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Classification of Image Corner Point Detection Systems to Identify a Shape

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Abstract. *Study This contains about the detection of circular object images. The circular object tested is the moon image object, the moon image was chosen because the moon image has various moon shapes, namely the full moon, half moon and crescent moon. To detect the shape of the circular object image, several stages are carried out by starting the image segmentation process. (1) The segmentation process using the bi-level thresholding method makes the image black and white, (2) after that the image is repaired with the morphological process of the opening and closing methods. (3) For training data, the shape extraction process is carried out, namely the circular nature of the object (circularity) to determine the roundness of an object. For the testing process, the same process is also carried out as the process of obtaining circular image detection.*

Keywords: *Circle Image Detection, bi-level thresholding, opening, closing, extraction circularity form.*

1. INTRODUCTION

Detection of circular objects is performed on moon images that have various shapes, namely a full moon that is a perfect circle, a half moon and a crescent moon. In this study, various steps of the detection process for circular objects were carried out. The steps of the research process using shape extraction using the circularity method on rice images to obtain good rice varieties. Circularity shape description indicates a perfect circle shape if it has a value of 1 and the shape becomes more elongated if it approaches 0 (Adnan et al 2019).

AnalysisLeaf shape also uses shape extraction with rectangularity, circularity, sphenricty, eccentricity, axis ratio, diameter, complexity and perimeter features. Also using color and texture features for feature result selection that correlates with each other which can increase accuracy (Valimmal, N. et al 2022). From the previous research above, this research will conduct a series of trials onfeature extraction of shape combined with segmentation steps, morphological opening and closing processes to improve the performance of circle image object detection.

2. THEORETICAL BASIS

Bi-level Thersholding Segmentation

Separation of circle image objects with their backgrounds using bi-level thresholding segmentation. This segmentation uses the intensity value in the image, a value smaller than the threshold value is required as the first area and one that is greater than or equal to the threshold

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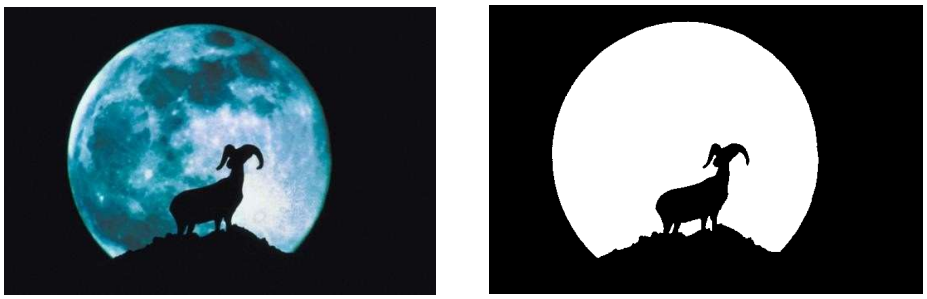
value is grouped as the second area (Abdul Kadir. 2019). Calculation of bi-level thresholding segmentation using equation 1.

$$1, untuk\ (y, x) \geq T \quad (1)$$

$$0, untuk\ (y, x) < T$$

In equation 1, T represents the intensity threshold which results in black (intensity value 0) and white (intensity value 1) images. An example can be seen in Figure 1.



(a) (b)

Figure 1. (a) Input image, (b) bi-level thresholding segmentation results.

Morphological Process

The morphological process is used to change the structure of the object's shape contained in the image. The use of the morphological process is applied to black and white (binary) images. The two operations that underlie morphology are dilation and erosion. Two other operations that are very useful in image processing are closing and opening formed through these two basic operations (Abdul K. 2019).

Opening Operation

The opening operation is an erosion operation followed by dilation using the same mask element. This operation is useful for smoothing the contour of an object and removing all pixels in an area that is too small to be occupied by the mask element (Abdul K. 2019).

$$A \square B = (A \square B) \square B \quad (2)$$

The opening operation keeps the relative size of the object the same, although it also removes small objects. However, it should be noted that the opening operation smooths the edges.

Closing Operation

Closing operation is useful for smoothing contours and eliminating small holes (Abdul K. 2019). Closing operation performs dilation operation first and then followed by erosion

operation.

$$A \square B = (A \square B) \square B \quad (3)$$

Circularity Shape Feature Extraction Process

Shape extraction is used to find out the values of an object's shape pattern. Before discussing shape extraction, the basic understanding of shape, descriptors and features will be discussed.

Shape is geometric information that remains when the effects of location, scale, rotation are performed on an object (Stegmann el at. 2022). Descriptors are a set of parameters that represent certain characteristics of an object, which can be used to express the features of the object. The features are expressed by a series of numbers used to identify the object (Adul K. 2023). The circularity shape feature extraction is a comparison between the average Euclidean distance from the sntroid to the edge of the area (Abdul K. 2023).

$$c = \frac{\mu_R}{\sigma_R} \quad (4)$$

In this case, $\square_r$ in the form of

$$\frac{1}{R}\sum_{i=1}^{N} \frac{}{N} |(y_i, x_i) - (\bar{y}_c, \bar{x}_c)| \quad (5)$$

And $\square_r$ in the form of

$$\frac{1}{R}\sum_{i=1}^{N} \frac{}{N} [\,|(y_i, x_i) - (\bar{y}_c, \bar{x}_c)| - \mu_R\,]2 \quad (6)$$

3. RESEARCH METHODS

System Diagram

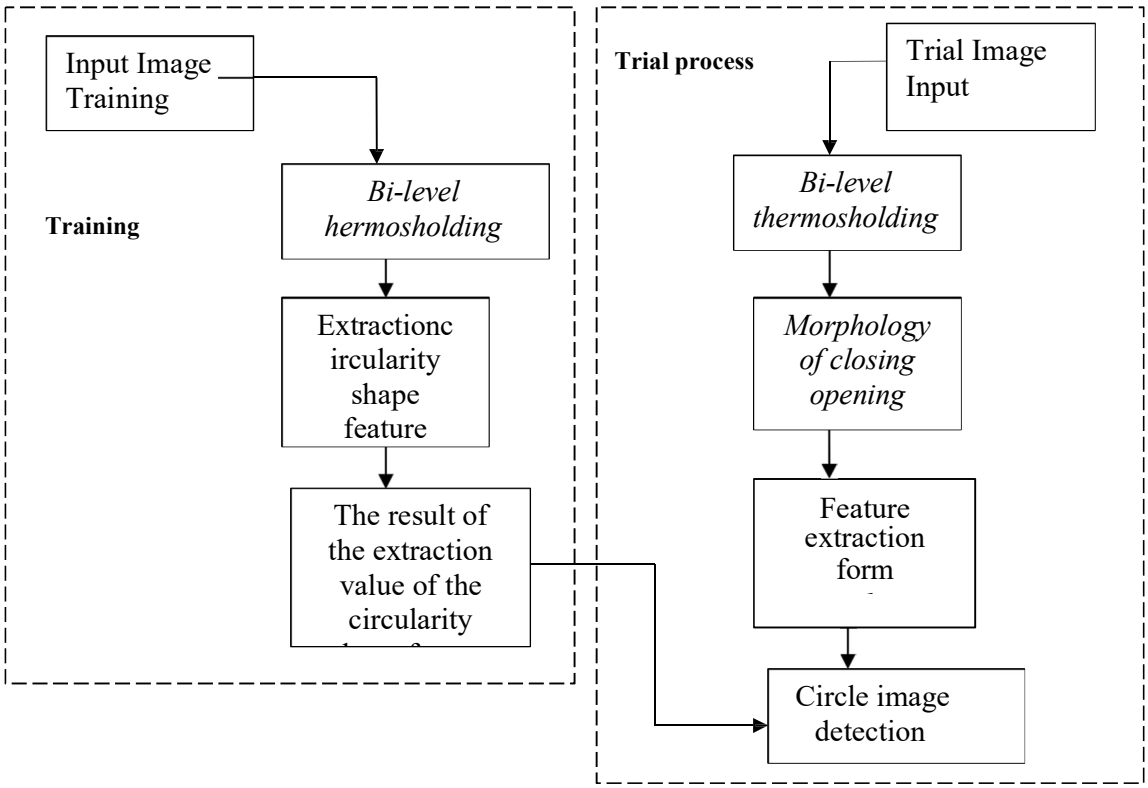


Figure 2. Diagram of the circle image detection system

The system diagram is described to determine the steps of the circular object detection process that will be carried out

Image input

There are two input images, namely training images and trial images. For training images, they are black and white (binary) circle images and semicircle images which can be seen in Figure 3.

(a) (b) (c)

Figure 3. (a) circle testing image, (b) left half circle testing image, (c) top half circle testing image.

For the test image, the RGB color image of the moon object is used, while the data for the test is three images of the moon object taken from the internet.

(a) (b) (c)

Figure 4. (a) input trial image with code a1, (b) input trial image with code a2, (c) input trial image with code a3

Bi-level Thersholding

The training image and the reading test image are subjected to a bi-level thresholding process to obtain a binary image so that it can facilitate the process of extracting shape features. For the lower threshold value of 40 and the upper threshold of 100 using equation 1.

Figure 5. Bi-level Thersholding image results

Morphology

The morphological process is used for the image testing process to improve image quality. For the morphological process, the first process used is the cloasing process with the equation 3. After the closing process is carried out with the opening process using equation 2. For each closing and opening process using the mask value 7.

(a) (b)

Figure 6. (a) segmented image, (b) image after morphological closing and opening **process.**

Circularity Shape Feature Extraction

The circularity shape feature extraction is used to determine the value of the shape feature extraction on a circular image object, so this method was tested on training data, the results can be seen in table 1.

Table 1 Results of feature extraction of circularity shape Citra Training

Image Name	*Circularity Value Results*
Circle image	0.9003213
Half image left circle	0.6701525
Half image top circle	0.681084

The results obtained using equation 4, equation 5, and equation 6 produce values that are close to 1, while for image a2 and image a3 where the circle is half-shaped, the values obtained are greater than 0.5.

The same thing is done for the test image, but it is possible that the test image has more than one object, so for the object to be detected, the white object is selected and compared with the training object.

4. RESULTS AND DISCUSSION

Results

In testing the detection of circular objects on moon images using shape feature extraction, this was carried out on three test images which produced the results in Figure 7.

Figure 7 Results of roundness detection on the moon image (image name a1)

From figure 7, the results of 3 detections on the moon image are obtained which have one perfect circle shape and two images which have a semicircle shape. The results of the Circle object detection image can be seen in table 2.

Table 2 Circle Object Detection Results

Test Image Name	*Detection Results*
Image a1	3
Image a2	2
Image a3	0

Discussion

For image a2, the detection result of 2 is due to the imperfect morphological results, which should only detect 1 circular object, the same as image a3 which is caused by another object in the middle of the circular object, so that during the morphological process the circular object is not perfect.

Figure 8. Results of the morphology of the a3 image object

Figure 8 shows the results of a circle that was subjected to the morphological process so that when the circularity feature extraction process was carried out, it obtained a value of 0.3880317, which is far from the training data value.

5. CONCLUSION

Based on the research that has been conducted along with the trials that have been carried out, the following conclusions can be drawn.

a. The morphological process can affect the results of the circularity feature extraction process.

b. The shape of the image position does not greatly affect the value of the circularity feature extraction results, for example in the left semicircle image with a feature extraction value of 0.6701525 and the upper semicircle image with a feature extraction value of 0.681084.

6. SUGGESTION

In further development of circle detection, the process of improving morphological images and their segmentation can be carried out by means of image smoothing before carrying out the morphological and segmentation processes. This research can also be developed with other methods for extracting circular shape features, for example the Hough circles or convec hull method.

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