimating portion sizes proves to be a daunting task due to the diverse physical characteristics of different foods. Despite advancements in computer vision and deep learning technologies, there remains a lack of readily available solutions to effectively address these challenges, leaving a significant gap in the path towards healthy eating through convenient calorie tracking.

**1.3.** **The Promise of Deep Learning and Segmentation:**

This research aims to bridge this gap by leveraging the power of deep learning and image segmentation techniques. By developing a model that accurately identifies and segments individual food items within an image, we can estimate their volumes and subsequently, their calorie content. This approach eliminates the need for manual portion size estimation, offering a more objective and convenient method for individuals to track their calorie intake.

**1.4. Significance and Impact:**

The successful development of such a system can significantly impact individual and public health. By empowering individuals to make informed dietary choices through accurate calorie tracking, this technology has the potential to:

* Promote weight management and reduce obesity rates.
* Prevent diet-related chronic diseases like diabetes and heart disease.
* Encourage healthier eating habits and mindful food choices.
* Facilitate personalized dietary interventions and nutritional guidance.

**2. Literature Review:**

While software estimating food calories from pictures holds promise, no current options are accurate or user-friendly. Over 2000 people estimated calories for 20 diverse food pictures. Even experts only averaged 5 correct out of 20. Surprisingly, even small crowds (10 people) were more accurate than individuals or experts. Women and younger people did better, while people overestimated calorie-dense foods and struggled with pictures containing reference objects like credit cards. These findings show crowdsourcing could improve accuracy, but limitations remain. Understanding biases is crucial for better software and analysis. [4,5]

Other works proposed a layered deep learning approach for automated calorie estimation which included techniques like

Faster R-CNN, Canny edge detection, Grab Cut, and Deep learning models. [1]

Convolutional neural networks (CNN) were also used. The network, trained on labeled food images and calorie data, directly predicts the total calorie content of the food in the image.[2]

In the various studies conducted for food calorie prediction, two key concepts remained:

* People individually have poor judgment capabilities for calorie estimations due to personal biases and beliefs.
* Use of machine learning techniques gave promising results up-to a certain extent.

We can improve upon these key ideas by:

* Educating the mass about calorie intake and healthy lifestyle ways.
* Improving machine learning techniques by incorporating new features and better models.

**3. Dataset Details:**

The chosen dataset, IEEE’s FOODD, for this task comprises of images of 16 types of food items out of which we are using 7, namely Apple, Banana, Carrot, Cucumber, Onion, Orange and Tomato. These categories were taken for the creation of a Proof-of-Concept model as these categories were the simplest to predict in terms of calorie count.

**3.1. Exploratory Data Analysis:**

The images corresponding to various food items are not labeled and hence we had to implement crude pre-processing to correctly obtain the calorie values.

It was observed that each of the images were comprising of 4 parts:

* White plate
* The food item
* The background
* The finger of the user holding the plate.

We implemented layers of OTSU thresholding along with contouring to obtain the individual components. Further, we specify the size of the finger to scale each component. This allows us to have a measure of the relative size of the food item.

Using the class of the food item, we split the items via shape for the volume derivation via the relative pixel area. With the help of density of table for the common food items, we are able to now generate approximate answers for the calories present in the food item.

**4. Methodology:**

We are employing a variety of deep learning architecture based on convolutional neural networks. *Our process is unique as we attempt to train the model using the preprocessing function and test the accuracy based on extrapolation capabilities.*

**5. References:**

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