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Digital Image Processing Techniques for Object Detection From Complex Background Image

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Abstract

This paper discuss about the method or techniques on how to detect the mango from a mango tree. The techniques using are such as colour processing which are use as primary filtering to eliminate the unrelated colour or object in the image. Besides that, shape detection are been used where it will use the edge detection, Circular Hough Transform (CHT). This technique will determine the candidates of mango and find the circular pattern with the given radius within an image by collecting the maximum voting. The program should automatically detect the desire object and count the total number of it.

Keywords: *Edge Detection, mathematical morphology, color processing, Circular Hough Transform.*
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Nomenclature

RGB	Red, Green and Blue
CHT	Circular Hough Transform

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1. Introduction

Detecting and location object in digital image has become one of the most important applications for industrial use to ease user and save time. This techniques has been develop years ago but improvement of it is still require in order to achieve the targeted objective in more efficient and accurately.

The goal of this project is to detect and allocate the object (here we consider using mango) using few method such as color processing and shape detection. The MATLAB program should automatically detect and count the total number of object from mango tree.

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MATLAB software is one of the most powerful software using worldwide and it also consist a lot of image processing library which can be use for object detection. For this project, the program code is writing using this software and it shall be efficient to detect the mangos, eliminate the background image and automatically count the total number of object.

Mango has a clearly different color comparing to mango leaves. So it's one of the advantages to take to determine the location of object. On the other hand, mango has a very unique shape comparing to the sounding object such as leaves. By using appropriate method of shape detection such as CHT [1-2], most of the round object may be detected.

In the process of object detection, targeted object which is obscured due to presence of other object is one of the main problem faces in image processing field. This is due to the object are not clearly expressing in the image and will assume and eliminated by the program. Besides that, objects which overlapping each other also made the process challenging where hidden object will be detected and counted and the total number will be no accurate. On color processing, lighting intensity may also affect the original color of object to be not accurate. The light intensity on each object makes the background object have almost the similar color as the target object. To eliminate all these problem, a proper image segmentation process and technique must taken into account.

The image with 320x240 pixels has been used through this study. The image with RGB color contain are feed into the color processing process while the image which already transform into grayscale will be put into another preprocessing process which the CHT take place. The CHT had been used in several researches such as in detecting fingertips position, automatic ball recognition and iris detection for face recognition which the object are related to circle[3].

2. Methodology

To achieve the objective, several steps and method had been taken into account in order to get the result such as show in Figure 1. The block diagram in Figure 3 shows the recognition process that use in this project. Several steps are taken into account in order to detect the object through the color processing [4-8]. By referring to the Figure 1, the images are sent into the preprocessing block and perform image resize where set to 320x240 pixels. After that, it will directly go to the RGB adjustment where it will readjust the lighter and darker the object color and background. Next, color processing take place and the elimination of the unrelated color will take place and left the color of the mango. The elimination of the unrelated object in here are by comparing the current pixel RGB value with the default RGB value of mango. If detected color is not related then change the current pixel RGB value to 0 which is in black color. Below are the steps:
  (1) Prepare color images of mango.
  (2) Image RGB adjustment.
  (3) Detect the color of each pixel and determine whether mango color or background which is unrelated to the object color is.
  (4) Delete the unrelated region by replacing the color with all black color.
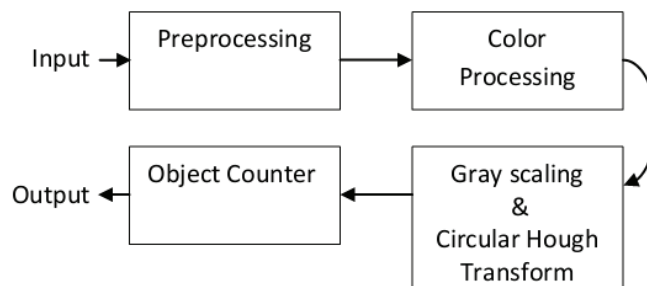

Figure 1: Mango recognition Block Diagram

After the colour processing, the only left for the image is a clear mango and the leaves which have the same color as mangos. In here, shape detection process is use to detect the shape instead of using color detection. Before that, it must be change to gray scale perform medium filter to eliminate the small pixel and smoothing the image. In the medium filter, it will eliminate the pixel which is small and smoothing the images to make the objects edge more clear and clean[9]. After that, it will be change to binary image and go through another object elimination that eliminate the binary objects which is lesser than 200 pixels in a group of objects.

After that the CHT are applied on the selected image to find the circular patterns within an image. It uses to transform set of feature points in the image into set of accumulated votes in the parameter space. Accumulated votes are in form of array and highest number of array indicates the presence of the shape. A circular pattern can be described by
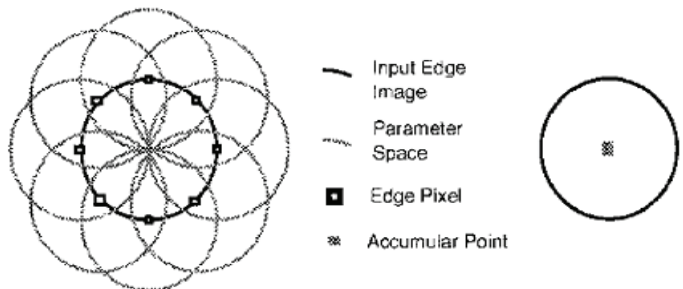
$$(xp - xo)^2 + (yp - yo)^2 = r^2 \qquad (1.0)$$

Figure 2: Contribution of eade points to the accumulator space.

3. Result

A. Color Processing

For the color processing, the readable images are very high percentages and it may achieve 100% of detection of targeted object if combining with other features. The color detection will only detect the RGB color which is it will only detect the specified color that match only and will eliminate others.

Although the color processing may stand highest chances in mango detection but it can only detect the targeted object with the static lighting condition only. Different lighting condition may affect the colors of targeted object change not linearly. The color will have lot of changes depending on the intensity of light, the reflected rate of the object and the background of the object may also generate the same RGB color as the object. Due to this project may need to detect the inconstant lighting condition and complex background, the method for object detection may required to focus on shape detection by using CHT.

In this colour processing, it take each pixel to compare to a common RGB colour of the green mango and perform the elimination. It takes combination of RGB colour to perform accurate green mango detection which is such as table below where show the RGB value in decimal of maximum 255.

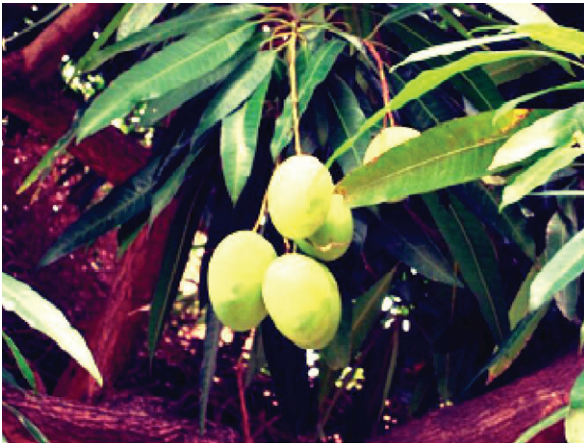|	Detected RGB Colour to be Eliminate		
	RED	GREEN	BLUE
Case 1:	<100		
Case 2:	>Green & >Blue		
Case 2.1:	<=100		<=100
Case 3:	<=100	<=100	<=100
Case 4:	>Green & >Blue		
Case 4.1:		<100	<100
Case 5:		>=100	>=100
Case 5.1:		<=170	<=150
Case 6:		> Blue	>Red
Case 7:	<200	<200	<200
Case 7.1:	>= Green	>= Blue	
Case 8:			>Red & > Green

Figure 3: Result of Mango 1 Detection after RGB Adjustment.

Figure 4: Result of Mango 1 Detection using RGB Filtering.

Figure 5: Result of Mango 2 Detection after RGB Adjustment.

Figure 6: Result of Mango 2 Detection using RGB Filtering.

B.   Circular Hough Transform (CHT)

Due to the inconsistent of the background image and intensity of colour, the colour processing may not consider as a good technique for object detection comparing the shape detection. By referring to the sample mango picture Figure 3, we can clearly see that the shape of the unit which it almost look like a sphere. By using the CHT, it can eliminate the object that is not considered as the circle such as leaves. Figure 4 shows Result of Mango 1 after using RGB filtering. The natural colour of mangos is lighter up and clearly can differentiate it.

In CHT, it performs simple mathematical calculation such as circular formula. In here, it detect the location of "1" from the binary image and from there, it perform the calculation and determine the circular objects. To detect it, the radius of the object must be given in order to detect the required round objects size.

Example shows in Figure 5 which is a good sample of mango after RGB Adjustment since colour intensity of leaves are varied from colour intensity of mangos. While Figure 6 shows best result of RGB after filtering because it has the very clear intensity different between object and background image.

While for Figure 7, it detects 60% of it. In this step, some unrelated object are detected due to it has the similar circular area because of the CHT are detect the object base on the edge of each object. In Figure 8, it also shows that one of the object are detected twice due to the object has the longer shape. In Figure 7, it clearly show that there are total 6 object detected but only 3 of them are detected due to the perfection of circular are not clear. Figure 8, there are overlapping of circular detection where it detect extra 1 object from the total due to the object cannot fit in only 1 circle and also the object are not exactly circular.

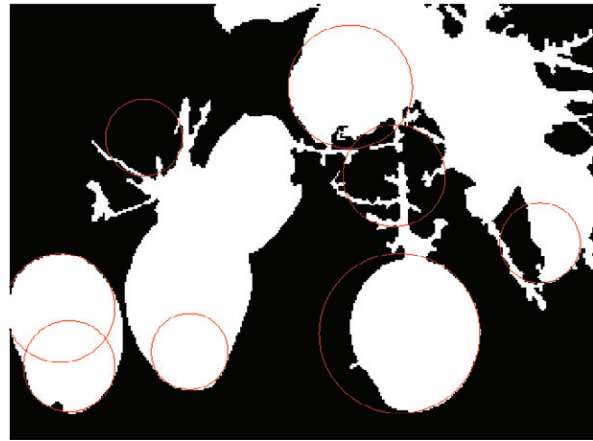Figure 7: Good Result of Mango 1 Detection using CHT.

Figure 8: Result of Detected Mango 2.

Images	Total Objects	Circular Detected	Total Accurate Object Detected	Accurate Object Detected (%)
Image 1	5	6	3	60%
Image 2	9	8	5	55%

Table 2: Object Detected

4. Conclusion

In this project, it is successfully detect the object from the background image using color processing is used as the 1st filter to eliminate the background image, 2nd step by using grayscale filtering and lastly by binary filtering and Circular Hough Transform (CHT) for circular object detection. The use of color processing is due to it's one of the powerful technique to detect the object as in real color processing it contain a lot of information as human eyes does. While for the grayscale filtering, it filters the pixel and smoothness the image to make the edge clearer. Lastly, CHT take place to detect the circular objects and display the total number of it.

In the processing of detection, back light condition affect the image the most where the RGB color reflected will be difference according to the light intensity and it's affect on the color processing result as well. Besides that, grayscale image will contain lots of noise because the grayscale filtering cannot eliminate the low intensity pixel which is declared as noise. Lastly, the CHT may not exactly detect the circular object as sometimes it is connected with other object together and give an inaccurate result.

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