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Robust Contrast Enhancement Using Gamma Correction and Contrast Stretching Using Laplacian Pyramid for Detection of Microcalcification in Mammography

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***Abstract* - In this paper, the use of different enhancement techniques to increase the contrast of the mammogram is presented. By far, the best method to come up with is the Laplacian pyramid method. In this method, the original image is convolved with a Gaussian kernel which is a low pass filtering operation with the band limit reduced correspondingly by one octave with each level. The Laplacian Pyramid differentiates smoothed brightness values and produces a set of band pass filtered copies of the original image. The Laplacian pyramid with level 5 is presented in this paper. Then the reconstructed images are finally brought back the original image with increased contrast by subtracting the images of each level of the pyramid with the reconstructed images. It is shown that the visibility of micro calcification clusters and anatomic details is considerably improved in the processed images. The code of this algorithm is generated using MATLAB 7.5 software.**

Index Terms:Mammogram,Enhancement, Equalization, Gaussian kernel, Laplacian Pyramid.

I. LITERATURE SURVEY

In 2007, Zhibo et.al. proposed a method which aimed at minimizing image noise. He optimized the contrast of mammographic image features and emphasized more on the mammographic features. He achieved it by applying a nonlinear mapping function to the set of coefficient from each level. He also used contourlets for more accurate detection of microcalcification clusters. The transformed image is denoised using stein's thresholding. In 2007, Fatemehet.al.focused on the analysis of large masses instead of micro calcifications. Thus, making it easier to Detect /Classify mammograms: Normal and Abnormal. He also used Contourlets Transform for automatic mass classification.

In 2008, Papadopoulus et al. proposed a method for Microcalcification detection using neural network by Pre-processing image enhancement. He got best results by applying the local range modification algorithm, redundant discrete wavelet linear stretching and shrinkage algorithm.

In 2009, Razzi et al. proposed a two-stage decomposition wavelet filtering wherein, the First stage reduced the background noise; and the second stage used a hard thresholding technique to identify microcalcification. In 2010, Balakumaranet.al.focused on Microcalcification Detection using Wavelet Transform and Fuzzy Shell Clustering. In 2011, Camiluset al. proposed an efficient method to identify the pectoral muscle using a Watershed transformation and a merging algorithm to combine catchment basins.

In 2013, Zhang et.al.proposed a method where he used Hybrid Image Filtering Method for morphological image processing using Wavelet transform technique. He focused more on the presence of microcalcification clusters. In 2013, Lu et.al.used Hybrid Image Filtering Method for Multiscale regularized reconstruction. He mainly focused on detecting subtle mass lesions in Digital breast tomosynthesis (DBT) by Noise regularization in DBT reconstruction.

In 2014, Leeuwet.al.Used Phase derivative to detect microcalcifications. A template matching algorithm was designed which focused on detecting microcalcifications in breast specimens using MRI, a Noise regularization in image reconstruction. In 2014, Shanklaet.al.proposed a method for automatic insertion of simulated microcalcification clusters using a software breast phantom. It mainly focused on the Algorithm which was developed as part of a virtual clinical trial (VCT). It includes the simulation of breast anatomy, Mechanical compression, Image acquisition, Image processing, displaying and interpretation.

In 2015, A Survey on Enhancing Mammogram Image was done by T.A.Sangeetha, M.Sc., M.Phil., (PhD). And Dr.A.Saradha on various enhancement techniques.

II. MOTIVATION

The motivation for this research springs from the problem of not detecting the breast cancer in its early stages. So this gave the motivation for our research to move forward wherein the micro calcifications could be detected in its early stages before they are considered as malignant. So that we can quickly and accurately detect it in its early stages and overcome the development of breast cancer into its final stages.

Thus, by detecting it in its early stages it would lead to better Cancer Survival Rates. It also provides a "second opinion", i.e., a computerized decision support systems which is Fast, Reliable and Cost-effective.

III. PROBLEM STATEMENT

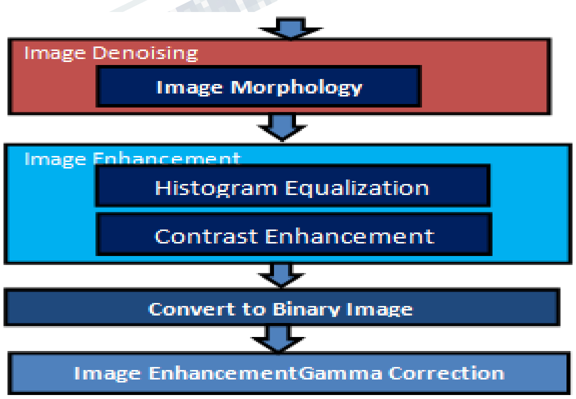
>To overcome the development of breast cancer quickly and accurately.

>For Better Cancer Survival Rates (Facilitate Early Detection).

IV. TECHNICAL APPROACH

The technical approach here is to use different enhancement techniques to increase the contrast of the mammogram. The proposed method to increase the contrast of Mammogram image is as shown below:

Mammogram



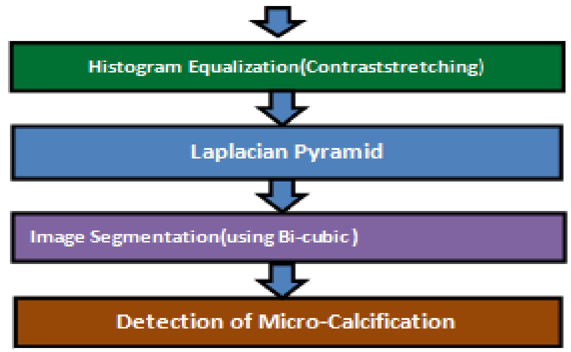


Fig 1: Flow chart for microcalcification detection

Gamma correction:

Gamma correction refers to change in the value of gamma to increase the contrast and the ratios of RGB.Without gamma shades captured by digital cameras wouldn't appear as they did to our eyes.

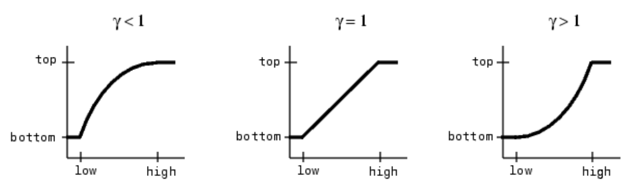


Fig 2: Gamma correction

Histogram equalization:

Image Histogram is a type of histogram that acts as a graphical representation of the lightness/color distribution in a digital image.

Histogram equalization is a technique for adjusting image intensities to enhance contrast which allows for areas of lower local contrast to gain a higher contrast.

Histogram equalization is of different types; namely adaptive histogram equalization, contrast limited adaptive histogram equalization. The type of equalization which we use is adaptive Histogram Equalization.

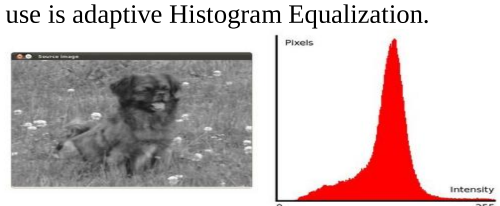
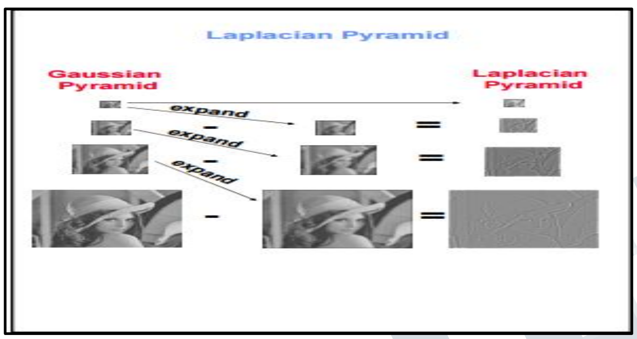


Fig 3:Histogram Equalization on an image

Laplacian pyramid:

A Laplacian pyramid is very similar to a Gaussian pyramid but saves the difference image of the blurred versions between each levels.

A Laplacian image is the difference between the two levels of the Gaussian pyramid and the Laplacian pyramid is a sequence of the differences L0, L1,….., Ln. The adjacent levels Gl and Gl+1 in the Gaussian pyramid are of different size, Gl+1 is expanded to achieve the same size of Gl. This can be obtained by an operator EXPAND, which is the reverse of the operator REDUCE



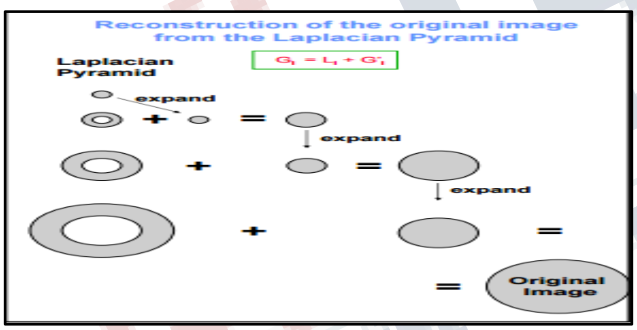
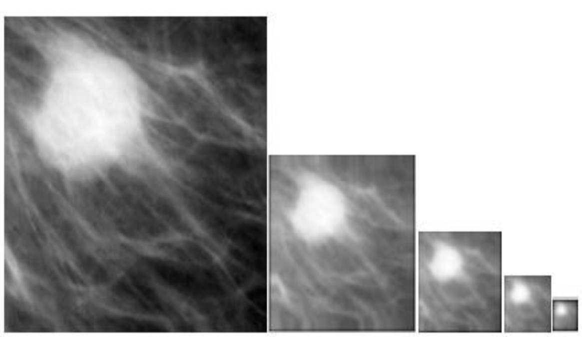


Fig 4: Image construction & Reconstruction using



V. SIMULATION RESULTS

Here we compare the simulation results of all the three contrast enhancement techniques to see which one gives us the best result.

1.Gamma Correction:

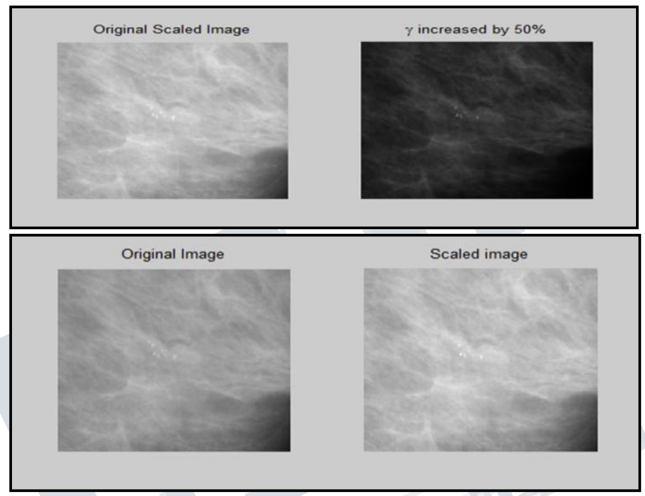
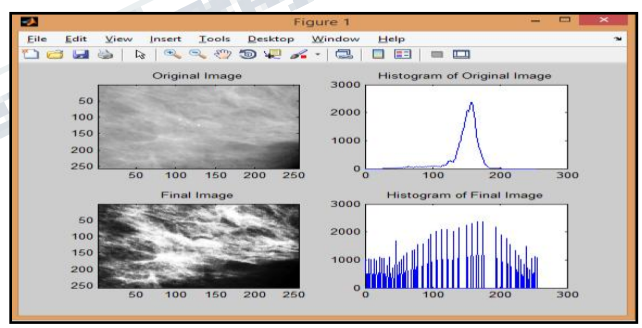
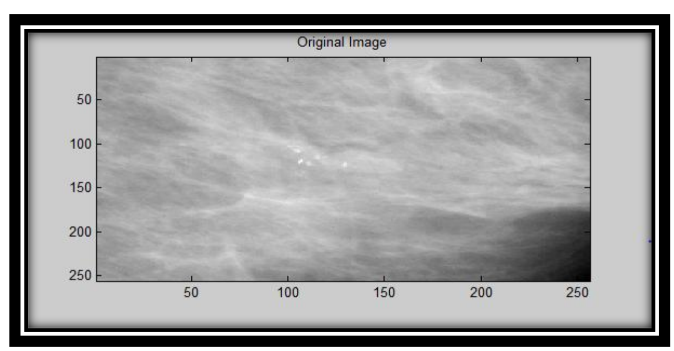


Fig 6: Gamma correction on an image

2.Histogram Equalization:





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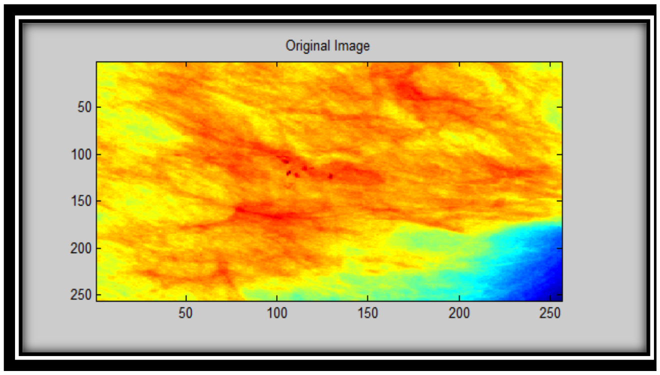

Fig 8: Original image is first converted into color and then the final image is seen

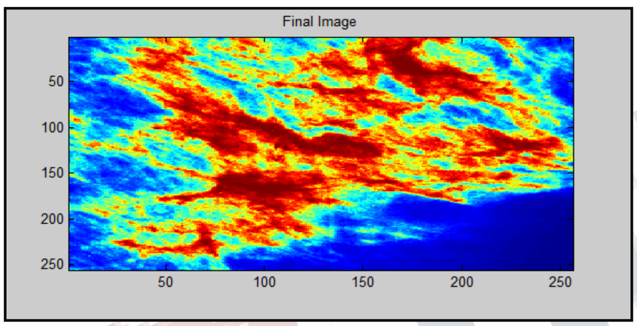

Fig 9: Final output image

Here, the program is modified such that we first convert the black and white image into color image and then the remaining program follows.Hence we get the final image in color.In the final image we can see the micro calcifications very clearly (The redarea).

3.Laplacian Pyramid:

In Laplacian pyramid, we used 5 stages. Outputs of all the 5 stages are shown below:

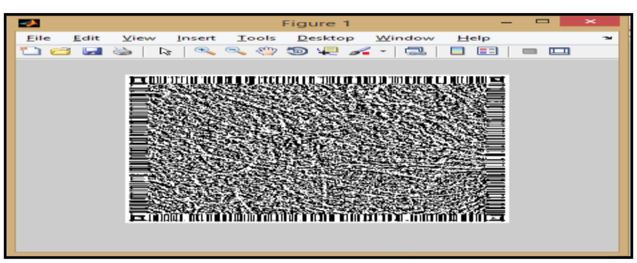

Fig 10: Stage 1 of Laplacian pyramid

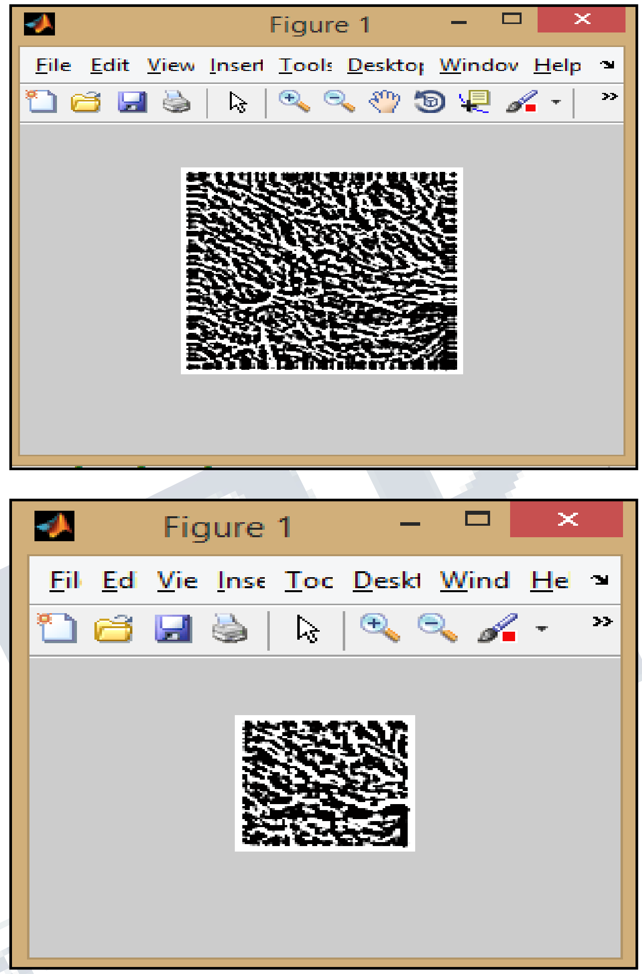

Fig 11: Stage 2 and Stage 3 of Laplacian pyramid

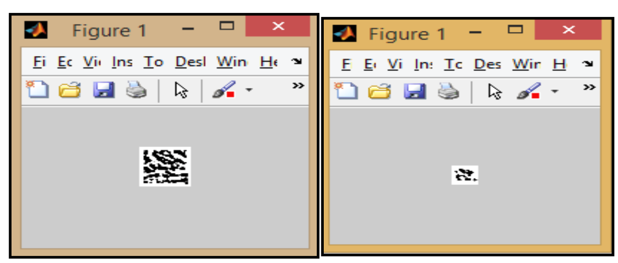

Fig 12: Stage 4 and Stage 5 of Laplacian Pyramid

These outputs of Laplacian pyramid are once again added to the reconstruction outputs of each level to finally obtain the contrast enhanced image.

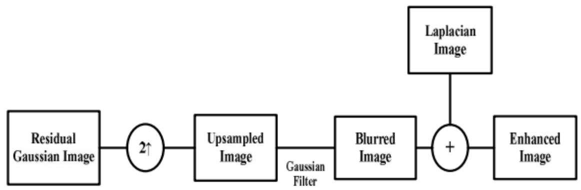

Fig 13: Reconstruction of Laplacian pyramid

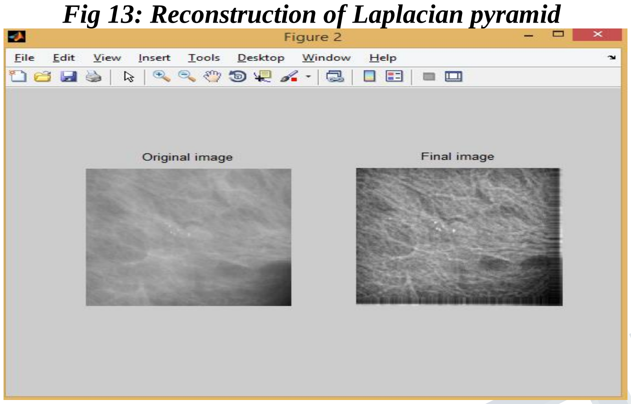

Fig 14: The final output of Laplacian pyramid

VI. CONCLUSION

Image enhancement techniques such as spatial and transform domain technique are important techniques. Most of the techniques are useful for altering the gray level values of individual pixels and hence the overall contrast of the entire image. But they usually enhance the whole image in a uniform manner which in many cases produces undesirable results. There are various techniques available which produce highly balanced and visually appealing results for a diversity of images with different qualities of contrast and edge information and it will produce satisfactory result. The aim of image enhancement is to improve the information in the images for human viewers. Image enhancement algorithms offer a wide variety of approaches for modifying images to achieve visually acceptable images. The choice of such techniques is a function of the specific task, image content, observer characteristics, and viewing conditions.

Image enhancement is the improvement of digital image, without knowledge about the source of degradation. In this paper a contrast enhancement technique for digital mammography based on a multi - scale Laplacian pyramid with level 5 is proposed. This paper presented a comprehensive classification and evaluation of mammogram enhancement algorithms. The enhancement techniques were categorized into four distinct techniques. The techniques being gamma correction, histogram equalization, unsharp masking and Laplacian pyramid. These techniques have been performed and evaluated. From the review, it is obvious that the results produced from the Laplacian technique are best suited for enhancing both masses and micro-calcifications. Several mapping functions based on empirical analysis were developed to enhance the subtle contrast of the digital mammogram. Since, subtle information such as, calcifications lie on different scales, this technique has special importance in digital mammography. The method enhances both the global and local features of the image by suppressing noise content of the image. Conventional image processing algorithms were compared experimentally with the proposed image processing algorithm which proves the acceptance of the algorithm for enhancing the contrast of digital mammography. The proposed method would be helpful for other image processing applications. The future scope will be the development of adaptive algorithms for effective image enhancement usingNeural Networks &FuzzyLogic.

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