

# Food-Type Recognition and Estimation of Calories Using Neural Network



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## 1 Introduction

In recent years, the numbers of diabetic patients are increasing due to lack of knowledge in diet control. The most important cause of diabetes is the less insulin production in the human body. This leads to many of the diseases like continuous urination, increased blood pressure, loss of weight, and sometimes cardiac arrest. These enable us to develop the system to educate the people to have proper healthy foods every day. The proper system is built in MATLAB to food-type recognition and estimate food calories consumed.

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## 2 Related Work

The clustering techniques have been proposed to identify the food types. To segment the food item, affinity propagation and unsupervised clustering method have been adopted. The affinity propagation with agglomerative hierarchical clustering (AHC) obtains 95% of accuracy. The Monitoring of Ingestive Behavior model has built to monitor and estimate the calories [1]. The input food images have been taken from smartphones with single and mixed food items and fed into training and testing. The preprocessing steps are carried first, followed by vision-based segmentation done, and deep learning algorithm applied to estimate calories [2]. In the input food image, chopstick is used as a reference for measurement. The density-based database of the food is considered to evaluate the food volume, weight, and calorie estimation. The estimated weight and calories' relative average error rate are 6.65% and 6.70% [3]. The two datasets have been collected and trained with single-task and multitask CNN. The above multitask CNN classifiers achieved good results in food identification and calorie estimation than single-task CNN [4]. The top 10 Thai curries are considered. The segmented image is fed into the fuzzy logic to identify the ingredients based on their intensities and boundaries. The calories are calculated by sum of all the ingredient calories [5].

## 3 Proposed Work

The proposed technique has been divided into two phases as the training phase and the testing phase. The input image is resized using the scaling technique. Feature extraction consists of the SIFT method, Gabor Filter, and color histogram. The feature extraction is converted into the classification that implements the segmented process and MLP, and these processes are implemented in testing phase. After the classification procedure, the total area computation and the volume measurements are identified for producing the calorie estimate. The entire process is demonstrated in Fig. 1.

### 3.1 Algorithm – Multilayer Perceptron Neural Networks

Initialize all neurons ( $v_{ih}$ ) and weights ( $w_{hj}$ .)

Run=1

While (Run)

Do{

Store all  $w$  and  $v$ .

Epoch=epoch+1 /\*training\*/

For all  $(x^t, r^t) \in X_{\text{training}}$  in random order.

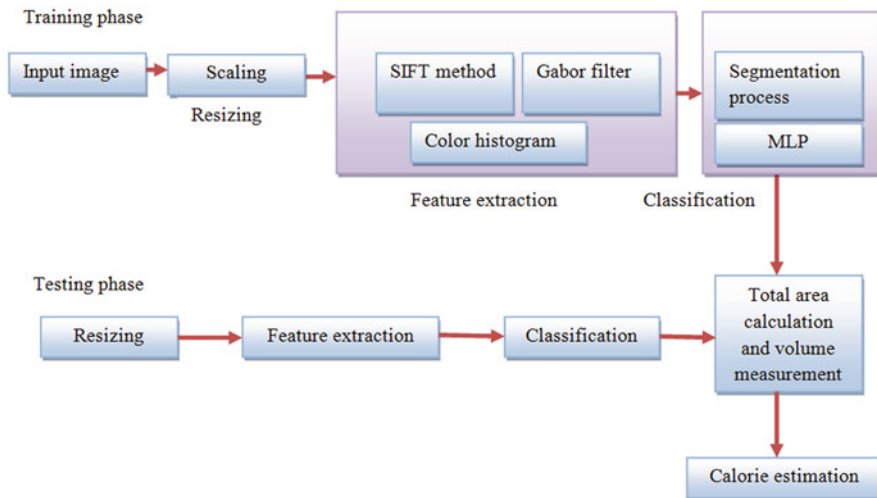


Fig. 1 Proposed system architecture

For all hidden nodes  $z_h$ ,

$$z_h = \text{sigmoid} \left( \sum_{j=0}^d w_{hj} x_j^t \right)$$

For all output nodes  $y_i$

$$y_i = \text{softmax} \left( \sum_{h=0}^H v_{ih} z_h \right)$$

For all weights  $v_{ih}$

$$\Delta v_{ih} = \eta (r_i^t - y_i^t) z_h$$

$$v_{ih} = v_{ih} + \Delta v_{ih}$$

For all weights  $w_{ih}$

$$\Delta w_{ih} = \eta \left( \sum_{i=1}^K (r_i^t - y_i^t) v_{ih} \right) z_h (1 - z_h) x_j^t$$

$$w_{ih} = w_{ih} + \Delta w_{ih}$$

For all  $(x^t, r^t) \in X_{\text{Validating}}$

For all hidden nodes  $z_h$ ,

$$z_h = \text{sigmoid} \left( \sum_{j=0}^d w_{hj} x_j^t \right)$$

For all output nodes  $y_i$

$$y_i = \text{softmax} \left( \sum_{h=0}^H v_{ih} z_h \right)$$

$$\text{err}(\text{epoch}) = \frac{1}{2} \sum_{x \in X_{\text{validating}}} \left( \sum_{i=1}^K (r_i^t - y_i^t)^2 \right)$$

If  $\text{err}(\text{epoch}) > \text{err}(\text{epoch}-1)$

Run=0

}

For all  $(x^t, r^t) \in X_{\text{testing}}$

For all hidden nodes  $z_h$ ,

$$z_h = \text{sigmoid} \left( \sum_{j=0}^d w_{hj} x_j^t \right)$$

For all output nodes  $y_i$

$$y_i = \text{softmax} \left( \sum_{h=0}^H v_{ih} z_h \right)$$

If  $y == r$

“Successfully recognized”

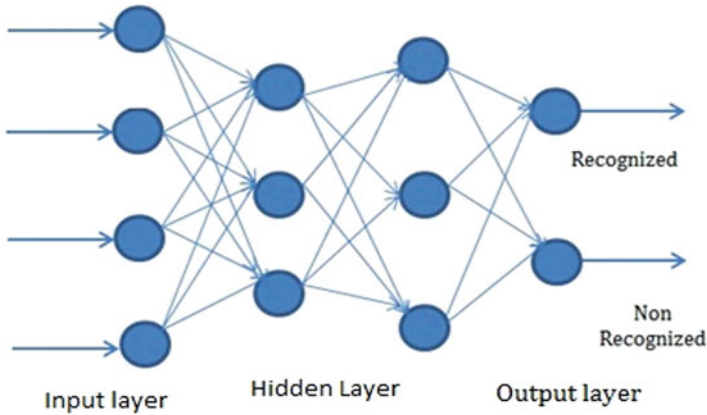
Else

“Failed to recognize”

### 3.2 Multilayer Perceptron Neural Network

Multilayer perceptron neural network working principle is relatively based on the human brain and belongs to feed forward NN. Normally a human brain stores the information as the pattern and gains the knowledge to solve the complex problems by experience and it is demonstrated in Fig. 2.

The multilayer perceptron neural network recognizes the patterns by supervised training algorithm fed forward from input to output layers. Activation function is computed as given in Eq. (1).



**Fig. 2** Multilayer perceptron neural network

$$x_i^{m+1}(n) = f \left[ \sum_{j=1}^M W_{ij}^m x_j(n) \right] \quad (1)$$

## 4 Performance Evaluation

The proposed work is carried out in MATLAB with six food classes. Here, precision and recall are identified for different food classes for SVM and MLP based classifier to have better results. The accuracy is tested using F-measure. The F-measure is calculated by taking the precision and recall values of each class and is shown in Table 1.

## 5 Conclusion

In this proposed work, identification of food type is made and estimation of calorie is done using MLP and the results proposed. Single food item types were considered previously, but here mixed food item types are taken to have better results. The implementation is processed in MATLAB with 1000 fruit images containing 6 food classes with good accuracy. The automatic dietary control is made available for diabetic patients.

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**Table 1** Performance comparison

Class	Precision SVM	Precision MLP	Recall SVM	Recall MLP	SVM = $2*(p*r/p+r)$	MLP = $2*(p*r/p+r)$
Apple	0.7	0.8	0.7	0.8	0.70	0.80
Banana	0.8	0.9	0.8	0.9	0.80	0.90
Bread	0.8	1	0.9	1	0.85	1
Guava	0.6	0.7	0.6	0.6	0.60	0.65
Pizza	0.7	0.9	0.9	0.9	0.79	0.90
Pomegranate	0.6	0.8	0.6	0.7	0.60	0.75

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