

THE QUALITY IDENTIFICATION OF FRUITS IN IMAGE PROCESSING USING MATLAB

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Abstract

The ability to identify the fruits based on quality in the food industry which is the most important technology in the realization of automatic fruit sorting machine in order to reduce the work of human and also time consuming. This work presents a hierarchical grading method applied to the Fruits. In this work the identification of good and bad Fruits is focused on the methods using MATLAB. First we extract certain features from the input fruit image, later using different method like thresholding, segmentation, k-means clustering and thus we get related databases. Comparing several trained databases, we get a specific range for the good and bad fruits. From the proposed range we can identify the good and bad fruits. Thus this paper analysis the good and bad fruits with a very high accuracy successfully using image processing.

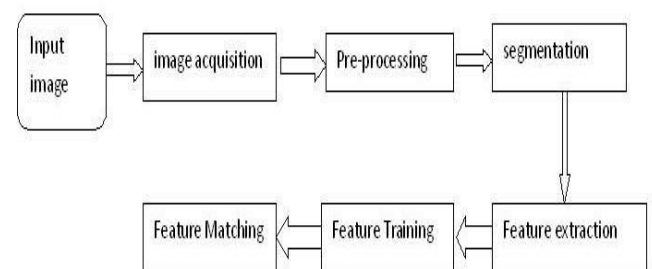
Keywords: Image Acquisition, Pre-processing, Segmentation, feature extraction, feature training, feature matching.

1. INTRODUCTION

Fruit is grown as it has many vitamins and necessary nutrients for human bodies. Fruits, commonly consumed in daily diets, are a major source of anti-oxidants (Sgherri et al., 2008). There are a seasonal fruits and their availability is limited during certain seasons (Rodriguez-Lafuente et al., 2010). Fruits find numerous uses in both fresh and processed forms. Processed forms include jam, paste and juice. Export of these processed products of fruits yield more income for the country. In order to get good quality of processed products the quality of fruits should be good. Identifying good and bad quality fruits in industries manually is the main obstacle as it is time consuming and for high labour cost. Therefore it is very important to identify the quality of fruits for the purpose of its usage by an automatic sorting machine for various necessities in industries. To overcome this problem, image processing method in industries has become a major issue in recent years. Using MATLAB software as a tool in image processing, we can find the quality of Fruits using various algorithms. Finally after collecting lot of trained data bases, we have proposed certain range. With these ranges we can identify the quality of Fruits, whether it is good or bad.

2. PROPOSED METHODOLOGY

The stages in the proposed methodology are shown below.



The steps involved in identification of good and bad quality of Fruits are image acquisition, pre-processing, segmentation, feature extraction, feature training and Feature matching. Finally the quality of fruit is identified.

3. IMAGE ACQUISITION

An image is analyzed as it is clicked. Then the user is given tools to discard that he considers noise. The image acquisition is done using a digital camera and it is loaded and saved using MIL software. MIL works with images captured from any type of colour (RGB) or monochrome source (Gray). MIL supports the saving and loading of images. It supports file formats such as TIF (TIFF), JPG (JPEG), BMP (bitmap), as well as raw format. Here the input image got is an RGB image.

4. PRE-PROCESSING

Basically the images which are obtained during image acquisition may not be directly suitable for identification and classification purposes because of some factors, such as noise, weather conditions, and poor resolution of an

images and unwanted background etc. We tried to adopt the established techniques and study their performances.

The steps involved in pre-processing are

- A. Input image
- B. Background subtraction
- C. Converting RGB to gray
- D. Converting gray to binary
- E. Filtering

All the steps mentioned above is easily and efficiently done by using basic commands MATLAB toolbox.

4.1 RGB Image

RGB is one of the formats of colour images. Here the input image is represented with three matrices of sizes regarding the image format. The three matrices in each image corresponds to the colours red, green and blue and also says that of how much of each of these colours a certain pixel should use.

4.2 Background Subtraction

Background subtraction is a process of extracting foreground objects in a particular scene of a image. A foreground object is defined as an object of attention which helps in reducing the amount of data to be processed.

4.3 Gray Image

Gray scale images have one colour which is a shade of gray in various ranges in between. Monochrome image is another name of gray image. This denotes the presence of only one (mono) colour (chrome). To convert any colour image to a gray scale representation of its luminance, we must obtain the values of its red, green, and blue (RGB) primaries in linear intensity encoding, by gamma expansion.

4.4 Binary Image

A Binary Image is a digital image which has two assigned pixel values. Typically the two colors used for a binary image are black and white. The gray image of Fruits is converted to binary image this means that each pixel is stored as a single bit (0 or 1). Binary images used in digital image processing as masks or as the result of some frequent operations such as segmentation, thresholding, and dithering.

4.5 Filtering

The purpose of filtering is to smooth the image. This is done to reduce noise and improve the visual quality of the image. Often, smoothing is referred to as filtering. Here filtering is carried out by median filter since it is very useful in detecting edges.

4.6 Median Filter

The best known order-statistics filter is the median filter, which replaces the value of a pixel by the median of the gray levels in the neighborhood of that pixel

$$\hat{f}(x, y) = \text{median}_{(s,t) \in S_{xy}} \{g(s, t)\}$$

The original value of the pixel is included in the computation of the median. Median filters are quite popular because, for certain types of random noise they provide excellent noise reduction capabilities, with considerably less blurring than linear smoothing filters of similar size. The median value is not affected by the actual value of the noise cells. The Median filter is particularly good at removing isolated random noise, as in this example[4][5][6]. It also preserves edges and line features better than the Low Pass / Average filter, but does produce some blurring.

5. SEGMENTATION

The purpose of image segmentation is to divide an image into meaningful regions with respect to a particular application. The segmentation is based on measurements taken from the image, may be grey level, colour, texture, depth or motion. Here edge-based segmentation is properly suitable. As edge detection is a fundamental step in image processing, it is necessary to point out the true edges to get the best results from the matching process. That is why it is important to choose edge detectors that fit best to the application. In this way canny edge detector is chosen.

5.1 Canny Edge Detector:

Canny edge detection algorithm is also known as the optimal edge detector. Canny's intentions were to enhance the many edge detectors in the image.

- 1) The first criterion should have low error rate and filter out unwanted information while the useful information preserve.
- 2) The second criterion is to keep the lower variation as possible between the Original image and the processed image.
- 3) Third criterion removes multiple responses to an edge.

Based on these criteria, the canny edge detector first smoothes the image to eliminate noise It then finds the image gradient to highlight regions with high spatial derivatives. The algorithm then tracks along these regions and suppresses any pixel that is not at the maximum using non-maximum suppression. The gradient array is now further reduced by hysteresis to remove streaking and thinning the edge.[7]. Here fig1.6 shows the edge detection of good and bad Fruits using canny edge detector.

6. FEATURE EXTRACTION

Feature extraction is defined as grouping the input data objects into a set of features. The features extracted carefully will help to extract the relevant information from the input data in order to perform the feature matching. Using this we can reduce the representation input size

instead of the full size input. Here clustering process has been used to extract features from good and bad fruits.

6.1 Clustering Basics

Clustering is the process of grouping together similar objects. The resulting groups are called clusters. Clustering algorithms group objects according to various criteria. Unlike most classification methods, clustering handles data that has no labels, or ignores the labels while clustering. Here fig 1.7 shows the clustering values of good and bad Fruits.

6.2 Clustering Algorithm:

K-Means Clustering Algorithm

STEP1:

The training vectors are grouped into M clusters based on the distance between the code vectors and the training vectors using the below equation (1) and (2).

$$dy = \sum_{j=1}^k |xi - yi| \quad \text{-----1}$$

Where dy is the distance between the training vector X_i and the code vector Y_j .

$$Sum_{ij} = X_{ij} \text{-----2}$$

Where, c is the cluster strength

STEP2:

Compute the sum vector for every cluster by adding the corresponding components of all the training vectors that belong to the same cluster using the equation (3).

$$Centroid = Sum_{ij} / n_i$$

Where $i=1, 2, \dots, n$

STEP3:

Compute the centroid for each cluster by dividing the individual components of the sum vector by the cluster strength in using the equation (3).

STEP4:

Replace the existing code vector with the new centroid to form the revised codebook.

STEP5:

Repeat the steps 1 through 4 till the codebooks of the consecutive iterations converge[8]

7. FEATURE TRAINING

Feature training method includes collection of large number of trained features of clustered values of good and bad fruits. More number of collecting trained features gives more accuracy. In this method, the number of closest code vectors for each training vector is identified and is stored as the corresponding cluster density. The cluster densities for

all training vectors are computed and are sorted in descending order. From the sorted list, the top M training vectors with higher cluster densities are identified and grouped as codebook. This codebook is saved and loaded in MATLAB for feature matching.

8. FEATURE MATCHING

Feature matching methods essentially consist of identifying features in images that can be matched with corresponding features in the other images from which a transformation model can be estimated. Feature matching is an important task in the area of image processing. Here correlation method is used for feature matching. Here the clustered values of good and bad fruits are taken more in number. With the extracted features each value are correlated with one another and we get a specific value for good and bad fruit. With these values we can identify good and bad Fruits.

9. CONCLUSIONS

In this paper the identification of good and bad fruits based on quality in image processing using MATLAB is successfully done with 80% accuracy. The use of image processing for identifying the quality can be applied not only to any particular fruit. We can also apply this method to identify quality of vegetables with more accuracy. Thus, this will enable the technology to be applied in many products.

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