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IMAGE PROCESSING ALGORITHM FOR FRUIT IDENTIFICATION

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Abstract - *Fruits should be quickly and correctly differentiated from their surroundings for the fruit harvesting robot. Edge based and color based detection methods are generally used to segment images of fruits obtained under natural lighting conditions. In this work, Digitized images of mango fruits along with its background were selected from the Internet in order to find a mango in each image and to locate its exact position. We compared the results of Edge based and colored based segmentation results and found that color based segmentation outperforms the edge based segmentation in all aspects. The comparison results are shown in the segmented image results. Accordingly, a new mango detection method is proposed to position the centroid of mangoes.*

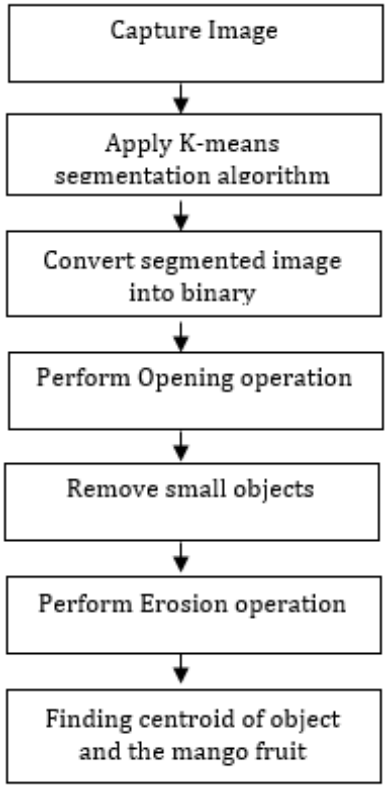
KeyWords*: *color based segmentation, edge based segmentation, machine vision, clustering, OpenCV.

I. INTRODUCTION

In the last decades, researchers have interested in fruit detection algorithms and applied many different computer vision techniques. The overall aim of most of these studies is robotic fruit harvesting [1]. But fresh fruit harvesting is a sensitive operation. According to [2], cost of harvesting by labors is very expensive and time consuming. In addition, picking of fruits by hand is very tedious. To solve these problems, human works can be replaced by automatic robots. Automatic harvesting operations reduce the harvesting costs [3]. For automatic fruit/vegetable harvesting systems, it is extremely important to effectively detect the object in outdoor conditions. There are several problems on fruit detection in outdoor condition, which can be classified into two groups: lighting and occlusion. Overcoming these problems is very crucial for the success of robotic harvesting. The first major task of a harvesting robot is to recognize and localize the fruit on the tree. This paper focuses on recognition of mango fruits by using edge and color based segmentation methods and we compare the results of both segmentation results. In the next section the details of our proposed edge and color based segmentation methods are presented. The results and discussion is given in section III. Finally, in section IV, conclusions of the proposed approach were presented.

II. DETECTION OF MANGO FRUIT ON TREE:

A. Color based segmentation



Proposed Model:

Pre-processing input images:

In this step, we perform some necessary operators on the captured image. The captured image of size m*n is converted into square image of size 256*256 fig (a).

Image segmentation using K-means clustering Algorithm:

The image segmentation means that the original image is divided into desired number of parts. Its purpose is to cluster the pixels which have the same features in image. It is the first step of process. There are several methods for this aim. Some of the works are based on the histogram or clustering. In detection of fruit, it is purposed to separate

the fruits from background in the image. Here, the method which has been preferred to use is 'k means clustering algorithm', K means clustering algorithm is superior from the other clustering algorithm and is known as unsupervised clustering algorithm [1]. With K-mean,we obtained k different groups from data sets. The distances between every groups are calculated. So, that the groups have to be far away as much as possible from the groups which are not similar, and the members of the particular group are somewhat similar.

K means clustering algorithm requires iteration. For this method, firstly, clustering centres are determined and the data is clustered according to those centers. New clustering centers are assigned to previous results. As repetition of these processes is increased,result of the algorithm is close to perfection. In the image processing, k means clustering algorithm provides less number of color sets for current colors of image fig(b).

Image Binarisation:

Segmented image is converted into binary image fig(c). Image binarization is the process of converting rgb image into the binary image. A binary image is a digital image that has only two possible values for each pixel. Binary images often arise in digital image processing as masks or as the result of certain operations such as segmentation, thresholding, and dithering x.

Morphological operations:

The Binary image is morphologically opened fig(d) using opening function from OpenCV. A disc- shaped structural element is used. Using this disc shaped structural element, removal of small blobs takes place. Here the small regions which do not belong to fruit can be eliminated by using threshold value. If the number of pixels in this region less than the threshold value, they can be deleted fig(e), thus the unwanted region turns black after this operation. The erosion is performed after removal of small objects. The erosion makes the edges sharp fig(f).

Finding centroid of object:

After performing morphological operations, the center is calculated as follows:

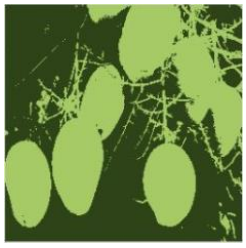
Xdistance = Xmax – Xmin

Ydistance = Ymax – Ymin

center point = [(Xmin + Xdistance/2), (Ymin + Ydistance/2)].

After these values are calculated the geometric center of estimated mango fruit was positioned as shown in fig (g).

(a) Original image



(b) Segmented image

(c) Binary image

(d) Opening operation

(e)Removal of small objects

(f) Erosion operation

(g)Mango position with center positions

Fig. 1. IMAGE SEGMENTATION ALGORITHM IMPLEMENTATION

B. Edge Detection

The Canny edge detector is a popular method for finding edges that begins by smoothing an image by convolving it with a Gaussian of a given sigma value. Based on the smoothed image, derivatives in both the x and y direction are computed; these in turn are used to compute the gradient magnitude of the image. Once the gradient magnitude of the image has been computed, a process

called 'non-maximum suppression' is performed; in which pixels are suppressed if they do not constitute a local maximum.

The final step in the canny edge detector is the hysteresis operator, in which pixels are marked as either edge, non-edges and in-between, this is done based on threshold values. The next step is to consider each of the pixels that are in-between, if they are connected to edge pixels these are marked as edge pixels as well. The result of this edge detector is a binary image in which the white pixels closely approximate the true edges of the original image. The input image (fig 1.a) and edge detected images is shown in fig 2.

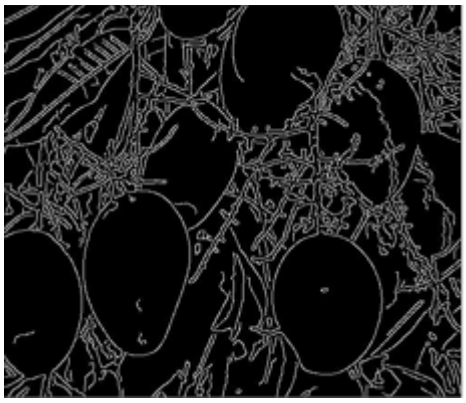


Fig 2. Canny Edge Detector Result

III. RESULTS AND DISCUSSION

The main idea was to develop a general algorithm under various natural lighting conditions. Thereby, no supplemental lighting source was used to control the luminance. Since the images were acquired under uncontrolled natural daylight conditions, they included tree canopies including tree branches, leaves, fruits, sky, etc. Each object of the image has its own edges, making image sets of edges of which the mango is just a subset. So, an edge detection algorithm was not successful (Fig. 1).

Color based algorithm detect the fruit regions in the images better; however, it was more complicated than the edge detection. It can be safely concluded that this method can achieve reliable and accurate results. The accuracy of the color based algorithm was 85%.Figure 7 shows the comparative analysis of proposed edge and color based segmentation.

IV. CONCLUSION

In this paper, the segmentation method based on color segmentation accurately detects the fruit regions in the image. It outperforms the results of edge based segmentation. So, edge detection based method was not as reliable as color based segmentation; color based algorithm was able to detect mangoes with 85-90% accuracy.

In color based algorithm, Clustering method has been applied on the images because of sharp differences between background. But it couldn't be achieved for all the images. There are some reasons which have had influence on analysis. Especially illumination conditions cause this situation. Also, there can be observed false detection. Not only the fruits but also background objects seem to be different color tones because of sunlight. Therefore, it can be detected as a fruit, even if there isn't any fruit. Occlusion is another problem which prevent sufficient analysis. In image processing detection fruit is a difficult problem. In this work, better results were obtained than other works in the literature.

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