# "Gabor Wavelet analysis for mammogram in Breast Cancer Detection"

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***Abstract –*** The main purpose of the proposed system is to develop the diagnosis breast cancer from mammogram image. Presented system includes Preprocessing on mammogram image and uses wavelet feature extraction to improve sensitivity. The proposed system involves three major steps-Preprocessing, Feature Extraction and Classification. Gabor wavelets based features are extracted from medical mammogram images representing normal tissues or benign and malign tumors.

***Keywords:*** *Mammograms, Gabor Wavelet, Principal component analysis, Support Vector Machine.*

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## I. INTRODUCTION

Breast cancer is among the most common and deadly of all cancers, occurring in nearly one in ten women. Mammography is a uniquely important type of medical imaging used to screen for breast cancer. All women at risk go through mammography screening procedures for early detection and diagnosis of tumors. Special x-ray machines developed exclusively for breast imaging are used to produce mammography films. These machines use very low doses of radiation and produce high-quality x-rays. A typical mammogram is an intensity x-ray image with gray levels showing levels of contrast inside the breast which characterize normal tissue, different calcification and masses.

This cancer originates from breast tissue, mostly from the inner lining of milk ducts or the lobules that supply the ducts with milk.It has been one of the major causes of death among women since the last decades and it has become an emergency for the healthcare systems of industrialized countries. If the cancer is detected early, the options of treatment and the chances of total recovery will increase.

The crude Breast Cancer cases in urban Indian women is 25-30 and the age adjusted rate is 30-35 new cases per 1,00,000 women per year. This is increasing the average increase over a 30 year period in Mumbai was 11 per decade Breast Cancer is increasing both in young (11 percent per decade) and old women (16 percent per decade) There are an estimated 1,00,000-1,25,000 new Breast Cancer cases in India every year.

The number of Breast Cancer cases in India is estimated to double by 2025. The age adjusted incidence of cervix in urban India is 15-20 new cases per 1,00, 000 women per year. The most common sign of Breast Cancer is a new lump or mass in the breast. The possible signs of breast cancer are Nipple discharge or redness ,Breast or nipple pain, Swelling of part of the breast.

The risk factors includes Age, Family history, Previous diagnosis of breast cancer, Childbearing and menstrual history, Being overweight or obese and Being tall. , Having no children or the first child after age 30 increases the risk of breast cancer. The breast cancer screenings include: Mammograms are a very good screening tool for breast cancer, Clinical Breast Exam (CBE): Women should have CBE as part of regular health exams by a health care professional about every 3 years for women in their 20s and 30s and every year for women 40 years of age and over, Breast self-exam **(**BSE): It is an option for women starting in their 20s.

Imaging techniques include Chest X-ray, Computerized tomography (CT scan), Bone scan, Positron emission tomography (PET scan), Magnetic Resonance Imaging (MRI). The molecular imaging techniques are effective in the early detection of cancer and can be used to help distinguish malignant and benign tumors through the cellular absorption of a tracing agent.

The work presented in this paper relies on extracting Gabor wavelets with different frequency scales and orientations Contrary to other wavelets, Gabor wavelets exhibit specific orientation properties that can be easily tuned by modifying the Gaussian parameters. In some sense our work is similar to the one described in [7].

## II. PROPOSED SYSTEM

The detection of tumors in mammogram is divided into three main stages. The first step involves an enhancement procedure, image enhancement techniques are used to improve an image. Then the Gabor Wavelet based features are extracted

ISSN: 2321-8169
778 – 781

from mammogram. Then the next stage involves the classification using SVM classifier.

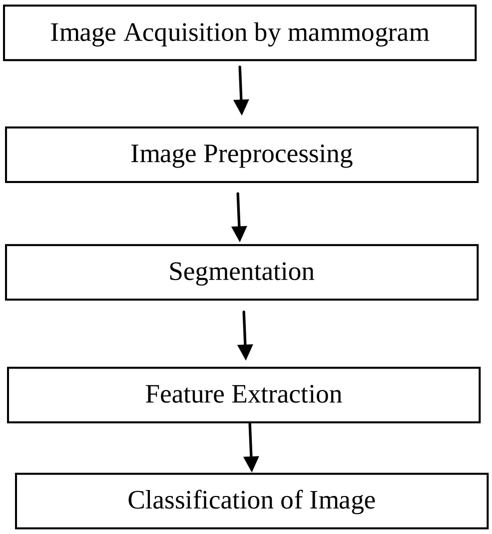
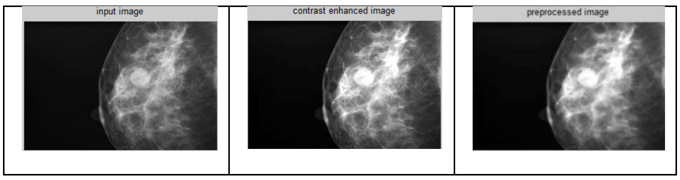



Fig 1. Flowchart Proposed System

***Image Preprocessing***: A Preprocessing Phase of the image is necessary to improve the quality of the image and make the feature extraction phase more reliable. After digitization image may carry some unwanted noise. The preprocessing stage reduces noise and distortion, removes skewness and performs skeltonizing of the image. Fig c) shows Preprocessed image. After preprocessing phase, a cleaned image goes to the segmentation phase.




a) b) c)

fig 2: a) Input image b) Contrast enhanced Image c)Preprocessed Image

***Feature Extraction:*** After segmentation, set of features are required for each image. In feature extraction stage every image is assigned a feature vector to identify it. This vector is used to distinguish the image. Gabor Wavelet is used for Feature Extraction. A complex Gabor wavelet (filter) is defined as the product of a Gaussian kernel with a complex sinusoid.

***Classification:*** Classification is the main decision making stage of image recognition and finding whether the image is cancerous or not. It uses the features extracted in the previous stage to identify the image segment according to preset rules. Advanced classifiers such as Support Vector Machines (SVM ) applied to image patches extracted around image.

## III. GABOR WAVELETS

Wavelets are used quite frequently in image processing for feature extraction, denoising, compression, face recognition, and image super-resolution. A complex Gabor wavelet (filter) is defined as the product of a Gaussian kernel with a complex sinusoid. A 2D Gabor wavelet transform is defined as the convolution of the image ***I (z):***

$$J_k(z) = \iint I(z')\varphi_k(z - z')dz' \quad (1)$$

with a family of Gabor filters (functions):

$$\varphi_k(z) = \frac{k^T k}{\sigma^2}\exp\left(-\frac{K^T k}{2\sigma^2} z^T z\right)\left(\exp(ik^T z) - exp\left(-\frac{\sigma^2}{2}\right)\right) \quad (2)$$

Where z = (x, y) and k is the characteristic wave vector:

$$K = (k_v \cos \emptyset_\mu \;\; k_v \sin\emptyset_\mu)^T \quad (3)$$

with

$$k_v = 2^{-\frac{v+2}{2}\pi}, \varphi_\mu = \mu\frac{\pi}{8}, v = 0,1,2,3,4, \mu = 0, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}$$

The parameters $v$ and $\mu$ define the frequency and orientation of the filter. The effects of these parameters on the classification performance will be evaluated in next Section V.

## IV. MAMMOGRAM DATABASE

The data samples used in our experiments were taken from Mammographic Image Analysis Society(MIAS) [6].The database contains 322 samples which belong to three categories: normal, benign and malign.There are 208 normal images,63 benign and 51 malign cases,which are considered abnormal.Each image of 1024 × 1024 pixels is centered. The wavelet transformation is used to analyze different frequencies of an image using different scales.

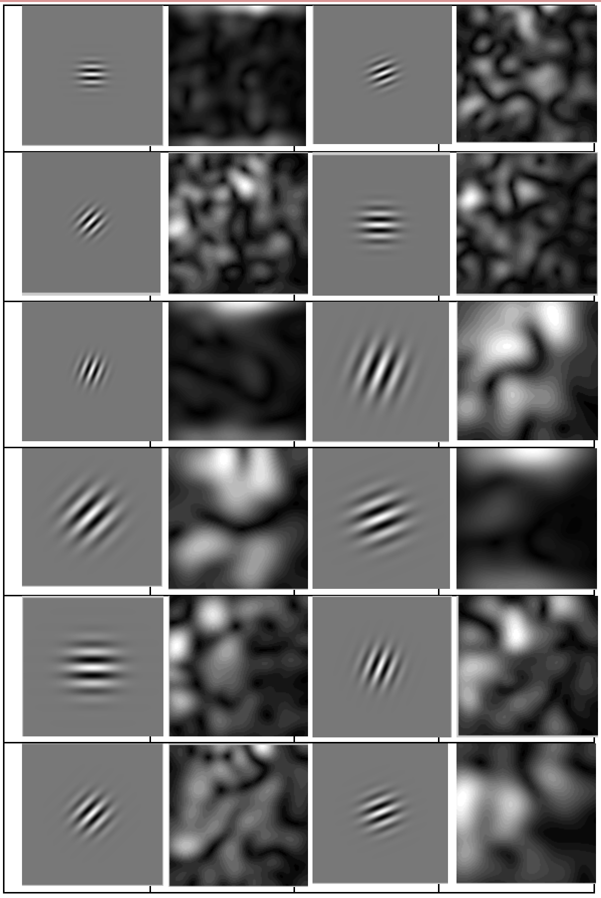


Fig.3 Patches of 140×140 pixels extracted from mammographic images.

## V. EXPERIMENTAL RESULTS

The images are taken from the MIAS database which consists of 208 normal images and 114 abnormal images. The abnormal images are further classified into two classes i.e. benign and malign. There are total 63 benign images and 51 malign images.

To discard irrelevant (background) information like breast contour, patches of 140 × 140 pixels surrounding the abnormality region were extracted from the original 1024 × 1024 pixels images. The patch size assures that, for most abnormal cases not only the abnormality region is captured but also the surrounding area, providing us information about the abnormality shape.

For the normal case, the patches were extracted from random position inside the breast area. In order to reduce the computational load each image was down sampled to a final size of 30 × 30 pixels. We split the mammographic data into two disjoint sets to test the generalization ability of the classifier with Gabor features as its input. Each image was convolved with several Gabor wavelets.As far as the Gabor filter parameters are concerned, we used four orientations: $0,, \frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}$ and two frequency ranges: high frequencies (hfr) with $\nu$ = 0,1,2 and low frequencies (lfr) with $\nu$ = 2,3,4.

## VI. CONCLUSION

The proposed system is developed for diagnosing the breast cancer from mammogram images. In first phase preprocessing on mammogram image is done which minimize the computational cost and maximize the probability of accuracy. Proposed method which uses wavelet feature extraction which improves sensitivity and performance of the for detection of micro calcification in digital mammograms. In second phase Gabor Wavelet feature are extracted. Once desired features are extracted, Principal Component Analysis (PCA) is applied to it. These extracted features are used for classification of mammogram into malignant and benign. The SVM classifier is used for classification. In our system we have applied PCA on the complete image for dimensionality reduction. The dimensionality reduction is process of elimination of closely related data with other data items in a set, as a result a smaller set of features is generated which preserves all the properties of the original large data set. Commonly used dimensionality reduction techniques are Principal Component Analysis (PCA).

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