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Optimization of Multiple Level Set Functions for Overlapping Cervical Cells Segmentation

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***ABSTRACT*-In the abdomen of human beings a layer of cells are formed these cells occur in the cervix regions and in worst situations it leads to cancer. Proper examination of these cells are essential for treatement. To gain more knowledge of these cells, segmentation is essential. In segmentation the particular area can be studied for further analysis. In this work multiple level set functions play an essential role in segmentation. It takes into account the unary and binary terms. To reduce the errors which results due to reinitilization, signed distance function is used. Level set plays an important role in segmentation. This method is very helpful for medical analysis of cervical images.**

Index terms-cell segmentation, Pap smear, cervical cells, Gaussian mixture model, pre-processing, Sobel operator.

I. INTRODUCTION

Any medical image can be analyzed in an better manner using segmentation techniques. There are various methods to segment an image, depending on the application focused any suitable method is taken. Level set methods are used in many areas of image processing. The results obtained using these methods are better and so cervical cells are based on level set segmentation.

Level set methods have proven to be effective in segmentation tasks. Wang et. al., proposed a new region based unified tensor level set method for image segmentation in [1]. This method uses Gabor filter bank and level set functions. The level set method uses Heaviside step function and Dirac delta function. They introduced a three order tensor to depict features of pixels like gray values and local geometrical features such as orientation and gradient. The region based level set method is generalized from scalar to tensor.
The method has the following advantages:

1. It has a Gaussian filter bank.
2. It is robust against salt and pepper noise.
3. It segments images more accurately and naturally,
4. the boundaries are given with more importance.

This method is tested with synthetic, medical and natural images. Unified tensor level set method is compared with the CV (Chan and Vese) method [2]. It is found that the proposed method is more robust against salt and pepper noise than CV method. The proposed method segments the object from a texture background more accurately than WV (Wang-Vemuri) method [3]. The proposed method is effective for natural images and CT images. Unified tensor pixel representation results in computational inefficiency.

Gao et. Al, proposed an edge based level set method in relay fashion in [4]. The proposed method is applied to set of artificial, natural, and medical images. The proposed method applies an edge based level set method in a relay fashion on a series of nested sub regions to obtain full segmentation. The zero level curve is used to detect the boundaries in associated region. With boundaries in all sub regions synthetic boundaries are obtained. Level set without reinitialization is used. Penalty term is used for keeping the level set as signed distance function. The method has the following advantages, it can execute automatically without human computer interaction, it

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obtains full segmentation without specifying the number of relays. The proposed method is compared with Li [5] and CV (Chan and Vese) method [2] and it is inferred that the new method works better when objects and background are homogenous. From the experimental results, conducted by Li and proposed method detects all shapes and CV method misses the triangular shapes. In the tests conducted in complex images, Li method [5] detects only boundaries, CV method boundaries are wrongly classified and new method detected interior boundaries.

II. PROPOSED METHODOLOGY

The steps involved in the process of overlapping cell segmentation is described in the following flow chart.

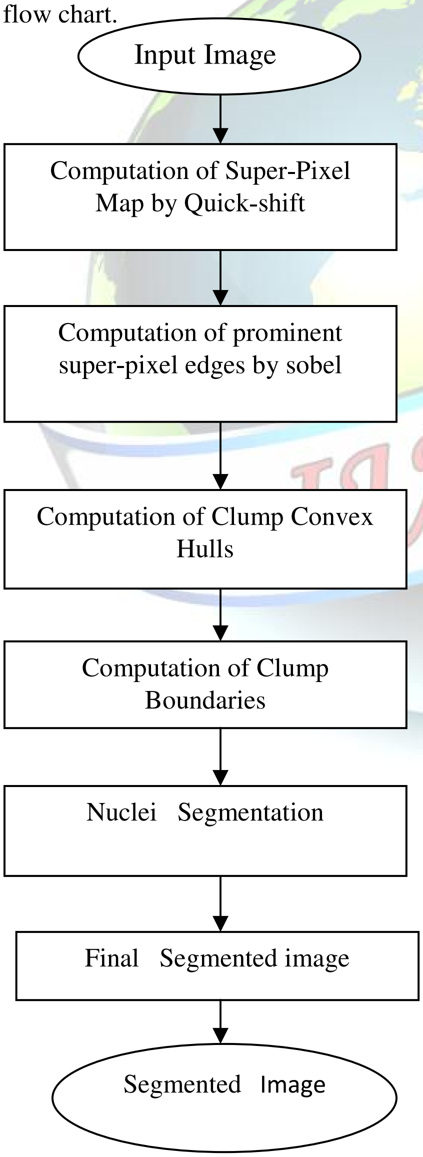

Fig. 1. Flow chart of the proposed system.

In the first step the super-pixel map [6] is computed. In the second step the sobel edge detection is used . Using the edge information the convex hull is computed in second step. In the third step clump boundaries are computed. In the fifth step MSER (Maximally Stable Extremal Regions) algorithm is used for nuclei segmentation. Using the previous results the final output is obtained .

The input image is cervical . Quick-shift is used in first step. It uses parzen density estimate. To determine the edges of the image is an important factor. There are various edge detection methods to find the edges. Depending upon the application any edge detector is choosen. In this work sobel edge operator [7] is choosen.

Pseudo-codes for edge detection method using Sobel:
Input: A Cervical Image
Output: Detected Edges
Step 1: The input image is taken
Step 2: The mask is applied to the input image
Step 3: Apply Sobel edge detection algorithm and the gradient
Step 4: Masks manipulation of gradient in both vertical and horizontal direction separately on the input image
Step 5: Using the above results the absolute magnitude of the gradient is determined
Step 6: the absolute magnitude is output edges.

Pseudo-codes for Convex hull method is given in fig. 2 below.

1. Find a point, P, interior to the convex hull by taking the average of the coordinates of all the given points [8].
2. The point which is interior namely P, and the other points, is translated. At the orgin point P is situated.
3. The angle between the line connecting P to each of the points with respect to the positive X-axis is determined and sorting is performed as per the magnitude of the angle.
4. The sorting gives the order in which the points will be processed.
5. The sorting determines the order that the algorithm will process the points.
6. For two points having the same angle, delete the point if it has smaller amplitude .
7. Label the points P0, P1, P2 which starts in the lowest Y-axis.
8. Let labels Pa, Pb, Pc refer to P0, P1, P2 respectively.

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9. If the interior angle which is formed by Pa, Pb, Pc is greater than or equal to 180° in this situation the point labeled with Pb is removed and the point Pb is set to point Pa.
10. If the interior angle formed by Pa, Pb, Pc from before is less than 180° in this criteria no points are eliminated. Then the points Pa, Pb and Pc are advanced forward one point.
11. The Algorithm is continued by repeating the step 10 till Pb = P0. At this point, the algorithm stops and only the points of the convex hull remain.

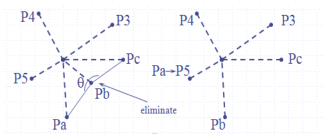


Fig. 2. Convex Hull Method

In the nuclei regions segmentation is done by Maximally stable extremal regions method. The MSER extraction implements the following steps:

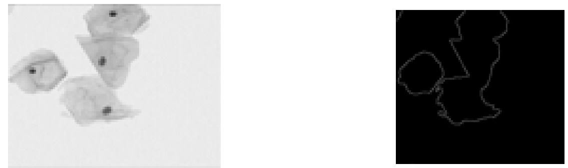
1. A simple luminance, thresholding of the image is performed by sweeping a threshold of intensity from black to white.
2. Extract connected components ie Extremal Regions
3. When the extremal region is Maximally Stable a threshold value is taken. Because of the discrete nature of the image, region below or above is coincident with the actual region. In this situation the region is deemed as maximal.
4. Approximate a region with an ellipse .
5. Keep those regions descriptors as features .

From the results obtained in the previous steps the final output is obtained.

Canny Gradient:The canny edge operator finds the gray scale intensity of the image changes the most. These areas are found by determining the gradients of the image given in fig.6(g). Gradients at each pixel in the smoothed image are determined by applying the sobel operator given in fig.3(b).

III. RESULTS AND DISCUSSION

The work is performed in MATLAB2013A environment.

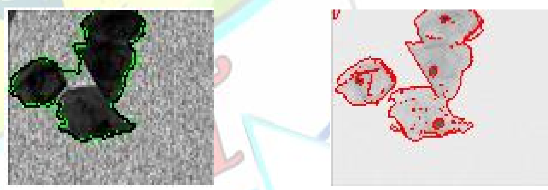


(a) (b)

Fig. 3. (a) Cell Image (b) Sobel edge detection

(c) (d)

Fig. 4. (c) Hull Image (d) Nuclei segmentation



(e) (f)

Fig. 5. (e) clumps are identified (f) Segmented output image

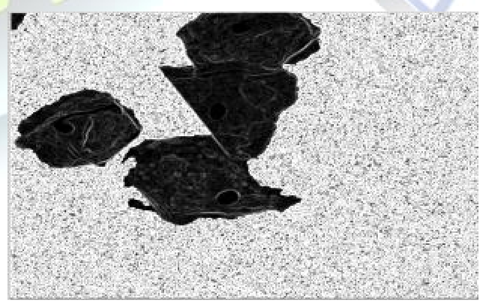


Fig. 6. (g) Canny Gradient

The input image given in fig.3(a) is converted to binary and threshold of 0.8 is applied. The resulting

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image consists of unwanted contents which are removed by morphological operations .The built-in functions are used to remove the unwanted portions by setting the structuring element shape as 'diamond' and parameter value of 2. For other shapes like ball, line, rectangle, and square and for other parameter value the unwanted contents are not removed. Cell image with unwanted contents removed is converted to binary which results in super-pixel map. Convex hull is used as mask fig.4 (c) over the input image extracting only the cervical cell parts covered under cervical cells. The threshold of 0.6 is applied to get the nuclei regions fig.4(d). The mask image of the convex hull along with the level set functions is used to find the clump boundaries fig.5(e). From the results previously obtained the output image results fig.5(f).

IV. CONCLUSION

Level set method is used to segment the cell clumps. This method performs in clump of cells more effectively. The cell shape, and nucleus is identified . The system can be extended for cell classification.

REFERENCES

[1] Wang, B., Gao X., Tao, D., Li, X.:, (2010), "A unified tensor Level Set for image segmentation". IEEE Transactions on Systems, Man, and Cybernetics,Part B: Cybernetics, Vol. 40 857-867.

[2] Chan T.F and Vese L.A, (2001),"Active contours without edges," IEEE Trans.Image Process., vol. 10, no. 2, pp. 266–277, Feb.

[3] Wang.Z and Vemuri B.C, (2004), "Tensor field segmentation using region based active contour model" , in Proc. Eur. Conf. Comput. Vis., , vol. 3024,pp. 304–315.

[4] Gao, X., Wang, B., Tao, D., Li, X.:, (2011), "A relay Level Set method for automatic image segmentation". IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics, Vol. 41 518-525.

[5] Li C, Xu C, Gui C, and Fox M.D, (2005), "Level set evolution without re-initialization: A new variational formulation," in Proc. IEEE Conf.Comput. Vis. Pattern Recog., San Diego, CA, Jun, pp. 430–436.

[6] Comaniciu, D., Meer, P.:, (2002) , "Mean shift: a robust approach toward feature space analysis". IEEE TPAMI, 24(5) 603-619.

[7] Shrivakshan1 G.T, Chandrasekar C.Dr, (2012), "A Comparison of various Edge Detection Techniques used in Image Processing", IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 5, No 1, September.

[8] Dillencourt, Michael B., Hannan Samet, and Markku Tamminen, (1992) , " A general approach to connected-component labeling for arbitrary image representations". Journal of the ACM (JACM) 39, no. 2 253-280.

[9] Matas, J., Chum, O., Urban, M., Pajdla, T.:, (2002), "Robust wide baseline stereo from maximally stable extremal regions. In Proc. BMVC, Cardiff, UK. 384-396.

[10] Li, C., Xu, C., Gui, C., Fox, M.:, (2010) , "Distance regularized level set evolution and its application to image segmentation". IEEE TIP, 19(12) 3243-3254.