ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 4, Issue 12, December 2017

DETECTION AND IDENTIFICATION OF COLOURED FRUITS AND VEGETABLES USING OTSU TYPE SEGMENTATION

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Abstract**:** Image processing techniques on digital systems which are used on agriculture can be evaluated for different aims. For instance; detection of wild herb, to estimate product, to determine ripeness and quality are some of them. The most widely used one is detection of fruits-vegetables. Particularly such image processing techniques are needed for robotic applications in agriculture. For example, identify and locating the fruit/vegetable is a major problem for the collection of fruit/vegetable by a robot. In this paper, the aim is to determine the locations of orange and green colour fruits, to separate from the leaves and branches in the area. In this paper, we recognize red and orange colour fruits conformation and segment the images through OTSU type segmentation and then trained database images evaluate the performance rate by supervised and unsupervised learning models.

Index Terms – Image processing, robotic applications, OTSU type segmentation, database images.

1. INTRODUCTION

Fruit detection system is primarily developed for robotic fruit harvesting. However this technology can easily be tailored for other applications such as on tree yield monitoring, crop health status monitoring, disease detection, maturity detection and other operations which require vision as a sensor. For fruit harvesting system, it is very necessary to detect the fruit on the tree more efficiently. The vision based fruit harvesting system for the fruit detection basically depend on the contribution of different features in the image. The four basic features which characterize the fruit are: intensity, colour, edge and orientation. This paper proposes an efficient multiple features based algorithm for the fruit detection on tree. Colour features in image could be successfully used to segment defects on fruits.

Texture features are found to contain useful information for quality evaluation of fruit and vegetables, e.g., classification of grade of apples after dehydration with the accuracy of 95%. Colour and texture features are used to locate green and red apples. Combining many features and classifiers, where all features are concatenated and fed independently to each classification algorithm. The fusion approach is validated using the multi-class fruit-vegetable categorization task in a semi-controlled environment, such as a distribution center or the supermarket cashier. The results show that the solution is able to reduce the classification error up to 15% point with respect to the baseline.

An efficient fusion of colour and texture is used for fruit recognition. The recognition is done by minimum distance classifier based upon the statistical and co-occurrence features derived from the wavelet transformed sub-bands. The spherical fruit recognition system developed with a laser range-finder model and a dual colour/shape analysis algorithm in . For the analysis of the image of oil palm fresh fruit bunches (FFB), the development of outdoor image analysis of oil palm fruit fresh bunches (FFB) are required. The software analysis generates the mathematical model and correlation factor between the light intensity in relation to value of FFB from Red, Green and Blue component of image taken. In citrus manufacturing industries, calliper and colour are successfully used for the automatic classification of fruits using vision systems.

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2. IMAGE ENHANCEMENT

Image enhancement is among the simplest and most appealing area of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured, or simply to highlight certain features of interest in an image. A familiar example of enhancement is when we increase the contrast of an image because "it looks better". It is important to keep in mind that enhancement is a very subjective area of image processing. It can be used to improve the quality of an input image. The enhancement doesn't increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they detected easily.

Point operation

Point operations are zero –memory operations where a given gray level x€ [0, L] is mapped to another gray level y€ [0, L] according to a transformation.

$$Y = f(x).$$

Smoothening filters

Smoothing filters are used for blurring and for noise reduction. Blurring is used in pre-processing steps such as removal of small details from an image prior to (large) object extraction and bridging of small gaps in lines or curves. Noise reduction can be accomplished by blurring with a linear filter and also by non-linear filter.

Spatial operation

The use of the spatial mask for image processing usually is called spatial filtering and the masks themselves are called spatial filter. It can be classified into

- Linear filters
- Non linear filters

Linear filters

They are based on the concept that the transfer function and the impulse or point spread function of a linear system are inverse Fourier transform of each other.

Non linear filters

This filter is based directly on the values of pixels in the neighborhood under consideration and they don't explicitly use co-efficient in the manner described. Noise reduction can be achieved effectively with a non-linear filter whose basic function is to compute the median gray level value in the neighborhood in which the filter is located.

Median filter

One of the principle difficulty of smoothening method is it blurs edges and other sharp detail. If the objective is to achieve noise reduction rather than blurring, an alternative approach is to use median filters. The gray level of each pixel is replaced by the median of the gray levels in a neighborhood of that pixel, instead of by the average. This method is particularly effective on the noise pattern consists of strong spike like components and the characteristics to be preserved is edge sharpness.

- Median filters are non-linear.
- The median value (m) of a set of values is such that half the values in the set are less than m and half are greater than m.

Sharpening filters

The principle objective of sharpening is to highlight fine detail in an image or to enhance or as a natural effect of a particular method of sharpening image acquisition.

3. IMAGE DEGRADATION

Image Enhancement is an area that also deals with improving the appearance of an image. However, unlike enhancement, which is subjective, image restoration is objective, in the sense that restoration techniques tend to be based on mathematical or probabilistic models of image degradation.

Enhancement, on the other hand, is based on human subjective preferences regarding what constitutes a "good "enhancement result. It means to reconstruct the input image signal. Recover an image that has been degraded by using a prior knowledge of the degradation phenomenon. Model the degradation and applying the inverse process in order to recover the original image.

The effectiveness of restoration of image restoration filters depends on the extent and the accuracy of the knowledge of the degradation process as well as on the filter design criterion. Digital image restoration may be viewed as the process of obtaining an approximation to f(x, y), given g(x, y) and a knowledge of the degradation in the form of the operator H.

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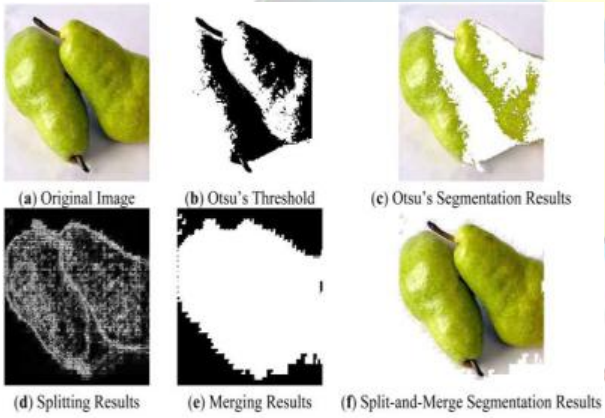
4. OTSU THRESHOLDIND METHOD

In computer vision and image processing, Otsu's method, named after Nobuyuki Otsu is used to automatically perform clustering-based image thresholding, or, the reduction of a gray level image to a binary image. The algorithm assumes that the image contains two classes of pixels following bi-modal histogram (foreground pixels and background pixels), it then calculates the optimum threshold separating the two classes so that their combined spread (intra-class variance) is minimal, or equivalently (because the sum of pair wise squared distances is constant), so that their inter-class variance is maximal. Consequently, Otsu's method is roughly a one-dimensional, discrete analog of Fisher's Discriminate Analysis. Otsu's method is also directly related to the Jenks optimization method. The extension of the original method to multi-level thresholding is referred to as the multi Otsu method.



Computer vision

Industrial cameras, machine vision systems can for example measure and count products, calculate their weight or volume, and inspect goods at top speed with respect to their predefined characteristics. Furthermore, they automatically extract limited, but crucial, information from huge quantities of data, or they help experts interpret images by filtering, optimizing and supplementing the latter, or by facilitating quick retrieval and availability thereof. They work tirelessly and neutrally, and perform consistently. Machine vision systems are used in a variety of applications, including manufacturing, medicine, traffic monitoring and security systems.

Industrial cameras are an important element in the industrial image processing chain. The camera uses a specific protocol to communicate with a computer, which then processes the image data and which maybe used to modify the camera's settings. The requirements for an industrial image processing camera vary from application to application, but are markedly different from those you might be familiar with specific to your digital camera. The key requirements, for example, relate to noise level, refresh rate, sensitivity, dynamic range, exposure mode and resolution. To achieve its full potential, the camera must also be properly supported by its peripherals. As such, the optics and interface used by the camera to pass on data are also of crucial importance.

Thresholding Method

To make thresholding completely automated, it is necessary for the computer to automatically select the threshold T. Sezgin and Sankur (2004) categorize thresholding methods into the following six groups based on the information the algorithm manipulates.

- **Histogram shape**-based methods, where, for example, the peaks, valleys and curvatures of the smoothed histogram are analyzed
- **Clustering**-based methods, where the gray-level samples are clustered in two parts as background and foreground (object), or alternately are modeled as a mixture of two Gaussians
- **Entropy**-based methods result in algorithms that use the entropy of the foreground and background regions, the cross-entropy between the original and binaries image, etc.
- **Object Attribute**-based methods search a measure of similarity between the gray-level and the binaries images, such as fuzzy shape similarity, edge coincidence, etc.
- **Spatial** methods [that] use higher-order probability distribution and/or correlation between pixels

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- **Local** methods adapt the threshold value on each pixel to the local image characteristics. In these methods, a different T is selected for each pixel in the image.

Multiband thresholding

Colour images can also be threshold. One approach is to designate a separate threshold for each of the RGB components of the image and then combine them with an AND operation. This reflects the way the camera works and how the data is stored in the computer, but it does not correspond to the way that people recognize colour. Therefore, the HSL and HSV colour models are more often used; note that since hue is a circular quantity it requires circular thresholding. It is also possible to use the CMYK colour model.

5. MORPHOLOGY

The field of mathematical morphology contributes a wide range of operators to image processing, all based around a few simple mathematical concepts from set theory. The operators are particularly useful for the analysis of binary images and common usages include edge detection, noise removal, image enhancement and image segmentation. Morphological techniques typically probe an image with a small shape or template known as a **structuring element.**

The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighborhood of pixels. Morphological operations differ in how they carry out this comparison. Morphology operations often take a binary image and a structuring element as input and combine them using a set operator creating an output image of the same size. In a morphological operation, the value of each pixel in the output image is based on a compression of the corresponding pixel in the input image with its neighbors. By choosing the size and shape of the neighborhood a morphological operations that is sensitive to specific shapes in the input image can be constructed.

6. TEXTURE ANALYSIS

Object defines by colors, texture or shape. Shape means graphical data that contains location, size and rotational effects are filtered out. Grading applied on many fruits and vegetables. In this section review is made on how different parameters can be used for automatic fruit grading system. An image texture is a set of attribute calculated in image processing designed to find texture of an image. Image texture gives us information about the image color or intensity. Image textures are one way that can be used to help in segmentation or classification of images. To analyze an image texture in computer graphics, there are two ways to approach the issue: Structured Approach and Statistical Approach. In this section review is made on how different parameters can be used for automatic fruit grading system.

STATISTICAL APPROACHES

It yields characteristics of texture as smooth coarse grains and so on. To describe the texture, the gray level histogram of on image or region is considered and number of different gray levels is used. The variance is defined as the measure of gray level contrast which is used to establish the relative smoothness descriptors. It is defined as the measure of the skew as asymmetry of the histogram of a region. It can also be measure of the relative flatness of the histogram. The limitation of statistical moments use only the histogram of an region and it do not provide any information.

Fig: Statistical approaches diagram

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STRUCTURAL APPROACH

It deals with the arrangement of image primitives, such as the description of texture based on regularity speed parallel lines .The principal idea behind the structural techniques is that a simple texture primitive can be used to form more texture patterns by forming some rules to limit the number of possible arrangements of the primitives.

If the string of the meaning "circles to the right" allows generation of the texture pattern. It can be used to display the pattern in 2-D texture form. It can be work based on arrangement of image primitives.

Fig: Structural approaches diagram

SPECTRAL APPROACHES

Spectral techniques describe the texture based on the properties of the Fourier spectrum. Three features of Fourier spectrum are useful for texture description. Prominent peaks in the spectrum gees the principal direction of the texture patterns. The locations of the peaks in the frequency plane give the fundamental spatial period of the patterns. Eliminating periodic components via filtering leaves non periodic image elements which can then described by statistical approaches. It can be used for location of highest value.

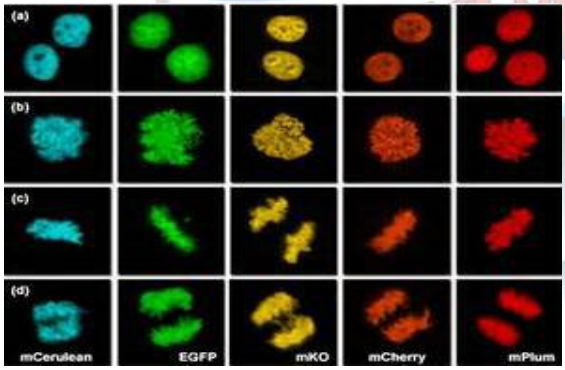


Fig: Spectral approaches

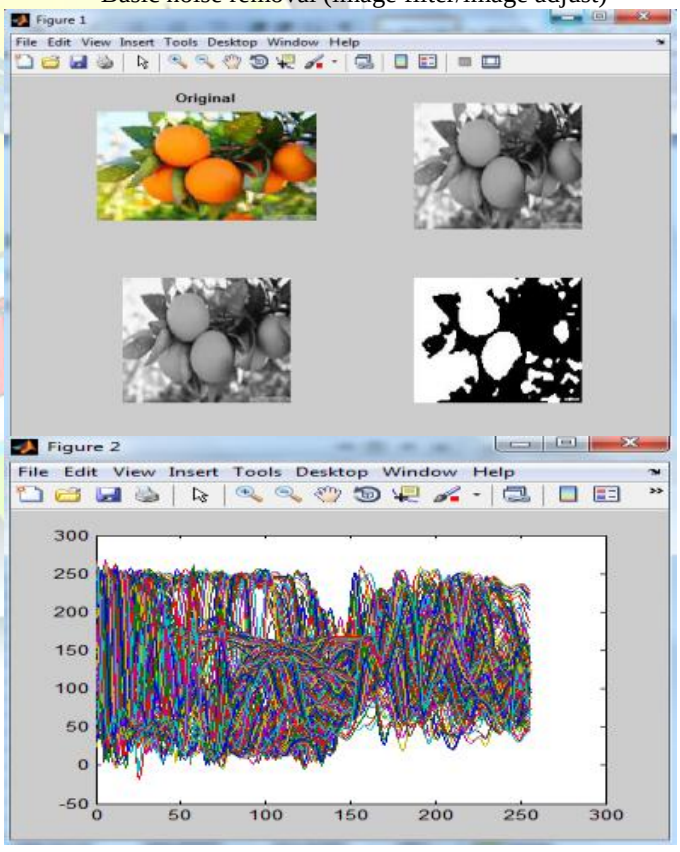
7. RESULT

Input:

- Input is a low resolution sample image its may be a radar, spectral or mining type.
- Format of image like *.jpg, *.bmp,*.png etc.

Preprocessing

- Preprocessing is a type which we had already taken in input section it may be not in specific size and noise level presence.
- To create this image for regularized one.
- To resize using (image resize)
- Gray scale conversion (rgb2gray)
- Basic noise removal (image filter/image adjust)



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TEXTURE ANALYSIS

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CONCLUSION

Efficient fruit detection using multiple feature based algorithm is developed and proposed in this paper. Multiple features like intensity, colour, edge and orientation are analysed. It computes the feature map for different type of feature points and according to the feature map the fruit regions are extracted. The process is entirely automatic and does not need user intervention. The proposed method is not domain-specific and does not impose limits on the variety of clustered sectional tree image. It can be used for all kind of images provided that there are at least one or more meaningful fruit regions. A simple feature cannot entirely represent the character of the fruit region. Therefore, multiple features analysis is used in the proposed method. Fruit detection using other imaging devices other than the usual RGB camera will also be investigated in the future work.

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ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 4, Issue 12, December 2017

Horticulturae 824: Internation Symosium on Application of Precision Agriculture for Fruits and Vegetables.

BIOGRAPHY

Ms.L.Megala is an Assistant professor of ECE in V.R.S college of Engineering & Technology. She completed her B.E/ECE in Idhaya Engineering College for women, Chinnasalem in the year 2008. She completed her M.E in the field of Applied Electronics in S.K.P Engineering College, Thiruvannamalai in the year 2011. She has attended 6 national conferences and 3 international conferences. She is the life time member of ISTE. She has a teaching experience of 7.5 years. At present, she is going to have a research work in the field of Digital Image Processing.

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