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Adaptively and Automatic Detection of Breast Cancer Using Adaptive K-Means Clustering Algorithm and Classification Based on GLCM and Geometric Features Using SVM

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Abstract — *Mammogram Images is very useful to detect a breast cancer because of high effectiveness and low cost. Paper presents an algorithm for detection of Breast Cancer Tumor in Mammogram. The proposed approach follows step by step procedures such as (a) Image Pre-processing (b) Image Segmentation (c) Image Post-processing (d) Feature Extraction and (e) The Classification Using SVM classifier. Images from the data set are initially preprocessed using Median Filter to Remove Noise and Adaptive Histogram Equalization to enhance image contrast. Then Segmentation is Done by Adaptive K-means Clustering Algorithm to Detect ROI. Then Region of Interest (ROI) is determined and post-processing is Done to Remove Impurities of Segmentation. Many Various features like Gray Level Co-occurrence Matrix (GLCM) features, Statistical Features Are Extracted for Further Classification Support Vector Machine (SVM) classifier is trained Using above features. The mammography data set has been taken from the Mammographic Image Analysis Society (MIAS). Proposed System Gives Accuracy up to 94.28%.*

Keywords- *Mammograms, SVM Classifier, GLCM, Masses, Benign, Malignant, Feature Extraction*

I. INTRODUCTION

Breast cancer is one of the common type of cancer in women. About 10% of women are suffered with breast cancer in their life. Early detection and diagnosis of breast cancer using digital mammography and image processing can increase survival rate. Number of image processing techniques have been developed to improve the detection of abnormal features in breast mammograms like 1. Microcalcification 2. Masses 3. Bilateral Asymmetry 4. Architectural distortion. Microcalcification is a calcium spots presents in Breast. Masses are the common signs of cancer and appear brighter than the surrounding tissue [3]. Benign masses are well-defined and have sharp borders and malignant tumors have ill-defined shape and Border. Bilateral asymmetry is an asymmetry of the left and right breast, may indicate breast cancer in its early stage. An architectural distortion on a mammogram is basically a disruption of the normal shape of Breast. [4] Image Filtering Using Median Filtering and Image enhancement using adaptive histogram equalization, segmentation using Adaptive K-means Clustering, Classification using SVM were proposed. Many techniques have been developed for the detection of Microcalcification, Masses and bilateral asymmetry.

II. RELATED WORK

Many Abundant studies have been made based on diagnosing breast cancer, based on mammograms. Region of interest (ROI) is selected in [1] by using Dynamic k-means method. ROI is detected in [2] using seed based region growing and k-means method. Region growing Segmentation methods by Senthilkumar et.al [3] and using water shade in [9] by Sura. In this case the number of ROIs increases as the density of breast tissue increases. Morphological features such as Density, Shape, Margin, Abnormality assessment rank etc. were extracted by Jenefer and Marija in [12] & [13] from the area extraction stage using Segmentation. The SVM classifier used in [5] achieved Precision of 93 %. In [6] textural analysis based statistical descriptors such as averages, standard deviations and higher order statistics of intensity values were extracted as features. By selecting such features the percentage of classification rate was 79.31%. Basha in [7] uses Fuzzy c-means techniques to segment mammogram. Basheer at [11] proposed a method to Segment image using texture analysis. Sayedesh presents Water shade and hidden Morkov model for segmentation at el [10].

III. PROPOSED WORK

Cancer Tumor Detection in Mammogram images is divided into Four steps. The step-1 involves the Filtering and enhancement of the image, the step-2 involves the tumor segmentation and the step-3 involves the feature extraction and step-4 involves classification. The noise removed using Median Filtering method. Image is Enhanced using Adaptive Histogram Enhancement Method. The tumor area is segmented using the Adaptive K-means Clustering. The features of tumor area are extracted and it is used to measure the properties of the segmented image and Finally classified using SVM classifier. The functionality of the proposed approach is shown in Figure-1.

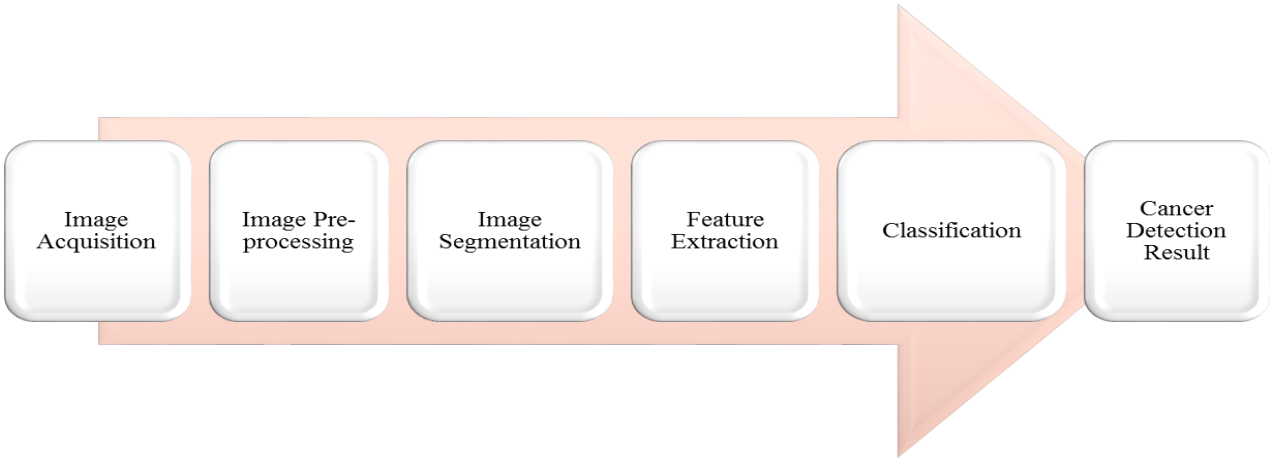

Figure 1. Proposed System

A. Proposed Algorithm:

Step 1: Read Grey Level Image Mammogram
Step 2: Median Filter to Remove Noise and to make Image Smooth
Step 3: Histogram Equalization is used to enhance Image Using Histogram of Original Image
Step 4: Adaptive k-means Segmentation Algorithm to Obtain Image Clusters Adaptively
Step 5: ROI is Detected Using Adaptive Clustering which is Mass in Breast Mammogram
Step 6: Mass Features Are Extracted from ROI
Step 7: Extracted Features help to classify normal or abnormal.

B. Image pre-processing

It is required to preprocess an image to remove noise and impurities of image. Image enhancement is used to enhance contrast of an image and image filtering is used to remove noise present in mammogram. Proposed approach uses median filtering to remove noise present in mammogram and adaptive histogram equalization is used to enhance contrast of mammogram. Mammogram after image preprocessing techniques is shown in Figure 2.

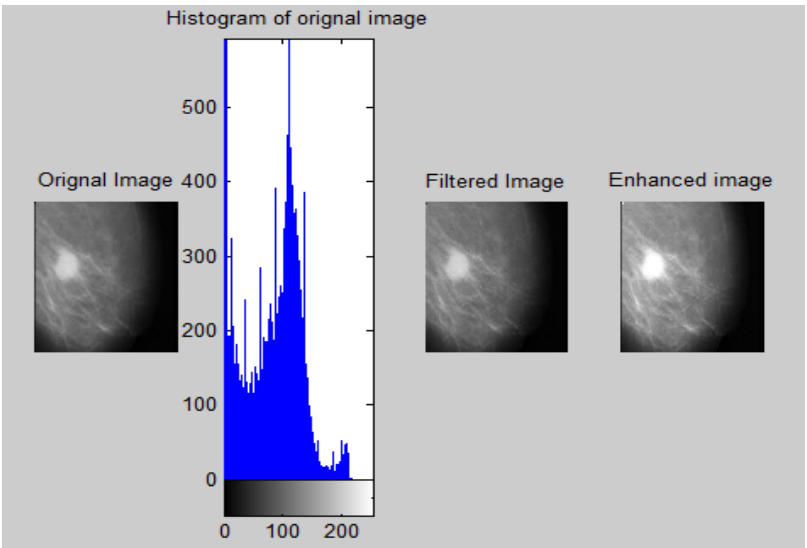

Figure 2. Original Mammogram, Histogram of Original Mammogram, Filtered Mammogram and Enhanced Mammogram

C. Image Segmentation

Image segmentation is a key part of image processing. It segments a mammogram image into various partition which makes image more easy to analyze. It helps to detect abnormal part easily. Adaptive k-means clustering algorithm is used to segment a mammogram image. It groups pixels having similarities and separates pixels which are dissimilar. Adaptive k-means clustering algorithm automatically finds out number of k. Adaptive k-means clustering Algorithm Reads Grey Level Mammogram Then Converts it into Grey Image. After calculating Mean of Array which is declared as Initial Point for Cluster. Initialize counter and Increment it for each Iteration. By Finding Distance Between Initial point and Grey level pixel and Bandwidth of Cluster Center. It Checks Values are in Selective Bandwidth or not then updates mean.

Assign new Mean as a new Seed Point and Remove Values which has Assigned a Cluster Store Center Points and Reset Counter. Check Maximum Number of Cluster not more than 10. Sort Centers of Each Cluster and make Clustered Image Using These Clusters. Image segmentation after image preprocessing is shown in Figure 3.

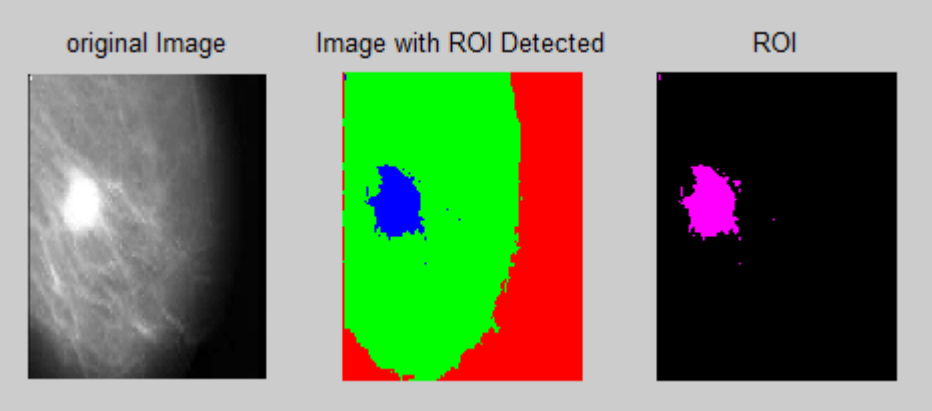

Figure 3. Original Mammogram, Segmented Mammogram and ROI

D. Feature Extraction

Different Features are extracted and Calculated for ROI of Segmented Mass. Different Features like GLCM Features, Wavelate Features and Geometric Features. In gray level co-occurrences matrices, the number of rows and columns are equal to the number of gray levels. Indexing and retrieving the visual contents in an image can be obtained by Feature Extraction method. Using the feature extraction method, the texture properties of the mammogram images are extracted. These feature values are used by the classifier after some times to categorize the images accurately. Textural features are the characteristics of the surface of mammogram images and the relationship among the nearest neighbor pixels on the surface. There are several textural features available a mammogram. but in this proposed method the Contrast, Correlation, Energy and homogeneity of the pixels is calculated. Other features like mean, Standard Deviation, Variance, Entropy, Skewness and Area Are Calculated. Extracted Features Are Shown in below tables.

PNO	CONTRAST	CORRELATION	ENERGY	HOMOGINITY
1	1.046	0.59	0.886	0.99
2	0.597	0.85	0.890	0.987
3	0.611	0.8130	0.896	0.98
4	0.65	0.689	0.94	0.988
5	1.34	0.85	0.90	0.98
6	0.56	0.94	0.92	0.99
7	0.64	0.76	0.95	0.98
8	1.11	0.811	0.86	0.981

Table 1. GLCM Features

PNO	AREA	MEAN	SD	KURTOSIS	SKEWNESS	VARIANCE	ENTROPY
1	64232	5.9	1.73	10.2418	-3.03	3.0132	0.263
2	82370	7.6	2.12	11.41	-3.22	4.53	0.26
3	33392	3.9	8.6	11.33	-3.21	7.5	0.256
4	47559	4.47	3.11	15.09	-3.75	3.23	0.154
5	86250	7.8	2.44	9.22	-2.86	5.9	0.23
6	30052	2.83	6.8	15.78	-3.8	4.65	0.177
7	44435	2.32	5.3	17.95	-4.11	2.8	0.145
8	12620	1.13	3.72	8.04	-2.65	1.39	0.318

Table 2. Geometry and Statistical Features

E. Classification

Extracted Features are used to classify a normal or abnormal mammogram. There are many features are extracted but only five features are used to classify in proposed work. One is area and other are texture features. SVM classifier classifies normal or abnormal mammogram images.

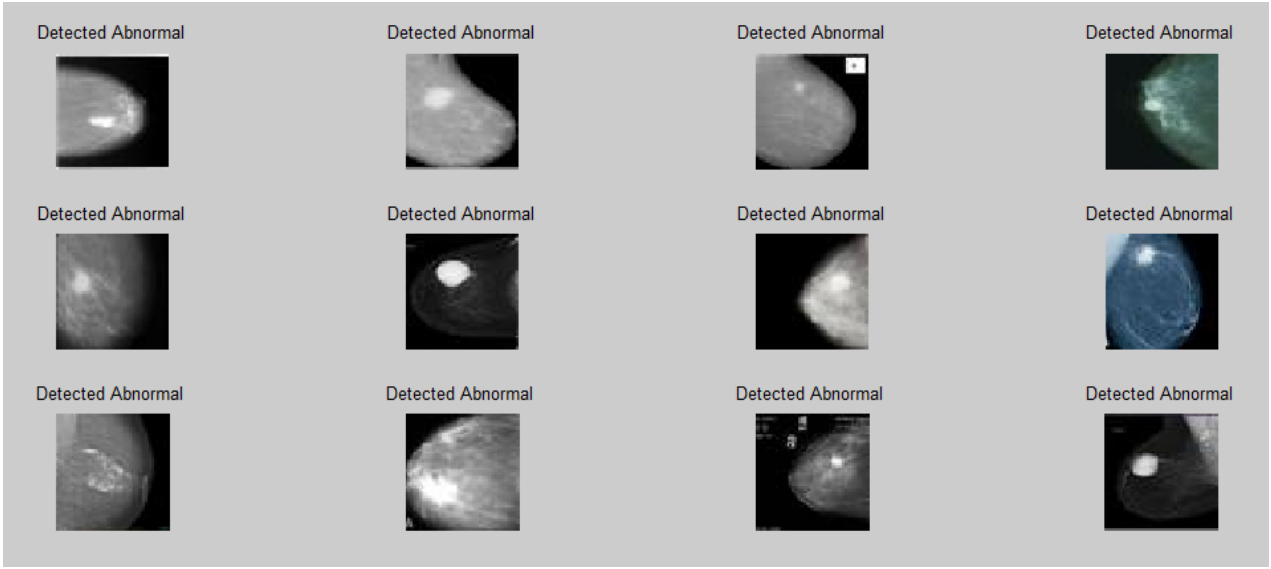

Figure 4. Detected Abnormal Images

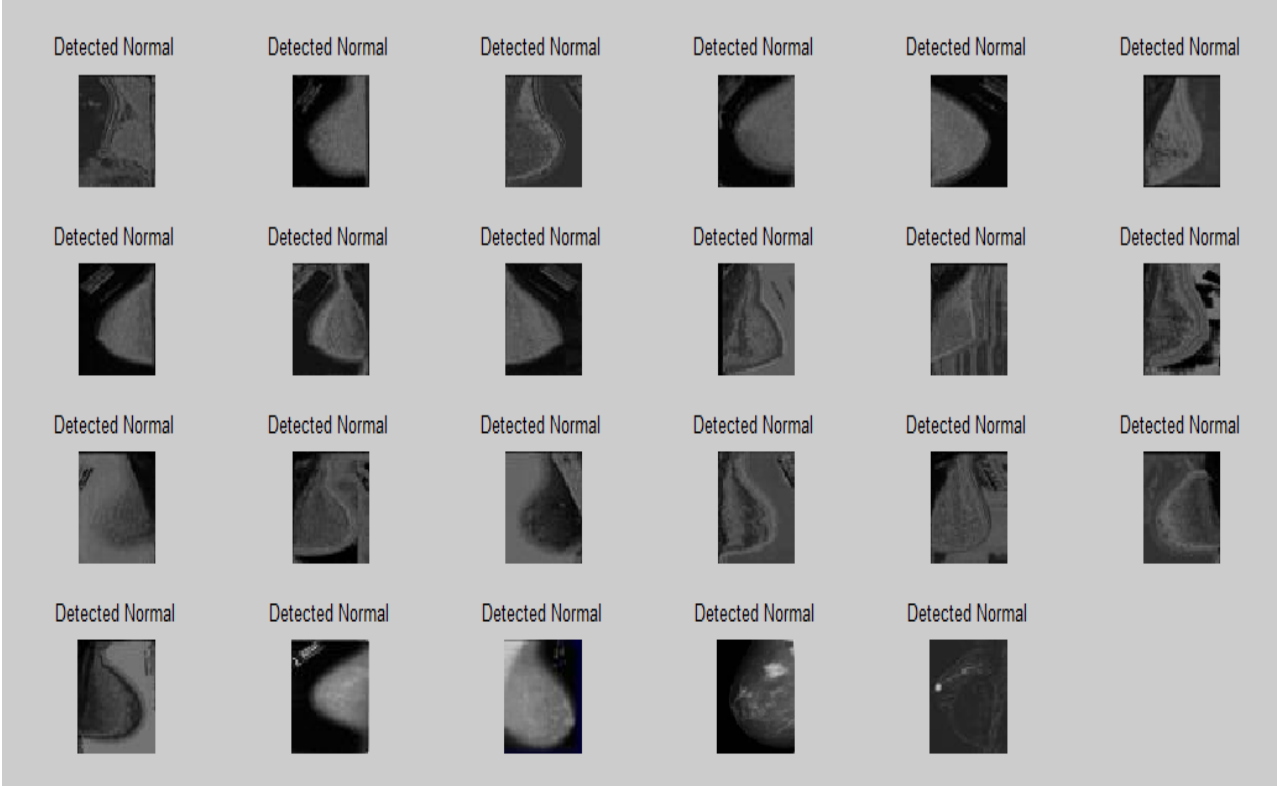

Figure 5. Detected Normal Images

F. Experimental Result

Experimental Results are shown in below Figure.

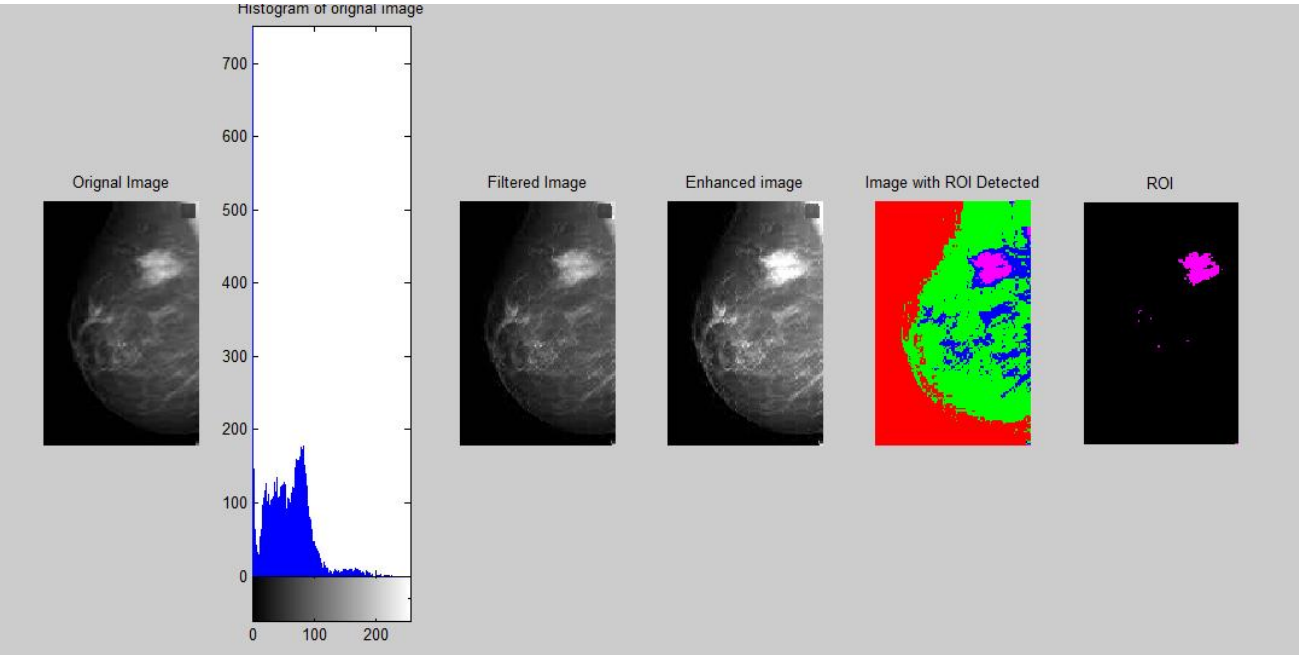

Figure 6. Experimental Result

To evaluate the performance of the proposed approach using evaluation metrics such as sensitivity, specificity and accuracy which are computed using the following equations given below:

$$\text{Sensitivity} = TP/(TP+FN)$$

$$\text{Specificity} = TN/(TN+FP)$$

$$\text{Accuracy} = (TP+TN)/(TP+TN+FN+FP)$$

Where, TP=True Positive, FP=False Positive, TN=True Negative and TN=True Negative.
Here, Total Number of Images = 35, TP =12, TN = 21, FN = 0, FP = 2

$$\text{Sensitivity} = 12/(12+0) = 100\%$$

$$\text{Specificity} = 21/(21+2) = 91.30\%$$

$$\text{Accuracy} = (12+21)/35 = 0.94285 = 94.28\%$$

IV. CONCLUSION

In this paper, the various steps involved in Automatic Tumor detection were implemented. The proposed approach includes Image Preprocessing Using Median Filter and Adaptive Histogram Equalization. Adaptive K-means Clustering for Segmentation, Different Features like GLCM, Geometric, Statistical Feature Are Extracted for Classification and SVM classification proved its performance via performance metrics such as Sensitivity is 100%, Specificity is 91.30% and its Accuracy in classification is 94.28%. Our system gives the better performance when compared with existing methods, so it is very helpful to the medical people in detecting tumor. In future, it is concentrated on automatic detection of tumor with Classification in Other Image Types like MRI images.

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