Review of Different Techniques for Ripe Fruit Detection

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***Abstract* –Many techniques have been developed for ripe fruit image detection. Such as K-means clustering, fuzzy c mean, color segmentation etc. Segmentation is a technique which partitions the images by similarity or equality etc. Segmentation is most important step in image processing. It is used to distinguish various objects in the image. Different ripe fruit detection techniques have been developed by the researchers to detetct ripe fruits image. In this review paper various techniques for ripe fruit image detection are considered.**

Keyword –Histogram; K-means Clustering; Fuzzzy c-mean clustering; ANN.

I. INTRODUCTION

Image segmentation is a technology to divide the image into a number of specific and unique areas and extract the target. Image segmentation is a critical step in the extraction of ripe fruit because the segmentation result affects subsequent processing directly. There are a lot of general algorithm and technique have been used to segment image, such as clustering methods, edge detection methods, watershed segmentation methods, and neural network methods [1]. However, these methods have only their own application areas. There are no general methods used to solve the entire image segmentation problem. Hence, these image segmentation methods are often used combining with other knowledge to achieve a good segmentation.

Some images of fruit from greenhouses are used to verify the proposed method. By analyzing these images, we can figure out that the color of ripe fruit is red, yellow, etc. while the color of leaves and backgrounds are green or others.

II. USED VARIOUS TECHNIQUES FOR SEGMENTATION

A. SEGMENTATION BASED ON EDGE DETECTION

This method attempts to resolve image segmentation by detecting the edges or pixels between different regions that have rapid transition in intensity are extracted [5,7] and linked to form closed object boundaries .The result is a binary image [6]. Based on theory there are two main edge based segmentation methods- gray histogram and gradient based method [8]. Edge detection is a well-developed field on its own within image processing. Relation between Region boundaries and edges are closel, since there is often a sharp adjustment in intensity at the boundary region. Therefore Edge detection techniques been used as the base for another segmentation approach for sharp segmentation. The edges traced by edge detection are often discontinuous. For segmenting an object from an image with high complexity however, one needs closed connected region boundaries. The desired edges are the boundaries of such objects. Segmentation approaches can also be applied to already traced edges using edge detectors for more sharp edges.

B. ARTIFICIAL NEURAL NETWORK (ANN)

A neural network is an artificial representation of human brain that try to simulate its learning strategies and can be use for decision making processes. An artificial neural network is often called a neural network. Recently an artificial neural networks are mostly used to solve the problem of medical image segmentation. Neural network that simulate life, especially the human brain's learning procedures. Each node can perform some basic computing. The learning process can be achieved through the transferring the connections among nodes and connection weights[16]. Its main advantage is not dependent on the probability density distribution function. It can also prove the segmentation results when the data deviation from the normal situation. Neural network can also reduce the requirements of expert intervention during the image segmentation process. This problem is prevalent in many age segmentation methods. First of all ,the image segmentation problem is converted into energy minimization or classification issues and so on. Then the issues solved based on neural network in this method. The neural network was trained with training sample set in order to determine the connection and weights between the nodes. Then the new images were segmented with trained neural network. Neural network segmentation method includes two important steps: feature extraction and image segmentation based on neural

C.REGION BASED SEGMENTATION

Comparing to edge detection method, This technique falls in the category of region and are relatively simple and more immune to noise. Edge based techniques partition an image based on quick changes in intensity near edges whereas region based techniques, Arrange an image into region that are same according to a set of defined criticism.

Region growing is a procedure which group's pixel in whole image into sub region or larger region based on defined criticism. Region growing can be processed as Below:

1. Mark the group of seed pixels in original image.
2. Select a clustering criticism such as grey level intensity or color and set up a stopping rule.
3. expand the region by connecting to each seed to the neighboring pixels that have satisfied the cluster properties similar to seed pixels.
4. Stop region growing when no more pixels met the criticism for included in that region (i.e. Size, likeness between a candidate pixel & pixel grown so far, as a result shape of the region being grown)

D. CLUSTERING TECHNIQUE

Clustering is an unsupervised learning process, where one needs to define a finite set of bunches known as clusters to classify pixels [9]. Clustering use no training stages rather train themselves using presented data. Clustering is usually used when classes are known in prior. A similarity mapping is defined between pixels [6],and then similar pixels are grouped together to become a clusters Clustering algorithms are characterized as (i)hard clustering, (ii)k- means clustering, and (iii) fuzzy clustering, etc.

K-means Clustering:

The k-means algorithm is an algorithm to cluster n objects based on attributes into k partitions, $k < n$ [4]. It is similar to the expectation-maximization algorithm for mixtures of Gaussians in that they both attempt to find the centers of natural clusters in the data. It assumes that the object attributes form a vector space. The objective it tries to achieve is to minimize total intra-cluster variance, or, the squared error function,

where there are k clusters Si, i = 1, 2, · · ·; k and μi is the centroid or mean point of all the points $xj \in Sj$. The steps of the proposed algorithm are as follows.

1. Choose the number of clusters, k.
2. Randomly generate k clusters and determine the cluster centers, or directly generate k random points as cluster centers.
3. Assign each point to the nearest cluster center.
4. Recompute the new cluster centers.
5. Repeat the two previous steps until some convergence Criterion is met

A drawback of the k-means algorithm is that the number of clusters k is an input parameter. An inappropriate choice of k may yield poor results. The algorithm also assumes that the variance is an appropriate measure of cluster scatter. if the number of clusters is estimated in accurate manner, K-means image segmentation will provide better results. They proposed a new method based on edge detection to estimate number of clusters. Phase congruency is used to detect the edges. Then these edges are used to find clusters[19].

E. MORPHOLOGICAL SEGMENTATION

In some image analysis and machine vision applications—such as industrial defect inspection or biomedical imaging segmentation based on thresholding or edge detection is not sufficient because the image quality is insufficient or the objects under inspection touch or overlap. In such applications, morphological segmentation is an effective method of image segmentation. Morphological segmentation partitions an image based on the topographic surface of the image. The image is separated into non-overlapping regions with each region containing a unique particle [11]

Morphological segmentation is a multiple-step process involving several functions. The following list describes each morphological segmentation step and where to find more information about each step [11],[12].

1. Use a global or local threshold to create a binary image.
2. If necessary, use binary morphology operations to improve the quality of the image by filling holes in particles or remove extraneous noise from the image.
3. Use the Danielsson function to transform the binary image into a gray scale distance map in which each particle pixel is assigned a gray-level value equal to its shortest Euclidean distance from the particle border.
4. Perform a watershed transform on the distance map to find the watershed separation lines.
5. Superimpose the watershed lines on the original image using an image mask.

F. MARKER-CONTROLLED WATERSHED SEGMENTATION

Separating touching objects in an image is one of the more difficult image processing operations. The watershed transform is often applied to this problem. The watershed transform finds "catchment basins" and "watershed ridge lines" in an image by treating it as a surface where light pixels are high and dark pixels are low.[18]

Segmentation using the watershed transform works better if you can identify, or "mark," foreground objects and background locations. Marker-controlled watershed segmentation follows this basic procedure:

1. Compute a segmentation function. This is an image whose dark regions are the objects you are trying to segment.
2. Compute foreground markers. These are connected blobs of pixels within each of the objects.
3. Compute background markers. These are pixels that are not part of any object.
4. Modify the segmentation function so that it only has minima at the foreground and background marker locations.
5. Compute the watershed transform of the modified segmentation function.

G. COLOR SEGMENTATION

Color-Based Segmentation is done by the Following below ways Using the L*a*b* Color Space, using K-mean clustering & Marker controlled watershed segmentation

L∗a∗b∗ Color Space:
Lab color space is a color-opponent space with dimension L for lightness and a and b for the color-opponent dimensions, based on nonlinearly-compressed CIE XYZ color space coordinates [2]. Unlike the RGB and CMYK color models, L∗a∗b∗ color is designed to approximate human vision. It aspires to perceptual uniformity, and its L component closely matches human perception of lightness. It can thus be used to make accurate color balance corrections by modifying output curves in the a and b components, or to adjust the lightness contrast using the L component [2] [3]. There are no simple formulas for conversion between RGB and L∗a∗b∗, because the RGB is a device dependent. The RGB first needs to be transformed to a specific absolute color space, such as RGB or Adobe RGB. This adjustment will be device dependent, but the resulting data from the transform will be device independent, allowing data to be transformed to the CIE 1931 color space and then transformed into L∗a∗b∗.

H. HISTOGRAM MATCHING

In [13], according to author “Color histogram represent the distribution or division of colors in an image”. Global contrast of many images can be increases with this method, especially when the usable data of the image is represented by close contrast values. These adjustments help in uniformly distribution of intensities on the histogram. Hence the areas of lower local contrast can gain higher contrast without affecting the global contrast In this method we convert the colored image into gray scale image and find its histogram. After that we compare that histogram with the histogram of object’s histogram sample and by this comparison we can easily find the needed histogram of image. A different histogram similarity measures are used to find most suitable and efficient one to check.

I. FUZZY C-MEANS TECHNIQUE

In this algorithm the test pixel is allowed to be member of two or more clusters with different membership coefficient. FCM algorithm is iterative in nature and generates fuzzy partition matrix and also requires cluster centre along with objective function. The values for cluster center and objective function are updated for every single iteration and are stopped when the difference between two successive object function values is less than some predefined threshold value. The objective function and the algorithm are as given below [17]

$$J_{FCM} = \sum_{k=1}^{n} \sum_{i=1}^{c} (v_{ik})^q \, d^2(x_k, v_i)$$

x={x1,x2,x3,……….,xn}⊆ R;
dataset n= number of data items
c= number of clusters; 2 ⩽ c < n =
v_{ik}=degree of membership of xk in ith cluster
q= weighting exponent of each fuzzy member
v_i= prototype of center cluster i

Algorithm:
1. Assign the values for c, q and threshold value Also initialize the partition matrix U = [].
2. Initialize the cluster centers and a counter p.
3. Calculate the membership values and store in an array.
4. For each iteration calculate the parameters and till all pixels are processed where
5. After each iteration update cluster center and compare it with the previous value (
6. If the difference of comparison is less than the defined threshold value stop iteration else repeat the procedure.

Table-1 presents the various Segmentation techniques with their functioning and pros and cons.

TABLE-1: VARIOUS IMAGE SEGMENTATION TECHNIQUS WITH THEIR PROS AND CONS

Sr. No	Techniques	Description	Pros	Cons
1	Artificial Neural Network	Used to classification	Utilize the parallel nature	Training Time long
2	Histogram[13]	Color histogram represent the distribution or division of colors in an image	Histograms are useful and easy.	It’s difficult to display several at the same time for Comparisons
3	k-means Clustering	It is used to cluster the object.	Segment can be Easily made	number of clusters k is an input parameter & gives poor results.
4	Edge Detection Technique[16]	Based on the detection of inhomogenity, generally tries to trace points with more or less	Edge detection technique is the way in which human perceives objects and works well for images	Does not fit for images in which the edges are bad
5	Color segmentation	Based on monochrome segmentation	It gives accurate results by using edge, region based techniques	No color space suitable & better for image yet.

III. CONCLUSION

In this paper, we surveyed multiple techniques for ripe fruit image detection. This techniques are used to segmentation of images based on edge detection, Region growing, clustering etc. it is conclude that every techniques are not appropriate for each images because of many reasons such as pixel colour, similarity of images. So it is impossible to apply any single technique to every images or All techniques are apply to each images. We also conclude that best technique for ripe fruit detection is k-means clustering and color segmentation technique. This review paper also present the pros and cons associated with Image segmentation techniques.

IV. REFERENCES

[1] LIN Kai-yan, WU Jun-hui, XU Li-hong, “A survey on Color Image Segmentation Techniques,” Journal of Image and Graphics, vol10, No1, Jan 2005.
[2] M. D. Fairchild, “Color and image appearance models,” Color Appearance Models, pp. 340-399, 2008. 2988
[3] G. Hoffmann, “Formulas from ’RGB’ to CIELab,” CIELab Color space,pp. 4-9, 2008.
[4] L. Vincent, “Morphological grayscale reconstruction in image analysis:applications and efficient algorithms,” IEEE Transactions on Image Processing, vol. 2, pp. 176–201, 2002.
[5] Rastgarpour M., and Shanbehzadeh J., Application of AI Techniques in Medical Image Segmentation and Novel Categorization of Available Methods and Tools, Proceedings of the International MultiConference of Engineers and Computer Scientists 2011 Vol I, IMECS 2011, March 16-18, 2011, Hong Kong.
[6] Zhang, Y. J, An Overview of Image and Video Segmentation in the last 40 years, Proceedings of the 6 th International Symposium on SignalProcessing and Its Applications, pp. 144-151, 2001.
[7] N. R. Pal, S. K. Pal,"A Review on Image Segmentation Techniques", Pattern Recognition, Vol. 26, No. 9, pp. 1277- 1294, 1993.
[8] T. Lindeberg and M.-X. Li "Segmentation and classification of edges using minimum description length approximation and complementary junction cues", Computer Vision and Image Understanding, vol. 67, no.1, pp. 88-98, 1997. "
[9] V. K. Dehariya, S. K. Shrivastava, R. C. Jain,"Clustering of Image Data Set Using K-Means and Fuzzy K- Means Algorithms", International conference on CICN, pp. 386- 391, 2010.
[10] Robert M. Haralick and Linda G. Shapiro. "Survey: Image Segmentation Techniques". Computer Vision, Graphics and Image Processing, 29:100,1985.
[11] Dorin Comaniciu and Peter Meer. "Robust Analysis of Feature Spaces: Color image Segmentation". IEEE, pages 12, 2007.
[12] Demin Wang. "Unsupervised Video Segmentation Based on Watersheds and Temporal Tracking". IEEE. Trans. on Circuits and System for Video Technology, 8(5):539546, September 1998
[13]Fatma Susilawati Mohamad, Azizah Abdul Manaf & Suriayati Chuprat, “Histogram Matching For Color Detection:A Preliminary Study”,Information Technology (ITSim), 2010 International Symposium in , Kuala Lumpur ,Vol. 3,pp. 1679 – 1684,,IEEE 2010
[14] Pooja Kamavisdar, Sonam Saluja, Sonu Agrawal M.E(Scholar), Computer Technology and Application, SSCET, Bhilai, India M.E(Scholar), Computer Technology and Application, SSCET, Bhilai, India Senior Asst. Professor, Computer Science and Engineering, SSCET, Bhilai, India “A Survey on Image Classification Approaches and Techniques”
[15] Muhammad Waseem Khan, “A Survey: Image Segmentation Techniques” International Journal of Future Computer and Communication, Vol. 3, No. 2, April 2014.
[16] Savita Agrawal, Deepak Kumar Xaxa“ Survey on Image Segmentation Techniques and Color Models” International Journal of Computer Science and Information Technologies, Vol. 5 (3) , 2014.
[17] Yong Yang, “Image Segmentation By Fuzzy C-Means Clustering Algorithm With A Novel Penalty Term”, Computing And Informatics, Vol. 26, 17–31, 2007.
[18] Bieniek, A., & Moga, A. (2000). An efficient watershed algorithm based on connected components. Pattern Recognition, 33, 907-916.
[19] R. Patil and K. Jondhale, "Edge based technique to estimate number of clusters in k-means color image segmentation," in Proc. 3rd IEEE International Conference on Computer Science and Information Technology (ICCSIT), pp. 117-121, 2010.