Performing Enhancement of Mammogram Images Based on ROI

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Abstract: *The study has proved that breast cancer affects one out of every eight women in their lifetime. The early detection of abnormalities can reduce the risk factor up to large extent. Mammography is the effective strategy for screening breast cancer as small clusters of micro calcifications looks as white spots on mammograms showing early sign of breast cancer. The early detection depends upon the quality of mammograms and of course on the ability of radiologist's to read mammograms. The research paper focuses on the performing enhancement of poor quality images on the ROI (Region of Interest). The paper illustrates the procedure followed in enhancing the image via appropriate images.*

Keywords: *Enhancement, Mammograms, Mammography, Median Filter, ROI.Abbreviations – AHE, CLAHE, DM, DR, NPDR, PDR*

1. INTRODUCTION

Image processing refers to convergence of an image into digital form and thereafter performing some mathematical operations on it with the motive of enhancing the image and extracting useful information from it. The input may be an image like photograph or video frame and the output is an enhanced image or characteristics associated with that particular image. Image processing finds in application in different sectors and medical science be the prominent one [9, 16]. The image processing comprises of three steps mentioned as under.

- First step involves importing the image via means of digital photography or optical scanner.

- Conducting appropriate manipulations on the input image like data compression, image enhancement and spotting patterns which are not visible to human eyes.

- The last stage is of obtaining output in the form of altered image or a report derived from detailed image analysis.

Breast cancer is the second leading cause of cancer affecting females in women, exceeded only by lung cancer.Mammography is among most demanding examinations in medical imaging which requires high contrast, fine details, minimum noise images, low patient motion, and suitable viewing conditions [17, 18]. The mammography must be performed using committed mammographic imaging equipment with low energy output imaging capability like tungsten anode at low kilovoltage of 30kVp or less or rhodium or molybdenum x-ray tube anode [14, 15]. Along with proper emphasis on use of technology, equal importance shall be laid on correct patient position and breast compression. Quality of image is of utmost importance in mammography and therefore an assurance of proper functioning of entire imaging chain is important. This involves the mammographic x-ray system, the photographic processor, the screens and film, and the view boxes, the viewing area, and digital displays [10, 11].

The need for developing new and innovative technologies for early detection of breast cancer is of utmost priority. As these technologies gets developed, the evidence-base for these becomes enough robust, effective and efficient screening tests superior to FFDM may develop. These new technologies may include below mentioned facts [12, 13].

- Improvements to breast imaging technologies: ABUS, contrast enhanced mammograph y, DBT, ductoscopy, electrical impedance tomography and positron emission tomography (PET).

- Imaging modalities that extend imaging of the breast: cone-beam breast computer tomography (CT) and molecular breast imaging.

- New breast imaging modalities: radar-based microwave imaging, optical breast imaging and spectroscopy.

- Computer-aided diagnosis, remote/tele-radiology, machine reading or other AI applications.

- Biological tests to detect abnormal proteins produced by cancers.

- Risk assessment tools and tailored risk-based screening, and

- Genomic testing or cancer gene fingerprinting.

2. LITERATURE SURVEY

K.Akila, L.S.Jayashree, A.Vasuki,(2015); stated about the importance of contrast enhancement in the field of mammographic image processing. Contrast enhancement can be broadly categorized into two broad categories of direct contrast enhancement and indirect contrast enhancement. Histogram equalization is one of the most prominent enhancement technique. The paper compared different indirect contrast enhancement techniques like HE, CLAHE, BBHE, RMSHE, and MMBEBHE. The parameters used for comparison are effective measure of enhancement (EME) and peak signal to noise ratio (PSNR) [1].

K.U. Sheba, S. Gladston Raj, (2018); stated that the detection of breast cancer in early stage can reduce the death rates in long term. Mammography is the best tool for standard screening but suffers from high false-negative and false-positive rates. The reason behind this is poor image quality, restrained nature of distortions and limitations of human visual system. The research paper is dedicated towards development of classification tool with enhanced breast screening accuracy to differentiate between healthy, benign, and malignant breast parenchyma in digital mammograms. The system proposed in the research paper can be used as a reference reader for performing double reading of the mammograms and assisting radiologists in conducting clinical diagnosis in order to find out suspicious abnormalities. The regions of interest (ROI) are spontaneouslynoticed and segmented from mammograms by means of global thresholding via making use of Otsu's method and morphological operations [2].

Manasi Hazarika, Lipi B Mahanta, (2018); proposed a breast border extraction method employing threshold based segmentation along with morphological operations. The contrast enhancement method is divided into two phases. . In phase I, a bi-level histogram modification technique is applied to enhance the image globally and in phase II a non-linear filter based on local mean and local standard deviation for each pixel is applied to the histogram modified image [3].

K. Rajendra Prasad, M. SulemanBasha, (2018); stated that detection of breast cancer is an emerging need which requires appropriate detection of the stages of breast cancer detection. The paper makes use of support vector classification method to perform mammogram classification. The paper presents the experimental results of classification performed on mammograms demonstrating the efficiency of SVM with underlying mechanisms of texture methods and it suggest the best combination of SVM and texture method to radiologist for better medical diagnosis of breast cancer detection [4].

Ahmed F. Yousef et al., (2018); stated that contrast-enhanced spectral mammography (CESM) enjoys high diagnostic accuracy. It works on principles having relevance with those of MRI and have similar acceptance of contrast enhancement. The paper studied and compared CESM and MRI in case of breast masses. The patients under study were of age range between 30 to 60 years. All multiple histologically proven lesions were detected by CESM (100%) and MRI (100%), with no significant difference in their site and number in both modalities. CESM is valuable for the diversity of local recurrence of post-treatment scarring after breast-conserving therapy and evaluation of residual tumor after treatment, with unknown primary site of malignancy [5].

Hanna Dumky et al., (2018); stated that around 8023 women were diagnosed in Sweden with breast cancer. The paper elaborates that mammography examinations vary with positioning of the patient. The study in paper is conducted using qualitative methods. The paper identified three main categories:

positioning of the patient, positioning of the detector, and compression. A fourth category, compliance, also emerged during the analysis work and was identified by the radiographers as being an important factor to be able to succeed with positioning and compression [6].

3. CONTRIBUTION AND IMPLEMENTATION

The primary purpose of the mammogram image is to process the poor quality input images in order to increase their contrast and reduce the presence of noise to enable the radiologist to detect the abnormalities [7, 8]. The manipulation of mammogram images has been divided into four broad categories mentioned as below.

- Conventional Enhancement Techniques

- Region-Based Enhancement Techniques

- Feature-Based Enhancement Techniques

- Fuzzy Enhancement Techniques

The research work concentrates on Region-Based Enhancement Techniques. The enhancement method for mammogram images adopted in the research work is depicted in the flowchart below.
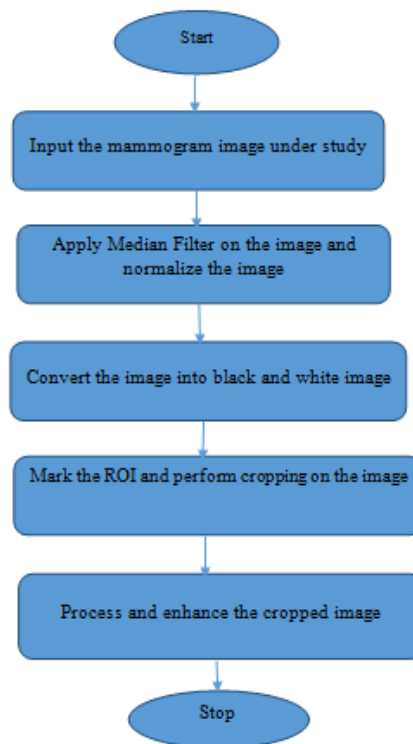
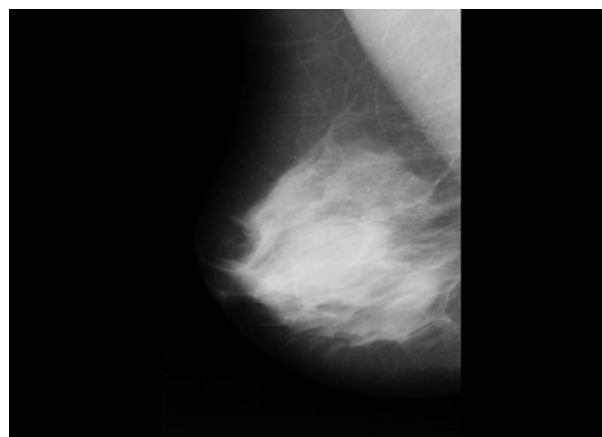**Fig1.** *The figure shows the flowchart of the adopted research methodology*

Fig2. *The figure shows the input image under study*

The median filter is applied to the input image and the resultant image is normalized to obtain the image as shown in Fig. 3.
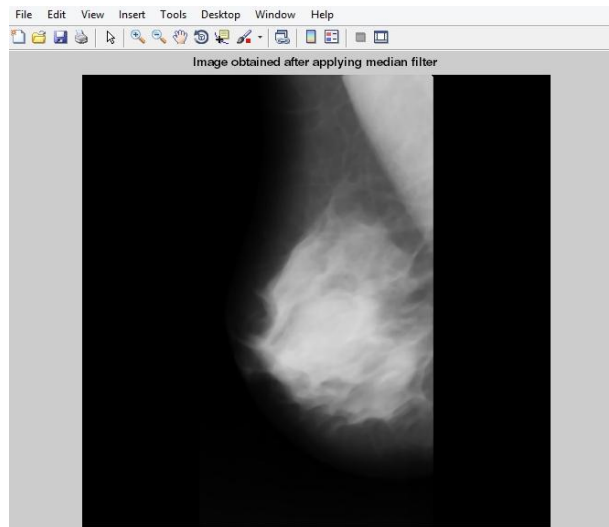

Fig3. *The figure shows the normalized image obtained after applying median filter*

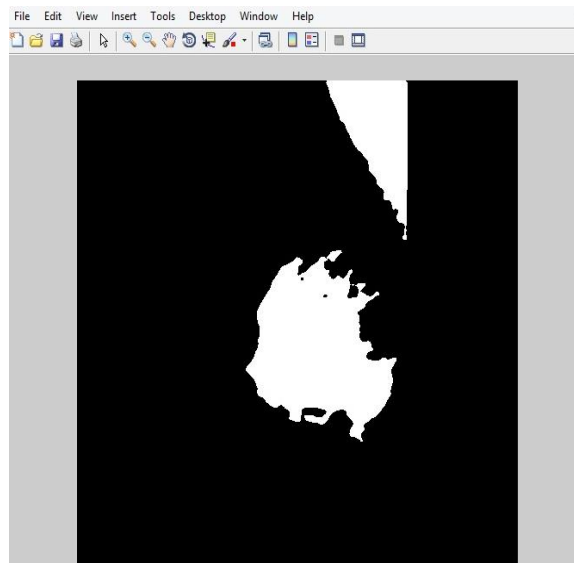Fig. 4 shows the black and white image of Fig. 3.

Fig4. *The figure shows the black and white image of Fig. 3*

Fig. 5 shows the marked ROI (region of interest) on which enhancement is to be performed.
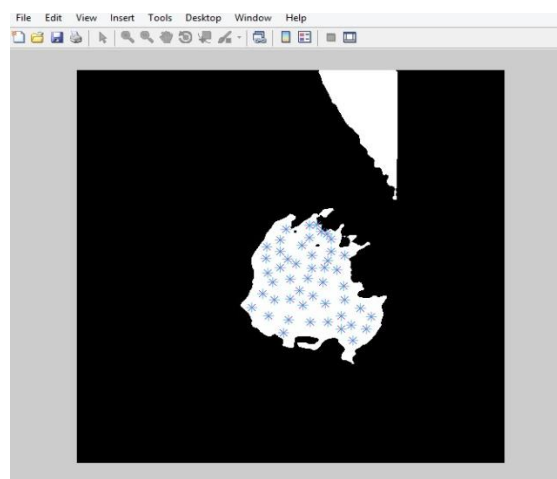

Fig5. *The figure depicts the ROI marked with ***

Iteration is performed through the black and white image in Fig. 5 and coordinates of the white portions. Fig. 6 shows the ROI been cropped from Fig. 5 to perform enhancement.
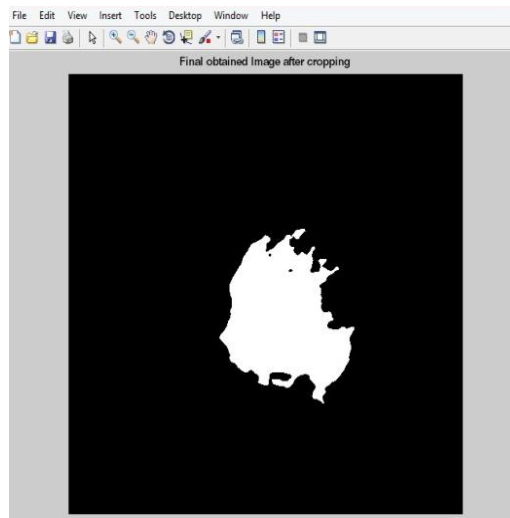

Fig6. *The figure shows the cropped image of ROI from original image.*

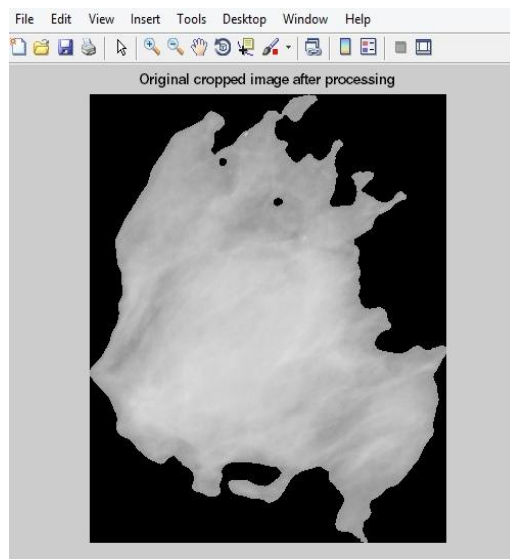Fig. 7 shows the processed image obtained from Fig. 6.

Fig7. *The figure shows the processed image obtained from Fig. 6.*

Fig. 8 shows the final enhanced image obtained after enhancing the figure obtained in Fig. 7
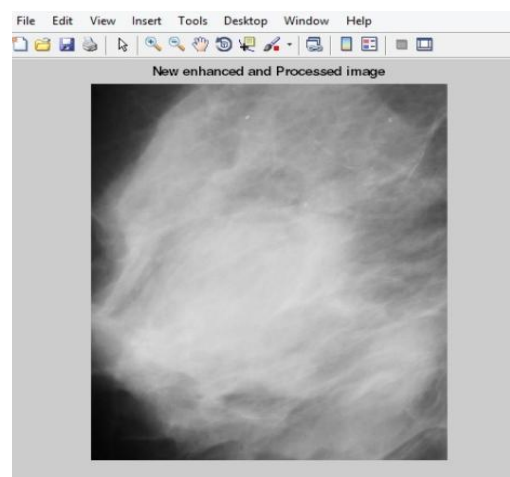

Fig8. *The figure shows the final enhanced image*

4. CONCLUSION

Contrast-enhanced spectral mammography (CESM) is a valuable tool in the analysis and staging of primary breast cancer. The primary aim of improving the diagnostic accuracy is achieved by combining iodinated contrast agent with conventional mammography, especially in case of women with denser parenchymal background images.The research paper emphasized on enhancing the poor quality images, working specially on region of interest (ROI).The paper studies the enhanced diagnostic accuracy of mammography, providing more accurate tumor sizing and identification of multifocal disease, particularly in women with denser parenchymal background patterns.

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