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A PROPOSED ALGORITHM FOR CIRCLE DETECTION USING PREWITT EDGE DETECTION TECHNIQUE

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ABSTRACT

This paper presents method to detect and accurately locate circle objects in digital image. The propose method consists of two steps. In first step the edge pixels are extracted using Prewitt edge detection algorithm and then a noise removal process is run to remove the non-circle edge points. The second step, Circle Hough Transform (CHT) is applied to detect circle from the digital image.

INTRODUCTION

A human being can find out a particular object like Circle or ellipse from various objects by observing their color, shape, feature and texture and after that we can calculate properties of shapes like perimeter, area etc. To generate this intelligence into a system, we need to implement method to help the system in recognizing the shapes of various objects (Shammi Sharma *et al*., 2012). For this, use Priwett edge detection algorithm. Edge detection is the first and very important step in shapes detection. In this paper we use Prewitt edge detection technique for edge detection. The masks of Prewitt edge detector are one of the oldest and best understood methods of detecting edges in digital image. Basically there two mask one for detecting image derivatives in vertical and other one for detecting image derivatives in horizontal. The Prewitt edge detection results are threshold in order to produce a discrete set of edges. In Figure 4.1. shown propose algorithm to detect circle from digital images using Prewitt edge detection technique.

Prewitt Edge Detection Technique

Prewitt operator (Guan Hongrui DingHui, 2009) is the first - order differential operator. It employs gray difference from top to bottom, left to right neighboring pixels to get the extreme edge in image. The principle of Prewitt method is like to Sobel method (Chun-ling Fan and Yuan-yuan Ren, 2010). The convolution masks are shown in Figure 2.1.

G_x=

-1	0	1
-1	0	1
-1	0	1

G_y=

-1	-1	-1
0	0	0
1	1	1

Fig. 2. 1. The convolution masks of Prewitt operator

Prewitt method is the 3 × 3 operator template. Each pixel in the image is carries out convolution by the two masks. The maximum is selected as the point of an output value, and the result of operation is a range of image borders (Chun-ling Fan and Yuan-yuan Ren, 2010).

Circular Hough Transform

Extraction of Circles

The shapes Detecting and recognizing in an image is extremely important in industrial applications in recognizing the various objects. The circle detection in an image is one of the problems that are discussed in this paper. Many algorithms, such as Linear Square Method (Hsiao *et al*., 2006)

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and Hough Transform, have been proposed to detect circles. These methods detect circles from the edge detected images. Amid these algorithms, Circular Hough Transform has been widely effective in meeting the real time requirement of being able to circles detection in noisy environments (Prajwal Shetty, 2011).

Circular Hough Transform

The most commonly used method to recognize different shapes in an digital images is Hough Transform (HT) (Yan *et al*., 2008). "Hough Transform was introduced by Paul Hough in 1962 and patented by IBM. In 1972 Richard Duda and Peter Hart modified Hough Transform, which is used universally today under the name Generalized Hough Transform (Duda and Hart, 1972). "An extended form of General Hough Transform, Circular Hough Transform (CHT) (Yan *et al*., 2008), is used to detect circles in digital image. The edge detected from the Prewitt edge detector forms the input to extract the circle using the Circular Hough Transform. In Circular Hough Transform, voting procedure is carried out in a parameter space. The local maxima in accumulator space, obtained by voting procedure, are used to compute the Hough Transform. Parameter space is defined by the parametric representation used to describe circles in the picture plane, which is given by equation (3.1). An accumulator is an array used to detect the existence of the circle in the Circular Hough Transform (CHT). Dimension of the accumulator is equal to the unknown parameters of the circle (Prajwal Shetty, 2011). The equation of the circle in parametric form is given by:

$$(x - x)^2 + (y - y)^2 = r^2 \quad \ldots (3.1)$$

Equation (3.1) implies that the accumulator space is three dimensional (for three unknown parameters x0, y0 and r). This equation (3.1) defines a locus of points (x, y) centered on an origin (x0, y0) with radius r.

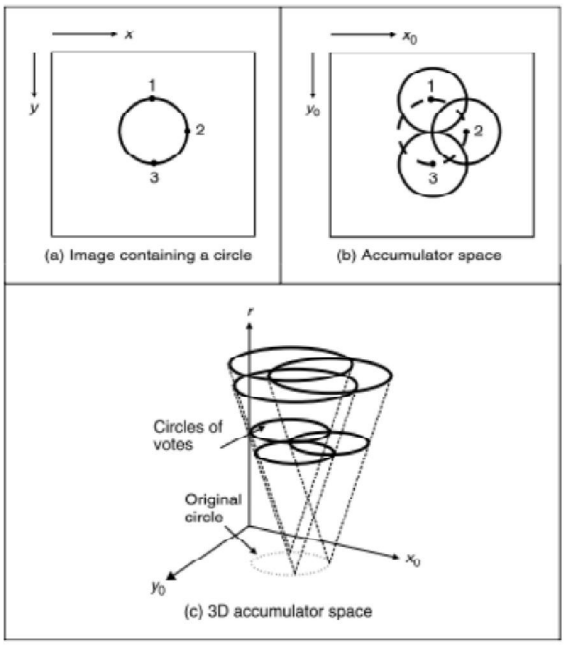


Figure 3.1. Illustration of circular Hough transforms

Points corresponding to x0, y0 and r, which has more votes, are considered to be a circle with center (x0, y0) and radius r.11 (Prajwal Shetty, 2011).

In Figure 3.1a each edge point defines a set of circles in the accumulator space (Yan *et al*., 2008). These circles are defined by all possible values of the radius and they are centered on the coordinates of the edge point. In Figure 3.1b shows three circles defined by three edge points labeled 1, 2 and 3. These circles are defined for a given radius value. Each edge point defines circles for the other values of the radius, also. These edge points map to a cone of votes in the accumulator space. Figure 3.1c explains this accumulator (Prajwal Shetty, 2011).

The Proposed Algorithm

The present method does not depend on intensity threshold. This method uses pixel direction to detect edges in images, which is one of the primary properties of an edge. Thus, the issue of finding the right threshold for every image is solved. The block diagram of the proposed system is shown in Fig 4.1.

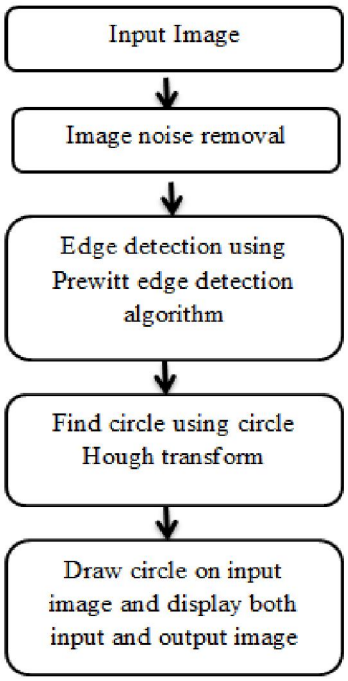
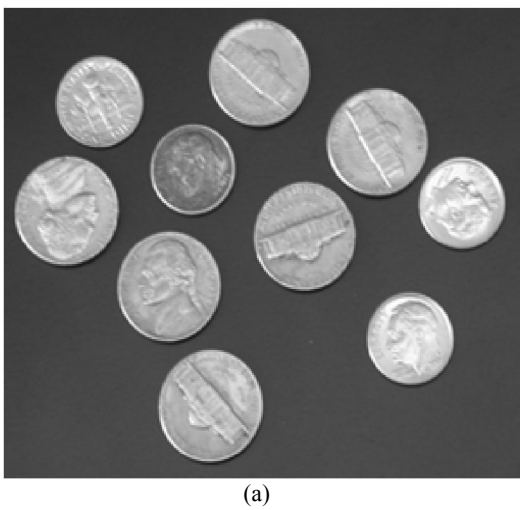
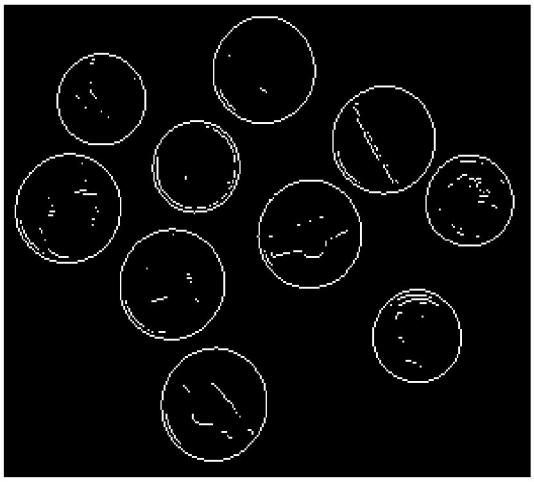


Fig. 4.1. Algorithm for detect circle from images using Prewitt edge detection technique

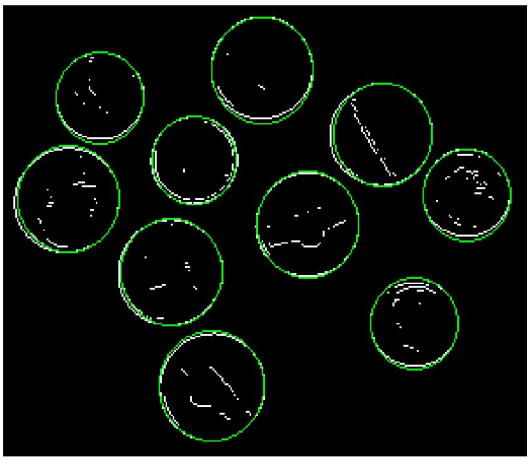
RESULTS



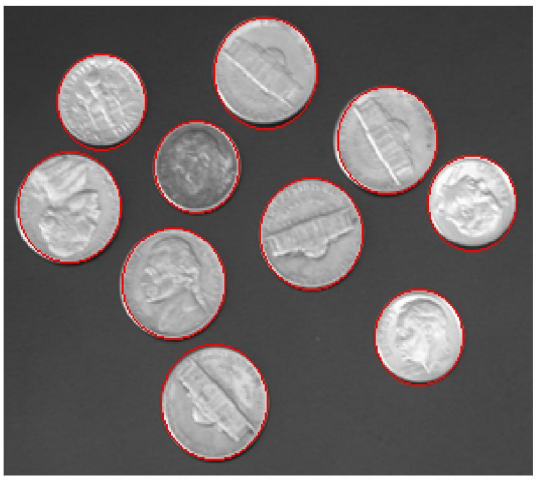
(a)



(b)



(c)



(d)

Figure 4.1. a. Original image (input image), b. Prewitt edge detection, c. Circle detection, d. Draw circle on input image.

Conclusion and Future Scope

The proposed algorithm implements to detect and locate circle in digital images. Hough transforms is the best method for circle detection in noisy environments so we can use this algorithm to detect numerical numbers and to recognize characters.

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