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Hybrid segmentation and performance analysis of mammographic images

Veda B Paschapur, Rajasree P M, Anand Jatti

Veda B Paschapur, M.tech in biomedical signal processing & instrumentation, Department of Electronics Instrumentation Engg. R.V College of Engineering, Bengaluru, Karnataka-570059, Email: vedabpaschapur@gmail.com

Rajasree P M, Assistant professor, Department of Electronics Instrumentation Engg. R.V College of Engineering, Bengaluru, Karnataka-570059. Email: rajasreepm@rvce.edu.in

Dr Anand Jatti, Associate professor, Department of Electronics Instrumentation Engg. R.V College of Engineering, Bengaluru, Karnataka-570059. Email: anandjatti@rvce.edu.in

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Abstract - *Hybrid segmentation method is the coordination of 2 or more methods which will effectively give preferred results over the single segmentation technique. The new hybrid method is applied on 30 hospital images and experiment results of performance and graph is compared and analyzed among the breast cancer images. In this work, comparative analysis of various performance parameters like PSNR, MSE, and SSIM is obtained. Proposed hybrid segmentation gives better result on seeing the overall performance.*

Key Words: Mammography; Preprocessing; CLAHE; Segmentation; Hybrid segmentation.

1. INTRODUCTION

One third of global breast cancer occurs in India, China & USA according to WHO statistics in 2012. Around 144,937 peoples where detected with existing of breast cancer and 70,218 are suspected to death in India. Breast cancer is the well-known disease among ladies more than 40 years.[1] Considers have demonstrated that early location and treatment can increase the reduction of rate of breast cancer & also in increasing the survival rate of patients. Early recognition of little tumors in breast helps visualization and prompts a huge decrease in mortality. Mammography is for this situation the best analytic procedure for screening. In many case, the understanding of mammograms is mainly difficult due to little contrasts and variations in density of various tissues present in an image. The investigation could reveal radiologists an upper level comprehension of generalizations and gives, in the event that it is identified at an initial stage, a higher ranking guess triggering a significant reduction in mortality. Nearly 80%-90% of the breast cancer diseases in ladies is identified by Mammography without any indication. Due its straight forwardness, convey potential & cost effective mammography is the best and practical breast imaging methodology. Around 33 % of patients experience initial Breast Cancer (BC) stage with illness repeat after early detection. Breast cancer if detected early is less demanding to treat, with less dangers and decreases death rate by 25%. An early identification thus may be done by subjecting ladies at danger (for the most part postmenopausal ladies) to a mammography at orderly intervals, breast tumor takes 5 years to reach 1mm growth in 2 more years to reach 5mm and it may take 2 years to reach around 2cm.[2]

Segmentation is the division of the image input into non-overlapping regions. Usually, it compares to the extraction of objects from the background. The segmentation should be possible with a specific end goal to get areas of suspicious areas to help radiologists for finding abnormalities. Segmentation intends to find conceivable regions of interest (ROI) and it is the front-stage preparing of image compression. Hybrid segmentation method is the coordination of 2 or more methods which will effectively give preferred results over the single segmentation technique. [3]

2. PRE-PROCESSING OF AN IMAGE

In medical related images, low contrast image examination is a testing issue. Low contrast computerized images diminish the capacity of onlooker in image study. Histogram based strategies are utilized to upgrade contrast of all kind of medical images. They are mostly utilized for all kind of medical images, for example, for MIAS-mammogram images, these strategies are utilized to discover accurate areas of cancerous regions and for low-dosage CT images, these techniques are utilized to increase contrast of small objects like vessels, lungs, and pulmonary crevices. CLAHE varies from conventional AHE out in its contrast constraining. This component can likewise be applied to global histogram equalization out, offering ascend to CLHE, which is rarely utilized as a part of practice. On account of CLAHE, the contrast limiting method must be applied for every area from which a change in transformation is determined. CLAHE is developed to overcome the disadvantage of over amplification of noise [4]

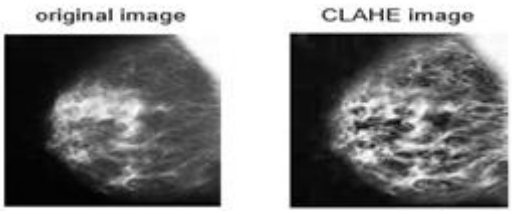

Fig1: Original image and CLAHE image

3. HYBRID SEGMENTATION

Hybrid segmentation method is the coordination of 2 or more methods which will effectively give preferred results over the single segmentation technique. Image segmentation goes about as a heart to the order strategy. The, proposed framework predominantly centered around restorative imaging to concentrate tumor and particularly in mammogram images. It has high-determination and precise situating of delicate and hard tissues, and is particularly appropriate for the conclusion of breast tumors. So this sort of imaging is more reasonable to distinguish the abnormal occurring in breast. Breast tumor is irregular tissues which can be contrasted from typical tissues. This could be recognized by the structure of tissues as shown in fig.3

Proposed work

Mammogram image containing cancerous cell is taken as input image. This work contains 3 phases.

Phase 1: The pre-processing steps have done using CLAHE i.e. Gray scale conversion and contrast enhancement to improve quality of image.

Phase 2: The contrast image is then applied with canny edge horizontal & vertical masks and parallel k-means algorithm and finally combined both the images and applied watershed segmentation.

Phase 3: Performance of the proposed method is measured by parameters such as PSNR, MSE & SSIM and comparison is made between them.

Performance analysis parameters are used to analyze which method has signal noise ratio, error and similarity between the original image and segmented one are calculated which is helpful for further process like feature extraction in classification.

Mean Square Error [MSE]: The aim of MSE is to compare 2 images by providing an appropriate value that represents the error or noise between the 2 images.

The error between the 2 images is calculated as

$$\mathrm{MSE} = 1/\mathrm{MN} \sum_{m=1}^{m} \sum_{n=1}^{n} \left[f\left(\frac{m}{n}\right) - f\left(\frac{m}{n}\right) \right] \ldots\ldots\ldots(1)$$

Peak Signal to Noise Ratio [PSNR]: It is the ratio of interference noise and maximum power possible and its unit is decibel scale and is given by

$$\mathrm{PSNR} = 10.\log_{10}[(255)^2/\mathrm{MSE}] \ldots\ldots\ldots\ldots\ldots(2)$$

Structural Similarity Index [SSIM]: It estimates the visual impact of shifts in image luminance, changes in image contrast and other remaining errors, entirely recognized as change in structure and is calculated as

$$\mathrm{SSIM}(x,y) = [l(x,y)]^{\alpha}[c(x,y)]^{\beta}[s(x,y)]^{\gamma} \ldots\ldots(3)$$

The contrast, structural components, & luminance are individually given by following equations [9]

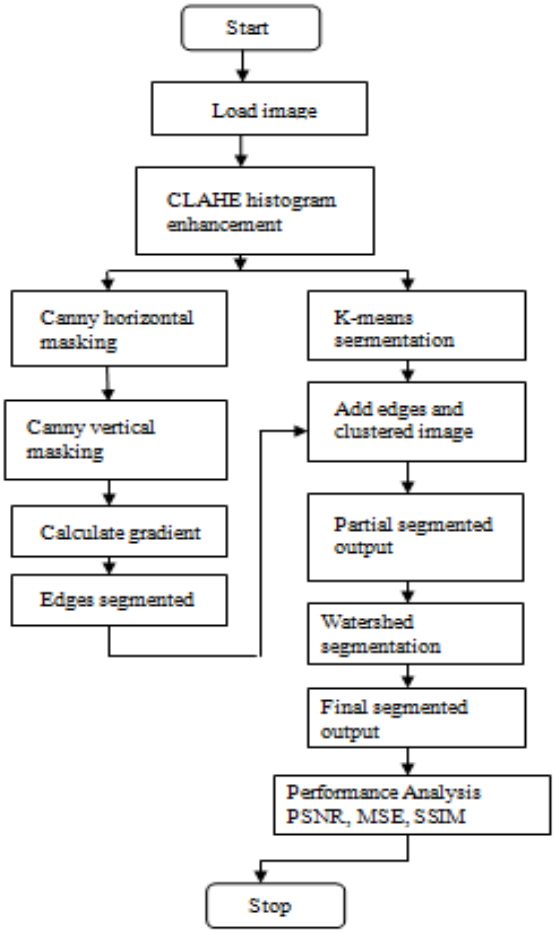

Fig2: Flowchart of hybrid segmentation

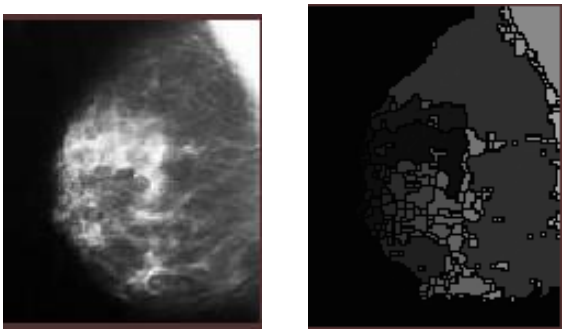

Fig3: a) Original image b) Hybrid output

$$l(x,y)] = \frac{2\mu_x\ \mu_y + C_1}{\mu_x^2 + \mu_y^2 + C_1} \ldots\ldots\ldots\ldots(4)$$

$$c(x,y)] = \frac{2\sigma_x\ \sigma_y + C_2}{\sigma_x^2 + \sigma_y^2 + C_2} \quad \ldots\ldots\ldots(5)$$

$$s(x,y)] = \frac{\sigma_{xy} + C_3}{\sigma_x \sigma_y + C_3} \quad \ldots\ldots\ldots(6)$$

Where
μx- The mean of original image.
μy- The mean of coded image.
σx & σy- Standard deviations of signals x & y,
σxy is the covariance of the two images.

4. RESULTS

The three methods and new hybrid method is applied on taking 30 different patients images and experiments result of performance is compared and analyzed with the breast cancer images where it is being noted that PSNR was high and MSE was low and SSIM was high in hybrid method which can be seen in the graph.

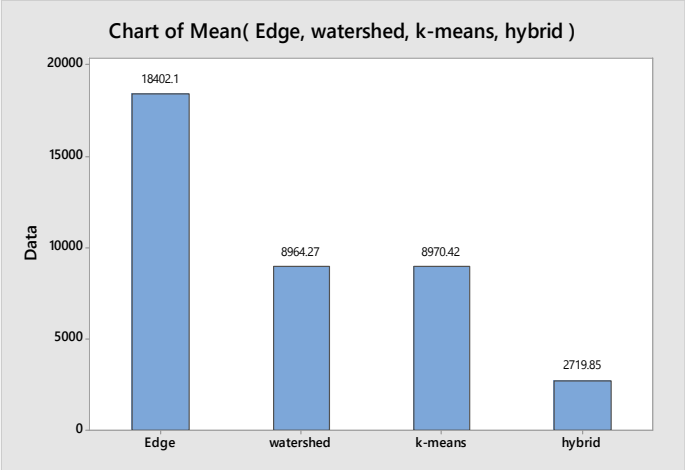

Fig4: Mean value of PSNR for 30 images

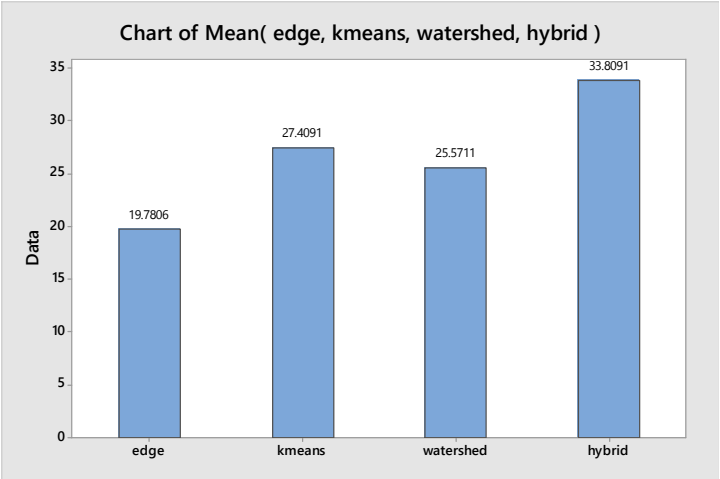

Fig5: Mean value of MSE for 30 images

The signal to noise ratio is high in hybrid segmented output image that is 33.8091 whereas the other methods such as k-means, canny edge and watershed segmented output images have less PSNR.

The error in the hybrid image is less as seen in fig4 as compared to other methods. The SSIM should be high which means the structure similarity between output hybrid image and original image matches.

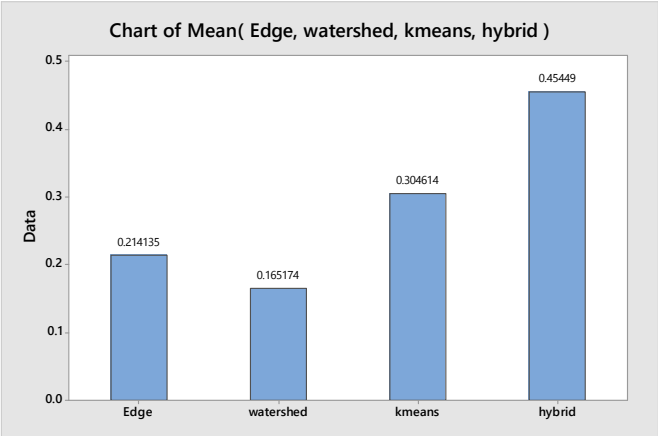

Fig6: Mean value of SSIM for 30 images

5. CONCLUSIONS

Image segmentation automatically is a very important part for detection of breast cancer in medical image processing. Hybrid segmentation which is implemented here overcomes the problems with that of early existing methods of segmentation where the PSNR is high and MSE is low. Different other parameters can be used to calculate the performance of hybrid segmentation and note the drawback of this method these drawbacks had overcome by different hybrid automatic segmentation to have better techniques for segmentation in medical images.

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