# Improvement In Watershed Image Segmentation For High Definition Images

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***Abstract:* - Image segmentation is the fastest and most exciting research area in the field of information technology. There are a number of techniques for doing the image segmentation, but the watershed image segmentation technique is the latest one. It is easy to use, but there is a major drawback of over- segmentation. This problem may or may not appear in the case of simple images, which are not high definition, but mostly it appears in the case of high definition images. The goal of this paper is to resolve the problem of over-segmentation. This can be done by reducing the size of the image first and then reducing the noise of the reduced size image. This can be verified by comparing the PSNR (Peak Signal to Noise Ratio) value of the traditional watershed algorithm to the improved watershed algorithm.**

***Index Terms:* - Image segmentation, watershed, catchment basin, flooding, over segmentation, MATLAB.**

## I. INTRODUCTION

Image segmentation is the fastest and most exciting research area in the field of information technology. Moreover, for image analysis segmentation is the essential step. It based mainly two type of approaches discontinuity based and similarity based [5]. Discontinuity based approach is the partition of an image based on abrupt changes in intensity. Techniques based on discontinuity attempt to partition the image by detecting abrupt changes in grey level [5]. The techniques involve are point, line, and edge detectors. Similarity based approach is the partition of an image based on regions that are similar according to a set of predefined criteria. Techniques based on similarity attempt to create the uniform regions by grouping together connected pixels that satisfy predefined similarity criteria [5]. Therefore, the results of segmentation may depend critically on these criteria and on the definition of connectivity. This includes image segmentation algorithms like thresholding, region growing, watershed, region split and merge.

In this paper, the watershed transform method used to do the image segmentation. For doing the segmentation, first we have to denoise the image because if there is a noise then the segmentation cannot done accurately. Noise can be anything-random variation in the form of color, brightness pixel value that is either due to environmental factor or due to technical limitation [8]. Actually, the noise is an unwanted affect. Before denoising the image we have to reduce its size to avoid the over segmentation, because the major drawback of watershed transform is over segmentation [6]. The goal of this paper to denoise the image and avoid the problem of over segmentation. The tool that we used to perform this algorithm is MATLAB.

## II. THE WATERSHED TRANSFORM

Watershed algorithm is a powerful mathematical morphological tool for the image segmentation. The watershed algorithm involves the basic three steps: -1 gradient of the image, 2 flooding, 3 segmentation. In the first step, the gradient of the image is calculated [2, 3]. It shows the directional change in the intensity or color in the image, the mathematical formula given in the below section.

The second step involves the formation of catchment basin and flooding [6] as shown in figure (1). In this step, if we consider the image a landscape image then the hole is pierced there where the intensity is very low. Moreover, where the hole is punched that is called as the local minima often called as the catchment basin. After that the flooding process starts. When that landscape or topographic relief is flooded with water, the divide lines of the domains of rain falling over the regions form the watersheds. Intuitively, a drop of water falling on a topographic relief flows towards the "nearest" minimum. The "nearest" minimum is that minimum which lies at the end of the path of steepest descent. These minima are the local minima [4]. The water filled up at these starting local minima and at points where water coming from different basins would meet and dams will be built as shown in figure (2).

The third step leads to the formation of dams [1], because at the end of the flooding process dams comes into account and these dams forms the rigid watershed lines. These dams avoid an event, which comes during the flooding when two or more flood coming from different minima may merge. These dams defines the watershed of the function f of an image, this separates the various catchment basin [1].

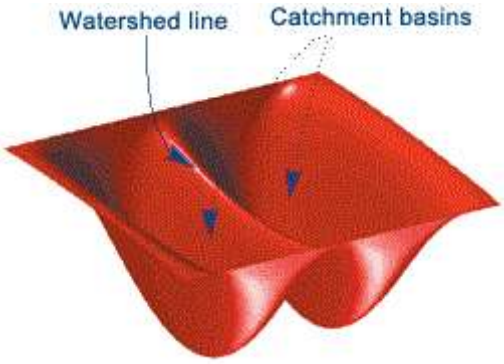



Figure 1: Watershed lines and catchment basin

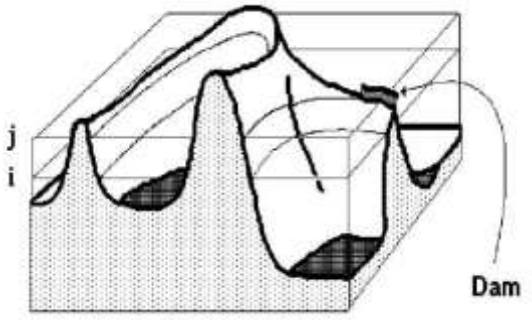



Figure 2: Flooding and dam building

## III. MATHEMATICAL FORMULATION

Consider an image having function$f$. Now consider a section $Z_i$ (f) of f at level i, and suppose that the flood has reached this height as shown in figure (3). Consider now the section $Z_{i+1}$ (f) we see immediately that the flooding of $Z_{i+1}$ (f) is performed in the zones of influence of the connected components of $Z_i$ (f) in $Z_{i+1}$ (f). Some connected components of $Z_{i+1}$ (f) which are not reached by the flood are, by definition, minima at level i+1. These minima must therefore be added to the flooded area. Denoting by $W_i$ (f) the section at level of the catchment basins of f, and by $M_{i+1}$ (f) the minima of the function at height i+1, we have [1]:

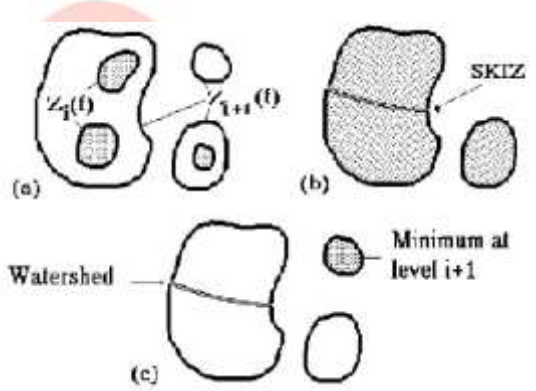



Figure 3: Watershed construction

$$W_i(f) = \left[IZ_{Z_{i+1(f)}} X_i(f)\right] \cup M_{i+1}(f)$$

The minima at level i+1 is given by:

$$M_{i+1}(f) = {Z_{i+1}(f)}\Big/{R_{Z_{i+1(f)}}(Z_i(f))}$$

Here $M_{i+1}$ is the local minima.

The iterative algorithm is initiated with$W_{-1}(f) = \emptyset$. At the end of process the watershed lines DL(f) is equal to:

$$DL(f) = W_N^c(f)$$ (With max (f) =N)

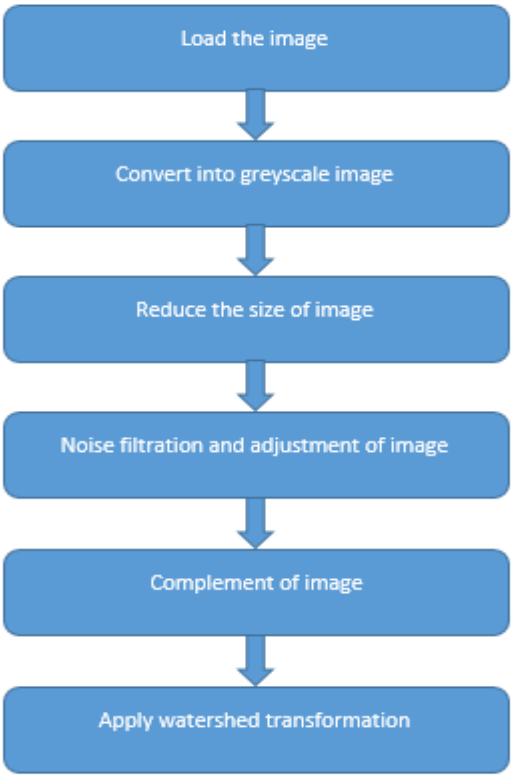
PSNR (Peak Signal to Noise Ratio):

$$PSNR = 10log_{10}\left(\frac{max^2}{MSE}\right)$$

Here max is equal to the maximum possible pixel value of the image and MSE is the mean square error of the image. Moreover, higher the value of PSNR better is the image segmentation [8, 16].

## IV. PROPOSED APPROACH

Here we have used a new approach of watershed algorithm for obtaining the better result in image segmentation. To do so a new algorithm is develop to get better and avoid the over segmentation. In the proposed approach, the input is a high definition color image. Then convert it into grey scale image. After that we reduce the size of the image which will help to avoid the over segmentation. After this, the noise is reduce from the resized image. After that, the adjustment of the image takes place and then compliment of the image has been there. At last, watershed transformation is applied to that image to get the desired result. After getting the segmented image calculate the PSNR of that image and compare it with the traditional watershed algorithm. The flow chart is given below:

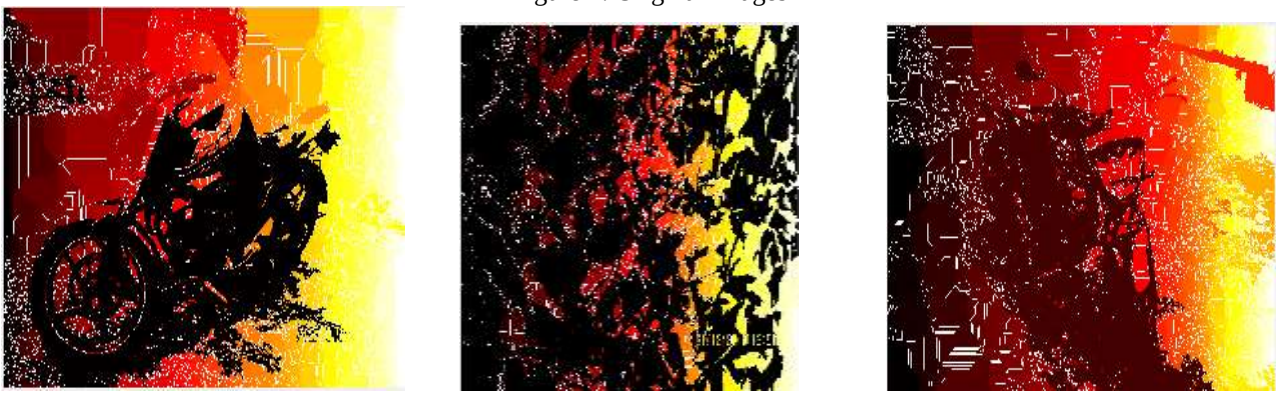



## V. RESULT AND DISCUSSION

Here we took a new approach of watershed transform to get the better result. We already discussed about the new algorithm earlier. We took three different high definition images. The first one image is of bike (4608 by 3456), the second image of the flower (4608 by 3456) and another image of the bike (4608 by 3456). Now the proposed algorithm is applied to these images to give the better segmentation. Here the figure (4) shows the original images. Next, the figure (5) shows the traditional watershed algorithm, here we can see that there is an over segmentation occur. Now figure (6) shows the proposed watershed algorithm, in this we can see that problem of image segmentation has been resolved.

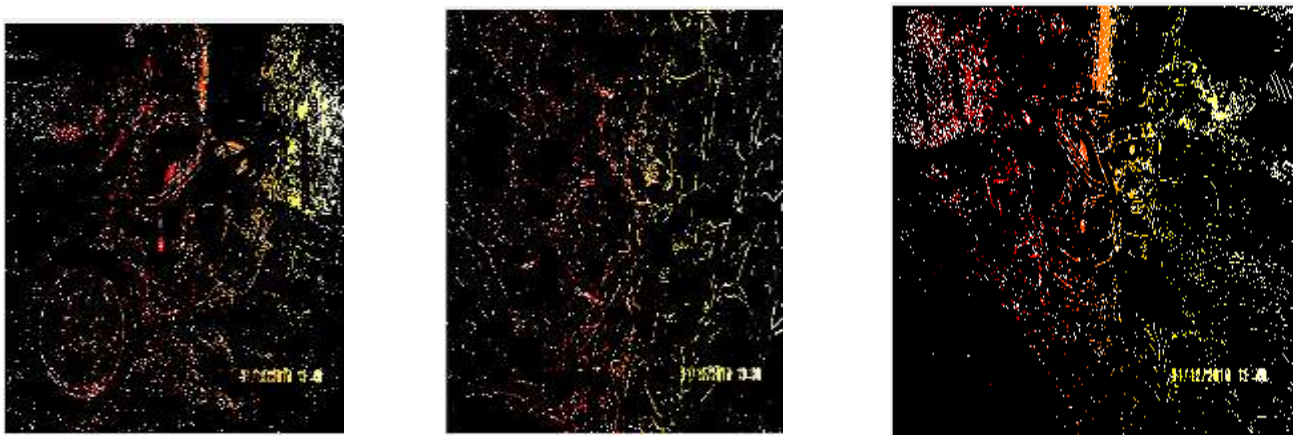
(a) Image 1 (b) Image 2 (c) Image 3

Figure 4: Original Images



(a) Image 1 (b) Image 2 (c) Image 3

Figure 5: Segmentation using traditional approach



(a) Image 1 (b) Image 2 (c) Image 3

Figure 6: Segmentation using proposed approach

The improvement in the image segmentation can be verify by viewing the PSNR value. Here we present a table of PSNR value in dB, which shows the comparison between the traditional watershed and the proposed watershed algorithm in table 1.

Table 1Comparsion of PSNR (Peak Signal to Noise Ratio)

| Image | Traditional watershed algorithm PSNR (dB) | Proposed watershed algorithm PSNR (dB) |
|---|---|---|
| Image 1 | 25.0416 | 35.118 |
| Image 2 | 27.683 | 36.2775 |
| Image 3 | 19.6803 | 34.0997 |

In addition, we show the comparison with the help of graph in figure (7).

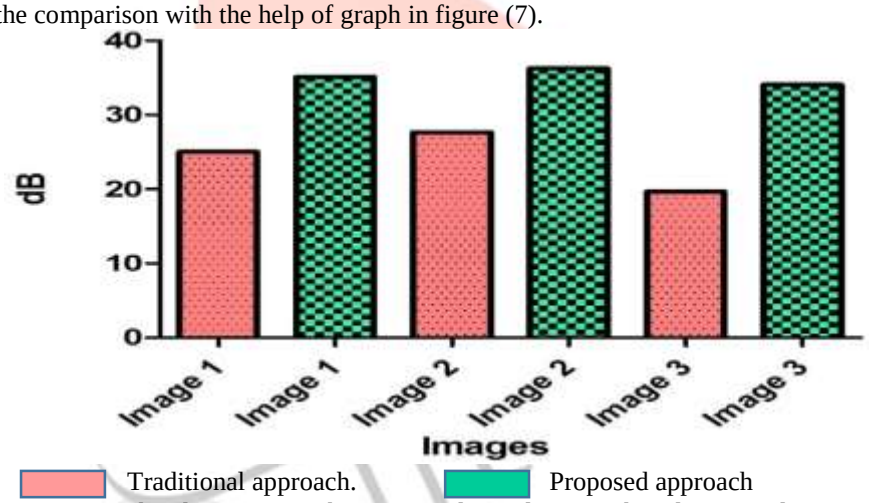



Figure 7: Graphical comparison between traditional approach and proposed approach

## VI. CONCLUSION

In image processing the edge detection is not subject to exemption. Therefore, in this paper we introduced an improved watershed algorithm approach successfully. From the above mentation table 1 we conclude that the proposed watershed algorithm gives us a better PSNR value and we earlier mentation that higher the value of PSNR will leads to the better image segmentation.

## REFERENCES

[1] S. BEUCHER, "The Watershed Transformation Applied To Image Segmentation", *Centre de Morphologie Mathématique Ecole des Mines de Paris 35, rue Saint-Honoré 77305 Fontainebleau Cedex (France)*.

[2] LAMIA JAAFAR BELAID1 AND WALID MOUROU2 *1Ecole Nationale d'Inge´ nieurs de Tunis & LAMSIN, Campus Universitaire, BP37, le Belve´de`re, 1002, Tunis, Tunisia; 2Institut National de la Statistique de Tunis & LAMSIN*, 70 rue Ech-Cham, BP256, 2000, Tunis, Tunisia (Accepted March 27, 2009)

[3] Nassir Salman, "Image Segmentation Based on Watershed and Edge Detection Techniques'' *The International Arab Journal of Information Technology,* Vol. 3, No. 2, April 2006

[4] Jos B.T.M. Roerdink and Arnold Meijster, "The Watershed Transform: Definitions, Algorithms and Parallelization Strategies'' *Fundamenta Informaticae* 41 (2001) 187–228

[5] Muthukrishnan.R 1 and M.Radha 2, "Edge Detection Techniques For Image Segmentation'', *International Journal of Computer Science & Information Technology (IJCSIT) Vol* 3, No 6, Dec 2011

[6] Anju Bala, "An Improved Watershed Image Segmentation Technique using MATLAB", *International Journal of Scientific & Engineering Research Volume* 3, Issue 6, June-2012 1 ISSN 2229-5518

[7] P.P.Acharjya1, A. Sinha2, S.Sarkar3, S.Dey4, S.Ghosh5 , "A New Approach Of Watershed Algorithm Using Distance Transform Applied To Image Segmentation'', *International Journal of Innovative Research in Computer and Communication Engineering* Vol. 1, Issue 2, April 2013

[8] Er.Samina Tahir Rizvi Er. Mandeep Singh Sandhu , "Image Segmentation using Improved Watershed Algorithm '', Samina Tahir Rizvi et al, */ (IJCSIT) International Journal of Computer Science and Information Technologies*, Vol. 5 (2) , 2014, 2543-2545

[9] Amanpreet kaur, Ashish Verma, Ssiet, "The Marker-Based Watershed Segmentation- A Review*'' International Journal of Engineering and Innovative Technology (IJEIT) Volume* 3, Issue 3, September 2013

[10] 1Priyanka G. Kumbhar, 2Prof. Sushil kumar N. Holambe, "A Review of Image Thresholding Techniques '', *Internatio nal Journal of Advanced Research in Computer Science and Software Engineering Volume 5, Issue 6, June 2015*

[11] Poonam Dhankhar 1, Neha Sahu 2, "A Review and Research of Edge Detection Techniques for Image Segmentation*'', International Journal of Computer Science and Mobile Computing IJCSMC, Vol. 2, Issue. 7, July 2013*

[12] Sujata Saini1 and Komal Arora2, "A Study Analysis on the Different Image Segmentation Techniques '' *International Journal of Information & Computation Technology*. ISSN 0974-2239 Volume 4, Number 14 (2014)

[13] Niket Amoda1, Ramesh K Kulkarni2 "Image Segmentation and Detection using Watershed Transform and Region Based Image Retrieval'' *International Journal of Emerging Trends & Technology in Computer Science* ISSN 2278-6856 Volume 2, Issue 2, March – April 2013

[14] Dilpreet Kaur1, Yadwinder Kaur2 "Various Image Segmentation Techniques: A Review" *International Journal of Computer Science and Mobile Computing* ISSN 2320–088X Vol. 3, Issue. 5, May 2014

[15] Geoffrey J. Hay et al, "An automated object-based approach for the multiscale image segmentation of forest scenes**"** *International Journal of Applied Earth Observation and Geoinformation* Volume 7, Issue 4, December 2005

[16] Monika Xess1, S. Akila Agnes2, "Analysis of Image Segmentation Methods Based on Performance Evaluation Parameters" *International Journal of Computational Engineering Research||Vol, 04||Issue, 3||*.