

Detecting square-shaped objects using the Hough transform

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ABSTRACT

Finding squares or circles in an image by a camera is always very difficult because the projections from a conventional camera and or even a simple webcam, get clogged from environment which has boasts Noise and Shadow and Find Many images. This makes the aforementioned square bit larger Villa boasts fractures in edges and when we want to get to the center coordinates of the robot is unable to come and pick it up trouble because the square of the desired shape is obtained, the coordinates will be wrong. Therefore, this paper tries to find the square object in a camera image using Hough transform and convert it to a polygon which is smaller, then You can calculate the coordinates of the center of mass of the smaller polygon which is the square of the coordinates Because the polygon is obtained under the main square

KEYWORDS: Edge detection, Find the square, Hough transform, Smaller polygons

INTRODUCTION

One of the fundamental problems in machine vision is to find the location of objects in image until now research has been done to find circles in the image by Hough transform. But no research has been done about a square or rectangle utilizing Hough transform.

Another problem that can be solved using the Hough transform is detecting straight roads in aerial photographs. Another case is in the factories where robots and industrial arm for lifting objects first need to detect them.

Several methods for object detection with different shapes in image has been suggested but no research on square-shaped objects has been done and in this paper we'll focus on the issue.

Hough transform tries to realize scene analysis by transmission parts to a parametric Space that matches to analytic equation of different objects.

These are researches that has been performed until now by Hough transform:

1-circle detection using Hough transform [1]

2-line detection using Hough transform [3]

3-car license plate detection using Hough transform [2]

4-fingerprint recognition [4]

As mentioned in several research for circle and curve detection has been performed but no Independent research has been conducted for finding square-shaped object using the Hough transform.

The main feature of the Hough transform is that the quantization and threshold concepts [3] does not have a significant impact on the results [2]

In this article the square-shaped object was detected by lines that is drawn by Hough transform. and by processing this lines the desired square will be found .at first camera captures film from object and then desired image from film will be obtained and in next section edges of object is detected by canny algorithm and in final section the object is identified by hough transform.

2. Definitions of two concepts:

1-2 Canny edge detection algorithm

The border is not a physical reality like the shadow. Border means where the image starts and ends [5]. edge occurs when there is high difference between the value of pixels and in other words in edges value of pixels change widely .there are different algorithms to find edges, which canny algorithm is one of them .canny algorithm's advantage is noise attenuation and deleting places with low possibility of being edge . The canny algorithm first make image smooth to remove the noise effect and then calculate gradient of the image to find the areas with high changes in value of pixel . Then

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verify this areas to skip from each pixel that its gradient is not maximum. in next step utilize high and low thresholds and if gradient of a pixels is smaller than minimum threshold make its value zero And if it was between the two threshold make its value zero unless there is a path from pixel to the other pixels with gradient above the maximum threshold and if a pixel's gradient is above the highest threshold pixels it is chosen to be the edge [6]

2-2 Hough transform:

The Hough transform is one of the classical computer vision techniques which dates back to 50 years ago [5].

Hough transform is an algorithm that can identify and extract specific shape in image. To find a specific shape by Hough transform shapes should have a specific Parametric form. Because of this reason Hough transform is used mainly to find a shape like line and circle that have specific Parametric form. Hough transform is a powerful method for locating lines in image so that each line in page x-y is described as follows:

$$x\cos(\theta) + y\sin(\theta) = \rho$$

Where ρ is the standard line length and θ is the angle of the line [8], [7]. So by processing edge points we obtain values of ρ and θ . figure 1 illustrates the description:

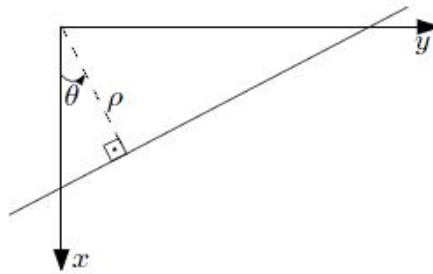


Figure1-shows a line that is obtained by Hough θ, ρ values

So different ρ and θ values obtained and finally the largest value of them specifies the edge line. In fact edge line passes through all edge points. But finally a line is passed through the object edge or Side of the square-shaped object. so a point in Cartesian coordinate is mapped to a Sine wave and a point that have most shared sine is considered as a candidate for The final line[10]. Therefore if we choose a point that is edge we can convert it to a line. So a set of points is mapped to a set of lines in Cartesian coordinate.[9]

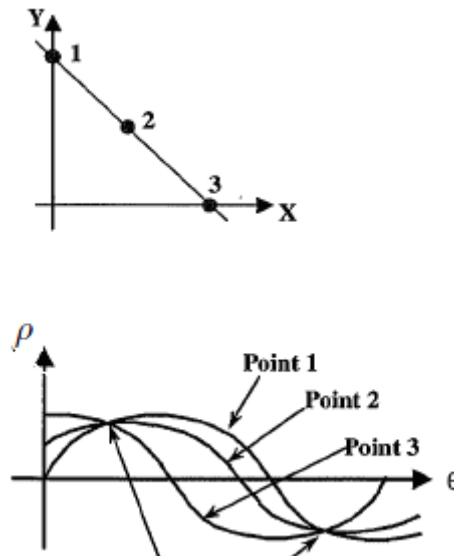


figure2

3-How it works

In this section, we describe our new algorithm by several images. First we enable camera and specify the desired shape, and it produced this photograph (image 3)



figure3. The original image of the object

After that we convert colorful image to binary space and apply filter for removal noise we specify its edges.

After noise removal and finding edges, we must do preprocess operation to obtain the best input for Hough transform[2] and after that desired lines and Hough values is obtained (figure3).

After detecting Hough lines that are edge of polygon (picture 4) in picture. Then we convert main square into smaller polygon and then we obtain centroid of the polygon.

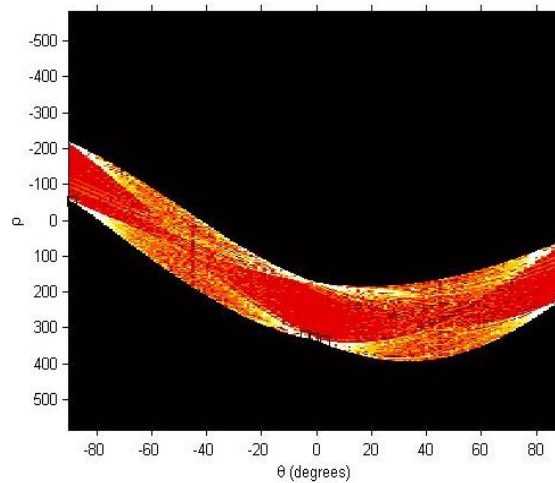


figure4-Hough transform

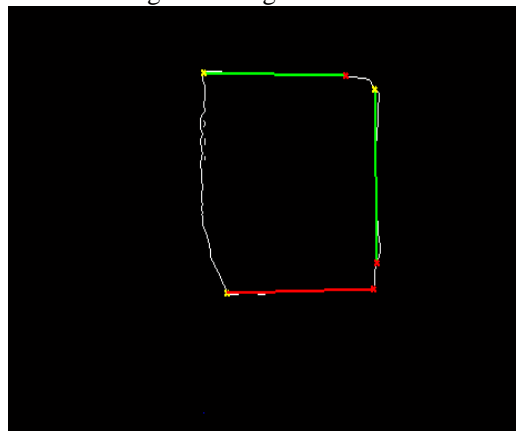


Figure5- The lines drawn by Hough transform on the object

We obtain polygon by calculating distance between Hough transform lines and specify two lines that are farther apart and we will draw this two lines. Then we must connect beginning point of two lines and also ending points of them after that, desired quadrilateral is obtained (Figure 5) so we have extracted a polygon from basic square object and then calculate centroid of extracted polygon .

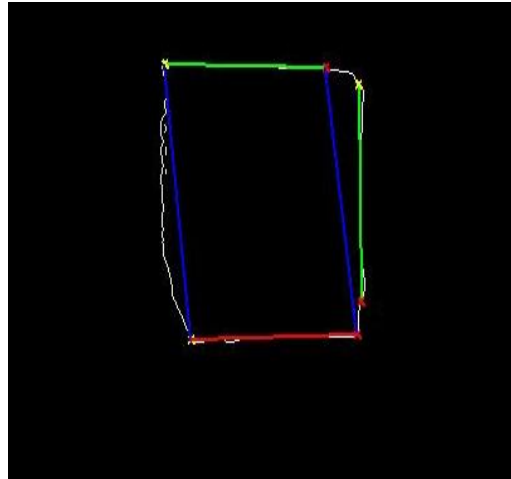


Figure6- desired polygon and work results

Finally, we calculate centroid of polygon that according to calculations done in MATLAB the following value were obtained:

```
ans =
    255.6785    135.8889
```

That is exactly polygon centroid.

4-CONCLUSION AND RESULTS

In this paper before specifying the square and finding its centroid something must be done such as converting videos to photo, converting colorful image to binary image and noise removal,... then our method tries to find image edges by utilizing canny algorithm, then by using Hough transform the lines on the every image edges are drawn, and finally find the lines that have longest Distance between each other , and then we connect their starting and ending points to create desired polygon on the square. Finally by using ready to use commands that exist in MATLAB we obtain centroid of polygon.

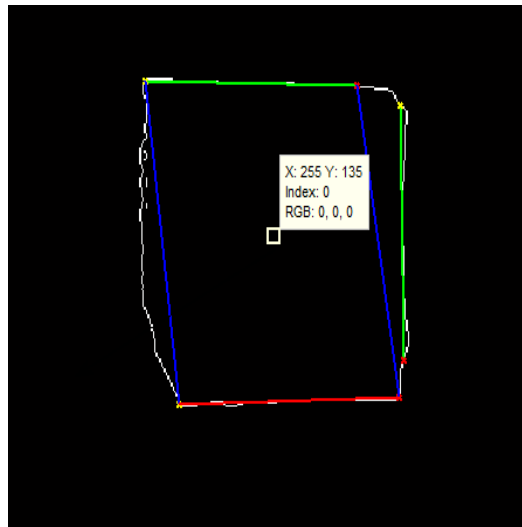


Figure7-Find the centroid coordinate of polygon

According to results obtained in this paper we found that Instead of finding a square with edges that are not straight in the image we find a smooth polygon that is extracted from square using Hough transform. and centroid of the polygon is not much different with the centroid square because the polygon is a small subset of the square and no more need to work with object that its edges are not smooth.

An important thing that should be considered is the principle of isolation in camera. When capturing pictures this issue always should be considered in any image processing tasks.

Advantage of this method is that objects can have different shapes and it is not necessary to be just square or rectangle.

Algorithm introduced in this paper is fully implemented in SCARA robot, and practical tests show this paper is completely correct and practical.

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