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Novel Method to Estimate Food Calories using Deep Learning

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Abstract:

Food is very essential for human lifestyles and its miles essential to human experience. Now-a-days nearly 20% of losses of life international are as a consequence of a dangerous weight-reduction plan.Due to the development in human being's standards of living, obesity quotes are increasing at an alarming speed, and this is reflective to the dangers in human health. People want to manipulate their everyday calorie intake via consuming more healthy foods, that's the maximum fundamental approach to avoid weight problems. Inthis paper is trying to provide a greater green manner of estimating calories. First, it desires the top view and aspect view photographs of the meals being analysed. Then, it's going to use Faster R-CNN to locate the food and calibration object, after which, a GrabCut algorithm is an image segmentation method, by using this algorithm we can estimating the quantity of food and also estimate the amount of energy.

Keywords **—Faster R-CNN, GrabCut algorithm, food calorie,obesity**

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[1] INTRODUCTION

In 2016, greater than 1.9 billion adults,18 years and older have been obese of these over 650 million had been overweight.In 2019, an anticipated 38.2 million youngsters beneath the age of five years had been obese or overweight.The fundamental purpose of weight problems and obese is an energy imbalance between calories ate up and calories expended. Globally, there has been: an extended intake of power-dense foods which might be high in fat and sugars; andan increase in bodily state of no activity due to an increasing number of sedentary natures of many kinds of work, changing modes of transportation, and growing urbanization.

When human being's Body Mass Index (BMI) is over 30 (kg/m^2), they are usually taken into consideration to be obese. High BMI can boom the

chance of illnesses like coronary heart ailment [1]. The important purpose of weight problems is because of the imbalance among the amount of caloric intake (consumption) and electricity output (expenditure). Because of unwillingness to document and song, loss of related nutritional statistics or different reasons, sufferers regularly enjoy problem in controlling the quantity of energy they devour. There are plenty of proposed techniques to estimate energy based on Computer vision [2, 3, 4, 5], but after the authors' evaluation, the accuracy of detection and extent estimation nonetheless want to be advanced. In Exiting papers, images are detected by GraphCut Here the images are represented by graph. The major problem in the GraphCut algorithm is not able to separate the fore gourd and background of an image .In this paper, the principle distinction from other comparable procedures is that it calls for an input of images and the use Faster R-CNN to stumble on the object and GrabCut set of rules to attain every food's contour. After that, the authors can estimate each meal's quantity and energy.

II. PROPOSED MODEL

Our System architecture is depicted in Fig. 1. For our gadget to paintings we take a photograph as enter from the person. The enter image contains perspectives the top and aspect view. The photo is then exceeded through quicker R-CNN block which is used for photo detection. This is explained in section B. The Faster R-CNN offers coordinates, self belief and class. After photograph detection, we carry out photo segmentation. For photo segmentation, we use grab cut algorithm. The grasp cut algorithm is explained in segment C. Since segmentation of the photo is carried out we perform calorie estimation on the segmented photo. For calorie estimation, we calculate the extent of the food object. The extent is then used to calculate the calories present in the food item. We give an explanation for this in phase D. All the above modules are then included to make the software program for calorie estimation the use of picture of the meals item.

Fig. 1 System architecture

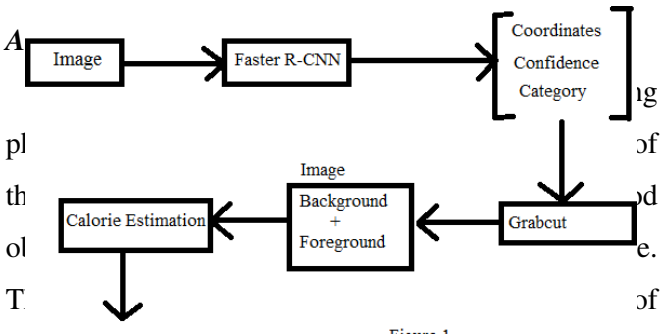


Figure 1

A ng pl of th od ol e. T of the meals object inside the unique photo. The dataset consists of snap shots of ten exclusive food objects. These consist of apple, banana, bread, Cherry, donut, mango, litchi, lemon, kiwi, orange and egg. The dataset is used for schooling the images. The dataset has thousand five hundred of snap shots of each meals object. In our dataset, we've pictures with one food object in addition to multiple meals objects.

B. IMAGE DETECTION USING FASTER R-CNN

For image detection, we use Faster R-CNN set of rules. In this algorithm, we offer the picture to the convolution network as an input and we get a convolution feature map as output. The algorithm uses a separate network to expect the place proposals. The ROI pooling layer is used for reshaping the anticipated vicinity proposals. The offset values for the bounding packing containers are expected with their help and the photos also are classified within the proposed place. Faster R-CNN is used for photograph detection because it's far the fastest amongst all of the other detection algorithms inclusive of R-CNN and Fast R-CNN. Faster R-CNN architecture is proven and illustrated in Figure 2.

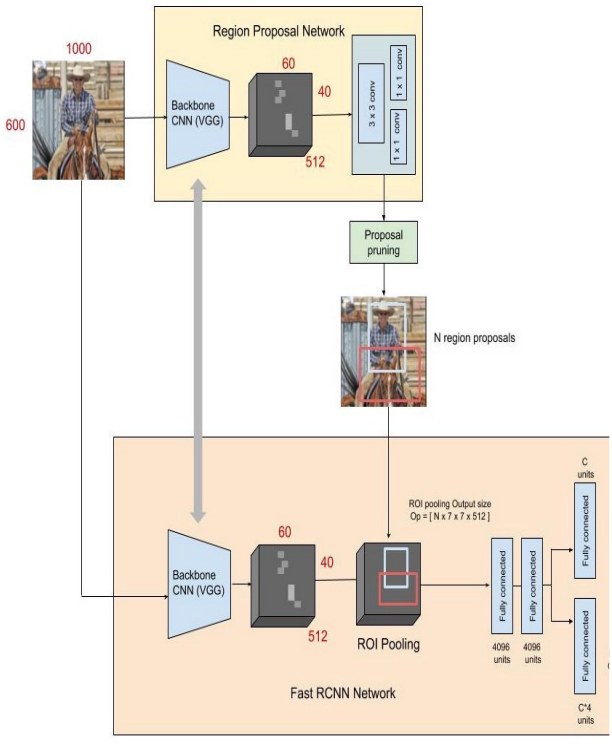


Fig.2 Faster R-CNN architecture

Anchors are used in Faster R-CNN. An anchor is essentially a field. A position of a photograph includes 9 anchors in the default configuration of Faster R-CNN. There is a danger that if an amazing set of anchors is used it can help in improving the rate as well as accuracy. The place suggestion network (RPN) gives the output of a bunch of bins/proposals. The classifier and regressed will have a look at the output to check for the occurrence of items.

C.IMAGE SEGMENTATION USING GRAB ALGORITHM

Image Segmentation the use of the clutch reduces set of rules. In the snatch reduce algorithm, we mark the object with the help of a field. The box is used to distinguish the object from the background. The outer a part of the rectangle is the background and the inner part of the set of rules is the mixture of some historical past and the object. After that, we use an iterative method which assigns every pixel as a background or foreground pixel. The preliminary labelling is accomplished through the pc consistent with the facts supplied through the consumer. Then we use the Gaussian combination version to model the foreground and the heritage. Then we mark the probably foreground or in all likelihood heritage pixels to unknown pixels. It relies upon on their

relationship with different tough-labelled pixels in terms of colour records. This could be very similar to clustering. Every node in the graph is a pixel additional nodes which include source and sink nodes are brought. The supply node is connected to the foreground pixel and sink node are related historical past pixel. The possibility of a pixel whether it's far foreground/heritage determines the load of the edges that are connecting the pixels to the supply node or stop node. The information on the threshold or the similarity among pixels is used to decide the weights among the pixels. Low weight can be assigned to the edge among the pixel if the difference in pixel colour could be very big. Then the Segmentation of the graph is finished the usage of minimum cut. The graph is cut into two isolating source node and sink node with a minimum fee function. The sum of all weights of the rims which are cut is known as the fee feature. After the cut, all of the pixels linked to the Source node end up foreground and those connected to link node end up background. The technique is continued until the type converges.

III. ESTIMATE VOLUME AND CALORIES

After analysis the data we are going to estimate the volume of the food and the calories of the food.

A. Volume Estimate

To estimate the volume, the authors calculate the scale elements primarily based on calibration items. The authors use a 1 CNY coin to show the precise procedure of calculating the volume. The diameter of the coin is 2.5 cm, and the aspect view's scale element turned into calculated with Equation 1.

$$\alpha_S = \frac{2.5}{(W_S + H_S)/2} \qquad (1)$$

In this equation, *Ws* is the width of the bounding box, *Hs* is the height of the bounding box. Similarly, the top view's scale can be calculated with Equation 2.

$$\alpha_T = \frac{2.5}{(W_T + H_T)/2} \qquad (2)$$

After, the authors divide the foods into three categories based on shape: ellipsoid, column, irregular. Different volume estimation formula will be selected for different types of food, according to Equation 3. HS is the height of side view PS and LkS is the number of foreground pixels in row k (k ∈ 1,2,…,HS). LMAX = max(Lk ,…,Lk), it records the maximum number of foreground pixels in PS. ß is a compensation factor (default value = 1.0). After that, for each food type there will be a unique value.

$$v = \begin{cases} \beta \times \frac{\pi}{4} \times \sum_{k=1}^{H_S} (L_S^k)^2 \times \alpha_S^3 & \text{if the shape is ellipsoid} \\ \beta \times (s_T \times \alpha_T^2) \times (H_S \times \alpha_S) & \text{if the shape is column} \\ \beta \times (s_T \times \alpha_T^2) \times \sum_{k=1}^{H_S} (\frac{L_S^k}{L_S^{MAX}})^2 \times \alpha_S & \text{if the shape irregular} \end{cases} \quad (3)$$

B.Calorie Estimation

After estimating the volume, the next step is to estimate each food's mass. It can be calculated in Equation 4, where *v (cm³)* represents the volume of current food, and *ρ (g/cm³)* represents its density value

$$m = \rho \times v \quad (4)$$

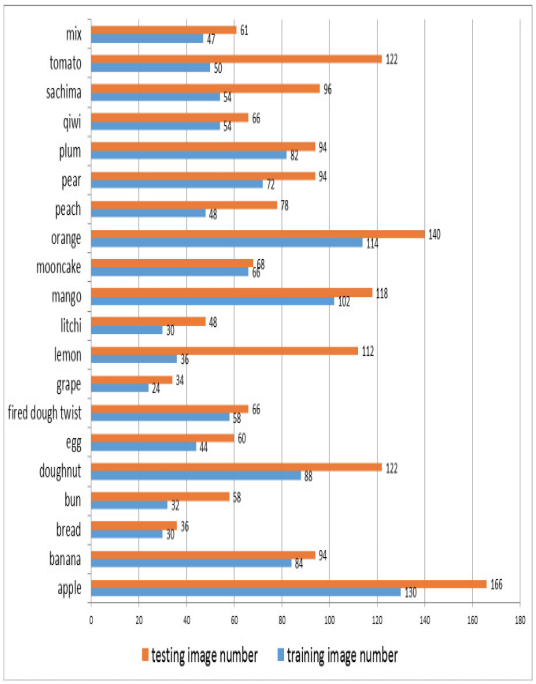
Then the calorie of the food can be obtained with Equation 5.

$$C = c \times m \quad (5)$$

Where m(g) represents the mass of current food and c(Kcal/g) represents its calories per gram.

IV. RESULTS

A comparison experiment to choose the object detection algorithm was used. The numbers of training images and testing images are shown in Figure 2. Average Precision was used to evaluate the object detection results. In the test set, Faster R-CNN achieves 93.0% while Exemplar SVM achieves 75.9%.



ß (compensation factor) in Equation 3 can be calculated with Equation 6, where *k* is the food type, and *N* is the number of volume estimation.

$$\beta_k = \left(\frac{\sum_{i=1}^{N} V_k^i}{\sum_{i=1}^{N} v_k^i}\right) \quad (6)$$

p in Equation 4 can be calculated with Equation 7.

$$\rho_k = \left(\frac{\sum_{i=1}^{N} M_k^i}{\sum_{i=1}^{N} v_k^i}\right) \quad (7)$$

After that, the authors give the shape definition, estimation images number, ß, ρ of each food in Table

Table 1: Shape Definition and Parameters in Our Experiments

Food Type	shape	estimation image number	β_k	ρ_k
apple	ellipsoid	122	1.13	0.88
banana	irregular	82	0.64	0.59
bread	column	26	0.70	0.13
bun	irregular	32	1.14	0.43
doughnut	irregular	42	1.38	0.42
egg	ellipsoid	30	1.00	1.16
fired dough twist	irregular	48	1.30	0.77
grape	column	24	0.25	0.25
lemon	ellipsoid	34	1.11	1.04
litchi	irregular	30	0.98	0.95
mango	irregular	20	1.24	1.33
mooncake	column	64	1.04	1.24
orange	ellipsoid	110	1.12	0.99
peach	ellipsoid	48	1.07	1.09
pear	irregular	72	1.12	1.09
plum	ellipsoid	82	1.22	1.19
qiwi	ellipsoid	54	1.11	1.09
sachima	column	54	1.13	0.25
tomato	ellipsoid	46	1.20	1.07

The authors use mean volume error to evaluate volume estimation results. The definition of mean volume error is as shown in Equation 8, where food type is *i*, 2Ni is the number of images Faster R-CNN recognizes correctly.

$$ME_V^i = \frac{1}{N_i}\sum_{j=1}^{N_i}\frac{v_j - V_j}{V_j} \quad (8)$$

The definition of mean mass error is in Equation 9.

$$ME_M^i = \frac{1}{N_i}\sum_{j=1}^{N_i}\frac{m_j - M_j}{M_j} \quad (9)$$

For the results in Table 2, we see that most types of food's estimation results are closer to reference real values. Other than banana, bread, and mooncake, the mean error between estimation volume and true volume does not exceed ±20%. Even if the drainage method is not that accurate, but the estimation method can be accepted.

V.CONCLUSIONS

In the above venture, we have calculated the energy of meals item using device studying and photograph processing. For that we have applied three modules, First, we stumble on the item the use of Faster R-CNN. Then we Segment the picture the usage of grab cut set of rules. After segmentation, we calculate the quantity of the meals object. In the very last step, we calculate the calories of the meals item. By the consequences of our task, it's been implemented effectively.

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