

Mammographic Image for Breast Cancer Detection using CAD

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Abstract: Breast cancer is major health challenge all over the world and its occurrence has increased rapidly in recent years. Only early diagnosis is most compelling way to handle breast cancer patients for treatment at right time. In innovative biomedical science several new approaches evolved for the timely detection of breast cancer. CAD systems can play crucial task in the early detection and diagnosis of breast cancer and can reduce the mortality in women suffering from breast cancer. Generally, a CAD system includes four stages: preprocessing, segmentation, feature extraction and classification. The present review will focus on most advance algorithms for preprocessing and segmentation

Keywords - Computer aided diagnosis (CAD), mammograms, masses, thresholding, segmentation

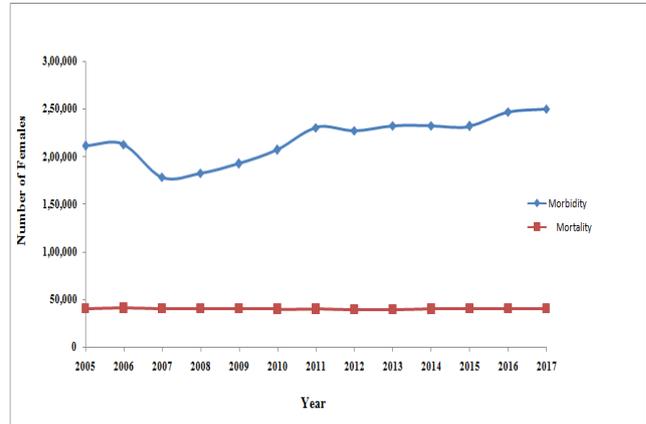
I. INTRODUCTION

most cancers is endless boom of cells at specific body region [3]. the gathering of cancer cells is referred as tumor [2]. Breast cancer is shape of tumors, advanced from breast cells [4]. Breast most cancers impacts 12 % of women's international. it's miles most invasive shape of cancer amongst girls and key cause of mortality in ladies [3]. In 2015, as steady with WHO (worldwide fitness employer) cancer accounted eight.8 million deaths global, in which 571000 deaths were, because of breast maximum cancers [2]. The table.1 represents yr smart approximate mortality and morbidity rate human beings suggested by means of American most cancers Society (ACS) [2]. Detection of breast most cancers at primary level performs essential role. Survival rate is 90 seven. five and 20. four % for non-invasive and metastatic cancer respectively over 5 years[5].

Mammogram screening is the crucial approach used for diagnoses of breast cancer. Mammography is extensively used tool via way of radiologist for breast maximum cancers detection. Asymptomatic girls can be tested to diagnose breast most cancers early and clinically unsuspected [4]. Mammography is the upright approach for early breast most cancers detection and able to decrease mortality charges up to 25 % [5]. It offers better first-rate images at low x-ray radiation dose and has excessive dynamic range. however, ultrasound produces a very good-superb assessment image, but lack in important tendencies of tumor tissue facts that may be received in digital mammogram. MRI indicates more sensitivity in contrast to Mammogram however it outcomes in more false wonderful that effects in futile more exams, biopsies growing affected man or woman tension.

the following graph offers the expected instances of deaths because of breast maximum cancers in female [32].

TABLE 1: EPIDEMIOLOGY OF BREAST CANCER



II. CAD SYSTEM FOR BREAST CANCER DETECTION

The mammogram screening may be very tedious work for radiologists; approximately 30% of most cancers loads are omitted for the duration of primary screening [8, 9, 10]. Understanding stage of radiologists and quality of photos are vital factors, which influences sensitivity of screening mammography. The radiologists must look at immoderate quantity of instances, which may have an effect on the general performance of radiologist.

The stepwise running of ordinary CAD device is given as beneath:

A] firstly mammogram analyzing is carried through the radiologists, to document questionable or suspicious regions.

B] The mammograms are further scanned the use of CAD gadget, to come across suspicious hundreds.

C] The results received using CAD structures are compared face to face with suspicious regions recognized via the use of radiologist manually in step [A] The CAD device may be stepped forward for accuracy and precision to growth sensitivity and decrease time of detection approach. [12] consequently, researches are working for better outcome of the CAD systems. This could be beneficial, to discover uncommon breast tissues in time and offer delicate standards for recommending biopsy.

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III. RESULTS & DISCUSSIONS

A. Pre-processing of Mammograms

Pre-processing techniques do decorate satisfactory of digital mammogram. The pre-processing method limits search for abnormalities inside the mammograms to lessen effect of heritage, labels wedges and plenty of others. In the mammograms. Consequently, pre-processing is beneficial for further processing of mammograms, getting rid of distinct and further factors from background of the mammograms. It consists of extraction of breast border and removal of pectoral muscle. But, labeling over mammogram with low and immoderate depth and tape artifacts etc. Are styles of noise placed in mammogram.

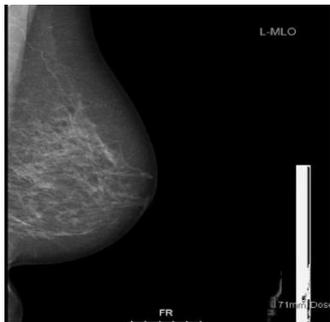


Fig 1: Noise detected in mammogram

TABLE 2: TECHNIQUES USED FOR PECTORAL MUSCLE DETECTION

Ref. No.	Author and Year	Technique Used	Results
41	M. Mustra, et al, 2013	Thresholding Cubic polynomial fitting	89% segmentation
42	M. Molinara,	RANSAC Algorithm	Acceptable
43	L Liu, et al, 2014	Global weighting scheme based to suppress non-PM regions pectoral muscle boundary is identified using Edge continuity and orientation	Average FP rate = 2.32 % Average FN rate = 3.81 %
44	R. Lakshmana n, et al, 2014	Detection: orientation ,eccentricity of elliptical box	false positive rate= 0.28% and false negative rate = 3.67%.
45	N. Alam, et al, 2014	K-means clustering segmentation algorithm	true positive=94.4 %, false positive=5% false negative=1%

46	S. Sreedevi, 2015	Global thresholding for identification Pectoral muscle is removed using gray level thresholding and canny edge detection,connected component labelling	90.06% Accuracy
47	C. Chen, et al, 2015	Linear enhancement mask Enhancement mask based on shape Selection of seed Point Shape-based Growth Strategy	Mean FP rate =1.02
33	P. S. Vikhe, et. al, 2016	Intensity based approach for Boundary point selection	Acceptance rate =96.56%
48	A. Shrivastava, et. al, 2017	Sliding window algorithm (SWA)	acceptance rate of 91.3% on the MIAS database

A. Image Enhancement

Extraction of diagnostic functions from masses and calcifications is the following step after getting rid of noise and enhancement of mammograms. those capabilities are beneficial in similarly evaluation of mammogram for evaluation of most cancers mass. The assessment enhancement strategies can help a radiologist to apprehend diagnostic features, which ends up in speedy and greater accurate breast maximum cancers analysis. appearance of images may be superior the use of image enhancement operations. moreover ther may be used to emphasise positive functions in photograph. comparison restrained adaptive histogram equalization (CLAHE) method has been used to reduce noise because of homogeneous areas [13]. It turned into at the beginning advanced for medical imaging [14]. Artificially precipitated limitations eliminated by way of combing neighboring tiles the use of bilinear interpolation. Besl et al. Has referred to consequences of test to enhance digital mammogram using CLAHE [15].

Bayesian estimator-based totally discriminator proposed by means of Simoncelli et al used to enhance photo by way of manner of placing aside photograph and noise, assuming noise as a priori Gaussian additive noise[16]. Spatially adaptive statistical version as proposed via Kivanc and Ramchandran used for image removal of noise. Wavelet coefficients have been used as Gaussian random variables with immoderate close by correlation and posterior possibility guidelines have been used to approximate particular coefficients from noisy



interpretations in the approach [17]. Sivaramakrishna et al. analyse the general performance of some assessment enhancement algorithms and finally stated that the ANCE algorithm is higher [18]. HISTEQ method proposed via the usage of Nugroho, Hanung Adi practice comparison stretching and unsharp overlaying filtering. They used PSNR AND MSE to evaluate the photograph high-quality after enhancement. Boulehmi, Hela [19] used detection and interpolation of galactophorous tree for contrast enhancement. Makandar, Aziz, and Bhagirathi [20] photograph exceptional extra high-quality photo first-rate through manner of the usage of wiener clear out and proposed that it offers and excessive PSNR in comparison to median clear out and min-max.

B. picture Segmentation

medical photo Segmentation is automatic or semi-automatic technique used for detection of barriers inside an photograph. a success clinical picture segmentation has trouble of immoderate inconsistency in medical photographs. Sanjay et al. Proposed Binary Homogeneity Enhancement set of rules via using factor detection technique and pectoral muscle suppression to broaden the seeded place growing approach. The seed of the tumor area grows into massive populace making sure in a related region. The set of rules may be sturdy and constraint unfastened .it's far primarily based on affiliation of processing of the pixel. Fusion approach proposed thru Indra et al is integration of ASB set of policies with seeded developing vicinity and can be used to divide regular and normal regions in breast tissue [22]. Dinsha proposed segmentation manner the usage of ok-approach and fuzzy c-manner [23]. Shan et al. [24] proposed an automatic seed choice set of rules in which each spatial and textual content abilities are considered. The precept weak spot of this scheme is that shadowing areas in the tumor incorporates similar intensity.

Norouzi A classified the technique of photograph segmentation in 4 groups: classifier approach, clustering technique, place-based totally technique, and hybrid method [26]. He stated that thresholding and location developing strategies are very liable to noise, however they will be easy to put in force. Abdul and Basit et al. Mammogram the use of Otsus approach [27]. The whole mammogram changed into divided into sixteen distinct training primarily based on variance and using the lowest cost of threshold the mammogram grow to be binarised. to pull out largest related element from binary mask connected trouble labeling (CCL) method changed into completed.

Maitra et al. said that depth primarily based technique of segmentation isn't appropriate for dense shape because it may produce faulty stop result [38]. Pectoral muscle is segmented the use of seeded region growing set of policies. Rouhi, Rahimeh [39] proposed segmentation techniques. in the first technique threshold required for vicinity developing set of rules is calculated using knowledgeable neural community. in the 2nd approach genetic algorithms are used to determine the parameters for a cellular neural community to partition the photo into significant areas. The requirements of dice and Jaccard is used for overall performance analysis of two segmentation techniques and

proved that 2d technique produces higher outcomes. Sharma, Jaya, J. okay. Rai, and R. P. Tewari [40] finished segmentation in tiers. within the first section used watershed set of guidelines using gray values as 0.33 spatial dimension. The ouput of k-technique clustering furnished markers for foreground gadgets.within the 2nd segment the watershed set of rules have been carried out on output of ok-technique clustering .

TABLE 3: STUDIES ON PREPROCESSING TECHNIQUES FOR BREAST CANCER DETECTION

Ref .No	Author and Year	Preprocessing Techniques	Results
28	Ryan, Conor, 2014	1.Background d Suppression:local thresholding 2.Segmentation:breast is segmented into three parts based on nipple, top and bottom of breast area	97% TP and FPIs of 4-15
19	Boulehmi, Hela etal, 2016	1.Wavelet Transform:to denoise the image 2. Pectoral muscle removal 2.Contrast Enhancement 3.segmentation:Generalised gaussian density(GGD) and Euclidean distance estimation	1.Masses recognition rate of 97.08% 2.Classification rate of 97%
29	Kamala kannan, 2015	1.laplacian filter and gaussian filter 2.OTSU's Thresholding methods	reliable method

30	Taheri, Mohamad, 2016	1.Noise Removal: Adaptive Median Filter 2.Histogram Equalization 3.Harris Corner Detection	reliable method
31	Mina, Luqman Mahmood, and Nor Ashidi Mat Isa, 2015	1.Thresholding method to convert gray level image into binary image 2.Morphological operation	99.06% results
32	Vikhe, P. S., and V. R. Thool, 2016	1.Thresholding method to convert gray level image into binary image 2.Segmentation of Pectoral muscle 3. Denoising and Enhancement using wavelets	True positive rate of 90.9%
33	V. R. Thool et al, 2016	1. Median Filter 2.Thresholding Technique 3.Intensity based Enhancement Filter 4. Selection of Boundary point of pectoral muscle	Acceptance rate =96.56%
34	Makandar, Aziz, and Bhagirathi Halalli, 2016	1.Image was binarized with threshold value 0.1	among 100 images 97 are properly segmented and 2 images are under segmented. Hence the correctness is 0.9897 and completeness is 0.9797 accuracy of the algorithm is 98% and 97% respectively.

		2. Modified region growing technique 3.Image quality was enhanced by using wiener filter	
35	Wang, Chunqiu, 2015	Segmentation based on KNN and GMM	1.GMM gives more specificity than KNN 2.KNN provides better segmentation
36	Spandana, P., and Kunda MM Rao, 2013	1.Image Enhancement : Gaussian Image Filter 2.Segmentation: Region Growing Technique Bilateral asymmetry was detected using Bspline interpolation	detected bilateral asymmetry
37	Qayyum, Abdul, and A. Basit, 2016	Median filtering, binary mask of a mammogram, connected component operation, pectoral muscle removal using canny edge operator, straight line estimation	good segmentation rate of 96.89% , 93% success rate of pectoral muscle detection
40	Sharma, Jaya, J. K. Rai, and R. P. Tewari	Morphological processing and adaptive histogram equalization for preprocessing , watershed segmentation and k-means clustering for segmentation	Two phase method of segmentation provides better results.



41	M Mustra - 2013	Hough Transform	89% segmentation
42	M. Molinar a, C. Marrocco, F. Tortorella, 2013	1. Image flipping 2. Normalization 3. Smoothing and gradient estimation- Gaussian Filter	Acceptable
43	L Liu - 2014	1. Anderson- Darling goodness-of- fit test	Average FP rate = 2.32 %, Average FN rate = 3.81 %
44	R Lakshmanan - 2014	1. Laplacian pyramids for image decomposition 2. Canny edge detection	False positive rate = 0.28% False negative rate = 3.67%.
45	N Alam, 2 014	1. Erosion and dilation 2. Histogram equalization 3. Contrast enhancement	True positive = 94.4% , False positive = 5%, False negative = 1%
46	S Sreedevi - 2015	1. Normalization 2. Noise filtering- using DCT based NLN filter	90.06% Accuracy

IV. CONCLUSION

Computer Aided diagnosis does a critical element within the early hour's detection of breast cancer. Big work has been completed within the development of CAD system over two decades. Essential purpose of CAD gadget is to assist radiologist. This paper is an define of literature of numerous techniques used to expand CAD structures. Terrific techniques for preprocessing and segmentation used are referred to in this paper. Noise, artifacts removal and extraction of vicinity of interest are the important factor requirements in effective breast cancer detection.

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