iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 **Issue:** III **Month of publication:** March 2015

DOI:

www.ijraset.com Volume 3 Issue III, March 2015
IC Value: 13.98 ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

"Marker-Controlled Watershed Transform in Digital Mammogram Segmentation"

Varsha J. Gaikwad

Abstract— Breast cancer is one of the major causes of death among women thus; to detect the breast cancer in digital mammogram, firstly we have to segment it properly. Segmentation refers to the process of partitioning a digital image into multiple segments. The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries in images. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image. Many algorithms have been proposed to improve the quality of segmentation in medical image analysis in that Marker Controlled Watershed algorithm is one such reliable approach to segment homogeneous regions in an image. It is superior to region growing method in terms of number of regions obtained after processing. In this paper a robust approach is discussed to improve, the primary drawback of watershed algorithm, over-segmentation. Only a few previous studies address the task of regularizing the obtained watershed lines from the traditional marker-controlled watershed segmentation. In proposed work we have used morphological marker controlled method and the use of gradient image for watershed algorithm to minimize over-segmentation in image analysis.
Keywords— Mammography, Morphological Operation, Marker Controlled Watershed, Image Segmentation.

I. INTRODUCTION

Breast cancer is one of the major causes of death among women. One in eight deaths worldwide is due to cancer. Cancer is the second leading cause of death in developed countries. Breast cancer screening is vital to detecting breast cancer. The most common screening methods are mammography and sonography. Compared to mammography, breast ultrasound examinations have several advantages: Breast ultrasound examinations can obtain any section image of breast, and observe the breast tissues in real-time and dynamically. Ultrasound imaging can depict small, early-stage malignancies of dense breasts, which is difficult for mammography to achieve.

With the help of digital mammogram we are able to detect the cancer with the help of some image processing technique. Firstly a very important task is to segment the mammogram properly which will be helpful for analysis of tumor [1]. Segmentation of an image is the division or separation of the image into regions of similar attribute. The most basic attribute for segmentation is image luminance for monochrome image and color components for the color image. Segmentation is required to distinguish objects from background.

In this paper we discuss the theory of marker controlled watershed transform and apply the algorithm for few test images. We also discuss marker controlled approach using morphological operations to improve the quality of watershed algorithm and to overcome its drawback of over-segmentation.

Morphological operations are the mathematical set theory operations that are very simple to use and mainly concerned with the ordering of the elements instead of the numerical values of members of the set. This mathematical morphology when combined with the logical operations gives very good results in image processing for performing operations like blurring, sharpening reconstruction and so on. Morphological operations are very much useful in watershed algorithm to construct dam between neighboring regions which is the key process in watershed algorithm.

In this research the MIAS image database total 322 has been used. Images acquired consist of left and right breast images of fatty, fatty-glandular and dense-glandular breasts.

The paper is arranged as follows: section II highlights marker controlled watershed algorithm, section III is on basic morphological operations, in section IV implementation results are discussed.

Before applying the images to watershed we have used a Thresholding technique to remove the pectoral part because it affecting on segmentation [2], [3].

II. MARKER CONTROLLED WATERSHED SEGMENTATION

The watershed transform is a tool morphological based for image segmentation [4], [5], [6]. Separating touching objects in an image is one of the more difficult image processing operations. So the watershed transform is often applied to this problem.

Watershed represents the boundaries between adjacent catchments as shown in fig 1. The minimum can be interpreted as markers of watershed regions.

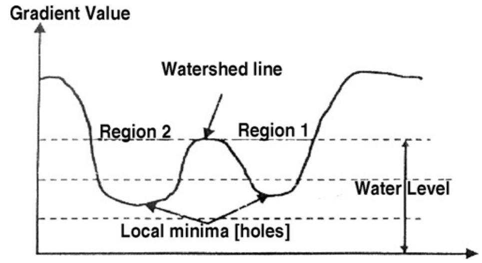


Fig 1: Watershed lines with catchments basins

The basic principle of watershed technique is to transform the gradient of a grey level image in a

Topographic surface, where the values of f(x, y) are interpreted as heights and each local minima embedded in an image is referred as a catchments basins [7].

The steps which illustrate the marker-controlled watershed approach as follows:

A. Firstly, compute the magnitude gradient of filtered & pectoral muscles removed image.

B. Compute the internal & external marker in order to identify all those regional minima's which have higher values than a specified threshold.

C. Suppress all other minima's except the minima's we specify from the gradient image & obtain the modified gradient image.

D. Compute the watershed of the modified gradient image in order to produce the watershed ridge lines.

E. Superimpose the resulting watershed ridge lines on the original image to show the final segmentation result.

F. Separate out the region of interest (ROI) from the segmented image.

III. MATHEMATICAL MORPHOLOGY

Mathematical morphology use morphological structuring element in order to measure and distill corresponding shape of an image to attain objective of analysis, to reduce image data and to keep basic shape character [8].

A. Opening

The morphological; opening of A by B, denoted by $A \circ B$ is simply erosion of A by B followed by the dilation of the result by B.

$$A \circ B = (\mathrm{A} \ \Theta \ \mathrm{B}) \oplus \mathrm{B} \quad (1)$$

Where,

$A \circ B$ Union of all translations of B that fit entirely within A

Morphological opening removes completely regions of an object that cannot contain the structuring element, smoothes the object contours, breaks thin connection, protrusions.

Opening and closing are two important operators from mathematical morphology. They are both derived from the fundamental operations of erosion and dilation [9].

B. Erosion

Erosion is the morphological dual to dilation. Erosion shrinks in a binary image. As in dilation, the manner and extent of shrinking is controlled by the structuring element.

The output of erosion has a value 1 at each location of the origin of the structuring element, such that the structuring element overlaps only 1-valued pixels of the input image.

The mathematical definition of erosion is similar to that of dilation.

The erosion denoted by $A \Theta B$, is defined as

$$A \Theta B = \left\{ z \mid B_z \cap A^c \neq \phi \right\} \quad (2)$$

In other words, erosion of A by B is the set of structuring element origin locations where the translated B has no overlap with the background of A.

C. Morphological reconstruction

Volume 3 Issue III, March 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

The morphological reconstruction is well known in the case of binary images, where it simply extracts the connected components of an image, which are 'marked' with another image [10].

Morphological reconstruction can be thought of conceptually as repeated dilations of an image, called the marker image, until the contour of the marker image fits under a second image, called the mask image. In morphological reconstruction, the peaks in the marker image 'spread out,' or dilate.

D. Closing

The morphological closing of A by B denoted by $A \bullet B$ is a dilation followed by erosion:

$$A \bullet B = (A \oplus B) \Theta B \tag{3}$$

Geometrically, $A \bullet B$ is the component of the union of all translations of B they do not overlap A.

Like opening, morphological closing smoothes the contours of the objects. Unlike opening, however, it generally joins narrow breaks, filling long thin gulfs, and fills holes smaller than the structuring element.

E. Dilation

Dilation is a process that translates the origin of structuring element throughout the domain of the image and checks to see whether it overlaps with 1-valued pixels. The output image is 1 at each location of the origin of the structuring element if the structuring overlaps at least one 1-valued pixel in the input image [11],[12].

Mathematically, dilation is defined in terms of set operations.

The dilation of A by B, denoted by $A \oplus B$

$$A \oplus B = \left\{ z \mid B^z \cap A \neq \phi \right\} \tag{4}$$

Where,

ϕ = empty set

B = structuring element

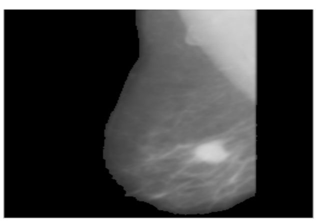
In words, the dilation of A by B is the set consisting of all the structuring element origin locations where the reflected and translated B overlaps at least some portion of A.

Dilation is commutative, i.e. $A \oplus B = B \oplus A$.

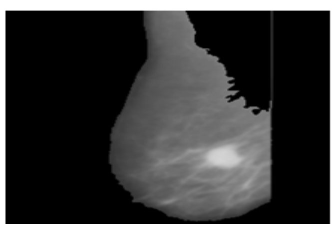
It is a convention in image processing to let the first operand of $A \oplus B$ be the image and the second operand is the structuring element, which is usually much smaller than the image. It is applied to binary images. The basic effect of the operator on a binary image is to gradually enlarge the boundaries of regions of foreground pixels (i.e. white pixels, typically). Thus areas of foreground pixels grow in size white holes within those regions became smaller.

IV. IMPLEMENTATION AND RESULTS

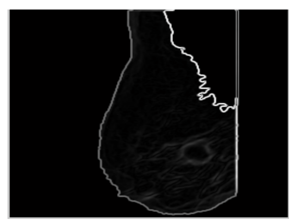
For marker controlled watershed segmentation implementation we have followed different steps of morphological operations with initial Thresholding preprocessing steps to remove the pectoral muscles part. The proposed algorithms are tested on 17 mammograms containing malignant masses. Expert-segmented data in all the images are provided in fig 2.



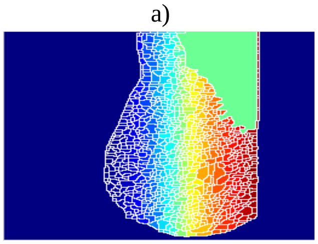
a)



b)



c)



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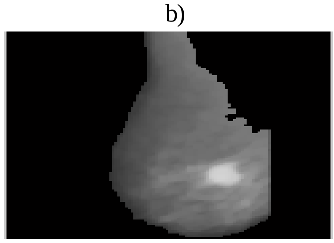
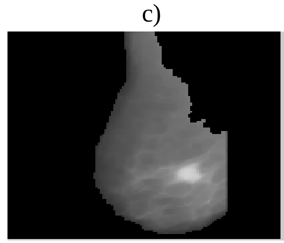


e)



f)

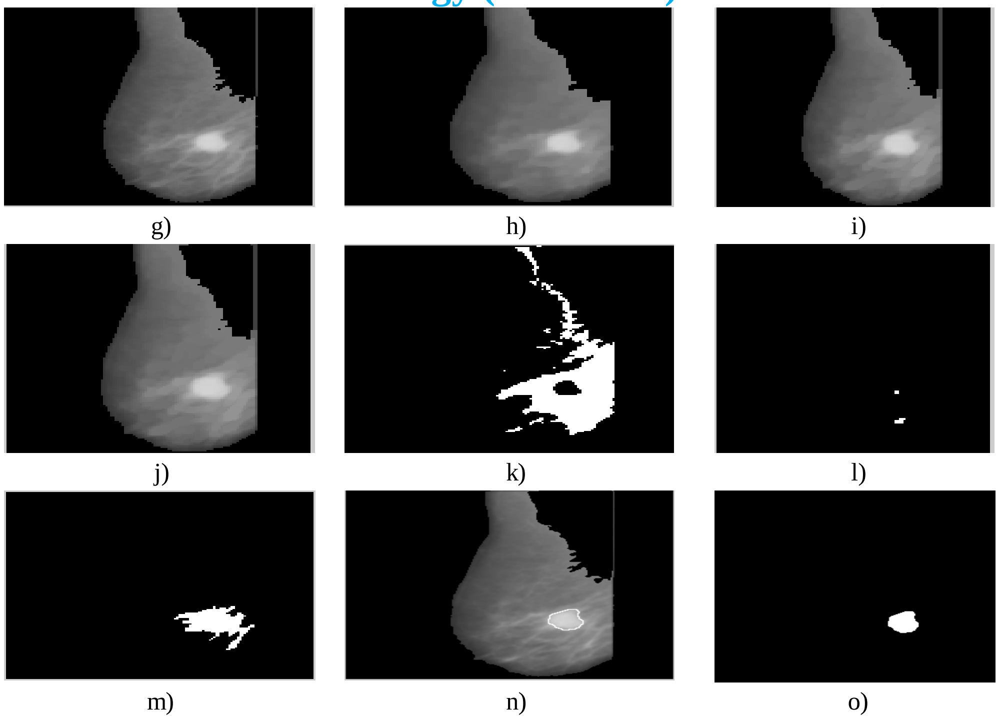


Fig 2: Different Segmentation steps a. Sample Mammogram Mdb028,b) Pectoral Muscles Removal, c) Gradient Magnitude) Watershed of gradient image, e) Opening, f) Erode, g) Opening by Reconstruction, n) Opening-Closing, i) Dilate, j) Complement k) Impose minima, l) Regional max, m) Binary, n) Segmented image with ridges lines, o) Final ROI detection mdb028.

V. CONCLUSION

We conclude that the proposed algorithm is superior to conventional algorithm in terms of over-segmentation. Despite of giving a good output the proposed algorithm in future it can still be improved to get accurate results by using mathematical transformations.

REFERENCES

[1] B.monica jenefer,v.cyrilraj "An efficient image processing methods for mammogram breast cancer detection" Journal of Theoretical and Applied Information Technology, ISSN: 1992-8645, 10th November 2014. Vol. 69 No.1 2005 – 2014.

[2] Raba D, Oliver A, Martí J, Peracaula M, Espunya J. "Breast segmentation with pectoral muscle suppression on digital mammograms",Lecture Notes in Computer Science. Berlin: Springer-Verlag; 2005. p. 471–78.

[3] Jawad Nagi , Sameem Abdul Kareem , Farrukh Nagi , Syed Khaleel Ahmed "Automated Breast Profile Segmentation for ROI Detection Using Digital Mammograms", 2010 IEEE EMBS Conference on Biomedical Engineering & Sciences (IECBES 2010), Kuala Lumpur, Malaysia, pp87-99,2010.

[4] D. Sujitha Priya "Breast Cancer Detection In Mammogram Images Using Region-Growing And Contour-Based Segmentation Techniques" International Journal of Computer & Organization Trends, Volume 3, Issue 8 Sep 2013, ISSN: 2249.

[5] Prakash Bethapudi , Prakash Bethapudi , Dr.Madhuri.P "Detection of Malignancy in Digital Mammograms from Segmented Breast Region Using Morphological Techniques" IOSR Journal of Electrical and Electronics Engineering, e-ISSN: 2278-1676,p-ISSN: 2320-3331, Volume 5, Issue 4 pp 09-12,(May. - Jun. 2013).

[6] Ahmad EL ALLAOUI and M'barek Nasri "Medical Image Segmentation by Marker-controlled Watershed and Mathematical Morphology" International Journal of Multimedia & Its Applications (IJMA) Vol.4, No.3, June 2012.

[7] K. Parvati, et al, "Image Segmentation Using Gray-Scale Morphology and Marker-Controlled watershed Transformation",Discrete Dynamics in Nature and Society, vol. 2008, Article ID 384346, 8 pages, 2008.

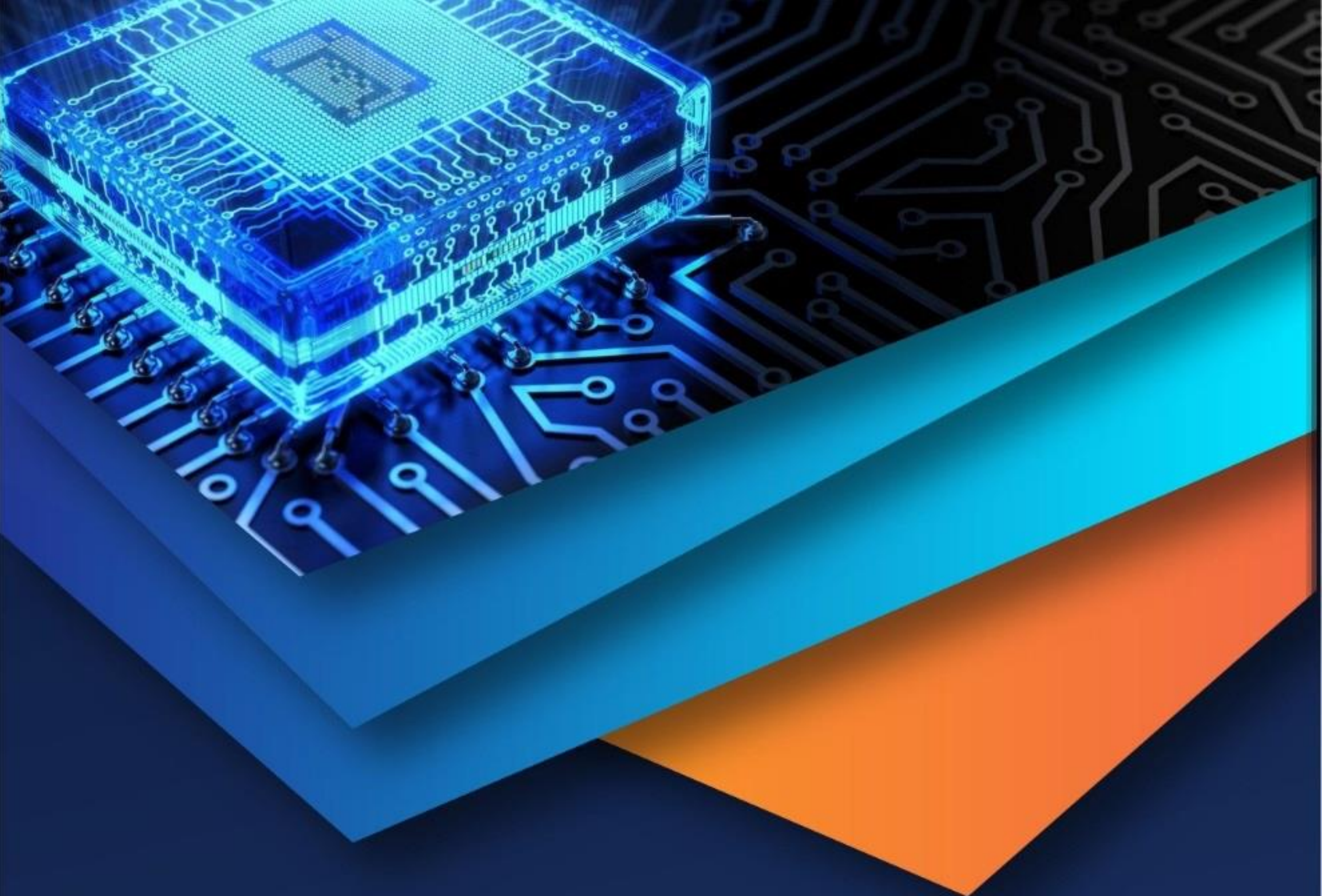
[8] Anju Bala "An Improved Watershed Image Segmentation Technique using MATLAB" International Journal of Scientific & Engineering Research, Volume 3, Issue 6, June-2012 1 ISSN 2229-5518.

[9] Prakash Bethapudi, Dr. E. Srinivasa Reddy, Dr.Madhuri.P "Detection of Malignancy in Digital Mammograms from Segmented Breast Region Using Morphological Techniques" IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) e-ISSN: 2278-1676, p-ISSN: 2320-3331, Volume 5, Issue 4 (May. - Jun. 2013), PP 09-12.

[10] Mandeep Kaur, Gagandeep Jindal,"Medical Image Segmentation using Marker Controlled Watershed Transformation" International Journal Computer Sciences and Technology, Vol. 2, Issue 4, Oct. - Dec. 2011 ISSN: 0976-8491,ISSN: 2229-4333.

[11] B.monica jenefer,v. cyrilraj "An efficient image processing methods for mammogram breast cancer detection" Journal of Theoretical and Applied Information Technology, ISSN: 1992-8645, 10th November 2014. Vol. 69 No.1 2005 – 2014.

Armen Sahakyan "Segmentation of the Breast Region in Digital Mammograms and Detection of Masses" International Journal of Advanced Computer Science and Applications, Vol. 3, No.2, 2012.



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