Adaptive Grass-Fire Blob Detection Algorithm (AGFBDA) for the Image Matrices

Ramanpreet Kaur  
College Of Engineering  
Chandigarh Group of College  
Landran, India  
sidhuraman04@gmail.com  

Dapinder Kaur  
College Of Engineering  
Chandigarh Group of College  
Landran, India  
cgccoe.cse.dapinder@gmail.com

Abstract - The blob detection methods play the vital role in the various image processing models. The blob detection models are utilized for the localization of the visible objects in the given images in order to understand the type and size of the objects. The blob detection can be utilized for the classification, categorization and other purposes in the image processing models. In the proposed model, the robust blob detection model based upon the recursive grass-fire method has been implemented to localize the objects in the given image matrix. The proposed model is intended to handle the moving or still objects in the given image, where the proposed model has been performed adequately well. The proposed model has been tested over the standard image set in order to understand the overall performance under the various perspectives, where it has detection all of the objects very clearly and described the boundary (known as bounding box) around the detected objects. The proposed model has efficiently detected and localized all of the objects in the given image set.

Keywords: Blob detection, Object detection, localization, boundary estimation.

I. INTRODUCTION

The blob detection or extraction is the process of isolating the visible objects in the given image matrix, which can be further classified, categorized or undergo other investigations or verifications in the user’s interest. The pixel level analytical theory is utilized for the assessment of the detection and localized blobs from the given image matrix, where the 3x3 or higher block size is utilized for the blob extraction based image processing practices. The blobs are extracted by analyzing the neighboring pixels of the centered pixel, where the 4 pixel analysis or 8 pixel analysis models are utilized as explained in the following figure.

In the figure 1, the below figure shows the 4-way connectivity where only right, left, top and bottom pixels are evaluated for the similarity with the centered pixels. In the 8-way connectivity evaluation, the right, right-top, right-bottom, left, left-top, left-bottom, top and bottom pixels are evaluated, which gives the analysis of 8-pixels at total, and hence called 8-connectivity or 8-way connectivity model.

Many differently designed methods are employed for the detection of the blobs in the given images, where the grass-fire and its various variants are the popular contenders. The blob detection can be determined as a clean or noisy blob detection in the various image differentiated by the nature of the image matrix submitted to the algorithm. The figure 1.2 (a) shows the clean image with no noise, hence all of the blobs play the vital role and must be detected accurately, whereas the figure 1.2 (b) has a man and other objects are considered noise, hence only man has to be extracted successfully, and not the other noise objects.

![Figure 1](image1.png)  
**Figure 1.** Image explaining the 4-way or 8-way connectivity or pixel analysis model for the blob detection

![Figure 2](image2.png)  
**Figure 2.** (a) The clean image matrix, (b) Image with noise and a man (primary blob)
II. RELATED STUDY

Grycuk, Rafał et. al. has worked on the blob detection with edge-aware multiple object localization. This model works on the basis of the quadrilaterals and the popular canny edge detection models.

Kong, Hui et. al. has worked on the Gaussian filter based blob detection with the noise removal application in order to extract the clean and primary blobs from the given image matrix. The laplacian of Gaussian (LoG) filter has been utilized in this model, which is used to add the adaptive blur to the image matrix in order to reduce the neighboring noise and loss of the primary component.

Zhang, Min et. al. has worked on the efficient model for the blob detection with the local convexity, blob shape mask and intensity aware algorithm in their implementation. This model utilizes the innovative Hessian based difference of Gaussian (HDoG) model for the extraction of the blob from the given image matrix.

Wu, Lingfei et. al. has worked on the outlier or outer boundary extraction for the target blobs detected in the image matrix. In this model, the authors have utilized the hybrid blob detection model by amalgamating the adaptive and flexible blob detection with boundary outline extraction.

CP Yu et. al. has worked on the detection and extraction of the 3-D blob from the given image matrix of the MRI scan images. The intelligent and robust 3-D matrix analysis algorithm has been implemented under this model for the extraction of the blobs from the given image matrix.

III. EXPERIMENTAL DESIGN

The Recursive Grass-Fire Algorithm: This model works on the basis of the sliding windows function, where the seed pixel is the left-top pixels and the column-to-column and row-to-row model is followed for the realization of the blob detection algorithm. This model is designed to work upon the binary matrix based images, where the white pixel defines the object and the black pixel described the null or empty space in the image. The white pixels are extracted by analyzing their neighbors and any combination or region of the white pixels higher number of pixels than 1 or any number N is considered as the eligible blob. Each pixel is acquired by its vertical and horizontal position, such as (2,3) describes the 2nd row and 3rd column. The 8-way connectivity model is applied to the target image for the extraction of the blob according to the following image (Figure 3).

Figure 3. The neighboring visits and density is described in the various scenarios

The core grass-fire model works on the basis of the detection of the grass and fire, where the fire in the image matrix by setting the burn pixels to value zero or black color, and the grass (visible grass) to value one or white color for the classification of the two primary characters in the given image set. The grass-fire algorithm works in two primary directions, known as horizontal and vertical in the given order to analyze the image in pixel-to-pixel paradigm.

Algorithm 1: Adaptive Grass-Fire Blob Detection Algorithm (AGFBDA)

1. Firstly, we evaluate and label the pixel 1 on the coordinate (2, 0) for the detection of the first blob and the pixel is considered burned or black.
2. Label, the burnt area must be black and others should be 1, where burn shows the area burnt by fire and other area is the grass.
3. In the next steps, this algorithm is considered to start the fire pixel at the 3rd row neighbor (3, 0), by estimating that this pixel is an object pixel or not an object pixel.
4. If it’s found as the object pixel, the pixel is labeled white (value 1) and otherwise zeroed (black).
5. Afterwards, the next layer's neighbors are evaluated and the decision is made and the certain pixel is converted to the desired color.

6. The following image shows the detected blob in the given region of the input image matrices.

7. Apply steps 1-6 on each pixel in column-to-column and row-to-row sliding fashion.

---

Figure 4. Figure showing the detected blobs in the given image set

IV. RESULT ANALYSIS

The circularity of the detection and localized blobs is detected and the perimeter of the target region is computed and marked with the boundary. The circulatory factor is utilized for the calculation of the overall perimeter of the detected blob regions with the following equation:

\[
\text{Circularity} = \frac{\text{Perimeter of BLOB}}{2\sqrt{\pi} \cdot \text{Area of BLOB}}
\]

The radii of the circular blob region is found and computed and marked with the bounding box or bounding circle. The radii variance or the extra region circulating the blob region is also extracted with the target blob. In the following equation the blob feature values are explained, where the feature value of binarized matrix has been converted to the numeric form for each of detection blob on the list. The feature values can be also extracted in the form of feature vector or feature list.

\[
\vec{f_1} = \begin{bmatrix} 0.31 \\ 6561 \end{bmatrix}
\]

We had seven number of blobs in the target image and we have successfully detected all of them as per shown in the following image, which are described with the value ranging from f1 to f7. The following image shows the detected regions or blob with their indices labeled on them.

Table 1. The results obtained from the target algorithm

<table>
<thead>
<tr>
<th>Blob Number</th>
<th>Circulatory or Convexity</th>
<th>Area in number of pixels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.31</td>
<td>6561</td>
</tr>
<tr>
<td>2</td>
<td>0.40</td>
<td>6544</td>
</tr>
<tr>
<td>3</td>
<td>0.98</td>
<td>890</td>
</tr>
<tr>
<td>4</td>
<td>0.97</td>
<td>6607</td>
</tr>
<tr>
<td>5</td>
<td>0.99</td>
<td>6730</td>
</tr>
<tr>
<td>6</td>
<td>0.52</td>
<td>6611</td>
</tr>
<tr>
<td>7</td>
<td>0.75</td>
<td>2073</td>
</tr>
</tbody>
</table>

V. CONCLUSION

The proposed model has been designed for the blob detection in the image matrix by using the grass-fire model, where the proposed model has been found adequately successful to localize the blobs of the various shapes and on the various angles and sizes, which shows the efficiency of the proposed model. The proposed model has been found very efficient in analyzing the blob regions for the area and circularity assessment. The proposed algorithm has shown slight variations from the original values of the circulatory and very correctly described the number of pixels in the detected blob regions.

REFERENCES

[1] Grycuk, Rafal, Marcin Gabryel, Marcin Korytkowski, Rafał Scherer, and Sviatoslav Voloshynovskiy. "From single image to list of objects based on edge and blob detection." In International...


