

## Object Detection from Complex Background Image Using Circular Hough Transform

S. Bindu<sup>1</sup>, S. Prudhvi<sup>2</sup>, G. Hemalatha<sup>3</sup>, Mr. N. Raja Sekhar<sup>4</sup>, Mr V. Nanchariah<sup>5</sup>

<sup>1, 2, 3, 4, 5</sup>LIET, Jonnada, Vizianagaram, Andhra Pradesh

### ABSTRACT

In this study we discuss about the method to detect the object from the complex background. Object detection and recognition in noisy and cluttered images is a challenging problem in computer vision. The goal of this project is to detect the object using few methods such as color processing and shape detection. Colour processing uses thresholding operation to eliminate the unrelated colour or object in the image. Circular Hough Transform (CHT) will determine the candidates of object with the given radius within an image by collecting the maximum voting.

**Keywords:** Canny edge detection, Circular Hough transform (CHT), Colour processing, Histogram Equalization

### I. Introduction

Object detection from a complex background is a challenging application in image processing. The goal of this project is to identify objects such as mangoes, sunflowers, buttons placed over a surface from a complex background image using the techniques such as colour processing, circular Hough transform (CHT)[1-2]. The detection of the objects can be extended using robotics for plucking of the objects like mangoes, sunflowers from the corresponding trees and plants respectively using the image processing techniques and it will be easier, faster, Convenient to pluck the mangoes and sunflowers rather than the manual plucking.

MATLAB software is used as a tool to achieve the goal of this project. 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 objects, eliminate the background image and detects the object.

There are several problems in detecting the objects from the complex background. First, the target object may get interfered with the other objects like leaves, stems. Second, the image itself may contain noise which makes the object recognition process difficult without the preprocessing and image segmentation steps. Third, the targeted objects may get overlapped and which makes the recognition process as challenging.

The main part of this work consists of two techniques: colour processing, Circular Hough transform (C.H.T)

Colour processing eliminates the background from the original image. The CHT is performed to detect the presence of circular shape. The CHT is a kind of Hough transform (HT) that can extract circular objects from an image. The CHT had been used in several researches in detecting fingertips position, automatic ball recognition [3] and iris detection for face recognition [4].

### II. Methodology

The recognition process that is used in this project can be shown in the form of a block diagram

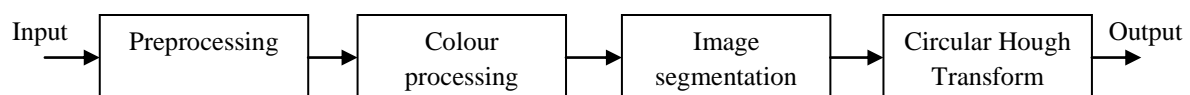


Fig. 1: The object recognition process

First the image is sent through the preprocessing block where the image had to be enhanced using histogram equalization. Histogram equalization tends to increase the contrast of the

image and produced a better result for region-based feature extraction.

Next in colour processing [5-7] block the unrelated colour and unrelated object has to be eliminated from the original image. The elimination

of the unrelated object can be achieved using thresholding operation.

Now, the image segmentation has to be carried out. The edge detection had to be employed to perform segmentation. The edge detection process is very important as the edge information is required for the CHT technique. Various edge detection methods have been applied for different application. Among them, canny edge detector has been employed to the image. After the segmentation process CHT techniques has to be applied.

The CHT is applied to image after the edge detection process. When using the CHT, the radius  $r$  is known in advanced because of the object's shape is peculiar feature by each other, so the radius  $r$  can be treated as known parameter.

#### A. Image segmentation

The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. The edge detection had been employed to perform segmentation. The edge detection process is very important as the edge information is required for the CHT technique. Various edge detection methods have been applied for different application. Among them, canny edge detector has been employed to the image. Canny gives thin edge compared to other edge detection techniques.

##### 1. Canny Edge Detection

The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. It was developed by John F. Canny in 1986.

#### Canny Edge Detection Algorithm

The algorithm runs in 5 separate steps:

1. Smoothing: Blurring of the image to remove noise.
2. Finding gradients: The edges should be marked where the gradients of the image has large magnitudes.
3. Non-maximum suppression: Only local maxima should be marked as edges.
4. Double thresholding: Potential edges are determined by thresholding.
5. Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong).

#### B. Circular Hough Transform (CHT):

The Hough transform can be used to determine the parameters of a circle when a number of points that fall on the perimeter are known. The

CHT relies on equations for circles. The equation of the circle is:

$$R^2 = (x - a)^2 + (y - b)^2 \quad (1)$$

A circle with radius  $R$  and center  $(a, b)$  can be described with the parametric equations:

$$x = a + R \cos(\theta) \quad (2)$$

$$y = b + R \sin(\theta) \quad (3)$$

When the angle  $\theta$  sweeps through the full 360 degree range the points  $(x, y)$  trace the perimeter of a circle. If an image contains many points, some of which fall on perimeters of circles, then the job of the search program is to find parameter triplets  $(a, b, R)$  to describe each circle.

If the circles in an image are of known radius  $R$ , then the search can be reduced to 2D. The objective is to find the  $(a, b)$  coordinates of the centers. The locus of  $(a, b)$  points in the parameter space fall on a circle of radius  $R$  centered at  $(x, y)$ . For each edge point, a circle is drawn with that point as origin and radius  $r$ .

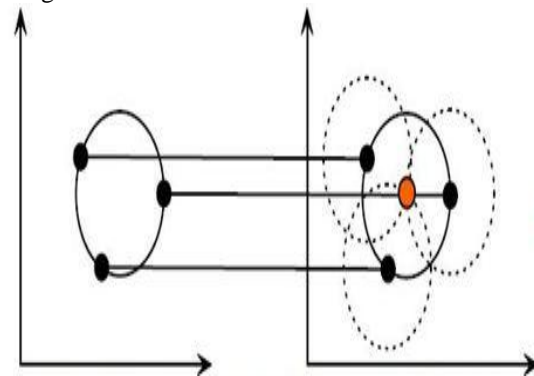


Fig. 2: Each point in geometric space (left) generates a circle in parameter space (right). The circles in parameter space intersect at the  $(a, b)$  that is the center in geometric space.

The CHT also uses an array (3D) with the first two dimensions representing the coordinates of the circle and the last third specifying the radii. The values in the accumulator (array) are increased every time a circle is drawn with the desired radii over every edge point. generates a circle in parameter space (right). The circles in parameter space intersect at the  $(a, b)$  that is the center in geometric space

The accumulator, which kept counts of how many circles pass through coordinates of each edge point, proceeds to a vote to find the highest count. The coordinates of the center of the circles in the images are the coordinates with the highest count.

### III. Experimental Results

We made experiments using 3 images to evaluate the performance of the proposed system. In this colour processing methodology thresholding

operation is used to eliminate the background from the original image. The lower bound  $rL$  and the upper bound  $rU$  on the radius of object in the input images were set to according to the radii of the image. The highest success rate of the proposed system to detect the object was 96.2%. In detection of the mangoes 4 mangoes out of 5 are detected, in the detection of the

sunflowers 2 sunflowers out of 3 are detected and in the detection of the buttons 24 buttons are detected out of 25 are detected. The accurate detection percentage of sunflowers is 66.66% it's because the image is captured from far away and the image tends to be small and it results difficulty in the detection process.

### C. Detection of mangoes



Fig 3: Original image of mangoe

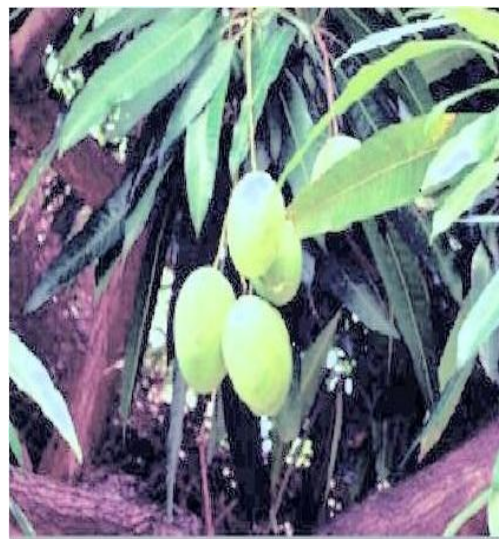


Fig 4: Result of mangoes detection after Histogram Equalization



Fig 5: Result of mangoes detection after Thresholding Operation



Fig 6: Result of mangoes detection after CHT

### D. Detection of sunflowers



Fig 7: Original image of sunflowers



Fig 8: Result of sunflower detection after Histogram Equalization



Fig 9: Result of sunflower detection after thresholding

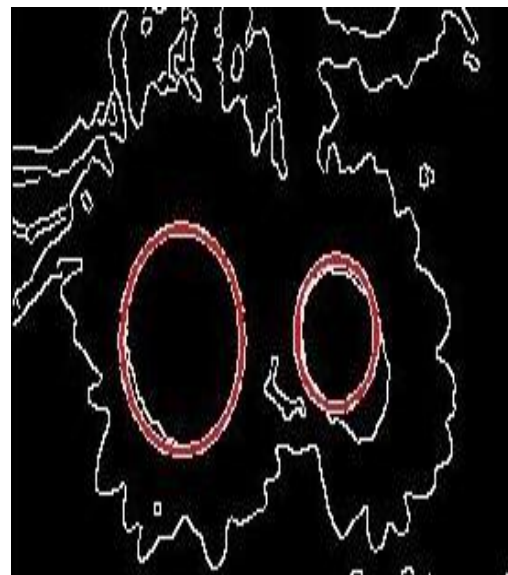


Fig 10: Result of sunflower detection after CHT Operation

*E. Detection of buttons placed over a surface*



Fig 11: Original image of buttons placed over a Surface

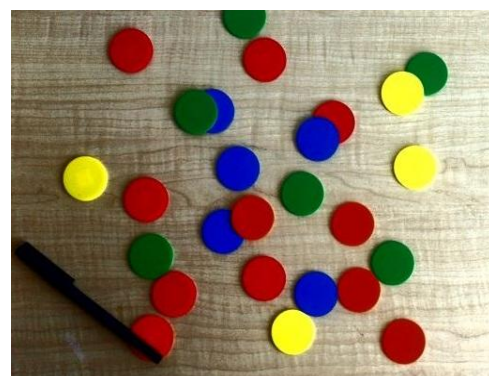


Fig 12: Result of buttons detection using Histogram Equalization

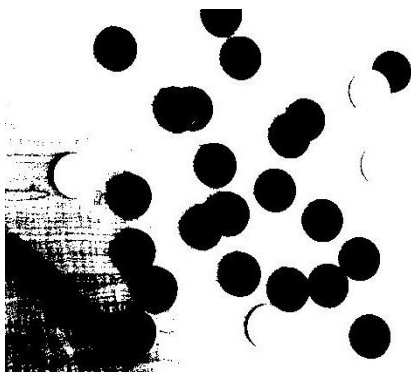


Fig 13: Result of button detection after thresholding Operation

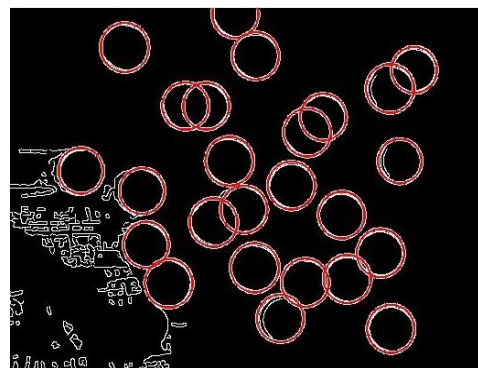


Fig 14: Result of button detection using CHT

Table I  
 SUCCESSFUL DETECTION OF OBJECTS

Images	Total Objects	Circular Detected	Total Accurate Objects Detected	Accurate Object Detected (%)
Mangoes	5	4	4	80
Sun flowers	3	2	2	66.66
Buttons placed over a surface	26	25	25	96.2

#### IV. Conclusion

In this research we have detected the various objects from complex backgrounds. Colour processing will eliminate the unrelated colour or the background image, then using CHT we detect the objects which are in circular shape. The main constraint in CHT is the size of the targeted objects. Matlab function is used to get the radius of the targeted object.

The highest success rate of the proposed system to detect the object was 96.2%. In detection of the mangoes 4 mangoes out of 5 are detected, in the detection of the sunflowers 2 sunflowers out of 3 are detected and in the detection of the buttons 24 buttons are detected out of 25 are detected.

The problem arises if the image is captured far away and the image tends to be small. Besides that, some of the objects are in a bunch and overlaps between each other. These make the detection method difficult in carrying out the task. In this research, Robotics can be used to assist the object gripping and plucking process. Future work in progress includes detection of several objects in a bunch and overlapping between each other.

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## BIOGRAPHY



**S. BINDU**  
Department of Electronics and Communication Engineering,  
Lendi Institute Of Engineering And Technology,  
Jonnada, Vizianagaram, Andhra Pradesh.



**S. PRUDHVI**  
Department of Electronics and Communication Engineering,  
Lendi Institute Of Engineering And Technology,  
Jonnada, Vizianagaram, Andhra Pradesh.



**G. HEMALATHA**  
Department of Electronics and Communication Engineering,  
Lendi Institute Of Engineering And Technology,  
Jonnada, Vizianagaram, Andhra Pradesh.



**N. RAJA SEKHAR**  
Department of Electronics and Communication Engineering,  
Lendi Institute Of Engineering And Technology,  
Jonnada, Vizianagaram, Andhra Pradesh.



**V. NANCHARAIYAH**  
Department of Electronics and Communication Engineering,  
Lendi Institute Of Engineering And Technology,  
Jonnada, Vizianagaram, Andhra Pradesh.