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E –BUTTON BASED PERSONAL DIETARY ASSESSMENT

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Abstract-Image based dietary assessment has recently received much attention in the community of nutrition and obesity research. The food intake of every individual is measured in terms of calorie which caters the energy of food. Recently, the dietary assessment becomes a challenging trend which is majorly based on self-reported data of patients. Manual report of dietary data is time consuming, so image processing holds the promising way to the automatic detection of dietary foods. This study deals the problem of image segmentation on images acquired by E - Button. Segmentation is a challenging task where each image varies in their shape, size and its texture. Initially, the segmentation is applied with input image which determines the regions where a particular food item is located using salient region detection, multi scale segmentation and fast rejection. After the features are obtained, the classification is performed for each segmented region using Sphere Shaped SVM model. Finally, the area and its volume are computed for every food item. It attains better accuracy when compared with the other methods.
Keywords- Dietary assessment, Segmentation, Feature extraction, Classification, Calorie value.

I. Introduction

In the last years there has been a rapid increase of diseases related to unnecessary or wrong food intake, most notably obesity and derived issues such as diabetes, cardiovascular diseases, musculoskeletal disorders, strokes, heart disease and some types of cancers [1]. Obesity has become a severe public health problem to general population in many developed countries and in the past three decades, the obesity rate is increased significantly [2]. A diet of at least 400 g per day of fruits and vegetables appears to decrease cancer risk. However, a key barrier to linking dietary exposure and disease is the ability to measure dietary factors, including intake of food groups such as fruits and vegetables, with specificity and precision [3]. Researchers are interested in developing methods to localent applications. Accurate assessment of food and beverage intake [4] is an open problem in the nutrition field. Accordingly, the current research focuses on developing a food record method and identifies perceptually similar food objects in an image for dietary assessment using a mobile device that will provide an accurate account of daily food and nutrient intake [5,6]. However, manual report based on food intake is the most common method. Where, this method is mostly inaccurate to the people under overweight, who often under report their calorie intake. The importance of accurate dietary assessment in such situation, a wearable computer 'E-Button' for objective evalution of food intake is designed for real – life setting [7,8]. It is small and can be pinned to clothing on the chest. Although there have been several image segmentation algorithms developed and applied to quantitative image analysis [9,10], the problem of automatic food segmentation has not been resolved due to several complex issues in images acquired from real-life settings. This paper is organized as follows: sections 2 previous works on food segmentation, section 3 describe details of the proposed methods and conclude with Section 4.

II. Previous works on Food segmentation

The topic of automatic food recognition has not been deeply investigated until recent years many works are explicitly tuned for food diary applications on Smartphone's and other mobile devices [11]. Kawano and Yanai [11], for instance, are particularly concerned with real-time performances on an Android-based Smartphone. To speed up the process, the user is asked to manually select a proper bounding box delimiting the food to be recognized. The bounding box is then adjusted based on the segmentation result by the GrabCut algorithm. The user also receives hints on how to move the camera to better acquire the food pictures. Then, the system extracts both color histograms and SURF-based Bag of Features, and uses them to assign the acquired image to one of 15 possible classes using a Support Vector Machine. The deformable shape features were classified using histogram-based and bio-feature methods [12]. The food classification is usually performed by two phases. Firstly, the features were extorted from the food item or segmented region which was then used for the classifier by decision making module where the class labels of each food items were assigned Moreover, the food quantification is also an important criterion in dietary assessment. The mobile telephone food record system was explained in [13] where the accurate amount of food intake and nutrients were calculated.

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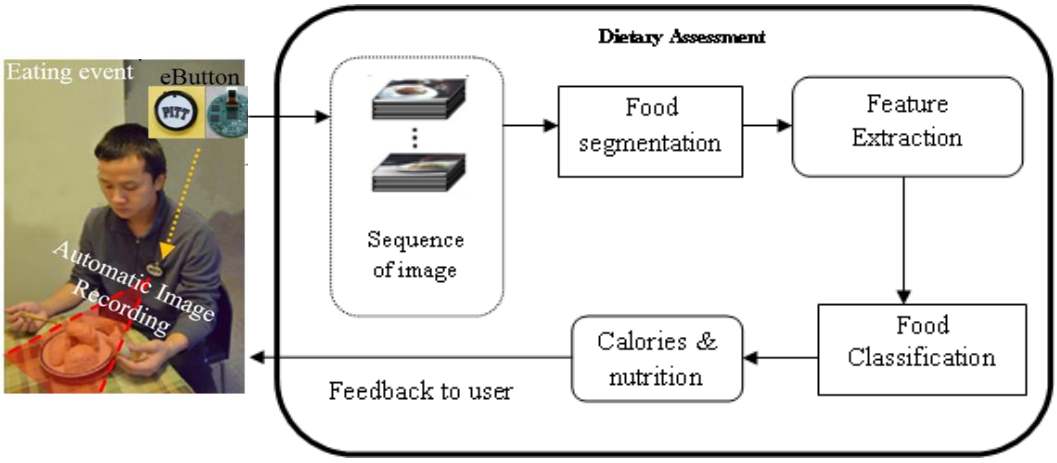

Figure 1: Personal dietary assessment using 'E – Button'.

III. Proposed Scheme

In Figure 1 user wears an E - Button on his shirt to record eating event. The acquired food image was then processed by food recognition, segmentation, and volume measurement to generate a dietary report. Patient-specific feedback can be provided to the user.

A) E - Button

The E - Button is a small, unobtrusive chest fob that can be pinned to clothing on the chest. It contains a low-power, high-performance central processing unit. In this study of dietary assessment, the E – Button camera is used to take pictures automatically at a rate of one picture per second during eating events as shown in the leftmost panel in Figure 1. The image data are stored on a SD memory card for later analysis. With the E - Button, an individual's diet can be passively recorded without disturbing the person during eating episodes.

B) Methods description for Image Segmentation

In this paper images from the E – Button is segmentation by using Region of interest, Multi Scale Segmentation and Fast Rejection.

i) Region of interest detection

The region of interest is commonly used to reduce the number of pixel from complexity issue by remove the non-food items such as utensils, table cloth, etc. Also, the regions from edges are also extracted by using the canny edge detector which is used to provide the normalized edge histogram. The background pixels and edge pixels are combined greatly assist by the canny operator. The distance measure is calculated between the edge histogram *a* and uniform distribution of regions *b* for each food component. The Euclidean distance measure is defined in eqn 1:

$$ED = D(a,b) = \sqrt{\sum_{i=1}^{N}(a_i - b_i)^2} \qquad (1)$$

ii) Multiscale segmentation

The image is represented as a weight and undirected graph in the normalized cut where the node pixel is generated by the pair of every pixel. Thus, the edge weight is determined by the similarity measure between the pixels. The image is divided into certain number of disjoint sets that leads to mitigate the edge weights. The similarity measure between the pixels is evaluated by the normalized cut ratio. Then the magnitude of edge image is used for the evaluation of affinity of every pixel which leads to cater the potential object boundary. Based on the combination measure and spatial separation, the affinity measure $w(x, y)$provides the various characteristics of the image. Thus, the image is segmented by the different scale with regard to the spatial region which is defined by,

$$w_{full} = w_1 + w_2 \approx w_1 + X_{1,2}^T w_2 X_{1,2} = w_{reconstruction} \qquad (2)$$

In eqn 2 the w_i has the affinity measure between the pixels are evaluated and also employs the interpolation matrix of two scales $X_{1,2}$.

iii) Rejection

Due to such redundancy in the segmented region of the food items, the fast rejection step is used to resolve this issue. In the rejection step, the certain pixel which does not contain any significant information to represent the object classes is eradicated. Thus, the background pixel in the salient region is assigned which leads to enhance the classification performance.

C) Texture Feature Extraction

After the food segments are obtained, it is then undergone for the feature extraction process. Here, the global and local feature extraction method is employed to extract the food features from the food segmented image. Due to large variation in shape of the food items, the global characteristics like colour and texture feature are extracted to improve the classification performance. The local feature of an image is extracted with the aid of local neighbourhood pixels or located around the regions of the points in the image. Here, the SIFT and SURF feature descriptors are utilized to detect the local feature information. Then the texture is achieved by i) Gradient Orientation Spatial Dependence Matrix (GOSDM), ii) Entropy categorization and Fractal Dimension (EFD) and iii) Gabor based image decomposition and Fractal Dimension estimation (GFD).

D) Sphere - Shaped SVM classifier for identifying the Food segments

After the segmentation and feature extraction the food items are classified using SS - SVM (Sphere – Shaped Support Vector Machine). SS – SVM differ other algorithm, this Sphere Shaped SVM is easily expandable due to its high efficiency. Classification phase usually involves training and testing. The goal of SS - SVM is to produce a representation, where the data instance in the testing test easily expands the target value. Based on the food items detected, the SS - SVM classifier will be executed. The SS – SVM classifier compared the features with the features of entries produced in the training step to the increase accuracy, after the SS - SVM module has determine the each food portion type, the system displays the name of detected food portion to the user.

E) Calorie Measurement for the identified Food segments

After the food items are classified by the SS - SVM, the classified results from the image are used to estimate the calorie value. The calorie and nutrition measure of each foods are calculated using eqn 3.

$$\text{Calorie from the photo} = \frac{\text{Calorie from the table} \times \text{Mass in the photo}}{\text{Mass from the table}} \qquad (3)$$

IV Conclusion

Food intake assessment is a building block of many treatments to public health problems, especially for obesity control. This paper has given a brief review of monitoring the person's food intake without troubling them and measures the calorie and nutrition by the images from E - Button. This system uses multi scale segmentation and classification using Sphere Shaped - Support Vector Machine to measure the calorie and nutrition level in the meal. System is cost effective and simple. Practical results of the system might boast the research in the field of food processing.

References

[1] Niki Martinel, Claudio Piciarelli and Christian Micheloni, "A supervised extreme learning committee for food recognition", Computer Vision and Image Understanding, vol. 148, pp. 67-86, 2016.

[2] Hongsheng He, Fanyu Kong, and Jindong Tan, "DietCam: Multi-View Food Recognition Using a Multi - Kernel SVM", IEEE Journal of Biomedical and Health Informatics, 2015.

[3] Md Hafizur Rahman, M. R Pickering, D. Kerr, C. J. Boushey and E. J. Delp, "A New Texture Feature for Improved Food Recognition Accuracy in a Mobile Phone Based Dietary Assessment System", In proceedings of IEEE International Conference on Multimedia and Expo Workshops (ICMEW), pp. 418-423, 2012.

[4] Fengqing Zhu, Marc Bosch, Carol J. Boushey and and Edward J. Delp, "Multiple Hypotheses Image Segmentation and Classification With Application to Dietary Assessment", IEEE Journal of Biomedical and Health Informatics, vol. 19, no. 1, pp. 377-388, 2015.

[5] Goris A H, Westerterp-Plantenga M S and Westerterp K R, "Undereating and underrecording of habitual food intake in obese men: selective underreporting of fat intake". Am. J. Clin. Nutr, 2000.

[6] Livingstone M B E, Robson P J and Wallace J M W, "Issues in dietary intake assessment of children and adolescents". Br. J. Nutr. Vol. 92, pp. S213–S222, 2004.

[7] Sun M, Yao N, Hackworth S A, Yang J, Fernstrom J D, Fernstrom M H and Sclabassi R J, "A human - centric smart system assisting people in healthy diet and active living". Proc. Int. Symp. Digital Life Technologies: Human - Centric Smart Living Technology (Taiwan, 28–30 May 2009).

[8] Bai Y, Li C, Jia W, Li J, Mao Z H and Sun M, "Designing a wearable computer for lifestyle evaluation". Proc. 38th Annual Northeast Bioengineering Conf. (Philadelphia, PA, March 2012).

[9] Chen H C, Yang T H, Thoreson A, Zhao C, Amadio P C, Sun Y N, Su F C and An K N,"Automatic and quantitative measurement of collagen gel contraction using model-guided segmentation" Meas. Sci. Technol, vol. 24, pp. 8, 2013.

[10] Lu H, Pan Y, Mandal B, Eng H L, Guan C, and Chan, "Quantifying limb movements in epileptic seizures through color-based video analysis", IEEE Trans. Biomed. Eng. Sci. Technol, vol.26, 2015.

[11] Y. Kawano, K. Yanai, "Real-time mobile food recognition system", in: Proceedings of Computer Vision and Pattern Recognition Workshops, pp. 1–7, 2013.

[12] P Viola and M Jones, "Robust real-time face detection", International Journal of Computer Vision", vol. 57, no.2, pp. 137-154, Jul 2004.

[13] A. Biem and S. Katagiri, "Feature extraction based on minimum classification error/generalized probabilistic descent method," In Proceedings of IEEE International Conference on Acoustic, Speech, Signal Process., Minneapolis, MN, USA, pp. 275–278, Apr 1993.