Food Image Recognition Using Svm Classifier for Measuring Calorie and Nutrition Values

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***Abstract*— Obesity is the major cause of overweight this leads to the type II diabetes, heart disease and cancer. Measuring the food is very important for a successful healthy diet. Measuring calorie and nutrition in daily food is one of the challenge methods. Smartphone plays a vital role in today's technological world using this technique will enhance the issue in intake of dietary consumption .In this project an food image recognition system for measuring the calorie and nutrition values was developed .the user has to take the picture of the food image this system will classify the image to detect the type of food and portion size and the recognition information will estimate the number of calories in the food. In this system the food area, size and volume will be used to calculate the calorie and nutrition in accurate way.**

***Keywords*— Food image, Pre-processing, Support vector machine (SVM), Feature extraction.**

I. Introduction

Obesity is one of the public health challenges our nation is facing today. Obesity rates have grown to epidemic proportions that threaten our economic and national security in the past two decades. Caloric and nutrition imbalance are the result of overweight and obesity at the most basic level. Healthy eating is central to overall health and reduces the risk of nutrition-related chronic diseases and obesity. Obese people are more likely to have serious health condition such as hypertension, heart attack, diabetes, breast and colon cancer and breathing disorder. Imbalance between the amount of food intake and energy consumed by individuals is the main cause of obesity.

A healthy weight daily food intake must be measured novel assistive mobile phone-based calorie estimation for the normal people to maintain their weight and monitoring system to improve the quality of life of diabetes patients and individuals with unique nutrition management needs. Recently, due to ubiquity of mobile devices such as smart phones, the health monitoring applications are accessible by the patients practically all the time. An automated food intake measurement application, running on a mobile device, could assist the patient to estimate his/her consumption calories.

Mobile phone plays an important role as a food recognition. Stage to gather static an dynamic background information in obtaining better food images have been getting increased attention in current dietary control approaches. The web-based system can also be used as a dietary management system which can be used by the ordinary peoples

Image archives are analysed by the system to identify the image. The nutritional composition and calorie values of these food items are determined by the further image analysis. On the other hand, image recognition smartphone is much more capable in terms of obtainability, announcement cost, interruption, and server costs. Rich computational power of recent smartphones and advanced object recognition technique are taken as advantage.

II RELATED WORK

Commonly, dietary intake measurement methods can be classified into traditional and electronic approaches. Use of the traditional methods has been well-known for decades, whether in hospitals or through research studies. Electronic methods have started to appear recently due to the widespread use of technology globally. In this chapter, we will present a number of the most common dietary intake measuring methods. As well, we will define the drawbacks of those methods to demonstrate the strength of our proposed monitoring system, which can be used for people with healthy weights and for medical purposes to improve the treatment methods related to misreporting for people who suffer from serious medical conditions, such as obesity and overweight. The following is a description of different methodologies behind food measuring systems.

A. Twenty-Four-Hour Dietary Recall

This method basically means an interview. It requires a dietician or even a trained interviewer to ask the respondent to remember and record in detail all the food and drink he or she consumed during a period of time in the recent past (typically the previous 24 hours). The interview can occur either by meeting with the patient or via phone the interviewer should be familiar with nutritional habits and cooking methods to complete and control the data collection format. Moreover, the interview itself is restricted specifically to help the patient remember all the needed information, which is not sufficient for overweight patients. Researchers illustrate that the interviewer's probing minimizes the chance of underreporting or forgetting by 25%.

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This means that self-monitoring and lack of communication with the interviewer leads to negative results in this approach. Additionally, it is quite credibility and obesity. Moreover, this method requires only short-term memory and an expert interviewer, which makes it an difficult for a person to remember the contents and amount of one's daily food intake, especially for obese patients.. Thus, the main disadvantage of the 24-hour dietary recall is the delay and inaccuracy of reporting the eaten food due several factors, such as age, gender, education, expensive method.

B Assistant-Based Approaches

Assistant-based approaches were therefore created to overcome the limitations of the clinical approaches. Technology such mobile-based systems has nowadays been used for calorie measurement. With this method, people can use mobile devices as a user-interface and send their data online to the specialist to calculate the amount of the food in the image. In this method, the first step is to send the captured image to the server for manual analysis. Next the nutrient information is extracted from the food using the Food and Nutrient Database for Dietary Studies (FNDDS) database . And finally analysis results are sent back to the user where the user confirms and/or adjusts this information. So this may take lots of time. The results of portion estimation part can have an error, and it can take a long time for the user to record the information In another study, researchers asked a group of overweight and obese adults to self- monitor their daily food intake (including habits and food consumed) in a period of 24-week behavioural weight control program by using a PDA and the result was that the use of PDA did not increase the validity of food intake reporting.

C Project Statement

Using of K-means clustering for segmentationThis method is one of the most popular clustering techniques, which are used widely, since it is easy to be implemented very efficiently with linear time complexity. However, the K-means algorithm suffers from several drawbacks. The objective function of the K-means is not convex and hence, it may contain many local minima. .Involves cloud computing technique which required client and server.Only limited features of food is measured. Image analysis is focused on large food portions

III SYSTEM COMPONENTS

The food database structure is the main point for building and testing our system These aspects are the usage of calories and nutrition tables, food density tables, image processing, shape acknowledgment as a part of image processing, and classification with the SVM.

A. ***Calories Definition and Nutritional Tables***

A calorie is a classic measuring unit defined as the quantity of heat energy necessary to raise the temperature of 1 gram of water 1 degree this unit is cast-off to measure the complete amount of energy essential for life processes in any food portion that contains of the main food components, which are carbohydrates. Each component has a standard quantity of calorie per gram. Calorie intake must rely mostly on the weight of the individual, his or her daily activity, age and gender. A certain amount of calories should be daily consumed by a person. If the amount of calories disbursement is increased, it will lead to increase the weight and, therefore, the threat of obesity. Thus, all nutrient fact tables should include the calories amount and other facts for any food classes or any food item.

B. Food Density

The term of density, ρ, is described as the mass of any material per volume. It is also defined as the ratio of any food element's component to the calorie. In the case of foods, there are numerous different types of density subject on the bond between volume and mass. Those types are true density, solid density, subdivision density, apparent density, and bulk density. In specific, true density signifies the density of pure elements that result from the calculation of the food component densities with safeguarding of mass and volume. Solid density represents the elements divided into very small parts to make sure no pores appear. Subdivision density is known as the density of material that has not been changed in it is internal construction and includes the density of the internal pore without taking into account the external pore. To calculate the density in apparent density, all internal and external pores must be considered. Bulk density is defined as the total density of the material if packed or the mass in the total volume occupied. Bulk density is considered the suitable type of density to use with the image-processing approach. The pictures that were used for food volume estimations were captured by a digital camera or cell phone camera, which indicates that the food volumes were measured with the internal and external pores included. Food density tables can be found online or in the Health Canada food guide. Food density can also be obtained from readily available tables

C. ***Shape Recognition as a Part of Image Processing***

Shape recognition is a sub-area of image processing focused on the definition of different type of characteristics achieved from each object present inside an image. Among others, the most common characteristics obtained are area; edge; size; Euler number (E), where E is defined by the number of connected components (C) and the number of object holes (H); and H is given by E=C-H and the geometric attributes shown by the shape if the silhouette of the object is closely related to a standard geometrical form, like regular shapes such as a 23 circle, square or triangle. From probability theory, the (m, n) moment of the probability density given by f(x, y) and applied in Hu's seven moments for visual pattern recognition can also be calculated for a specific object. Its shape will define the numbers gained by this calculation. This subset of results will define results exclusively related to each shape.

II. THE FOOD RECOGNITION SYSTEM

A. Pre-Processing

In the beginning, a simple conversion must be performed on the image to change the image size into a standard format for precise results for system segmentation. Thus, the size of each image will be compared with standard size categories. We have defined one size category as a standard, which are 970 × 720 pixels for simplicity. Larger images will be reduced to this size before accomplishment of any image-processing technique.

B .Image Segmentation and Feature Extraction

The segmentation phase starts immediately after analysing the pre-processing step. This part will operate with four different features: colour, texture, shape and size, on which we are mainly focused in this project. These parts also include the calculation in pixels of the thumb and its size in pixels by using a Gaussian edge detection filter and then the skin detection scheme. The extracted size will be used in transforming the pixel size of food portions to actual, real-life size. In addition, the colour feature will be extracted by using the colour histogram, while the size feature will be extracted by including the pixels in the Region of Interest (ROI) for each food portion. Moreover, this will give us the shape feature which will be used in our calculating method.

C. Classification by SVM

Classification with the Support Vector Machine has been done. The extracted features before revealed will be fed into the SVM classifier so that the classifier returns the food name as its output. For each feature, there will be training and testing phase. In fact, the aim of using the SVM in the FRS is to produce a system that can predict the board value of data cases in the testing set, which are just given by their features. To increase correctness and shrink misclassification, the system can interact with the user to verify the kind of food portions, and the user can then settle or alter the food type as mentioned before. The use of SVM method in this model contains five texture features, ten colour features, three shape features, and six size features. All the features of each food item are extracted throughout the segmentation phase. At the same time, it will be used as training vectors for the SVM. This step is important for the FRS to Calculate the amount of calories. Classification with the SVM provides the system with the type of food.

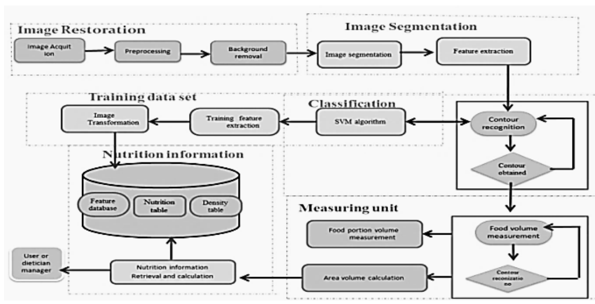

Fig 1 Module diagram

D .Obtaining Volume by Utilising Area Size

The estimation of food volume through an image is a major challenge in dietary intake calculation applications. In this section, the methodology of obtaining the volume of any food image by utilising the area size that has been extracted from the photo after the image analysis and the shape recognition process will be discussed. As soon as the photos of the selected food are captured, the system starts to analyse the pixels of both thumb and meal from the first photo. The main subsequent value from this calculation is the area size in pixels, which will be used with the other dimensions of the food item from the second photo to generate the volume. Finding the volume of the photo leads us to easily calculate the amount of the calories in the selected food via a special algorithm that depends on the nutritional tables stored inside our application.

E. Computing Mass

Measuring the mass of food in the picture is the interval step that will lead us to finding the amount of calories since each type of food has a specific amount of calories depending on its weight. For example, if an apple's weight is 138 grams, the amount of calories is roughly 70 calories. If the apple weighs 90 grams, the amount of calories will be about 35 calories. Additionally, all the nutrition tables that we rely on in our FRS as a standard are based on the mass of food. The knowledge of the food dimensions inside the image, as mentioned before, will give the system the ability to calculate the mass of the food in the image.

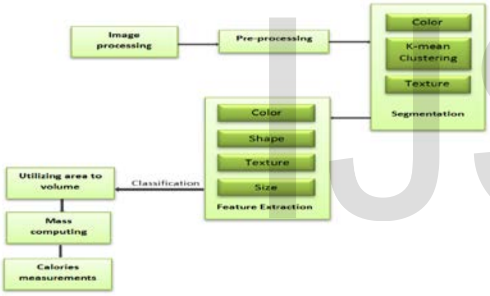

Fig 2 Flow Diagram for Proposed System

$M=\rho V$ ------- (1)

Where M is the mass of the food portion, ρ is the food density, and V is the food volume extracted before from the image, plus the user's thumb inside the photo. After all the previously stated procedures (pre-processing, image processing, shape recognition and SVM classification), the FRS can easily estimate the mass of any food inside the image. The measuring unit will be in grams, like the tables in real life.

F. Calories' Measurements and Estimation

The main objective of the FRS is to estimate the amount of calories and nutrition values for any food type from an image. Thus, caloric estimation is the main, final stage for our system. In fact, the importance of using the already stored nutrient fact tables will also appear in this stage. In general, the system starts to calculate the calories by comparing the inputs from the image (mass) with the inputs from the nutrient tables (mass measured by gram and calorie amount, which is measured by calories), which are already stored in the application's database. We propose a novel method to measure and estimate the amount of calories in any image. As mentioned before, this method depends on the association between the standard stored variables in the nutrient fact tables such as calories, food weight and nutrient values with the known variables extracted from the image to calculate.

IV RESULTS AND DISCUSSION

From the previous chapter, the proposed system is explained by using pre-processing module. Image segmentation module and feature extraction module and food volume measurement module. By using MATLAB software the food image processing, features is extracted using FCM algorithm. The area of the food is calculated to measure the nutrition and calorie value.

A . Simulation Results Of Food Image Preprocessing

The figure 3 Input Food Image gives the input image of the food, which is given as the Input to the pre-processing module by using the lab color space conversion the input image is enhanced for making it fit for feature extraction figure 4 Lab Colour Space Image is the output of the Lab Colour space conversion. The enhanced form of the lab Colour space image is shown in the figure Enhanced Image

Fig 3 Input Food Image

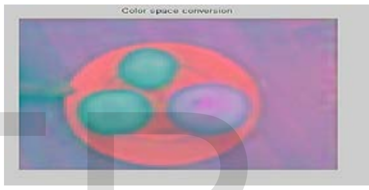

Fig 4 Lab Colour Space Image

Fig 5 Enhanced Images

B. Simulation Result Of Image Segmentation

The input image is shown in the Figure 3 Input Food Image in the module is segmented using FCM algorithm the output of the segmented image is shown in the Figure**6** Semgented Image.

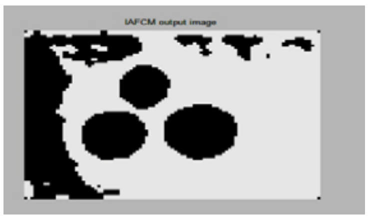

Fig 6 Semgented Image

C. Simulation Result Of Image Segmentation

The input of the food image is shown in the Figure 3 Input Image after the color space conversion, enchantment module the segmentation is done now the feature is extracted of the input food image is shown in the Figure 7 Feature Extractions which helps to find out the area of the food to measure the nutrition and calorie values present in the food using the food image. After this module area and volume of the food is calculated using this feature extracted food image to calculate the nutrition and calorie values of the input image.

Fig 7. Feature Extractions

D. Simulation Result Of Area Size

Finding the volume of the photo leads us to easily calculate the amount of the calories in the selected food via a special algorithm that depends on the nutritional tables stored inside our application The calculation of area and volume in the food image is just the first step that will allow the FRS to compute the mass of the food and consequently calculate the amount of calories through the food image

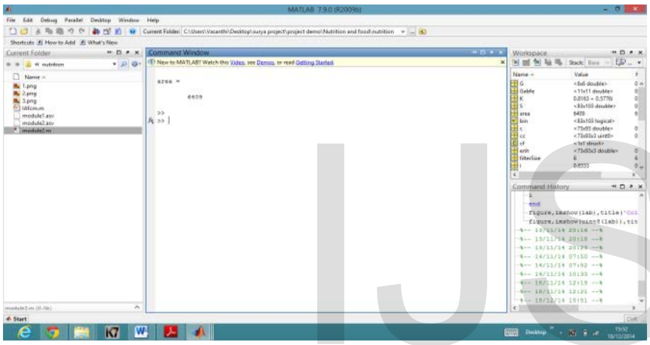

Fig 8 Screenshot of area size calculation of food image calculation

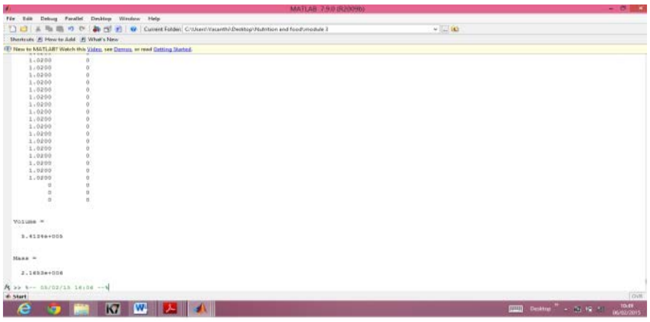

Fig 9 Screenshot of area size calculation of food image calculation of volume and mass

E. Nutrition and Calorie Database

Nutrition and calorie are stored in the database after classification the features will match with the original image and the calorie and nutrition values will be given the database creation is shown in the below figure.

Food Name	Measure	Weight(g)	Energy (kcd)	Protein (g)	Carbohydrate (g)	Fat (g)
Apple with skin	1	138	72	N/A	19	N/A
Potato	1	135	116	2	27	N/A
Chicken	75	75	135	16	0	9
Orange	1	131	62	1	15	N/A
Potato	1	98	38	1	9	N/A
Bread white	1	35	93	3	18	1
Zucchini	125	95	15	1	4	1

Table 1.1 Nutrition database

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