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Circle Detection Using Morphological Operations

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Abstract:

Circle detection is the very important and challenging field in image processing. In previous few decants the field of fining and detection of circular objects in images gain more attention because the location and additional information of circular object in the image can easily be find when a circle is extracted in that image so that information can be used in industries and businesses in many ways. The circle detection is today commonly used in computer application i.e. Computer vision applications and in the field of robotics to detect and recognize the circular objects. In measurement based images the circle detection is the most important task and necessary task. In my article I used a method that detect circle in the image with fast calculations and in short time instant of these methods that perform heavy calculations that consume processing power of GPU as well as time in circle detection. This method uses a simple algorithm that detect circle using simple calculations and detect multiple shapes in detect both filled and unfilled shaped by using morphological operation.

Keywords: Circular Hough Transform, Circle detection, Roundness matric.

1. Introduction:

Circle detection one of the important filed in digital image processing. There are many methods and techniques that are used for detection of circular objects in the images and results extract important information that used in many fields of computer science and other disciplines [1]. Many organizations pay attention in this field because information that is extracted from circle detection is very useful in many ways like with the help of circle detection the exact location of any circular object can easily detected. There are widely use of circle detection in the computer vision applications, hurdle detection and in robotics there object detection is a fundamental and important issue. I used roundness metric technique that is fast, time-efficient and storage efficient. By the use of morphological operation the algorithm finds the non-filled shapes in the image along with filled shapes and fill these circles and then detect circular shapes by giving range of number in between 0 to 1. Round shapes have number closer to 1 and other shapes have number closer to zero.

2. Related Work:

There are many methods and techniques introduced to detect circular shapes in images, the Adoptive Hough Transform (AHT) is a method that recognizes different types of shapes in a model by using its some characteristics as a parameter. This method is efficient as it finds multiple shapes in the image and also able to manipulate multiple images by using parallel processing. [2]

Circle detection by learning automata is another method of round object detection which used an algorithm that automatically detects the round objects by Learning Automata (LA) instant of traditional Hough Transform technique. This technique uses an objective function, three non-collision points and matching function to work on the random environment, evaluation of performance and then LA algorithm to detect circular objects. [3]

Another method that detects line and circles is Inverted Gradients Hash Map (IGHM). By inverted technique, the values of dataset are map and sorted to its location in the dataset and then with hash maps the related arrays are

implemented so this mminimizes the search time. The hash map stores the image gradient magnitude and orientation in inverted index. So in this way the algorithm detects circular objects. [4]

The article proposed the method of greyscale image by using one to one Hough transformation. The formula is used for purpose is first-order derivative and 2nd order derivative [1].the modify version of Hough transformation(CHT) is applied in this article[2].RCD algorithm is another way to perform circle detection in digital images without using Hough transformation[3]. In [4] article the ROI approach is used. In the article circle detection is used for iris detection.

Different researchers introduce different noise removal methods. The major techniques which are proposed by researcher for image noise removal are salt n paper, fuzzy logic and NOX, etc[5-7].

3. Method Proposed:

The roundness technique is a simple circle detection technique that detect circular objects. First of all the RGB image is converted into grayscale and then into binary image. With the help of morphological operations the smaller irrelevant dots and noise is cut off from the image. The conventional roundness technique has a limit that it only a analyzes the filled objects to determine the object is circular or not. I used a morphological operation that first fills the objects in the images then the algorithm analyze the objects, in this way all unfilled objects fill up and then all objects in the image analyzed more accurately. After analyses of each object with the help of object area and parameter object the roundness of object is calculated. Every object labeled with a number in between 0 to 1. If the number of the object is closer to 1 if means that object is almost round and number is close to 0 means it is not round. The algorithm is very time efficient, its process time is much faster as compared to previous methods. The flow chart diagram of purpose Algorithm is shown in figure 1.

Figure 1 shows that at the first stage read an image that contains objects of different shapes. The image maybe in the form of RGB or grayscale. All the RGB or Grayscale must be converted into binary image (black and white image) so the object boundaries will be tracked by bwboundaries function.

By using morphological functions, all the objects and extra pixels are removed form the image that that not concern with the target objects. I remove all the pixels and objects that not have more than 40 pixels in image.Before tracing the boundaries it is very important to fill all blank holes. Morphological function imfill used for filling of all empty objects in the image.

In this stage the detection of boundaries are done by function the bwboundaries with nohole option to trace boundaries with more accurately. The area and the perimeter of every Image object is estimated. By using simple metric result to indicate whether the object is round or not.

Metric = 4 * PI * area / perimeter ^ 2;

The result of the metric is one only if when the object is round and it is closer to zero if shape is no round. This shape distinguish process can be handle by setting proper threshold.

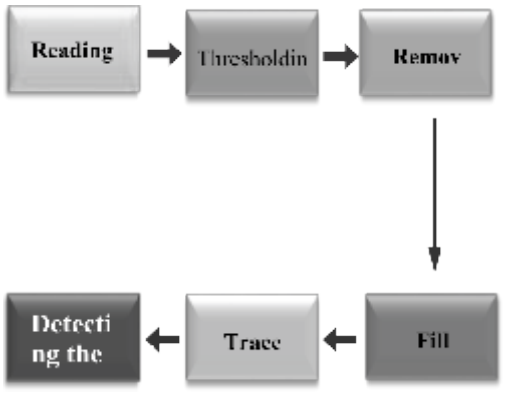

Figure 1: flow chart of purpose method

4. Simulation and Results:

Figure 2 shows the original image contains different objects. Then image is converted into binary and in window 3 the noise is removed from the image and circles are filled and in the last window, the metric assigns a label to every shape. Label is a number and number closer to 1 indicate the round object.

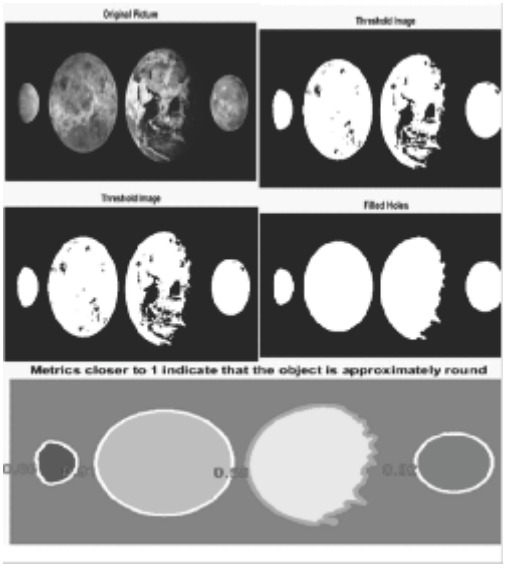

Figure 2:Original image and binary image

There are four planets in the image and four windows represent original, binarize, filled and final image respectively. First planet and earth's some part are dark remaining planets are round as shown in figure 3.

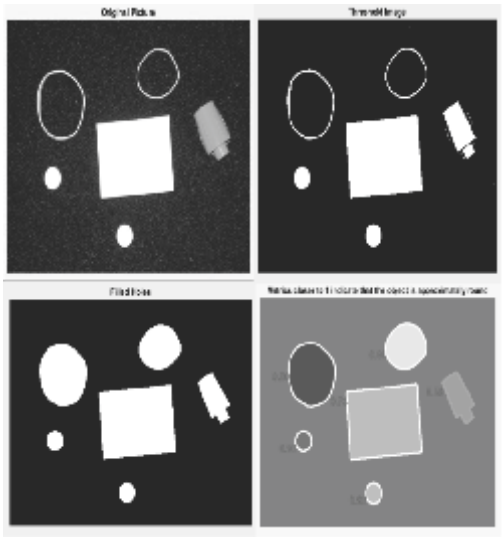

Figure 3: Detected images

5. Conclusion

For my article I studied different techniques of circle detection and found circle detection using Hough transformation is good technique but it also has many limitations. I choose roundness matric technique and with the help of morphological function it first fills all the shapes in the image and then analyze and determine all the shapes more quickly and efficiently, it cconsumesless storage space and processing power.

We are still working in this code and will overcome its limitations. In future, the method will also support the images with white background. The method will also detect the darker and hidden parts of different objects.

6. References

[1]. Ballard, D. H., & Christopher M. Brown. (1982). Computer vision. Retrieved from wikipedia.com: https://en.wikipedia.org/wiki/Computer_vision#References

[2]. Cuevas, E., Wario, F., Zaldivar, D., & Pérez-Cisneros, M. (2012). Circle detection on images using Learning. Computer Vision 6, 121-132.

[3]. Gonzalez, & Ruben. (2015). Fast Line and Circle Detection Using Inverted Gradient Hash Maps. 2015 IEEE International Conference on Acoustics, Speech, and Signal Processing: Proceedings (pp. 1-6). http://hdl.handle.net/10072/69667.

[4]. KITTLER, J., & KITTLER, J. (1987). The Adaptive Hough Transform. IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE, 690-698.

[5]. A. Manzanera, T. Nguyen, X. Xu, A. Manzanera, T. Nguyen, and X. X. Line, "Line and circle detection using dense one-to-one Hough transforms on greyscale images To cite this version : HAL Id : hal-01451134 Line and circle detection using dense one-to-one Hough transforms on greyscale images," EURASIP J. Image Video Process., 2017.

[6]. A. O. Djekoune, K. Messaoudi, and M. Belhocine, "A New Modified Hough Transform Method for Circle Detection A New Modified Hough Transform Method for Circle Detection," no. May, 2014.

[7]. T. Chen and K. Chung, "An Efficient Randomized Algorithm for Detecting Circles," vol. 191, pp. 172–191, 2001.

[8]. M. Chhabra, "ROI Reduction Approach for Fast Circle Recognition using Classical Hough Transform," vol. 6, no. 6, 2016.

[9]. H. M. Id and Y. Nie, "A two-stage filter for removing salt-and- pepper noise using noise detector based on characteristic difference parameter and adaptive directional mean filter," pp. 1–24, 2018.

[10]. Q. Xu, Q. Zhang, D. Hu, and J. Liu, "Removal of Salt and Pepper Noise in Corrupted Image Based on Multilevel Weighted Graphs and IGOWA Operator," vol. 2018, 2018.

[11]. K. Zhang et al., "Study on the Noise Reduction of Vehicle Exhaust NO X Spectra Based on Adaptive EEMD Algorithm," vol. 2017, 2017.