ENHANCEMENT MARGINAL SPACE AND MORPHOLOGY TECHNIQUE FOR ROBUSTNESS OBJECT OVERLAPPING DETECTION

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ABSTRACT
The object detection of overlapping object is still interested for image applications especially in 2D system. This article presents the robust object detection using marginal space and morphology technique. The second order of derivatives (Laplacian Operator) is selected to be edge detection technique which bases on the Laplacian of a Gaussian (LOG) to perform as the linear operator. The experiment results show that this technique give the accuracy performance at 81.67% which can identify the top object of object overlapping.

KEY WORDS
Object Overlapping, Marginal Space, Morphology.

1. Introduction
The object detection of overlapping object research is recently interested and applied to industrial area such as Slamet’s research work [1]. It is studied a shape characteristics analysis for papaya size classification. It specially uses the four combination shape characterization of area, mean, diameter and parameter. The automatic threshold based on the Otsu’s method is applied to convert RGB to be the binary image and the morphology technique also is introduced to distinguish the object from background more than 94 %. Wichit’s work [2] is studied the pineapple classification based on binary technique to identify the object position and separate the back ground. The image is then calculated the object size by black pixel counting at 92.6 %. [3] presents the searching a frame and area of interest in image using the template matching. The limitation of this work is based on database template of shape. In [4] presents the red-blood cell counting based on the black and white images using sum-result indexing technique, which is developed from run-length encoding(RLE) technique. The results show that the accuracy of this technique is same to contour tracing technique but using less time computation. In [5] presents the fish counting technique using parallel sum result indexing technique which is developed from two scan sum result indexing technique. The result show that this technique provides the accuracy counting and also using reduces the time computation. However it still have a problem when applies to the overlapping objective image. Therefore, to enhance the searching efficiency of overlapping object, this article presents the object detection using marginal space and the morphology technique to reduce background noise of images.

2. The Marginal Space Technique
The marginal space technique [6],[7] is the object detection using segmentation technique. Each segment divided into 5 parameters. The 1st and 2nd parameters are object position. The 3rd parameter is object characteristics. The 4th and 5th are properties and relative parameter between object and background. The highest effectiveness of the marginal space technique must perform task as following.

2.1 Edge detection
The classification of specific area of image is to distinguish between objects of interest from background. This article uses segmentation technique based on discontinuity properties pixel on the edge of object. The advantage of this technique is fast processing using only data from edge or boundary of object.

The edge detection techniques process begins with converting original image to gray scale image, 8 bits, range 0-255. Then the Laplacian operator is applied to search and distinguish the edge. The estimation of mask value will set zero crossing position at the edge of the object. The Laplacian equation as following.

$$\nabla^2 P = \frac{\partial^2 P}{\partial x^2} + \frac{\partial^2 P}{\partial y^2}$$

(1)

Edge detecting by “The Laplacian equation” is result of operation. The edge of object will become origin point from where the data of pixel can be minus or plus value.
2.2 Image filter

The background noise can be found after edge detecting process completed. The filter technique is introduced to eliminate the noise. This article uses convolution technique as collaborate voting between template and image to reduce noise. Template is a matrix size $M \times N$ of algorithm placed on object to find convolution result value where template value $i$ is template of image as equation.

$$\hat{I}(X,Y) = T * I = \sum_{i=0}^{\infty} \sum_{j=0}^{\infty} T(x,y)I(X-i,Y-j) \quad (2)$$

And $\hat{I}(X,Y)$ is value from convolution

Regarding the equation present density of the light at point $(X,Y)$ is sum of multiply value between template and density level of the light on overlapping image. The pointer from the equation $(X-i,Y-j)$

2.3 Edge enhancement

The opening technique is applied as edge enhancement by erosion method as 3rd and 4th equation for dilation method.

$$A \ominus B = \{ z \mid (B_z) \subseteq A \} \quad (3)$$

$$A \oplus B = \{ z \mid [\{B_z\} \cap A] \subseteq A \} \quad (4)$$

$A$ is image  
$B$ is Structuring element  
$Z$ is Set of element

Therefore, the opening equation is followed.

$$A \circ B = (A \ominus B) \oplus B \quad (5)$$

The opening technique has effect from eliminating of small object and dilute noise from image result to smoothing the boundaries of the object

3. Experiment

In this experiment, the circle shape has been used to test this technique. There are 60 digital images size 480x640 pixels which are selected to represent a circle shape as shows in Fig.1

Fig.1 Apple images

The process of classify the top object is followed in Fig.2

Fig.2 Process of classify the top object

Firstly, the original image has converted into grayscale images. The second order of derivatives (Laplacian Operator) is selected to be edge detection technique which bases on the Laplacian of a Gaussian (LOG) to perform as the linear operator. Because the LOG method uses the convolving technique which has effected directly to the image, the edge of image is occurred smoothly (noise reducing). The results show in Fig.3

Fig.3 Boundaries detected by LOG method

After the edge detection process completed, the result still has got a background noise. The filter technique is introduced to eliminate the noise by convolution technique. Then the opening technique is used to
eliminate small object and dilute noise from image. The result shows this technique can reduce the noise and make the smoothly edge of the objects show in figure 4. However, it can be noticed that there are some loss portion of boundaries in Fig. 4 this is because the luminosity of the light on the object is not balance.

![Fig. 4 The image after using the opening technique](image)

Finally, the center point of the object in boundaries area is considered from the center of area at horizontal coordinate (or x-coordinate) and vertical coordinate (or y-coordinate) respectively. The result of this process is shown in Fig. 5 this process is to create a point on the image which located on the top object.

![Fig. 5 Point creating on the top object](image)

### 4. Result

The experiment shows that this technique provides an effectiveness to detect interest object especially top object in 2D images as show in Fig. 6.

The results experiment in Fig. 6 are compared to [8] which can be explain in Table 1.

![Fig. 6 Experiment result](image)

<table>
<thead>
<tr>
<th>Picture</th>
<th>Qty.</th>
<th>Result</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Single object</td>
</tr>
<tr>
<td>3 Apples</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>4 Apples</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>5 Apples</td>
<td>10</td>
<td>1</td>
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<tr>
<td>8 Apples</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td>12</td>
</tr>
</tbody>
</table>

| Percentage of total (%) | 100  | 20  | 80 | 81.67 |

It can be noticed that this technique provides the accuracy performance at 81.67% which improve from the [8].
5. Conclusion

This article presents the improvement top object detection in 2D image. The apples image size 480x640 pixels, which are arranged in different position, are used to be in the input. The experiment results show that this technique give the accuracy performance at 81.67%. It can be notice that it more efficiency than [8] which can search top object interest from group object at 80% and single object 20%. However, this article still need more to improve and reduce the error. The error mostly comes from the luminosity of the light on object which affected to discontinuity of boundaries. Therefore, researching and development have to consider the light control and also another smoothing technique could be applied.

References