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Analysis and Classification of Abnormality in Mammogram with Fatty Background Tissue using Chebyshev Moment

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***Abstract*— Analysis of Breast Cancer at the early stage of its birth is difficult as its shape may be round and smooth in former/benign cases while it may be speculated as well as irregular in case of later/malignant cases. In thisproposedmethod image processing algorithm is developed to find out Chebyshev Moments of mammographic images. These moments for normal and abnormal breast cancer differ in their range and this property of Chebyshev Moment is used to classify breast cancer in to normal and abnormal classes. This proposed method makes the task of analysis and classification of Digital Mammogram Images much simpler and faster with desired accuracy than current method of manual analysis.**

Keywords- Mammogram, Breast cancer, Malignant, Chebyshevmoment ,Image processing.

I. INTRODUCTION

Analysis and classification of breast cancer in medical field is inspired due to inevitability of fast processing with high accuracy when human life is of concern. Also computer aided tool is necessitated in since it improves the analysis of Digital Mammographic Image with high accuracy. It plays an important role when it is necessary to achieve untrue negative cases at extreme low rate. To overcome this,a computer aided system to assist doctors is of great importance [2] [3].

Diagnosis of breast cancer using conventional method involves a lot of human interaction and re-reading of mammogram which may lead to cause reduced accuracy. This method is based on detection of specific features by testing person. Since there is large number of cases observed day by day for breast cancer, current method doesn't suits for this scenario as its error rate as well as time consumption is more.

Many methods have been developed for automatic analysis of mammograms based on Artificial Neural Network (ANN) and digital image processing techniques which involves much more complexity and basic knowledge of system so not good for person who is new in the field of image processing and neural network [5] [3].

In this paper the automated analysis and classification of breast cancer (Mammographic image) with the help of simple image processing technique and mathematical formulae is developed. The application of Chebyshev Moment (CM) in classification of breast cancer is not exploited much. So in this work efficiency of Chebyshev moments is tested t**o** analyze and classify digital mammograms with fatty background tissue as normal and abnormal.

Proposed algorithm involvesChebyshev moment based textural feature extraction from Log polar transformed (LPT) digital mammograms as key operation.Range of moment obtained is used to classify breast tissues in to normal and abnormal classes.

While processing using proposed algorithm texture of an image is an important factor.In texture based pattern analysis translation invariance of an image is very important which is achieved by calculating geometric moment of Region of Interest (ROI) to make image insensitive to noise and illumination variation [3][4].

While studying images of Mammographic Image Analysis Society (**MIAS**) database it has been observed that benign cases have well defined boundaries in distinction to ambiguous boundaries in case of Malignant breast cancer [3].

Total 83mammogram images with fatty background tissues as 43 normal images and 40 abnormal from MIAS database are processed using proposed method. Region of Interest (ROI) of image under test is selected manually by using center coordinates and radius of curvature of cancer is taken as 8 pixels for each image. Chebyshev moment based textural features extraction of all images is calculated using MATLAB.

II. LOG-POLAR TRANSFORM

This section will deals with log-polar coordinate transformations and their use in proposed work. In polar coordinates system (r,α) where r denotes radial distance from center (x_c,y_c) and α denotes angle mapping between Cartesian coordinates(x, y) and polar coordinates (r,α) are given in equation 1 and 2,

$$r = \sqrt{x^2 + y^2} \quad (1)$$

$$\alpha = \tan^{-1}\left[\frac{y}{x}\right] \quad (2)$$

where α varies between –π to +π. Polar coordinate transformations maps radial lines in Cartesian space of an input image to horizontal lines inthe polar coordinate space of transformed image[2] [3].

III. THE CHEBYSHEV MOMENT

The discrete orthonormal Chebyshev moments Tpq of an order p+q, with size N_xX Ny for an image f(x; y), are defined in equation 3[6] [7],

$$Tpq = \frac{1}{p(x,N)p(y,N)} \times \sum_{I}\sum_{I} \hat{t}p(x)\hat{t}q(y)f(x,y) \quad (3)$$

where x= 0,1-----(Nx-1) , y=0,1-----(Ny-1)

p=0,1-----(Nx-1) , q=0,1----(Ny-1)

$\hat{t}p(x) = \hat{t}q(y)$=$p^{th}$ and q^{th} orderrecurrence functions.

While the recurrence relation are given in equation 4,5 and 6 below

$$\hat{t}0(x) = 1 \quad (4)$$

$$\hat{t}1(x) = (2x - N + 1)/N \quad (5)$$

$$\hat{t}p(x) = \frac{(2p-1)t1(x)t_{p-1}(x) - (p-1)\left(1 - \frac{p-1}{Nx^2}\right)t_{p-2}(x)}{p}, \text{ if } p \geq 2 \quad (6)$$

Similarly one can write for $\hat{t}0(y), \hat{t}1(y)$ and $\hat{t}p(y)$.

Normalized squared factor is given by equation 7 as

$$p(x,N) = \frac{N\left(1 - \frac{1}{N^2}\right)\left(1 - \frac{2^2}{N^2}\right) \dots \dots \left(1 - \frac{n^2}{N^2}\right)}{2n+1} \quad (7)$$

Similarly one can write for p(y,N)

IV. MALIGNANT AND BENIGN BREAST CANCER

A. *Benign*

Unlike breast cancers, benign breast conditions are not life-threatening. Certain benign conditions are linked with a higher risk of developing breast cancer in the future.

These types of tumors shows slow growing and the do not spread in entire body. Benign tumors are easy to differentiate since tumorous tissues differ from original tissue in texture or grading [3] [4].

B. *Malignant or malignance*

A malignant tumor is a group of cancer cells that can grow into (invade) surrounding tissues or spread (metastasize) to distant areas of the body.These types of tumors spread rapidly throughout the body. Since a malignant tumor grows by fingering into original normal tissues they are difficult to remove entirely. Hence these tumors show property of re growing even after surgery [1] [7] [5].

V. PROPOSED ALGORITHM FORCLASSIFICATION OF BREAST CANCER USING CHEBYSHEV MOMENTS

i) Crop input image using center coordinates and radius of 8 pixel and select it as Region of Interest(ROI)
ii) Find log polar transformed image of ROI obtained in step 1 using equation 1 and 2 of
iii) Calculate T11 moment of log polar transformed ROI using equation 3 to 7.
iv) If T11<Th classify it as normal else classify it as abnormal
v) Stop

VI. PROPOSED FLOW CHART FORCLASSIFICATION OF BREAST CANCER USING CHEBYSHEV MOMENTS

Flowchart for proposed method for classification of breast cancer using Chebyshev moment is as given in Fig.1,

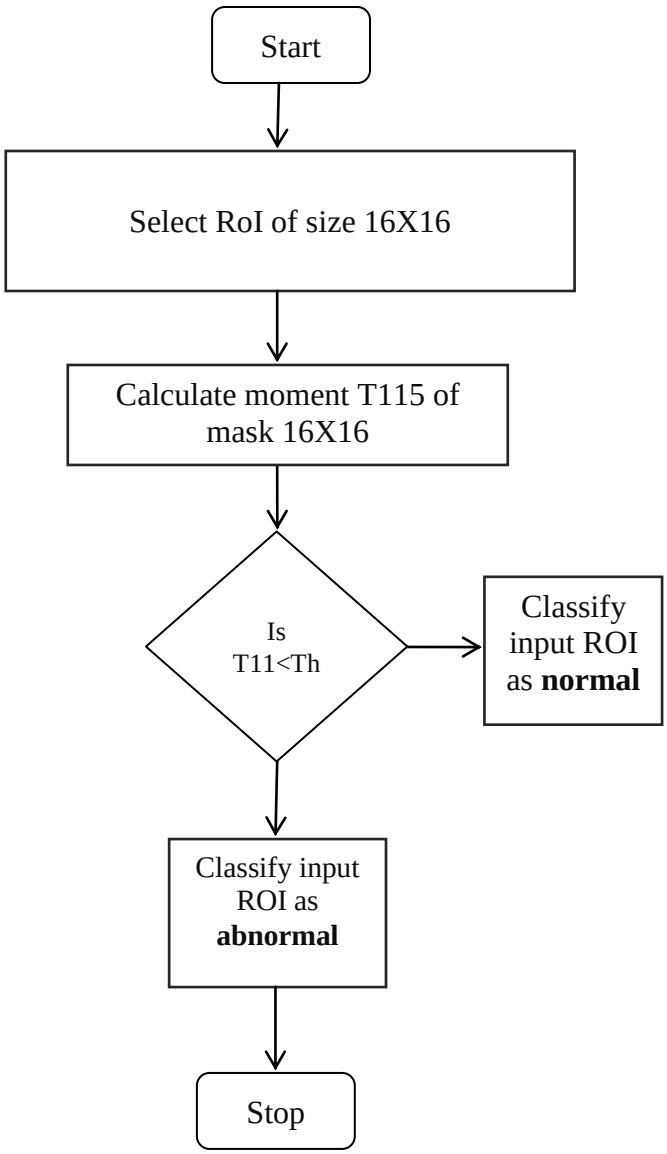


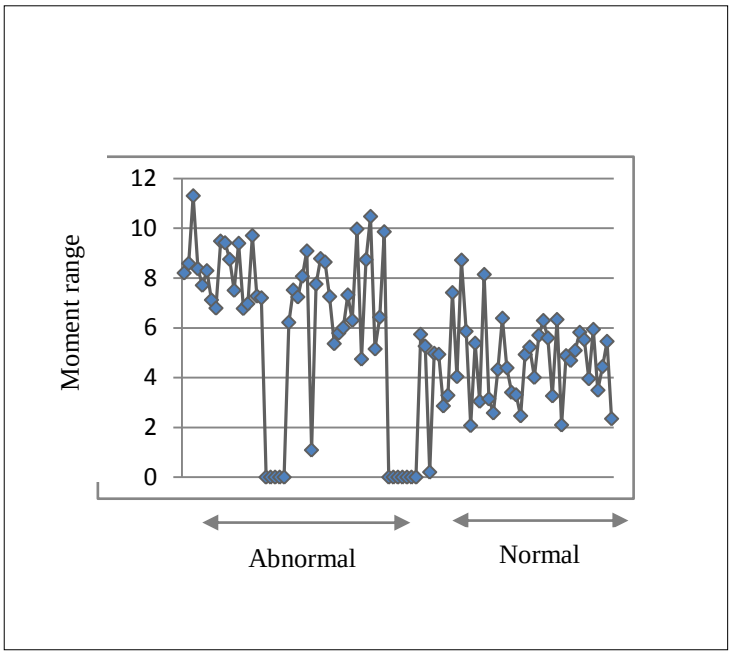
Fig.1: Flowchart for classification of breast cancer UsingChebyshev moment

VII. EXPERIMETS AND RESULTS

There are83 mammogram images with fatty background tissues in MIAS database.In this work analysis of 43 ROIsof normal and 40 ROIs of abnormal cases is done.
Every ROI was processed according to algorithm expressed under section V and T11 moment value for each ROI is calculated.

By analyzing moment values, it is observed that T11 moment gives best differentiation between normal and abnormal classes. Plot for moment T11for normal and abnormal cases is shown in Fig. 2. Proper threshold value is set with the help of the plot.

Fig. 2: Plot for T11 moment for normal and abnormal cases.



Summary of results obtained for moment values T11 for classification of normal and abnormal mammograms with fattybackground tissues is given in Table II,

Table II
Classification Summary

Moment	Result	Normal	Abnormal
T11	Tested	43	40
	Classified	37	34
	Misclassified	6	6

From this Table II, performance measures specificity, sensitivity and accuracy are calculated and are given in Table III.

Table III
Performance Measures

Normal/Abnormal classification using T11	
Sensitivity	85%
Specificity	86.04%
Accuracy	85.54%

After analysis of Table III it can be conclude that good classification is achieved at T11 moment values.

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