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Texture Analysis of Mammogram for the Detection of Breast Cancer using LBP and LGP: A Comparison

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Abstract— **Breast cancer is an life threatening disease in USA and UK. It is also one of the major diseases that has greater death rate. Cancer is the erratic growth of cells that originate in the blood tissue and Tumours may be malignant or benign. Early detection increases the chances of survival and reduces the death rate. This paper compares the approach to classify the mammogram based on the features extracted using local binary pattern (LBP) and local gradient pattern (LGP) with their histograms and the results were compared. Local binary pattern and Local gradient pattern are the techniques that are generally used for textural pattern analysis. The generated pattern is used to classify tumours using support vector machine (SVM) classifier which classifies the breast cancer.**

Keywords—breast cancer, mammogram, classifier, Local Binary Pattern, Local Gradient Pattern

I. Introduction

After HIV, Breast cancer is the leading cause of death for women across the world. About 10% of women agonize this disease during their life time [1]. Cancer is the spontaneous growth of cells in the blood tissue which destroys the particular part of the body tissue completely. Classification of benign and malignant tumours will be accurate only at the early detection [2]. About 25% to31% women die due to breast cancer in India.

The mammographic screening is widely used method in the early detection and diagnosis of breast cancer. Through mammogram analysis radiologists obtain a detection rate of 76% to 96% which is considerably higher than clinical examination. Many electronic databases are available for mammographic images [3]. In our paper we have taken the images from MIAS (mammographic image analysis society) database.

Textures are one of the important characteristics for identifying objects and region of interest of various kinds of images [4]. Texture analysis is important for automated analysis for classification, detection and segmentation of an image based on the intensity and color [5][6].The texture of a region usually describes the pattern obtained due to the variation of grey values in a neighbourhood where it is small compared to the region[7].

LBP is one of the best resulting approaches that yields greater accuracy for texture classification. This approach is simple and efficient pattern for detailed image and attractive classifications of results. Many applications such as face recognition, dynamic texture recognition and shape localization [8] uses this approach.

LGP is the other method for texture classification. Here the local pattern is computed based on the local gradient flow from one side to another side through centre pixel in a 3x3 centre pixel [9] The use of classifiers in medical diagnosis is increasing rapidly. Here we use support vector machine (SVM) classifiers which is considered as an effective learning method for classification .They rely on support vector for classification [10]. In this paper, we have computed features for the detection and classification of mammogram using LBP and LGP. The obtained features were given as input to the classifier to test the input mammogram image.

II. METHODOLOGY

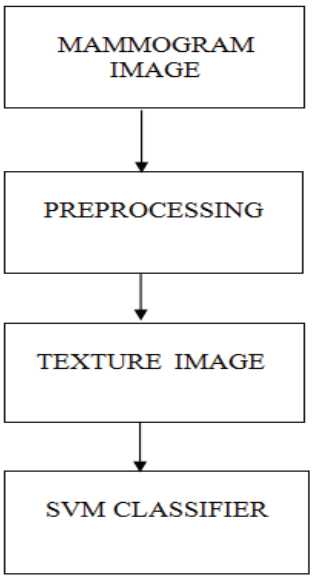

Fig 1: Block Diagram of Texture Feature Extraction

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The block diagram in figure 1 explains the process of extracting the features after obtaining the texture image from the original mammogram image which is the X-ray image. Initially Pre-processing technique is used to enhance the image and to increase the difference of gray levels between the desired objects and unwanted noise without destroying the important features of the image for the diagnosis. It is also used to increase the contrast level of the mammogram image so that the different intensity levels can be segregated for the efficient detection of masses in the breast region. Once the preprocessing is done, the modified LGP based texture image was obtained. From the texture image various features were computed and given to the SVM classifier for the classification of mammogram.

A. Local Binary Pattern (LBP)

Local binary pattern is simple but mostly used operator to achieve impressive results in classification of breast cancer. LBP is used to transform mammogram image into texture image. Initially the centre pixel is stipulated (i.e. 3X3 matrix which represents the image of the gray scale) and it converts the binary values to eight bit decimal code.

Fig-2(a) shows the sample matrix extracted from the input image which is represented in Fig-4(a). In the obtained 3X3 matrix the pixel at the centre of the matrix (for example 35) is considered as centre pixel and it was compared with the other pixels. If the centre pixel is greater than the value of the compared pixels then the computed value will '0' and if it is lesser than the other pixels then the value will be '1'. The generated values are stored in a new matrix as shown in fig-2(b). Now, all the binary values are gathered in a sequential order and an equivalent decimal code is generated.

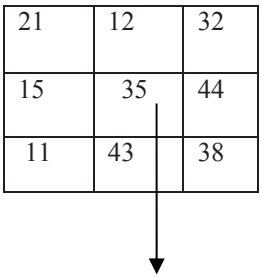

Fig 2 a) 3X3 Matrix extracted from input image

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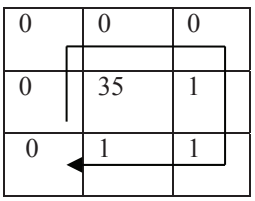


Binary value: 00001110 Decimal value: 14

Fig 2 b) Computed LBP values

Similarly, all the pixels in the matrix are considered as centre pixel and a new matrix is created with the generated decimal codes. The resultant image that was obtained from the new values will be the texture image of given mammogram image.

Mean and variance is calculated for the newly generated matrix. The computed values will be given to SVM classifier where the mean and variance of the classifier is compared with value of the newly created matrix. The classifier classifies the tumours as benign or malignant according to the compared mean and the variance value. The histograms are computed and used as a texture descriptor.

B. Local Gradient Pattern (LGP)

In LGP, for every pixel in a given image, 3X3 neighborhood pixels are computed as a matrix for computation. The mid value is considered as centre pixel. The average value of all the pixels in the 3X3 matrix was computed and it replaces the original centre pixel value. Then it was compared with the other neighborhood pixels in the matrix. If the centre pixel is greater than the value of the compared pixels then the computed value will '0' and if it is lesser than the other pixels then the value will be '1'. In this way a binary pattern was formed. From the obtained binary pattern, the decimal code was computed and it replaces the original centre pixel of that matrix in the given input image.

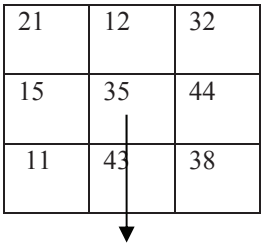


Fig 3 a) 3X3 Matrix extracted from input image

The average value computed from the matrix shown in Fig-3(a) is 27 and it replaces the original centre pixel value of 35. The new matrix is shown in fig-3(b).

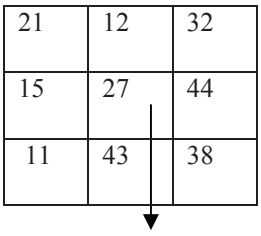
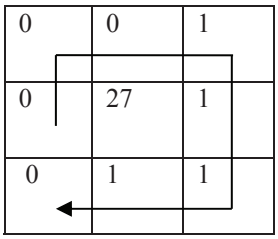


Fig 3 b) New matrix obtained

Using the new threshold value, the binary pattern is computed and the resultant decimal code is obtained which is shown in fig-3(c)

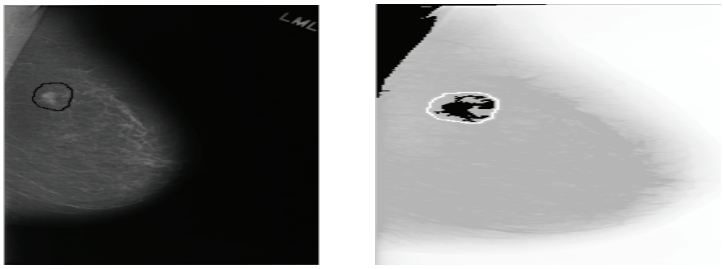


Binary value: 00011110 Decimal values: 30

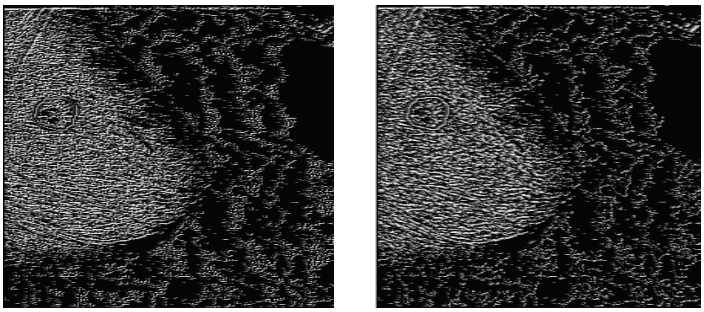
Fig 3 c) Matrix with Binary Pattern

III. RESULTS

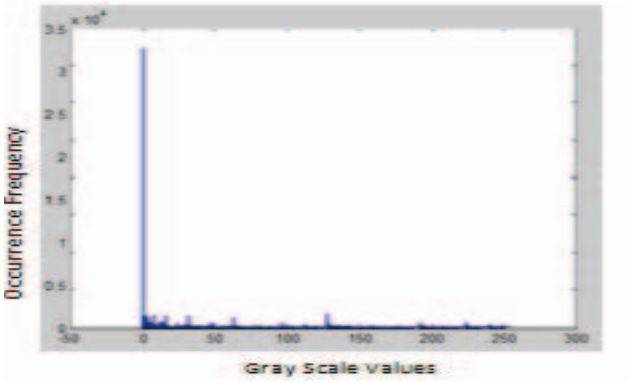
Mammogram image for our analysis was taken from MIAS database and it is shown in fig 4(a). At the initial stage of the process the mammogram image was preprocessed using the morphological operations like dilation, erosion, opening, closing, top-hat transform and bottom-hat transform. The contrast image is the resultant image obtained by the morphological operations. The complement of the contrast image is the enhanced image and it is shown in fig 4(b). The output of LBP and LGP with enhancement and their respective histograms are shown in fig-4 (c), (d), (e) and (f.)



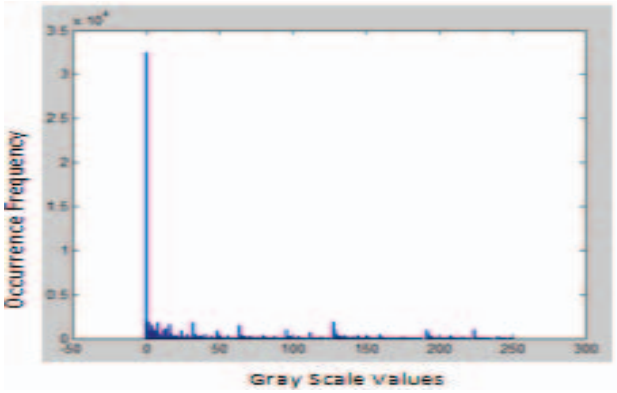
(a) (b)



(c) (d)



(e)



(f)

Fig 4 a) Mammogram Image b) Enhanced Image c) LBP with enhancement d) LGP with enhancement e) Histogram output of enhanced LBP f) Histogram of enhanced LGP

Initially LGP and LBP was applied separately to the original input image and to the enhanced image and the results were obtained. We found that the enhanced image provides better results than applying the texture methods in the original mammogram image. The pixel count and the image texture variations were analyzed using Histogram for better understanding. In histogram, the x axis represents the various grey intensity values that ranges between 0 to 255 and the y axis represents the count in a particular intensity level.

From our analysis we understand that the LBP separates the lower intensity pixels more efficiently than LGP which is an added advantage to the classification process.

Then the features like mean, variance, standard deviation and entropy were extracted and the classifier is trained accordingly. Out of hundred images that were taken from the MIAS database, thirty images were used for training and more

than seventy images were used for testing purpose. The results obtained are given in Table 1.

Table 1: Accuracy, Sensitivity, Specificity

Texture Pattern	Accuracy	Sensitivity	Specificity
LBP with enhancement	91%	90%	92%
LGP with enhancement	95%	92%	94%

IV. CONCLUSION

In this paper we compare the classification accuracy that was obtained using LBP and LGP texture patterns using SVM classifier. From the outputs obtained we conclude that LGP has greater accuracy than LBP. The reason can be understood from the histograms. LGP shown peak pattern than LBP though LBP separates the zero intensity pixel more than LGP. Also LGP has smaller detection error compared to LBP and the computational simplicity is also better than LBP. Thus we conclude that Local Gradient Pattern is more accurate, coherent and coherent compared to Local Binary Pattern when it is used for classifying the mammogram images using SVM classifier..

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