IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 1, January 2017

A Food Recognition System for Calorie Measurement

Ms. Ankita A. Podutwar[1], Prof. Pragati D. Pawar[2] , Prof. Abhijeet V. Shinde[3]

Second Year M. E. Student (Digital Electronics), Dr. Bhausaheb Nandurkar College of Engineering and Technology Yavatmal, India[1]

Assistant Prof. of Electronics and Telecomm. Dept., Jawaharlal Darda Institute of Engineering and Technology Yavatmal, India[2]

Assistant Prof. of Electronics and Telecomm. Dept., Dr. Bhausaheb Nandurkar College of Engineering and Technology Yavatmal, India[3]

Abstract : Food is one of the most important requirements of every living being on earth. The human beings require their food to be fresh, pure and of standard quality. The standards imposed and automation carried out in food processing industry takes care of food quality. Now a day, people across the universe are becoming more sensitive to their diet.

Unbalanced diet may cause many problems like weight gain, obesity, diabetes, etc. So different systems were developed so as to analyze food images to calculate calorie and nutrition level. This system proposes a effective way to measure and manage daily food intake of patients and dietitians. The system will take the images of food and using image processing, segmentation and classification it calculates the nutrition and calorie content in the food. The proposed system will certainly improve and facilitate the current calorie measurement techniques.

In this paper, food portion recognition system use for measuring the calorie and nutrition values. The user just to take a picture of the food image then to recognize the image to detect the type of food portion and classify using support vector machine. we are performing segmentation, food portion recognition using skull striping and classification using support vector machine to calculate the calorie along with the type of energy in accurate way.

Keywords: Calorie and Nutrition estimation, Segmentation by Fuzzy C Means, Classification using Support Vector Machine.

1. INTRODUCTION

Calorie is a measuring unit which is defined as the amount of heat energy needed to raise the temperature of one gram of water by one degree. The process of providing or obtaining the food necessary for health and growth is called Nutrition. This unit is commonly used to measure the overall amount of energy in any food portion that consists of the main food components of Carbohydrate, Protein and Fat. Calories are a must for the body, as they are generate energy. But it is said that an excess of anything is bad and the same applies to the intake of calories too. If there is an excess of calories in our body, it gets stored in the form of fats, thus making us overweight. Adult calorie requirements differ from that of a child and in the same way, the daily calorie requirement of an Body Mass Index is a person's weight in kilograms divided by the square of their height in meters.

It is one of the most commonly used ways of estimating whether a person is overweight or not. A person is considered obese when his / her BMI is higher than or equal to 30 kg/m^2. The rate of obese person is increasing in alarming rate from last few years . Also there are many chances for obese people to face a serious health problems like hypertension, heart attack, diabetes, obesity ,hypertension, high cholesterol etc. So the main cause for obesity is imbalance of the amount of food intake and energy consumed by the individual since it is necessary to have healthy meal. Therefore, different systems were developed which would measure the nutrition level of the diet and helps the patients and dietitians to control their obesity. This system reviews the different systems which had taken the food images to measure the calorie and nutritional level in the food sample. As such, this system is use to 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 calorie conscious person.

Obesity treatment needs the patient to note the amount of the daily food intake, but in most cases, it is not simple for the patients to measure or control their daily intake due to the lack of nutrition, education or self control. Therefore, by using a automatic food intake monitoring system, we can assist the patient and provide an effective tool for the obesity treatment. Nowadays, new technologies such as computers and smart phones are involved in the medical treatment of different types of diseases, and obesity is considered as one of the common disease. From the last

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 1, January 2017

few years, a numbers of food intake measuring methods have been developed. But most of these systems have drawbacks such as large calculation errors and it is not an user friendly. In this paper, there is no need of large calculation for calorie and nutrition measurement.

In our proposed system, we use color, size, shape and texture features for proper result and accuracy. We design a method to apply Fuzzy C means clustering technique for improving the accuracy of food images. Also create an hybrid combination of segmentation and classification. For performing this, simply take an enhanced image to do segmentation after that performing an classification through clustering. Means this is hybrid technique combined of segmentation and classification to give an appropriate result with high accuracy.

2. RELATED WORK

A daily diet is very necessary in day to day life. So it is necessary to manage our daily food item intake. In 2008 to 2010, more than one in ten of the world's adult populations were obese [1], but in 2012 this figure or range has risen to one in six adults [2], an alarming growth rate. The recent paper studies have shown that obese people are more likely to have serious health conditions such as hypertension, heart attack, diabetes, high cholesterol, breast and colon cancer, and breathing disorders, thyroid etc. The main cause of obesity is the imbalance between the amount of daily food intake and energy consumed by the individuals [3]. There is another system which is based on support vector machine but use the thumb for calibration of each and every food image but it require long calculation for measuring nutrition that measurement system also uses a photo of the food, taken with the camera of a smart phone, but uses the thumb of patient for calibration, which solves the problem of carrying cards or special trays. More specifically, an thumb image is captured and stored with its measurements in the first usage time (first time calibration). Now, this unique method will lead to relatively accurate results without the difficulties of other methods. Food images will then be taken with the user's thumb placed next to the dish, make it easy to measure the real life size of the portions. We then apply image processing and classification techniques to find the food portions, their volume and area of the food and get the calorie and nutrition but the use of thumb is necessary[4]. So, in order to lose weight in a healthy way, as well as to maintain a healthy weight for normal people, the daily food intake measured is must [5]. That system's are uses image processing and segmentation to identify food portions (i.e., isolating portions such as chicken, rice, vegetables, etc., from the overall food image), measures the volume of each food part, and calculates nutritional facts of each part by calculating the mass of each portion from its measured volume[6].

Color is used in identifying objects for many years and also Texture is one of the most active topics in machine intelligence and pattern analysis since the 1950s which tries to discriminate the different patterns of images by extracting the dependency of intensity between pixels and their neighboring pixels [7], or by obtaining the variance of intensity across pixels [8]. Recently, different features of color ,texture, size are combined together in order to measure food nutrition more accurately [9]. The problem with this manual approach is obvious people not remembering exactly what they are ate, forgetting to take note, and needing to see an expert dietician on a very frequent basis so the dietician can guess how much calories and nutrient the patient has taken. To evaluate the shortcomings of these clinical methods, researchers have been trying to come up with new improved techniques. Some of these techniques require the person to take a picture of the food before eating food, so that the picture can be processed offline, either manually or automatically, to measure the amount of calorie.

For example, the work in [10] proposes a method that uses a calibration card for an reference, this card should be placed next to the food when capturing the image, so that the dimensions of the food are known. However, this card must always be present in the photo when the patient or obese people wants to use the system. The drawback is of the system will not work without this card, which means that in the case of absence of the card, the system will not work. Another method which use the photo of the food and feeds that to a Neural Network developed by researchers in [11]. But the user must have to capture the photo in a special tray (for calibration purpose), which might not be always possible and so the method may be difficult to follow for the user. That system also uses an photo of the food, taken with the camera of a smart phones, but uses the patient's thumb for calibration, which solves the problem of carrying cards or special trays. More specifically, an image of the thumb is captured and stored with its measurements in the first time usage (first time calibration). Different food images will then be taken with the user's thumb placed next to the dish, makes it easy to measure the real size of the portions. We then apply image processing and classification techniques to find the food portions, their volume, and their nutritional facts. Yet another approach appears in [12], where the picture of the food taken with a smart phone is compared to photos of predefined foods with known nutritional values which are stored in a database, and the values are estimated based on picture similarity. The main disadvantage of this system is that it does not take into account the size and shape of the food, which is extremely important. One example, which is typical of current clinical approaches, is the 24-Hour Dietary Recall system. The idea of this method is the listing of the daily food intake by using a special format for a period of 24 hours. This method requires a trained interviewer, such as a dietician, to ask the respondent to remember in details all the food and drinks s/he has consumed during a period of time in the recent past or a whole day (often the previous 24 hours). The 24HR requires only short-term memory, and if the recall is

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 1, January 2017

unannounced, the diet is not changed for that person. Also, the interview is relatively brief (20 to 30 minutes), and the subject burden is as less in comparison with other food image recording methods [13].

3. METHODOLOGY

The methodology consist of two main parts first one is segmentation using fuzzy c means and second one is classification by SVM. These important steps are described below,

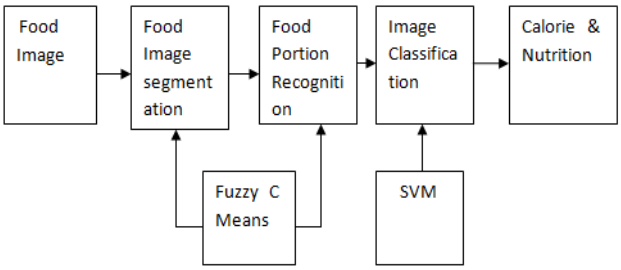

Figure 3.1 General Block Diagram

Segmentation is a process of extracting and representing information from an image is to group pixels together into regions of similarity Segmentation subdivides an image into its constituent regions or objects that have similar features according to a set of predefined criteria. The goal of image segmentation is to cluster pixels into salient image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects. A segmentation could be used for object recognition, occlusion boundary estimation within motion or stereo systems, image compression, image editing, or image database look-up.

For input we primarily consider image brightness here, although similar techniques can be used with color, motion, and/or stereo disparity information. The quality of the segmentation depends on the image. Smoothly shaded surfaces with clear gray-level steps between different surfaces are ideal for the above algorithms.

The assessment of segmentation algorithms therefore needs to be done on standardized datasets. If an image has been preprocessed appropriately to remove noise and artifacts, segmentation is often the key step in interpreting the image. Image segmentation is a process in which regions or features sharing similar characteristics are identified and grouped together. Image segmentation may use statistical classification, thresholding , edge detection, region detection, or any combination of these techniques. The output of the segmentation step is usually a set of classified elements, Most segmentation techniques are either region-based or edge based. In image processing, Segmentation is the process of partitioning a digital image into several segments. The goal of segmentation is to simplify an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. The pixels in the same region have similar characteristics, such as color, or texture. In this application food with similar ingredient will be placed in the same segment. So dividing the food in separate parts, aid the classifier to find the correct result. In this project we are using fuzzy c means for segmentation.

Clustering of numerical data forms the basis of many classification and system modeling algorithms. The purpose of clustering is to identify natural groupings of data from a large data set to produce a concise representation of a system's behavior. Fuzzy c-means (FCM) is a data clustering technique in which a dataset is grouped into n clusters with every data point in the dataset belonging to every cluster to a certain degree. For example, a certain data point that lies close to the center of a cluster will have a high degree of belonging or membership to that cluster and another data point that lies far away from the center of a cluster will have a low degree of belonging or membership to that cluster. This iteration is based on minimizing an objective function that represents the distance from any given data point to a cluster center weighted by that data point's membership grade. Using of K-means clustering for segmentation This 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 Fuzzy C-Means Clustering. The function FCM takes a data set and a desired number of clusters and returns optimal cluster centers and membership grades for each data point. We can use this information to build a fuzzy inference system by creating membership functions that represent the fuzzy qualities of each cluster.

4. CLASSIFICATION USING SVM

SVM is one of the popular techniques used for data classification. A classification task usually involves training and testing data which consist of some data instances. Each instance in the training set contains one class label and several features. The goal of SVM is to produce a model which predicts target value of data instances in the testing set which are given only by their attributes. In our model, we use the radial basis function (Linear) kernel, which maps samples into a higher dimensional space in a non-linear manner. Unlike the linear kernels, the Linear kernel is well suited for the cases in which the relation between class labels and attributes is nonlinear. The feature vectors of each food item, extracted during the segmentation phase, will be used as the training vectors of SVM. For increasing the accuracy, after the SVM module has determined each food portion type, the

IJARCCE
ISSN (Online) 2278-1021
ISSN (Print) 2319 5940
International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 1, January 2017

system can optionally interact with the user to verify the kind of food portions.

The SVM module uses this information and recognizes the type of food for each portion. Also, as mentioned earlier, at this stage the system can ask the user to verify whether the food type recognized by the SVM module is correct 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 color features. All the color 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.

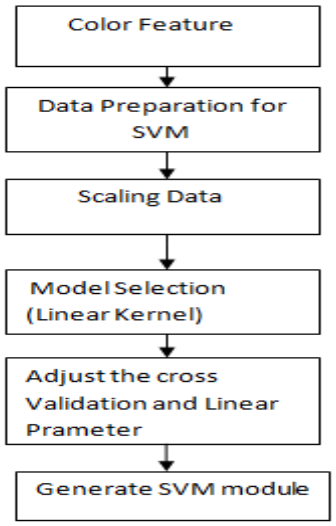

Figure 4. SVM Algorithm

5. CALORIE AND NUTRITION MEASURING ALGORITHM

This are the implemented algorithm for getting the result. In this we have made two algorithms, one for training and another for testing. The first trailing algorithm is the part of input or we can say that creating the database and then stored a particular image as it is energies or low energies which shown by the energy graph. If calorie is high, and nutrition is also high, then it will shows energies is high and also shows the percentage of energy present in that food.

We are performing segmentation using fuzzy c means. After segmentation there is recognition done by the use of skull stripping. The main aim of this is use for detection purpose. Then this detection, it will go for counter recognition and we have to stored that image in database using that energy graph.

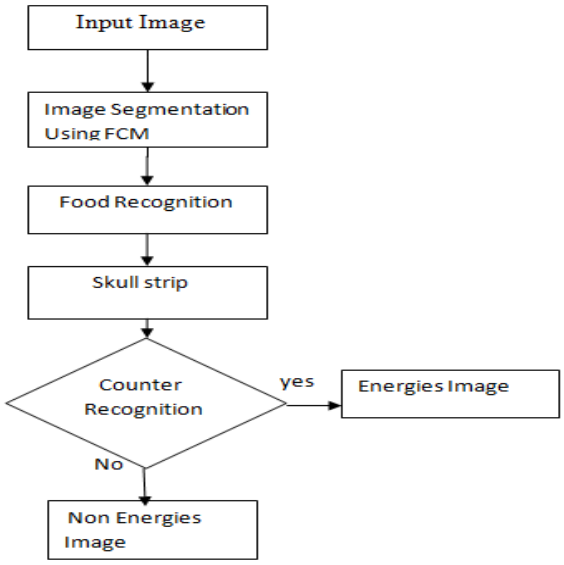

Figure 5.1 Training Algorithm

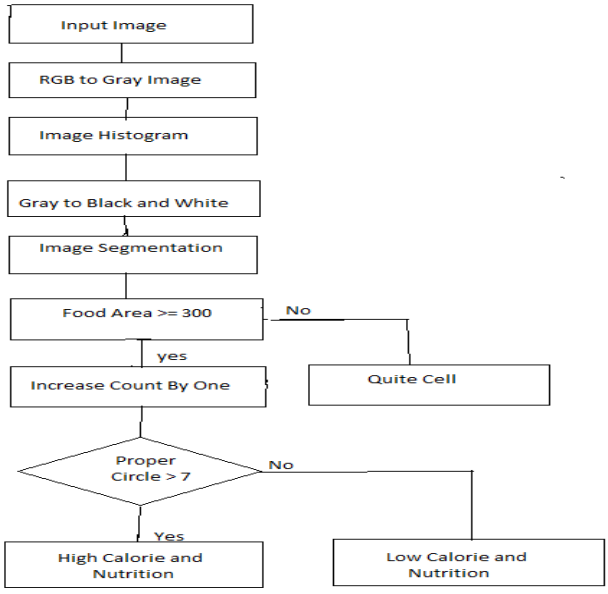

Figure 5.2 Training Algorithm

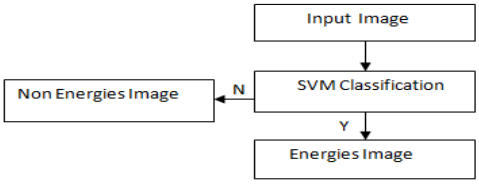

Figure 5.3 Testing Algorithm

IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 1, January 2017

6. RESULTS AND ANALYSIS

To calculate the food recognition system rate we need group of images, meaning that the results are for a group of images, not only for a single images. Hence we get system recognition table, but before that we have an typical nutritional table[1]. The implemented system relies on this table as a reference to measure nutritional facts from any selected food photo.

No.	Food Name	Measure	Weight	Energy
1	Apple	1	140	80
2	Potato	1	135	116
3	Orange	1	110	62
4	Tomato	1	123	30
5	Bread	1	100	17
6	Cake	1	100	250
7	Egg	1	150	17
8	Cucumber	1	100	30
9	Banana	1	100	105
10	Orange	1	110	62

Table No. 1 Typical Nutritional Table

This is an input procedure to stored an food images according to the energy graph. By using testing algorithm, we are getting the final result of our project. After all this preprocessing ,we have to simply apply classification by using support vector machine with linear kernel model selector.

In this paper, we proposed a measurement method that estimates the amount of calories and Nutrition from a food image by measuring the food portions using skull stripping to measure the amount of calorie and nutrition in the food. And if Calorie or Nutrition one of the parameter is high in the image then it will shows that it is an energies food if not then low energies food. With that it will also show amount of calorie in given food.

By using this formula we are getting the recognition rate of our system and this is shown in table[2]. At last our system give an approximate value of calorie in respected food item and this results are in table[3].

$$\text{Accuracy} = \frac{TP+TN}{TP+FP+TN+FN} * 100$$

True Positive (TP) - Low energious food is correctly identified as Low energious food.

True Negative (TN) - Energious food is correctly identified as Energious food.

False Positive (FP) - Energious is incorrectly identified as Low energious.

False Negative (FN) - Low energious is incorrectly identified as energious.

No.	Food Item	Previous Result	Proposed System
1	Apple	91.41	93.33
2	Orange	90.19	90.00
3	Corn	97.00	96.66
4	Tomato	79.82	80.00
5	Carrot	92.34	93.33
6	Bread	93.50	95.00
7	Pasta	96.10	96.66
8	Cheese	93.43	95.00

Table No. 2 Food Recognition System

For finding the recognition rate of our system, we are going to compare this system with the recent paper work i.e. Measuring Calorie and Nutrition from Food Image published in 2014 and Hence we are compare this food recognition system with our proposed system and get the results as shown in table no. 2

No.	Food Portion	Calculated Calorie	Real Calorie	Absolute Accuracy
1	Apple	99.35	114	86%
2	Banana	136.15	157	87%
3	Orange	81.90	90	91%
4	Raspberries	100.15	126	79 %
5	Pomegranate	92.57	100	93%
6	Pineapple	104.84	112	94%
7	Custard Apple	104.82	110	95%
8	Mango	82.42	95	87%
Average Accuracy				**89%**

7. CONCLUSION

In the implementation of food recognition system based on image processing the comparative study of various software scheme is done. we proposed a measurement method that estimates the amount of calories from a food's image by measuring the area of the food portions from the image and using nutritional facts tables to measure the amount of calorie and nutrition in the food. And calorie is shown in final results with approximate value.
Thus the paper is designed to aid dieticians for the treatment of obese or overweight people, although normal people can also benefit from our system by controlling more closely their daily eating without worrying about overeating and weight gain This is simple and easy to use. Hence this system is very important in the field of biomedical, the actual program is clear and easy to understand.

DOI 10.17148/IJARCCE.2017.6146

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 1, January 2017

We focused on identifying food items in an image by using image processing and segmentation, food classification using SVM, food portion area measurement, and calorie measurement based on food portion and nutritional tables. Our results indicated reasonable accuracy of our method in area measurement.

8. FUTURE WORK

In Future, we also implement these system by using an hardware for an calorie and nutrition measurement along with mass. By using an MATLAB and hardware interfacing controller for measuring the mass with high megapixel camera and precision sensor to take liquid food such as milk, sauce, tea, juices and etc.
Also, more work is needed for supporting mixed or even liquid food. Advance system can be design to use any kind of plates having a different color for capturing a photo instead of white only. An obvious avenue for future work is to cover more food types from a variety of cuisines around the world.

REFERENCES

1. Http://www.noo.org.uk/uploads/doc789_40_noo_bmi.pdf
2. World health organization. (2011, october) obesity study.[online]. Http://www.who.int/mediacentre/factsheets /fs311/en/index.html
3. World health organization. (2012) world health statistics 2012.[online]. Http://www.who.int/gho/publications/world_health_statistics/2012/en/index.html
4. Parisa Pouladzadeh, Shervin Shirmohammadi and Rana Almaghrabi, "Measuring Calorie and Nutrition from Food Image" Food Recognition -IEEE-TIM-final.rar ,2014
5. George a. Bray and claude bouchard, handbook of obesity, second edition, ed. Louisiana, usa: ennington biomedical research center, 2004.
6. Geeta shroff, asim smailagic, "*Neural Network based Food Recognition and Calorie calculation for diabetes patients*", diawear technical report, pp. 1-8, march, 2009.
7. Keigo kitamura, chaminda de silva, toshihiko yamasaki, kiyoharu aizawa, "*Image Processing based approach to food balance analysis for personal Food logging*", ieee icme, pp. 625-630, 2010.
8. Parisa pouladzadeh, gregorio villalobos, rana almaghrabi, shervin shirmohammadi, "*A Novel SVM based Food Recognition method for Calorie Measurement Applications*", IEEE International Conference on Multimedia and expo workshops, pp. 495-498, 2012.
9. S. Anushadevi, "*Calorie Measurement of Food from Food Image*", International Journal on Applications in Information and Communication Engineering, pp. 14-17, 2015.
10. Junqing shang , eric pepin, eric johnson, david hazel, ankur teredesai, alan kristal, and alexander mamishev, "*Dietary Intake Assessment using Integrated Sensors and Software*", spiedigitallibrary, pp. 1-11, 2015.
11. Nikha dharman, shafna ps, shahana cm, simi shanmughan, nicy johnson, "*Image2 Calories"*, International Journal of Computer trends and Technology, pp. 144-148, 2015.
12. Kavitha s. And pavithra s., "*Performance Analysis of Nutritional contents in Food Images using Saran*", arpn journal of engineering and applied sciences, pp. Pp.5429-5433, 2015.
13. R. Surya, S.Saru Priya, "*Food Image Recognition Using Svm Classifier for Measuring Calorie and Nutrition Values*", International Journal of Scientific & Engineering Research, pp. 324-328, 2015

DOI 10.17148/IJARCCE.2017.6146