International Journal of Engineering and Techniques -Volume 4, Issue 5, Sept - Oct 2018

RESEARCH ARTICLE OPEN ACCESS

Extraction of Lesions and Micro calcifications from Mammograms of Breast Images: A survey

Abhay Goyal

Abstract:

Images taken from different scans have always been a method of detection and evaluation of different disease in the field of medicine. The paper presents an array of enhancement methods which can be applied to mammographic images. The paper concentrates on image enhancement techniques and refinement of regions of concern. When the analysis of CT-scan or an MRI is carried out by a radiologist, it is the clarity of the image which plays a major role in the process of detection, a blurry or a grey scale image will not only obstruct the ROC but will also not allow us to extent of disease spread. The paper presents numerous ways of image enhancement techniques to choose from and conveys that there are things that can be done to detect breast cancer at an early stage to save lives.

INTRODUCTION

Cancer is a kind of disease in which the cells start to grow abnormally in any part of the body like breasts, brain, tongue, mouth, nose, leg etc. The paper concentrates on breast cancer. Now the important question is why breast cancer? Breast cancer is the 2nd most common type of cancer in India and mostly in rural India. Of all the types of cancer that effect women, breast cancer tops which takes nearly 30 % of all the different types. There are majorly 2 types of methods of cancer detection, namely invasive and non-invasive. Breast cancer is a non-invasive method, of detection. MRI has always been a better method of taking scans rather than any other type of scans such as X-rays of CT scans as they use 3T field which yields better images precision and clarity of image.

METHODOLOGY

Image Segmentation

Image segmentation is a method which partitions images into different and distinct regions with similar parts or features or attributes. These regions are useful in image analysis and are then used to relate to depict features and areas of interest. The success of partitioning depends on the ability of partitioning accurately which is a challenging problem. Segmentation techniques can be either contextual or non-contextual. The latter take no account of spatial relationships between features in an image and group pixels together on the basis of some global attribute, e.g. grey level or colour. Contextual techniques additionally exploit these relationships, e.g. group together pixels with similar grey levels and close spatial locations.

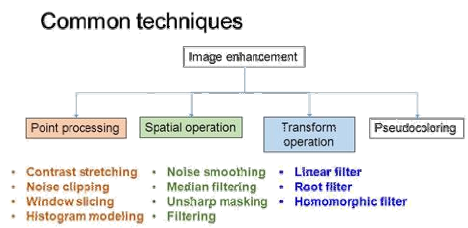

Image enhancement

The main goal of image enhancement is to improve the interpretability and the perception of images for human viewers or for other automated processes. It is majorly classified into 2 parts namely

1.Spatial Domain methods

2.Frequency Domain methods/Transform methods

3.Point Processing

Histogram Equalization

In histogram equalization, the whole image is improved by equalizing the important parts to improve the visual appearance of the image.

Unsharp mask filtering

Unsharp masking is an image sharpening technique which is the technique to better the blurred or negative image to create a mask of original image. It is generally categorized into linear and non-linear filter.

Contrast enhancement

Contrast in image enhancement plays a important role for the subjective evaluation of the image. Contrast is created by difference in visual properties and make object distinguishable from other images. The visual system is more sensitive to contrast rather than absolute luminance.

Fourier transform

Fourier transform is a method to analyze the frequency components of the image. However, if we take Fourier Transform of the whole time the, we cannot tell at what instant the particular instant the frequency rises. Hence, short time Fourier Transform uses a sliding windows to get both time and frequency. But still the length of the window limits the resolution .Wavelet transform is the solution to the problem above.

Related Work

Jong et al.[1] proposed an adaptive image enhancement method for mammographic images, based on the first derivative and the local statistics. The adaptive enhancement method consists of three processing steps. Local statistics of the image are utilized for adaptive realization of the enhancement, so that image details can be enhanced and image noises can be suppressed. The proposed model was evaluated using the ROC

Curve. 78 X-ray mammograms were used to test the formula. 50 out of the 78 consisted of clusters of micro calcifications. To check the detectability 3 radiologists were also given the images and they reported the confidence in form of 5 different levels. The images were first enhanced by film-artifact removal and these were the divided 2 parts of which one was further enhanced and then these were compared to each of the division. However, the difference between the enhanced images with artifact-removal and original images was not significant, because the film-artifacts effect the performance in a false positive manner.

Song et al.[2] proposed an enhancement in HE or histogram equalization which is a good way to enhance the images but this may lead to the decreasing in contrast in the images and so the bi-histogram contrast enhancement is used in which the data is divided into two from the mean. To show the performance of the algorithm they have been compared with other algorithms and using special images. The proposed algorithm on comparison shows that the algorithm increases the brightness. The paper formulates a efficient recursive and integer based solution. Simulation result show that very low, very high contested images were not handled properly by other algorithms but this can be done effectively by MMBEBHE. The Equal Area Dualistic Sub-Image Histogram Equalization (DSHIE) is seen to outperform it.

Karen et al.[3] introduce a novel method to better the image quality. The author uses, NLUM i.e. non-linear unsharp masking. In unsharp masking the high frequency elements of the image are amplified and a new filtered image is produced which is then fused with the original image which leads to a better image quality . A set of 19 mammograms selected. 4 algorithms applied namely:-NLUM, RUM, ANCE, CLAHE and 95 images in all. Evaluation shows that NLUM method is best. To optimize the design parameters in NLUM, SDME enhancement is used. A total of 8 coefficients are used in NLUM. 322 mini mammograms were used to test the data. All test mammograms were cropped up images. RUM was good but shows spots artifacts. ANCE also has the same performance as RUM. CLAHE over enhances the images background and hence is not preferred. DICE is a good method but is not accepted due for overall enhancement which leads to enhancement of unwanted regions of the image. ROC curve was made to analyze the images. The ROC curve is used to measure the false positive and false negative relation. The mammograms were made into 2 groups: the original and the enhanced ones. The co-author being a medical profession tested the images and they were divided into truly mammogram and false mammograms. The area under curve or the AUC is between 0 to 1. The enhanced ones had the value of 0.957 while the not enhanced ones had the value of 0.874 which clearly shows that the diagnosis was made better by the algorithm. . There are many benefits of this and its helps in adding the flexibility of 1)embedding filters 2)choose different linear and nonlinear operations 3) allowing the manual selection of NLUM parameters.

Nicholas et al.[4] introduced the DWCE i.e. density-weighted contrast enhancement method wherein the elements of the image are enhanced and so with this enhanced structure, the Laplacian-Gaussian edge detection can be done which makes it easier to locate the places and classify them as needed as the boundary is known. The DCWE segmentation removed mass objects from 25 subsampled images. Splitting was not applied to them as the detected regions were much smaller than true structures. For comparison LDA and BPN algorithms were used. The algorithm is applied locally to each object and allows the filter to adapt to the intensity distribution under ROI. As the images are growing bigger by merging their splitting can lead to edge locations lessening the effect of classification stage. It was found that the end enhancement was better than the BPN and LDA.

Jinsahn et al.[5] tried to applied wavelet transform and multiscale representation of image to show the different places of the breast and the mammogram can be viewed in a better manner. This will help the radiologists in viewing the images and will allow them to understand the exact region of infection. The images were selected from the database of University of Florida and the experiment . For this, a performance measure is defined based on the Laplacian operator in a region of image. The region contrast of 10 regions is selected which and the region consisting of calcifications was measured in the experiment. 10 parts from these 10 images of different mammograms was selected. The image is enhanced and then the region contrast value was computed. It was seen that the parts cropped from enhanced image had better contrast than the original image but there is a limitation to this enhancement and cannot be made better beyond a threshold value as that would enhance noise and background variations. 3 algorithms are compared namely the unsharp masking, histogram equalization and the direct enhancement and it was seen that the proposed was the best algorithm. Human subjective test was carried out in mammograms. The group consisted of 20 cancerous and 20 non-cancerous images. One group was used with enhancement and the other without the enhancement. With image enhancement, the expert selected an ROI in the images and then the proposed image enhancement was used to enhance the region selected. In the proposed model the enhancement is uniform and it is easy to adjust it using a single parameter. Future work can be done for non-uniform enhancement of these images which will enhance only the important regions. This can be done by weighing the regions after enhancement and then further concentrating on them the second time. This will make the enhancement 2 fold.

Heinlein et al.[6] proposed a new algorithm for the enhancement of micro calcifications in mammogram. Filter banks are made out of the continuous wavelet transform. These discrete wavelet discrete wavelet decomposition called integrated wavelets are designed to enhance the multiscale structure of image. The model also refines existing methods and makes it more specific to micro calcification. This has also been implemented in a mammogram workstation for softcopy reading at IMAGETOOL, Germany. For comparing we have used the comparison between the filter approach of wavelets and wavelet for edge detection. The image shows that the filter approach for making the wavelet is much better than the edge detection method. The enhancement operator is further increased by exploiting the additional knowledge of wavelets. A feature namely local regularity is added so as to differentiate the film scratches from the micro calcifications. This algorithm outperforms it predecessors and hence is a good method.

Arianna et al.[7] suggested a novel method of detecting microcalcifications and masses by making the image better using the dyadic wavelet processing. The denoising phase is based on a local iterative noise variance estimation. An adaptive tuning of enhancement degree is proposed at different wavelet scales for microcalcifications, whereas in the case of mass detection, a new segmentation method combining dyadic wavelet information with mathematical morphology is used. The innovative approach consists of using the same algorithmic core for processing images to detect both microcalcifications and masses. The data has been taken from, DDSM i.e. Digital Database for Screening Mammography. It contains approximately 2500 images. The information from the algorithm was compared with that of the radiologists. The Region of Interest (ROI) of original image with microcalcifications lesion was seen and it can be seen the piecewise operators make the microcalcifications more prominent. The preliminary test of 106 images shows that lesion was identified correctly, whereas the edge contour was overlap by more than 0.5 with mean of 0.8 and the radiologists declared that shape of contour was correct. It is said that is this method is better as it has adaptability feature in the image under analysis.

Results and Analysis

The survey has been presented focusing on the methods of image enhancement and it can be said that the different methods are good enough for the betterment of the images. The spatial method uses statistics and derivatives which helps in not only breaking the whole image into parts so as to enhance it piecewise but also makes it combine and a lot of the work done by radiologists can be done by them. Similarly, the wavelets method in the frequency domain helps by making the images into waves and this helps in edge clarification and enhancement of the images. The histogram enhancement method is betterment of the previous one which helps in contrast imaging enhancement.

Conclusion and Future Work

From the survey, we can conclude that there has been considerable research in this area of enhancement and there are many people who have done this but there is still scope of betterment wherein we use advanced mathematical tools such as second derivative to get a finer detail into the image. A better method of using the advanced mathematics would certainly open many new areas of research and betterment in this area.

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