Watershed Approach for Image Segmentation

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Abstract – Segmentation is the process of subdividing an image into multiple segments. On applying the watershed function directly on an image in order to obtain segmented image, leads to over-segmentation. In this paper we are proposing a technique to solve the over-segmentation problem. This technique uses watershed algorithm along with gradient magnitude and opening and closing operations of morphological reconstruction. Thus, by using this approach we can eliminate over-segmentation efficiently.

Keywords: Segmentation, Morphology, Gradient Magnitude, Reconstruction, Watershed.

I. INTRODUCTION

In image segmentation humans are interested only in the certain properties of an image. So in order to identify the required targets we need to segment the whole image. Image segmentation is the technique to subdivide a digital image into multiple segments. The goal of segmentation is to change the meaning of an image into something which is more meaningful and easier to understand. The result of segmentation is image which is partitioned into distinct regions containing pixels with similar properties. The main practical applications include medical imaging, face detection etc.

In this paper we are proposing an improved watershed algorithm for the segmentation, which overcomes the drawbacks of previous watershed segmentation algorithm. Our proposed approach initially segments the image using watershed function which results in over-segmentation. So in order to obtain the proper segmented image we are using gradient magnitude along with morphological reconstruction functions and hence the over-segmentation can be eliminated.

The paper is structured as follows: The section 2 contains system model which describes the overall structure of proposed model. Section 3 contains the previous work. Section 4 contains proposed methodology. Section 5 contains the experimental results. Section 6 concludes.

II. SYSTEM MODEL

The proposed model is mainly divided into four components as shown in the Fig 2.1 which describes the system model of the proposed technique.

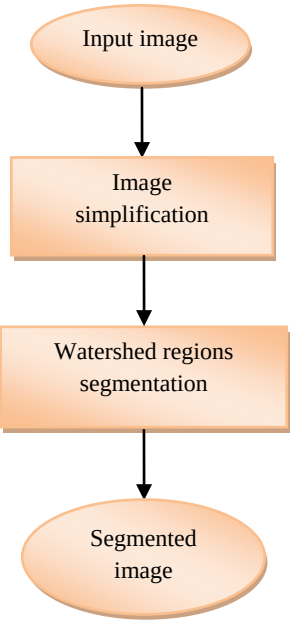

Fig. 2.1 Block diagram of watershed approach

Each block in the diagram describes the different processes involved in watershed segmentation. Initially the processing starts with input image where the image is read by the user for further processing. In the image simplification, the image undergoes preprocessing mechanism in order to filter noise. In the next step segmentation is performed using watershed function along with morphological functions. Finally, the segmented image is obtained.

III. PREVIOUS WORK

Vincent[1] proposed "Watersheds in digital spaces: an efficient algorithm based on immersion simulations[1]". Even though this technique provides the good basis for the future improvement of watershed techniques, it doesn't completely eliminate the over-segmentation.

Orlando[2] proposed a technique "Image Segmentation by Histogram Thresholding Using Fuzzy sets[2]". This is the most commonly used segmentation algorithm using feature thresholding due to its inefficiency in choosing threshold value causes over-segmentation and under-segmentation problems.

Susanta[3] proposed "Multiscale morphological segmentation of grayscale image[3]". This algorithm decomposes image into regions having visual similarity

which are classified depending on their segmentation techniques. This technique has its own limitations and benefits in terms of applicability, performance and computational cost. It is difficult to achieve all these qualities by a single segmentation algorithm.

Li[4] proposed "Controllable watershed segmentation based on morphological multi-scale gradient[4]" which has advantage of edge information to enhance and revise the edge in the gradient image, but adjusting the fill threshold would lead to the loss of outline.

Gao[5] proposed "New unsupervised image segmentation via marker-based watershed[5]" which is used to extract the region from the object, but the over-segmentation resulted from illumination is too obvious.

The proposed work contains a technique which overcomes the drawbacks of above mentioned approaches.

IV. PROPOSED METHODOLOGY

In the proposed model, initially the input image is read. For the input image preprocessing mechanism is applied. Preprocessing involves converting into grayscale and applying gradient magnitude. The input image is converted into grayscale image which is used for further processing. On applying the watershed function directly on the grayscale image, the resultant image leads to over-segmentation.

In order to solve the issue of over-segmentation gradient magnitude function is being used which has edge detection techniques such as sobel or prewitt along with filtering technique. By using this, the boundaries can be clearly detected.

Now by applying the watershed function, the over-segmentation is not completely eliminated. In order to eliminate over-segmentation efficiently, here we are using opening and closing morphological reconstruction operation. Combining Opening reconstruction along with closing reconstruction operation, we can build the mixed opening and closing reconstruction operation with the purpose to eliminate heavy dark details and noise of the gradient image.

Opening reconstruction operation was performed so as to eliminate the maximum noise and the irregular interference of the gradient image that are smaller than the structural elements. In order to remove the dark noise and irregular interference that are smaller than the structural elements, the closing reconstruction operation was performed.

Thus, now on applying watershed function the segmented image without over-segmentation is obtained.

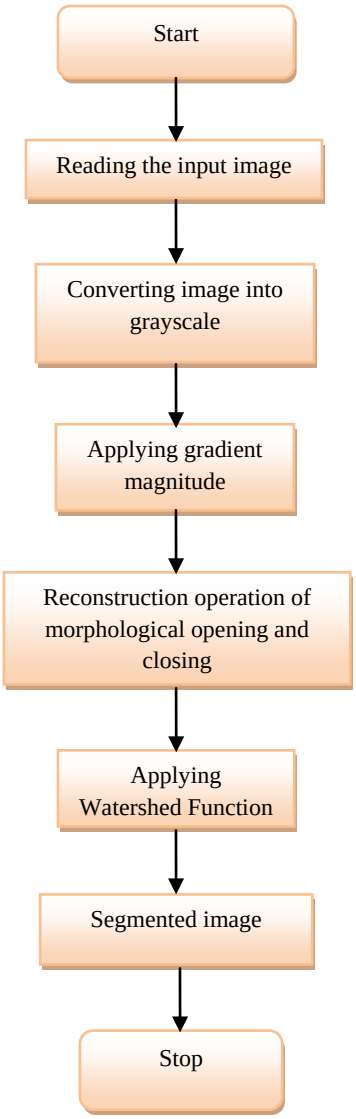

Fig. 4.1 Flow chart of Watershed approach

V. EXPERIMENTAL RESULTS

The Image segmentation results are shown in below figures. Fig. 5.1 represents the grayscale image which is used for further segmentation.

Fig. 5.1 Grayscale image

Fig. 5.2 shows the intermediate result of segmentation where the boundaries are highlighted. Fig. 5.3 is the result after applying opening and closing morphological reconstruction operation along with watershed segmentation.

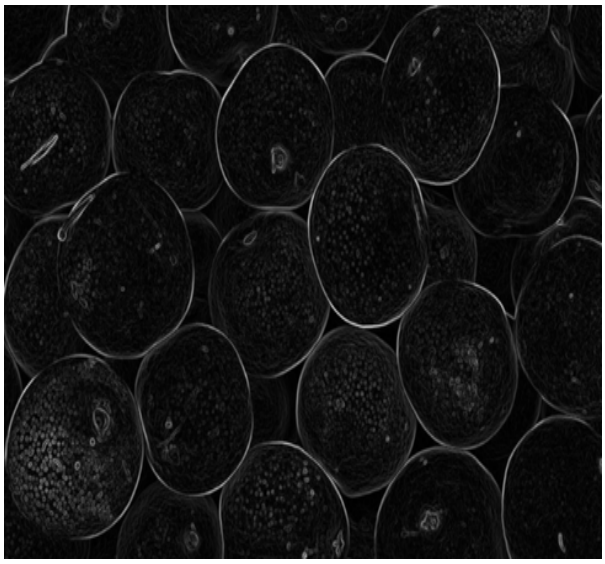

Fig. 5.2 Intermediate result

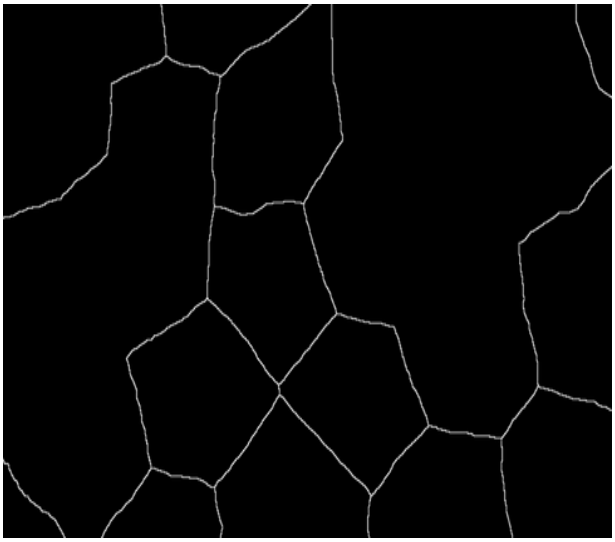

Fig. 5.3 Segmented image

VI. CONCLUSION

The Proposed technique provides an improved segmentation algorithm. To improve the quality of the input image, the morphological closing and opening reconstruction operation along with morphological gradient image is proposed. This technique effectively eliminates the over-segmentation and has the scale of causality. The experimental results shows that this approach performs well by eliminating the over-segmentation, the region contour positioning and removal of noise. Thus the proposed algorithm reduces the overall complexity of the segmentation.

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