



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 6, June 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512



9940 572 462



6381 907 438



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Food Nutrition Detection System

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ABSTRACT: In addition to physical activity and exercises, maintaining a healthy diet is necessary to avoid obesity and other health-related issues, such as diabetes, stroke, and many cardiovascular diseases. As people across the globe are becoming more interested in watching their weight, eating healthier and avoiding obesity, a system that can measure calories and nutrition in every day meals can be very useful. In this paper, we propose a food calorie and nutrition measurement system that can help patients and dieticians to measure and manage daily food intake. Our system is built on food image processing and uses nutritional fact tables. Recent advancements in machine learning applications and technologies have made it possible to develop automatic or semi-automatic dietary assessment solutions, which is a more convenient approach to monitor daily food intake and control eating habits. In our system we propose a personal software instrument to measure calories and nutrient intake using phone or any other mobile device.

KEYWORDS: Healthy Diet, Calories, Nutrition, Machine Learning, Feature Extraction, Food Type.

I. INTRODUCTION

Obesity and overweight are defined as the result of energy imbalance between calories intake and expenditure [1]. This has been related to the risks of developing chronic heart diseases, diabetes, and other vascular syndromes. In fact, all existing obesity treatment techniques require the patient to record all food intakes per day to compare the food intake with consumed energy. However, in most of the cases, unfortunately patients face difficulties in estimating and measuring the amount of food intake due to the self-denial of the problem, lack of nutritional information, the manual process of writing down this information (which is tiresome and can be forgotten), and other reasons. As such, a semiautomatic monitoring system to record and measure the amount of calories consumed in a meal would be of great help not only to patients and dietitians in the treatment of obesity, but also to the average calorie-conscious person.

II. PROBLEM DEFINITION

Conventional dietary assessment programs require maintaining a daily record of consumed food, manual identification of its contents, and an estimation of its volume. However, these methods pose a challenge for elders especially when it involves an accurate estimation of the amount and time of the food intake. For these reasons, the need for a sophisticated system to automatically carry out all the tasks of food intake, such as detection, food type classification, and volume estimation, has been the main focus in many recent research efforts.

Recent developments in smartphone applications have made it possible to develop an efficient and more convenient solution for automatic dietary assessment. In this research, we propose a personal software instrument to measure calorie and nutrient intake using a smartphone or any other mobile device equipped with a camera. Our system uses image processing and segmentation to identify food portions (i.e., isolating portions such as chicken, rice, vegetables, and so on, from the overall food image), measures the volume of each food portion, and calculates nutritional facts of each portion by calculating the mass of each portion from its measured volume and matching it against existing nutritional fact tables.



A. Objective:

1. The segmentation of food images.
2. A classification approach either with handcrafted feature, or using deep learning.
3. The estimation of food volume and its nutrient information.
4. Analyze the nutrition of detected food and summarize the report.

B. Scope:

To measure calorie and nutrient intake using a smartphone or any other mobile device equipped with a camera.

In this project prepared, occluded, or mixed food items are not considered. Volume estimation methods have been only application to solid and separable food items.

III. LITERATURE SURVEY

1. **P. Pouladzadeh, S. Shirmohammadi and R. Al- Maghrabi**, "Measuring Calorie and Nutrition From Food Image," in IEEE Transactions on Instrumentation and Measurement, vol. 63, no. 8, pp. 1947-1956, Aug. 2014, doi: 10.1109/TIM.2014.2303533.

Author proposes a food calorie and nutrition measurement system that can help patients and dietitians to measure and manage daily food intake. Our system is built on food image processing and uses nutritional fact tables.

2. **N. Tammachat and N. Pantuwong**, "Calories analysis of food intake using image recognition," 2014 6th International Conference on Information Technology and Electrical Engineering (ICITEE), Yogyakarta, 2014, pp. 1-4, doi: 10.1109/ICITEED.2014.7007901.

This paper presents a technique of image processing to recognize images of food taken by users. From the input food images, the users can understand the amount of calories they will take in each meal by using the proposed algorithm. Our method creates feature vector using several features about texture and color, then classify the food images using SVM.

3] P. Pouladzadeh, S. Shirmohammadi and R. Al-

Maghrabi, "Measuring Calorie and Nutrition From Food Image," in IEEE Transactions on Instrumentation and Measurement, vol. 63, no. 8, pp. 1947-1956, Aug. 2014, doi: 10.1109/TIM.2014.2303533. Author proposed a system that built on food image processing and uses nutritional fact tables. Recently, there has been an increase in the usage of personal mobile technology such as smartphones or tablets, which users carry with them practically all the time. Via a special calibration technique, our system uses the built-in camera of such mobile devices and records a photo of the food before and after eating it to measure the consumption of calorie and nutrient component.

- 4] **Q. Yu, M. Anzawa, S. Amano, M. Ogawa and K. Aizawa**, "Food Image Recognition by Personalized Classifier," 2018 25th IEEE International Conference on Image Processing (ICIP), Athens, 2018, pp. 171-175, doi: 10.1109/ICIP.2018.8451422.

In this paper, Author attempted to solve food classification problems by using deep convolutional neural network features to build a personalized classifier which incrementally learns the user's data and adapts to the user's eating habit.

- 5] **L. Jiang, B. Qiu, X. Liu, C. Huang and K. Lin**, "DeepFood: Food Image Analysis and Dietary Assessment via Deep Model," in IEEE Access, vol. 8, pp. 47477-47489, 2020, doi: 10.1109/ACCESS.2020.2973625.

In this paper, author develop a deep model based food recognition and dietary assessment system to study and analyze food items from daily meal images (e.g., captured by smartphone). Specifically, they propose a three-step algorithm to recognize multi-item (food) images by detecting candidate regions and using deep convolutional neural network (CNN) for object classification. The system first generates multiple regions of proposals on input images by applying the Region Proposal Network (RPN) derived from Faster R-CNN model.



IV. PROPOSED SYSTEM ARCHITECTURE

Image segmentation:

The first step is to segment the food area from the input food image. In our implementation, we assume that table and dish have no texture. Therefore, texture segmentation could be used to segment the food area from the input food image because food area should have a dense texture area.

Feature extraction:

After the food area is segmented from the input image. We extract the feature vector from the input image. Since foods have usually have a distinct characteristic of their texture and color, we use texture feature and color feature to construct a feature vector for our study.

Classification:

After the feature vector is constructed, we use the support vector machine (SVM) as a tool to recognize the input image. Support vector machines are a set of related supervised learning methods used for classification and regression.

Algorithm details:

Image Segmentation using K means:

In computer vision, image segmentation is the process of partitioning an image into multiple segments. The goal of segmenting an image is to change the representation of an image into something that is more meaningful and easier to analyze in our case we extract the food part from background. It is usually used for locating food and creating boundaries. It is not a great idea to process an entire image with dish, table cloth etc. because this parts in an image does not contain any useful information. Therefore, by segmenting the image, we can make use of only the important segments i.e food for processing.

An image is basically a set of given pixels. In image segmentation, pixels which have similar attributes are grouped together. Image segmentation creates a pixel-wise mask for objects in an image which gives us a more comprehensive and granular understanding of the object.

V. CONTRIBUTION

In our proposed system, we use more features than other systems, including color, texture, size, and shape, whereas most of the existing methods in this area use only color and shape features. We design a method to apply Gabor filter for texture segmentation of food images.

VI. CONCLUSION

In this research, a wide range of strategies needs to investigate in machine Learning and artificial intelligence tailored for automated food recognition and dietary assessment. In practice, the entire process can be broken down into four tasks: food image acquisition from corresponding datasets, the segmentation of food images, a proper classification approach either with handcrafted features, or using deep learning, and finally the estimation of food volume and its nutrient information.

We also proposed a measurement method that estimates the amount of calories from a food's image by measuring the volume of the food portions from the image and using nutritional facts tables to measure the amount of calorie and nutrition in the food.

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