An Image Segmentation Comparison Approach for Extracting Mango Region from an Image

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Abstract— : Mango assessment is a very important task during export level, industry level and also at consumer's choice. Sorting and grading of mangoes can be done based on their features such as color, texture, shape, size and defects. In order to make this task easier, segmentation can be considered as one of the important steps in image processing. The major goal of segmentation is to optimize and change the representation of an image into something that is more important and easier for further pattern recognition. In this paper mangoes are selected as the case study. Segmentation technique is used to separate the mango region from the background including shadow. Different segmentation techniques are applied for extracting the mango region and accuracy of each segmentation technique is computed to present the best segmentation technique using performance measures. Ultimately K-means clustering segmentation technique is found to be the precise for mango region extraction.

Index Terms— Image Segmentation, Thresholding, Region growing, Morphological, K-means clustering

1 INTRODUCTION

Digital images are used widely as one of the key medium for conveying information. Extracting and understanding the information from digital images and using it for different tasks is one of the most important characteristics of machine learning. Quality and safety of products are the major requirements in food industry. In food industry, quality evaluation is performed manually by trained people, which are tedious, time consuming and expensive. Also the quality parameters are not consistently met by this human inspection method due to various factors. It is possible to replace the human operators with automated computer based machine learning methods so as to provide consistent quality in sorting and grading. In order to make the any recognition task easier using images, segmentation forms the most important step in any image analysis [1]. South Asia is the largest cultivator of mangoes and distributed worldwide, about 57% of the world's mangoes are from India. Mango belongs to the genus Magnifera and family Annacardiaceae, the name Magnifera Indica refers to Indian mangoes.

For qualitative analysis of these mangoes, segmentation forms a significant step. Thus, image segmentation is the first step in image analysis [1]. Image segmentation is one of the mostly used methods to classify the pixels of an image accurately in a selection oriented application. It divides an image into a number of regions, so that the pixels in each region have maximum similarity and high contrast between regions. In several fields, it is a powerful resource like education, imag e processing, traffic signal, pattern recognition, etc. There are different techniques for image segmentation such as threshold based, edge based, and cluster based. Sometime image denoising should be done before the segmentation to avoid from the false contour selection for segmentation, to segment the image without loss of information for further analysis on mangoes.

2. PROBLEM DEFINITION

Automatic document processing, that involves the document recognition and analysis, require the segmentation of the image. While developing the method for automatic processing many issues related to images need to be taken care of. One such problem is separating the background of the image from its foreground to make foreground image distinctly visible for future processing. Separating the foreground objects from the background is an important step in historical document images due to uneven background structure. In many situations foreground objects may be indistinguishable from the background this may lead to poor results. The accuracy of data extraction is crucial to the performance of object recognition system. The intensity of the pixels that forms the image plays an important role.

The main objective of this work is to test various segmentation algorithms in image processing as applied to extract mango region from the image which also consisting of shadow and to identify the best suitable algorithm by knowing the accuracy of each segmentation technique and it is applied to wide variety of mangoes.

3. LITERATURE SURVEY

Digital image processing is the application on the image of different algorithms to enhance the image quality by eliminating noise & other unwanted pixels as well as obtaining more image information. Many of the common applications for image processing include medical imaging, facial recognition systems, cropping systems, etc.[2]. Segmentation techniques discussed are edge detection, HSI colour space, Thresholding based segmentation, Region growing segmentation, Morphological and K-means clustering [2]. Several segmentation technique is used for extracting mango from the background and later the accuracy of each segmentation technique is calculated using the method of DSM (Dice similarity measure). Based on the accuracy obtained for each segmenta-

tion technique applied, the paper presents the based segmentation technique for extracting mango from the background [1]. Morphological segmentation combines morphological operations such as extended minima and morphological gradient to segment gray scale image. Image is eroded, which is followed by dilation with a defined structuring element [1]. Several image segmentation algorithms, as mentioned above are implemented on the data sets. The segmented mango is coloured back to the original mango colour by extracting each of the R, G, B planes and finally concatenating it [1]. Accuracy of each segmentation is calculated by DSM (Dice Similarity Measure). There has been a tremendous evolution in the field of accuracy calculation. Accuracy calculation is implemented based on the concept of under segmentation and over segmentation [1]. Any image captured by computer vision technology is greatly affected by noise. This image is initially filtered for noise removal. Several techniques available for noise removal are low pass, high pass, median and mean filtering. After noise removal the segmentation technique is applied in order to extract the required object from the background [3]. Image segmentation is the the first step in any image analysis and study of images for various applications for image processing. Image detection and filtration also involves segmentation of images [4]. Detection of edges plays a vital role in identifying and detecting the difference in intensities as an edge. It is a boundary that separates two homogeneous regions of an image. The edge detection refers to the method of distinguishing and locating sharp edges in an image [5]. Segmentation that divides the image into regions based on initial seed value given is the region growing segmentation. Region growing is based on continuity method. The image is divided into homogeneous areas of connected pixels. The region is computed based on some characteristics such as colour, intensity or texture. Region based segmentation works iteratively by grouping neighbouring pixels with similar values and dividing pixel groups that differs in value [6]. Threshold segmentation of images is an effective method for segmenting images that have light objects on dark background. Thresholding operation transforms a multilevel image into binary image, choosing a suitable threshold T, splitting image pixels into multiple images and separating objects from the background [7]. Clustering is the method of grouping the data into clusters in such way that object within a cluster have high similarity to each other, yet are quite different from objects in other clusters. K-means clustering is the most important method in segmentation. K-means is an algorithm used to cluster objects based on attributes into K partitions. It is basically an unsupervised algorithm, which is precise, fast and consistent [8].

4. PROPOSED METHOD

In this work, in order to extract mango region from an image, the following methodology is being adopted. The proposed system is illustrated in the Figure: 1, which involves various processes such as image acquisition followed by preprocessing, segmentation, accuracy calculation for each segmentation and comparison of accuracy for each segmentation technique.

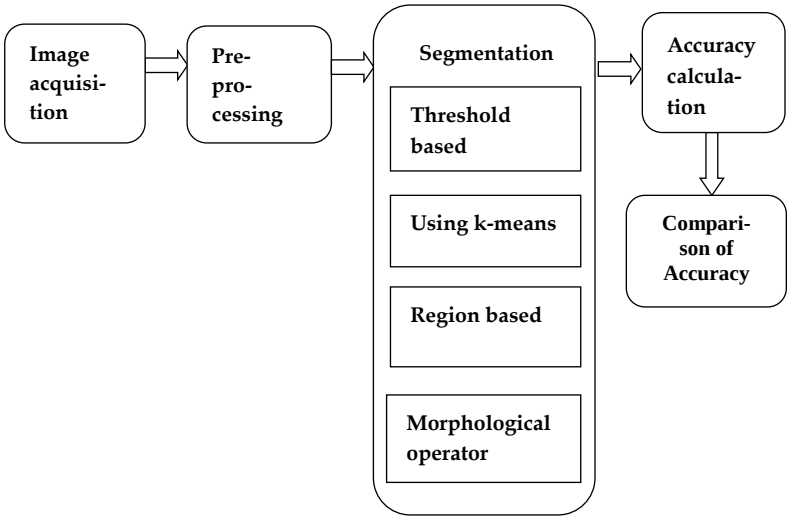

Figure: 1 Flow diagram of the proposed method

Image acquisition: The mango images are captured with computerized 8MP camera.

Pre-processing: Images should be processed before segmentation; various pre-processing algorithms such as converting RGB images to gray scale image, image resizing, etc. Median filtering is used to remove noise.

Segmentation: Segmentation depends on various features of an image i.e. color or texture. . Segmentation of images are based on two factors discontinuity or similarity based intensity values. In discontinuity based approach the segmentation is carried out by partition an image based on abrupt changes in intensity, such as point, line, edges etc. Various segmentation techniques and algorithm such as Threshold based, K-means clustering, Region growing and Morphological processing are applied and tested for all the data sets, so that the results can be compared and a best suitable segmentation technique can be adopted to extract the mango region from an image.

Segmentation Performance Analysis: To measure the performance of segmentation, we made a setup by marking the mango area called ground truth then compared the results of segmented image with the ground truth using the well-known segmentation performance measures proposed. They are as follows, measure of over segmentation (MOS), measure of under segmentation (MUS), measure of overlap (MOL) and dice similarity measure (DSM).

Measure of Overlap (MOL): It measures the overlapping area between segmented and ground truth area. The probability of segmentation performance is superior, when MOL is high.

Measure of Under Segmentation (MUS): It measures the percentage of under segmentation of segmented ground truth area. The segmentation performance is superior, if MUS is low.

Measure of Over Segmentation (MOS): It measures the percentage of over segmentation of segmented ground truth area. Lower the MOS, superior is the segmentation performance.

Dice Similarity Measure (DSM): It measures similarity between segmented areas with ground truth area. If DSM is

high, segmentation is superior.

Comparison of accuracy: Based on the accuracy parameters computed, best segmentation technique for extracting the mango region from the background is presented in result section.

5. RESULTS

Fig.2 Data sets considered for segmentation

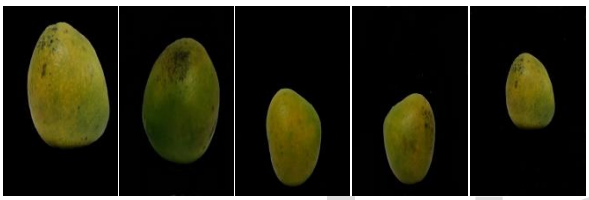

Fig.3 Ground truth

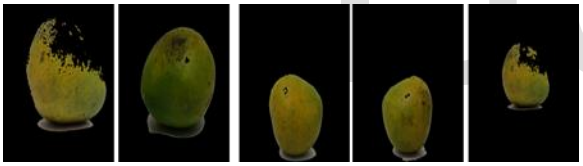

Fig.4 Results of Threshold based segmentation

Fig.5 Results of Morphological based segmentation

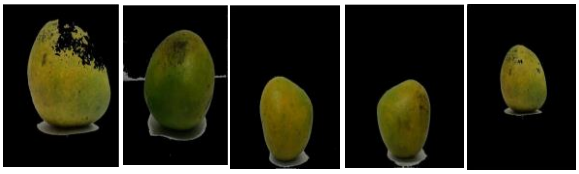

Figure.6 Results of Region based segmentation

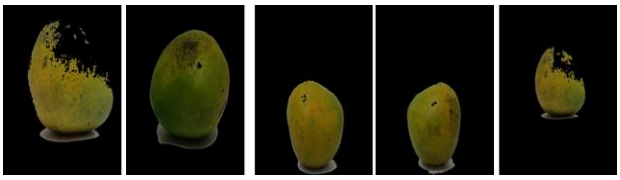

Figure.7 Results of K-means clustering based segmentation

Accuracy Tabulation

Table.1 Performance parameters for threshold based segmentation

Data samples	Performance measure in %			
	MOL	MUS	MOS	DSM
1	86.77	41.80	37.72	92.91
2	84.22	15.71	14.34	91.43
3	85.05	22.58	19.57	91.92
4	81.71	20.02	17.91	89.93
5	88.45	38.17	35.46	93.87

Table.2 Performance parameters for Morphological based segmentation

Data samples	Performance measure in %			
	MOL	MUS	MOS	DSM
1	80.83	38.93	37.72	89.4
2	86.105	15.35	14.34	92.53
3	84.87	22.58	19.57	91.82
4	80.29	20.34	17.91	89.06
5	84.377	40.425	35.46	91.52

Table.3 Performance parameters for region based segmentation

Data samples	Performance measure in %			
	MOL	MUS	MOS	DSM
1	81	39.15	37.72	89.05
2	83.02	16.06	14.34	90.72
3	82.25	22.52	19.57	92.03
4	79.58	20.612	17.91	88.62
5	84.31	40.48	35.46	91.49

Table:4 Performance parameters for K-means clustering segmentation

Data samples	Performance measure in %			
	MOL	MUS	MOS	DSM
1	95.92	38.65	37.72	97.91
2	89.36	14.08	14.34	94.38
3	83.77	20.08	19.57	96.79
4	87.80	18.03	17.91	93.50
5	88.50	37.37	35.46	93.89

Table: 5 Accuracy comparisons for different segmentation techniques

SEGMENTATION TECHNIQUES	ACCURACY
K-Means segmentation	95.29%
Region grow segmentation	90.86%
Threshold based segmentation	92.01%
Morphological based segmentation	90.47%

6. CONCLUSION AND FUTURE SCOPE

In this study, image segmentation is performed using different form of segmentation techniques and their performance is measured using four performance parameters. In this work, a comparative study on different segmentation technique has been presented and compared. Amongst all the segmentation techniques, K-means algorithm was found to be precise and accurate in extracting mango region from the image which also consisting of shadow. A higher value of MOL and DSM shows good segmentation result with lower values of MUS and MOS. Hence it was possible to develop a fast, cost effective, consistent and accurate method for extraction of mango region from the background. based on extraction of mango region from the background. In the proposed method we were able to remove the shadow region using K-Means clustering algorithm but failed in the other three techniques, therefore in future the proposed work can be extended for removal of shadow regions where it is present. In future work K-means cluster based segmentation technique can be used to segment only defected region in mango. Hence, sorting and grading of mangoes can be done effectively based on their defects.

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