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A NOVEL APPROACH TO IDENTIFY CIRCULAR OBJECTS AND CLASSIFY ON BASIS OF THEIR RADIUS

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Abstract

For the computer vision, fast and accurate detection of an object is challenging. Detecting a circular object in a cluttered image has always been a problem. Circular object detection has wide applications in the field of biometrics, automobile and other mechanical production industries. The traditional existing circular object detection are maximum likelihood estimation (MLE) and voting based methods. The voting based methods have high memory requirements and more computational complexity while these are less sensitive to noise. MLE approach consumes less memory and is efficient in terms of computational complexity but these approaches are more prone to noise. This paper proposes modified Hough transform based algorithm for detection of circular objects within other shaped objects also it can identify circular objects ob basis of diameter. The proposed algorithm worked efficiently and detected the circular objects on basis of diameters with very less computational time and less memory consumption.

I. Introduction

In computer vision, extracting the features of the image and detecting the shape, location and size of the image is one of the most challenging tasks. The

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object taken into consideration is not always of the desired one. It may come in pre-defined shapes and sizes. So it becomes very essential to determine the shape of the object in certain applications such as biometric, automobile, production, mechanical industries, microwave engineering, robotic systems and archeology [1-6]. The position, size and orientation of the object is estimated with the help of certain parameters of the object itself. The significant features of the object are detected. Then these parameters of the detected features of the object identify the shape, location and orientation of the object [7-8]. This is a very common way of performing the object recognition. The outline of many industrial objects can be of circular arcs or straight lines. So it becomes necessary to identify the shape of the object by extracting certain features of the object whose parameters help to locate the exact shape of the object. The commonly performed detection with Hough Transform is line detection but the circular object detection is somewhat complicated than line detection [9]. The orientation and location of the object can be defined with just one single circular arc. This defines the importance of circular object detection [10-12]. There are many approaches for finding out the circular fittings in any clutter of objects. One approach finds the circular object statistically where the list of measurements are the noisy circular points which is the Maximum Likelihood Estimator (MLE) [13-14]. Other approach of circular object detection is based on the object which is the Circular Hough Transform (CHT) [15-16]. The analysis of MLE is very difficult that becomes the main disadvantage. The iteration of the known algorithms in MLE makes it very difficult to analyze and compute the Gaussian errors in the circular object detection [17]. Whereas in CHT the main concept is that the space between the image and the parameter is mapped. CHT is free from noise and distortion and is quite robust in nature. The algorithm in CHT is very simple and feasible to implement. The sensitivity and specification of the circular object is improves using the modified Circular Hough Transform [18]. The algorithm used in CHT detects the shape in the image through extracting the parameters of the features being detected. An array is used in CHT to represent the coordinates of the circle in the form of dimensions. The value of the radius of the circle is the dependent variable in CHT. In the circular detection of any binary image, it is required that process should be accurate and robust. CHT fulfills almost all the necessities of the circular object detection with improved computational

power relative to other method and algorithms used for object detection. The errors and the noise are being highly reduced in order to achieve an accurate result of the circular object that is being detected in the clutter of images [19]. Further we have discussed different design steps to be followed for the detection of circular object.

Extracting circular objects from the images is one of the attention seeker tasks mostly used in industrial applications. Variations in the original CHT has been proposed a lot of times in order to get increased performance. For example GHT (Generalized Hough Transform) was proposed in which the parameters of the target object were replaced by look-up table. Arbitrary shapes were also detected using this approach. The hardware solution of CHT has also been provided which maintains the flexibility of the solution in software. CORDIC algorithm has been used to overcome the complexities of trigonometric operations. In this paper we have presented modified Hough Transform for detecting the circular shapes in a clutter.

II. Design Flow

The flowchart describes different steps that were followed in order to identify the circular object in the image. Figure 1 shows the flowchart of steps. Firstly the reference image was read which contained objects of different shapes. This cluttered image is used for the identification of the circular object in the image. Then the image is converted into the grayscale. The grayscale image is further converted into the binary image. This conversion of image from grayscale to binary is the most important step and which greatly defines the detection of the circular image. Then the radius of the circles are defines to be detected [20]. Then the circular objects are being detected using the modified algorithm through Circular Hough Transform (CHT). This method is quite efficient as it decreases the computational time and storage required for its implementation. And then in the last step finally, the circular objects are detected. All the steps given in the algorithm clearly defines the flow or process followed while identifying the circular objects.

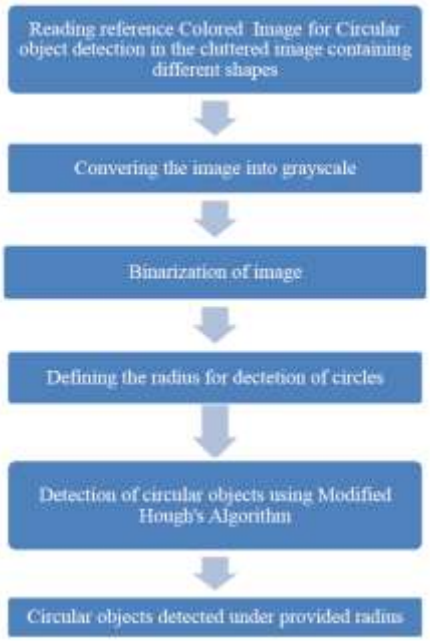

Figure 1. Flowchart of method of detection.

III. Results

The algorithm uses modified approach for the detection of circular objects. The following results show the different design steps that are followed. Figure 2 shows the input image from which the circular objects are to be detected. The image has different shapes in it. Figure 3 shows the result after converting the image to grayscale. Using the design flow the modified algorithm is compiled and run. In the figure 4 only those circular objects are detected which have the radius of 25. In figure 5 the circular objects with radius 40 are detected and similarly in figure 6 represents the circular object detection with radius 80. Figure 7 shows the results as detection of circular objects from the different shaped objects in image with very less time. The circular objects identified in figure 7 are of different radius. All the circular objects present in the image are detected with very less computational and storage time. The objects which are marked are identified as circular objects while the others are not identified as they are not circular. The part of the circular object is also identified in the non-circular objects as they contain the

circular images. In this way all the circular images are identified and detected whether fully as a complete circle or partially on the non-circular objects. This proves the accuracy and efficiency of the algorithm being used.

Figure 2. Input cluttered image with different shaped objects.

Figure 3. Image after conversion to grayscale.

Figure 4. Detection of Circular Objects with radius = 25.

Figure 5. Detection of Circular Objects with radius = 40.

Figure 6. Detection of Circular Objects with radius = 80.

Figure 7. Detection of all Circular Objects.

IV. Conclusion

In this paper, a modified and novel method for detection of circular objects under specific radius in different shaped objects is proposed and

discussed which produces results in less computational time unlike the other methods which come different sorts of limitations. The discussed approach is able to produce results without requiring any additional hardware or any additional input image. As the hardware comes with its own complexities and therefore do not provide efficient solution. As the computing time of algorithm is less it can be connected with a hardware which can respond and perform required operation in real time after detection. The software version overcomes all the limitations. The algorithm can be used for various application including rejecting non circular shaped objects as well as oversized circular objects in an industry.

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