A SURVEY ON FOOD RECOGNITION AND NUTRIENTS IDENTIFICATION FOR CLASSIFICATION OF HEALTHY FOOD

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ABSTRACT

Food Recognition system plays an important role in this modern day life. Accurate methods to measure food and energy intake by humans are important for the battle against obesity. High calorie intake in the human body has proved harmful leading to several diseases. To identify food items accurately in such system, image processing is used. Image processing techniques like image segmentation, feature extraction, object recognition, classification is used for food recognition and nutrients identification. For identifying the food items from the image the Artificial neural network method is used. Image classifiers are trained to identify and categorize individual food items on a plate from a single image. After food recognition the nutrients in the food will be identified and based on nutrients content the classification of healthy food items will be done.

Keywords: *Image segmentation, Feature extraction, Object recognition and Artificial Neural Network.*

1. INTRODUCTION

Recently, people are becoming used to modern lifestyle since they can be fully consumed by busy schedules at work and at home. Obesity in adults is becoming a common problem. The main cause of obesity is a combination of excessive food consumption and lack of physical activities[3]. Research shows that obese people are more likely to have serious health conditions such as hypertension, heart attack, diabetes, high cholesterol, cancers, and blood pressure. There is a wide spread of nutritional information and guidelines that are available to users at their fingertips on internet. However, such information has not prevented diet-related illnesses or helped patients to eat healthy. In most cases, people find it difficult to examine all of the information about nutrition and dietary choices. Furthermore, people are obvious about measuring or controlling their daily calorie intake due to the lack of nutritional knowledge, irregular eating patterns or lack of self-control[3]. Providing people with an effective long term solution requires a mechanism that help them make permanent changes to their calorie intake. A monitoring system to record and measure the amount of calories consumed in a meal would be of great help not only to patients and dieticians in the treatment of obesity, but also to the average calorie-conscious person[6].

Our goal is to empower users by a convenient, intelligent and an accurate system that helps them become aware of their calorie intake and also find the individual nutrients content in the food item. To identify the food in the

system, image processing and segmentation is used, measures the volume of each food portion and finds the amount of individual nutrients like protein, iron, carbohydrates in the food and classifies them.

2. FOOD RECOGNITION SYSTEM

Food Recognition System is used to recognize the food object in the image and calculate the amount of calories contained in the food portion. To identify the food in our system there are various steps like pre-processing, image segmentation, feature extraction and classification as shown in figure 1.

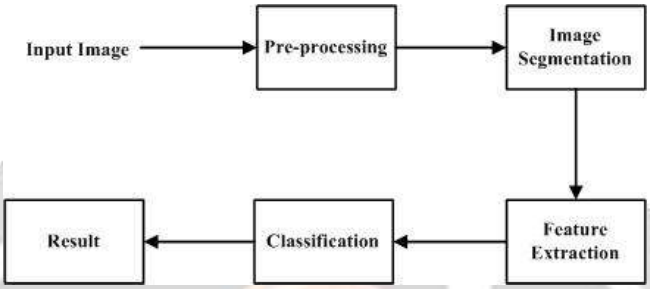

Figure 1: Basic Working of Food Recognition System

The steps for basic working are as follows :

Pre-Processing
In Pre-processing, basically removing noise and normalize the food image if image in any format need to converted in specified format, resize in the specified size and remove unnecessary features from it. There is a different technique for pre-processing like Histogram equalization, filtering and RGB image to Grayscale conversion, etc.

Image Segmentation
In Segmentation, the image is partitioned in equal segments. After segmentation, the boundary detection of irregular food portions become easy and it gives better detection of food portion.

Features Extraction
Feature Extraction is a crucial stage of FRS where the performance of recognition is depending. It extracts the meaningful set of information which is called feature vector. Feature Vector represents characteristics of food in images.

Classification
Classification applies on the feature vector of training and testing image. It is used for result of outcome in recognition. There is a different classifier like a Support Vector Machine (SVM), Deep learning Neural Network and Artificial Neural Network (ANN).

3. RELATED WORK

3.1 Using Graph Cut Segmentation for Food Calorie Measurement

Authors[1] have proposed combination of Graph cut and texture segmentation along with Support Vector Machine(SVM) classification model. Graph cut based method is efficient, robust and capable of finding the best contour of objects in an image.

In this method, the object and the background pixels are grouped and identified individually in the image and then a cut is made to differentiate the food object from the background. Texture segmentation is used

to identify and extract texture features from the food image. The output from the segmentation method is given to SVM to classify the recognized food.

3.2 Using Distance Estimation and Deep Learning to Simplify Calibration in Food Calorie Measurement

Authors[2] have proposed a method which is user-friendly calibration of the dimension of the food portion sizes, which is needed in order to measure food portion weight and its ensuring amount of calories. In deep learning method, first we train our food images with a deep neural network, then we generate the model file. Every time the user submits a food picture for calorie measurement, the system performs segmentation and extracts features, which are further written into hidden layers in the deep neural network. Training the deep neural network in this way, will allow us to make the necessary changes to the weight and bias, without majorly affecting the output of the network and giving us the desired results.

For Distance estimation, during the registration phase, the user is prompted to enter his height details (in feet or cm), which is used during the method to measure of the distance of food object from users phone. System then calculates the mobile phone's orientation using the rotation matrix and calculates angle to the target food object. Based on the angle value and the height entered by the user (example 165 cm), we are able to obtain the distance of the target food object from the mobile phone.

3.3 Food Calorie Measurement Using Deep Learning Neural Network

Here authors[3] have proposed Deep Learning Neural Network method handles the training and testing requests at the top layers, without affecting the central layers. Firstly the segmentation is done using Graph Cut segmentation followed by deep learning method. Here user's thumb is used for size calibration. In this method, the first step is to generate a pre-trained model file and then system is trained with positive set of images. In the second step, we re-train the system with the set of negative images (images that do not contain the relevant object).

In this system, once the model file is generated from the training, we load it into the application and test it against the images captured and submitted by the user. The system then performs the image recognition process and generates a list of probabilities against the label name. The label with the highest probability is prompted to the user in the dialog box, to confirm the object name. Once the object name is confirmed, the system performs the calorie computation part by calculating the size of the food item with respect to the thumb in the frame. It finally prints the output to the user with the required calorie.

3.4 Food Image Recognition with Convolutional Neural Network

In this paper authors[4] are using convolutional neural network method and divide it into the following steps : preparing dataset, building networks, training and testing the networks. It reduces the complexity of the network model and the amount of the weights, especially when the input is a multi-dimensional image. It is a multi-layer neural network. Each layer consists of several 2-D surface and each surface has plenty of single neural cells. The input of each cell connects with the retina below and extract the local feature.

3.5 Automatic Food Recognition System for Diabetic Patients

In this paper, authors[5] approach is to capture food image and fed it into Dense SIFT method, this method extracts key point and visual vector from an image. Extracted visual vector are clustered using K-means clustering technique. Then SVM classifier is used for classification of food image and measures the carbohydrate level.

In this system, Food recognition based Bag of Feature (BoF) model consists of two stages. First stage contains four steps; in this stage a set of characteristics representing the visual content of the image is extracted and quantified. This set provides input to the second stage, where a classifier assigns the image to one class out of a predefined set of food classes. The design and development of both stages involves two phases: training and testing. During the training phase, the system learns from the acquired knowledge, while during the testing phase the system recognizes food types from new, unknown images.

3.6 Measuring Calorie and Nutrition From Food Image

Authors[6] have proposed system in which images are taken by the user with a mobile device followed by a pre-processing step. Then at the segmentation step, each image will be analyzed to extract various segments of the food portion using color and texture segmentation. For each detected food portion a feature extraction process has to be performed. In this step various food features including size, shape, color, and texture will be extracted. The extracted features will be sent to the classification step where using the support vector machine (SVM) scheme the food portion will be identified. Finally, by estimating the area of the food portion and using some nutritional tables the calorie value of the food will be extracted.

4. COMPARISONS OF IMPLEMENTED TECHNIQUES

Table 1: Comparison of Implemented Techniques

Sr No.	Title	Method Used	Advantages	Disadvantages
1.	Using Graph Cut Segmentation for Food Calorie Measurement	Graph cut segmentation	Efficient , robust and finds best contour of objects.	Problem in detecting mixed food because the size of food portions in mixed food are not similar.
2.	Using Distance Estimation and Deep Learning to Simplify Calibration in Food Calorie Measurement	Deep learning method and Distance estimation method	High accuracy than SVM. The user now does not have to keep the finger in the plate for calibration.	System is not able to find the real dimension of food object.
3.	Food Calorie Measurement Using Deep Learning Neural Network	Deep Learning Neural Network	Deep learning does not affect central layers and works on top layers.	Determining the dimension of food portion based on image captured, as it depends on the distance from which the photo was taken.
4.	Food Image Recognition with Convolutional Neural Networks	Convolutional Neural Network	Reduces the complexity of the network model and the amount of weights when the input is multi-dimensional image.	Does not work well for small database.
5.	Automatic Food Recognition System for Diabetic Patients.	Bag of feature (Dense SIFT and SVM) and K-mean clustering	K-mean clustering has been used to reduce time needed for both training and testing	Food items were recognized, it spent long time to find food names.
6.	Measuring Calorie and Nutrition From Food Image	Color and texture segmentation	Calculating the area of the food portion with thumb is more flexible,	System assumes that the depth of the food is uniform throughout the

			controllable and reliable.	food's portion

5. PROPOSED WORK

To recognize the food object in the input image and to classify them based on the amount of individual nutrients contained in the food portion is the main aim of our proposed work. The steps of the proposed work are as follows :

Step 1 : Take an Image from database.

Step 2 : Perform pre-processing on input image.

Step 3 : Apply Texture Segmentation on pre-processed image.

Step 4 : Extract features from the segmented image using combination of Gabor filter and Wavelet transform.

Step 5 : Perform morphological operations like dilation and erosion to recognize food portion.

Step 6 : Identify nutrients from recognized food portion.

Step 7 : Check if the value is greater than initial value

Step 8 : If true, then perform classification using ANN to classify healthy food and enter the data in database.

Step 9 : If false, then stop the system.

6. CONCLUSION

In the system, a method for measuring the calories and nutrition of the food object is carried out. The system helps people by closely controlling their daily food intake. We focused on identifying food items in an image using image processing and food classification is done for identifying healthy foods. The proposed system identifies nutrients individually in the food according to which the classification is done using Artificial Neural Network. This system also works towards improving the accuracy of identifying the mixed foods.

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