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# Measuring Calorie and Nutrition from Food Image- Survey

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*Abstract*—A people becomes more interested to watching their weight, eating healthy food, and avoiding the obesity, the system can measure calories and nutrition in every day food intake. The method of food calorie and nutrition measurement systems are used to measure and manage daily food intake for patients and dieticians. The system has built on camera for food image processing and uses nutritional tables. Recently, these are increased in the personal mobile technology usage (i.e. smart phones or tablets). In special calibration technique, our system has the built-in camera of mobile devices and a photo of the before and after eating food can records and it to measures the consumption of calorie and nutrient components. Result of our system is acceptable accuracy and it efficiently improved and it facilitated the current manual calorie measurement techniques.

***Key words:*** Calorie and Nutrition Measurement, Mobile Technology, Food Intake

## I. INTRODUCTION

Today obesity is a serious problem in adults. Food volume (portion size) measurement is a critical component in both clinical and research dietary. The food pictures can be taken in cell phone or camera that are stored or transmitted easily to form an image based on the dietary record. It provides the missing information, enabling food volume estimation from a single image. Using this reference pattern and image processing techniques, the location and orientation of foods and their volumes are estimated [1].

The unichrome and opponent features are estimated from the Gabor filter outputs in color texture. The unichrome features are estimated from the spectral bands and the opponent features are combines the information about the different spectral bands at different scales.

Opponent features provides better accuracy of recognition [4]. The electronic photographic method and image processing algorithms are used to calculate the food portion size, and it provides the quantitative information about the nutrients and calories consumed in people's daily life [7]. The human body intake high calorie that is leads to several diseases. The food portion size and food portion weight are calibrated that needed to measure the amount of calories in the food.

The available methods for assessing, the dietary intakes of children are able to provide unbiased estimates of energy intake only for the group level, while the data for food intake of most adolescents are particularly prone to reporting error at both the group and the individual level. The associated biases in estimating nutrient intakes are estimated in dietary data [6]. Object recognition is one of the most challenging problems in digital image processing [5].

## II. METHODS FOR ENERGY INTAKE MEASUREMENT

### A. Electronic Photographic Method

The electronic method for food analysis has following steps: 1) The individual places of a calibration card besides the food; 2) The image is taken and showing both the food items and the card; 3) If the food items are consumed not completely, another image is taken for food portion measurement; 4) Food images are uploaded or transmitted to a computer; 5) The observer identifies the food items and measures its geometrical variables (e.g. surface, length and height); Finally, 6) the computer finds the food volume, and passes the information to a database and calculate the nutritional and caloric values.The problem of size estimation is equivalent to converting the problem of the image pixel coordinates to the world coordinates. The origin point of the world coordinate system is set of calibration board.

The Z-axis is perpendicular to the calibration board (orthogonal to the plane of the calibration board). The coordinate of world at any point on the calibration plane is $(x_w, y_w, 0)$ . Then, given the pixel index of a calibration board point (u, v), then the coordinate $x_w$ and $y_w$ can be expressed as

$$Z_w = 0 \quad (1.1)$$

$$u = u_0 + \frac{f}{dx}\frac{R11X_w + R12Y_w + R13Z_w + T1}{R31X_w + R32Y_w + R33Z_w + T3} \quad (1.2)$$

$$v = v_0 + \frac{f}{dy}\frac{R21X_w + R22Y_w + R23Z_w + T2}{R31X_w + R32Y_w + R33Z_w + T3} \quad (1.3)$$

Where, $\{f, d_x, d_y, u_0, v_0\}$ are the pre-determined intrinsic parameters, and $\{R_{i,j}, T_i\}$ are the entries of $R$ and $T$ . These methods have three major computational components. They are i) semi-automatic image segmentation, ii) camera calibration (with corner extraction), iii) portion size estimation.

Fig. 1: segmentation result of electronic photographic method

This method cannot provide details about the eating patterns and the contents of meals. In many cases, it cannot find the food portion size from a food image.

### B. Object Location and Orientation Using the Plate Method

The food items are estimated from the object plane that is in front of the subject. Image of the circular object becomes an ellipse/circle in an image plane. The equation of the ellipse is given by

 

$$ax^2 + 2h'xy + b'y^2 + 2g'x + 2f'y + d' = 0 \qquad (1.4)$$

Where, $f$ is the focal length of the camera. This is known as boundary fitting of the circle in the digital image. This boundary represents the base of a quadric cone. The boundary of the circular objects defines intersection between the quadric cone and the object plane.

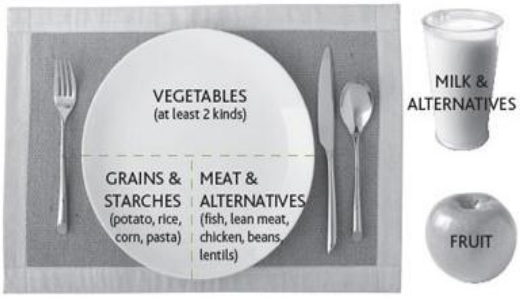


Fig. 2: food portion size measurement using plate method

The location of the image is non-unique because the intersection of conicoid plane is parallel that produces the similar image on the image plane, so the orientation of the image is find easily. However, if the circular object size is known, its location can be obtained by the geometry of perspective projection.

$$p = \frac{c_1 r}{\sqrt{c_2^2 + c_3^2 - c_1 c_4}} \qquad (1.5)$$

Where, r is the radius of the plate. This method is very difficult to obtain the analytical solution.

The error of volume estimation using the plate method was 4.3%. The larger objects are estimated that leads to a larger error. The size of the object increases so increase the absolute measurement error.

### *C. Object Location and Orientation Using LED Method*

A narrow beam LED is positioned at the wearable device that is small distance from the camera. When the picture is taken from the camera, the LED produces a 16° conic spotlight to the field. The LED light can be invisible or visible to the human eye, but must be visible to the camera.

The LED light is selected carefully because the spotlight of cross section is perpendicular to the axis of the beam is circular as possible. The normalized orientation vector of the object plane is given by

$$\begin{cases} l = \cos\theta \\ m = 0 \\ n = \sin\theta \end{cases} \qquad (1.6)$$

The LED light pattern is accuracy selection of points that causes a certain error in the estimation of location and orientation because the boundary region is not clear.

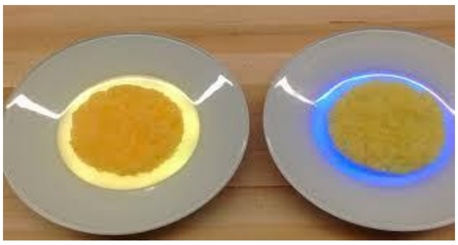

Fig. 3: food portion size measurement using plate method

Larger errors occur mainly in the height or diameter estimates. This is indicates a practical difficulty since, the height or diameter cannot well define for the food image without corners or with round edges such as a peach or an orange. As a result, errors of the spotlight in an image occur, and the larger error volume estimation is computed in the LED method.

### *D. Food Segmentation of Adaptive Thresholding and Snake Model*

Combination of adaptive thresholding model and edge-based snake model is used to segments the food from the detected plate region. At first, a simple user-drawing step is carried out on the background in order to obtain the information of color distribution in background. Then, the closing of morphological is performed to connect adjacent segment regions, and each of connected components with its size is greater than a certain minimum value is considered as a food region. Then build convex hulls, the Andrew's monotone chain algorithm is encloses the corresponding food region. Each hull acts as an initial contour of snake model in the deformation process that is achieved by minimization of an energy function $E_{snake}$, which is defines in terms of deformation degrees and image evidences of specifying target boundaries:

$$E_{Snake} = \int \Big(\alpha E_{shape}(v(s)) + \beta E_{constant}(v(s)) + (1 - \alpha - \beta) E_{homogeneity}(v(s))\Big)\, ds \qquad (1.7)$$

Where, $E_{shape}$, $E_{contrast}$, and $E_{homogeneity}$ are, the shape energy, contrast energy, and homogeneity energy, respectively. $\mathbf{v}(s)$ is the coordinate of the $s^{th}$ point of the snake contour, and $\alpha$ and $\beta$ are weight values. The total value of energies are increases in the model that deforms away from the target object. $E_{shape}$ is measures degrees of stretching and bending of the snake, is defined as

$$E_{shape} = (v(s)) = |v'(s)|^2 + |v''(s)|^2 \qquad (1.8)$$

Human food contains the multi-color textures. Only using a color gradient for attracting the snake is to locate undesirable edges inside the food. However, it can be observed the boundary of a complete food item between the food and the plate, that rather than between the ingredients. Based on the dissimilarity map snake is attract to the target boundary, that used to design the contrast and homogeneity energies.

$$E_{contrast}(v(s)) = \int 1LMd\Big(v(s) + an(v(s))\Big)\, da - \lambda \int -\mathrm{L0Md}\Big(\mathrm{v}(s) + \mathrm{an}(\mathrm{v}(s))\Big)\, \mathrm{da} \qquad (1.9)$$

Where, $n(v(s))$ represents the norm of outer-pointing of snake contour at $v(s)$, and $\lambda$ is the weighting factor that value is inversely proportional to the average intensity of the neighbourhood in outside of the snake contour. If this neighborhood present in lower pixel values of $M_d$, it has a higher probability then that these model is transition from the food to the plate. For some case, the value of $\lambda$ will increase that are enhances the food edge evidence. The homogeneity energies are calculates the regional dissimilarity variances outside of the snake contour. That is defined as

$$E_{homogeneity}(v(s)) = \int 1L \left| Md\Big(v(s) + an(v(s))\Big) - c \right|^2 da \qquad (1.10)$$

Where, $c$ is the mean of dissimilarity values outside of the snake contour regions. When the snake contour is attracted to undesired edges which has a large contrast value, $E_{homogeneity}$ is increase and the energy function ($E_{Snake}$) also penalized. The overall contrast and homogeneity energies are efficiently captured from the desired food boundaries of the segmentation of the complete food item, while the shape energy deformation are used to maintain the smoothness and avoids the excessive distortions.


Fig. 4: Food Portion Measurement in snake method

There are several practical problems occur in segmentation, such as shadow, reflections, complex food ingredient, motion blurring, and object occlusion, which frequently appear in real eating activity.

## III. Results and Discussions

Analysis of the various survey results provide the measurement of calorie and nutrition from the food for healthy purpose and maintain the weight. It is proposed to obtain a better food volume and daily energy intake from food image by using support vector machine method. From the survey it clears that to maintain the normal weight and avoid several diseases.

## IV. Conclusions

This article explains a survey of different method for estimating portion size from the food images. A support vector machines method used to calculate the volume of food from the several food images. Then the different methods are carried out. Calorie and nutrition are estimated from food for the different techniques.

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