

¹Dr. K. Dhanumjaya,
²P. Sreenivasulu,
³M. Venkata Sunil
 Srikanth,
⁴Sk. Moula

Breast Cancer detection using Modern Image Processing Techniques



Abstract: - Breast Cancer is most popular and growing disease in the world. Breast Cancer is mostly found in the women. Early detection is a way to control the breast cancer. Breast cancer classification can also be used to determine suitable treatment. Classification of Benign and Malignant patient groups is widely recognized research in the medical field. Due to the advantage of detecting critical features from a medical data set, machine learning is widely used in Breast cancer Prediction. Recently there has been greater attention to the use of machine learning methods in medical diagnosis. Basically our research is based on the images and Machine learning model is most popular technique to classify the images.

Keywords: Cancer, Breast Cancer, CNN, Accuracy

1.INTRODUCTION

Breast cancer accounts for the third most life-threatening disease among all types of cancers resulting in a quite high fatality rate. Even though the disease is deadly and causes a high mortality rate, the mortality rate reduction can be significantly brought down to 30% to 41% by early detection of the disease. Early detection of the disease can pave a path for treatment and cancer prognosis thereby resulting 98% survival rate. However, in the case of metastatic breast cancer, the survival rate is about 27%. Hence it is of paramount importance that the disease is diagnosed at its early stage for successful treatment and increased life expectancy. In the recent past, with the advent of novel detection and intelligent classification techniques, the early detection and classification of breast cancer is done most effectively. Greek Physician Hippocrates who is regarded as the “Father of Medicine” has coined the term cancer in (460-370 BC). However, it is a matter of fact that cancer existed much before that, as evidence of osteosarcoma (bone tumors) could be found in human mummies in ancient Egypt (3000 BC). Even today in the world, cancer in any form is regarded as the most deadly disease, attributing to large-scale fatalities. Cancer in any form results in the human body when the DNA gets altered or the genetic code gets corrupted as a result of chemical or radiation exposure or viruses changing the genetics mutation.

Breast cancer is attributed as the leading cause of death among women. Even though breast cancer does occur in men, still it is very much prominent in women and the second most lethal disease after lung cancer. Having said that early detection of breast cancer is the key for successful treatment increasing life expectancy, machine learning techniques are in rampant use for accurate early detection and classification of breast cancer for cancer prognosis. Machine learning techniques aid in even classifying tumors as benign or malignant deciding the course of treatment and undue surgical procedures are avoided. The well-developed machine learning algorithms are very precise and accurate as those are trained with an ample number of datasets. The machine learning algorithms are self-sufficient and learn on their own without any human intervention and produce highly qualitative results. These machine learning algorithms become very effective and produce accurate results by gaining experience, which aids in better decision-making. Breast cancer has several signatures like masses, calcifications, speculated lesions and architectural distortions. Every individual anomaly can be either benign or malignant. The benign category is non-invasive and does not penetrate to the surrounding tissues and is regarded as non-life-threatening, whereas the malignant one is highly metastatic and invades the surrounding tissues and very often causes mortality. The shapes of breast masses are different, reported as circumscribed, stellate, and lobulated.

In the process of detecting and diagnosing cancer, trained physicians use various kinds of methods majorly using medical images. With these methods firm indications can be observed during the last stages of the disease. This can be further improved using Machine learning which gives different mathematical support thereby systems can learn from prior knowledge to notice and recognize patterns from a dataset. But the restrictions are 1) They may use defective dataset 2)They don't wrangle the data accurately 3)Select features appropriately.

¹ E-mail: dhanu.karumanchi@gmail.com 1, sreenu306@gmail.com2, mvss423@gmail.com 3 ,
 moulask.ece@audisankara.ac.in4
 Audisankara College of Engineering and Technology
 Corresponding Author: Dr.K. Dhanumjaya 1

This work is carried out to predict and group accurately to give a guarantee using benign and malignant classes of breast cancer.

Various tumors like benign and malignant tumors are classified by different techniques of Machine Learning. The prediction and survival rate of the patients can be boosted with the early detection of Breast Cancer. This kind of prediction helps doctors to give right treatment at right time. The prediction of various end results cost minimization and improve the healthcare value to save lives of people. Tumors classification is possible with the help of different techniques of Machine learning and deep learning. If data is complex and huge in dimension deep learning techniques are preferable the Machine learning techniques. A number of data sets related to the affected area of breast are considered to do research for accuracy. With the help of medical images after applying various technologies are used to diagnose and treatment of diseases. Each type of technology provides a diversity of information about the area of the body. Physicians will feel comfortable and easy to diagnose with the usage of medical imaging technology to diagnose. Generally, the technologies used for imaging like Mammography, Radiography, Ultrasonography, MRI (Magnetic Resonance Imaging), CT Scan, etc., Here in this work Ultrasound medical images are used for research.

2. RELATED WORK

Pavithra S, Vanithamani R, Justin J [1], have presented a novel method to detect breast cancer for ultrasound images random forest classifier by considering GLCM features like Mean, Standard deviation, Energy, Entropy, Homogeneity, Contrast and Correlation. The simulation results have shown the comparison between decision tree, KNN and random forest classifier. The random forest has been proved as the best one and it has given the classification accuracy of 88%.

Jing Zheng, Denan Lin, Zhongjun Gao, Shuang Wang, Mingjie He, And Jipeng Fan [2], have explained Breast cancer detection and classification using the proposed DLA-EABA method. It is compared DALF, HER2NET, MSTL CNN, FRCN, GMM CNN and DLA-EABA methods. Matthews correlation coefficient index, Segmentation Accuracy and the Dice coefficient ratio have been considered to compare the above-mentioned methods. The proposed method has produced Matthews correlation coefficient index as 98.5 as the best value.

Yongjun Wang, Baiying Lei, Ahmed Elazab, Ee-Leng Tan, Wei Wang, Fanglin Huang Xuehao Gongf, And Tianfu Wang [3], have narrated the article related to a novel method to classify breast images. It is compared PCA, LLE, MRR, DALM and a novel method. The proposed method has given 97.7%.

Wei-Chung Shia, Li-Sheng Lin & Dar-Ren Chen [4], have developed a new way to extract the image features and classification. The paper concentrated on the AUC, sensitivity and specificity values for different existing models.

Yong Joon Suh, Jaewon Jung and Bum-Joo Cho [5], have done a model with Gradient-Weighted Class Activation Mapping for region of interest for CNN model. The model has been verified on different density level images. The accuracy of 88% has been achieved in the proposed model on the average.

Yanjun GuoI, Xingguang Duan, Chengyi Wang, Huiqin Guo [6], have experimented a trail on Segmentation and recognition of breast ultrasound images based on an expanded UNet. Anji Reddy Vaka, Badal Soni, Sudheer Reddy K [7], have prepared a model for Breast cancer detection by leveraging Machine Learning. The proposed deep neural network with Support Value (DNNS) model has produced the accuracy of 97%, precision of 98% and recall of 97%. The values were obtained as the best values when compared with Naive Bayes classifier, SVM classifier, Bi-clustering and Ada boost techniques, RCNN classifier and Bidirectional Recurrent Neural Networks.

Saad Awadh Alanazi, M. M. Kamruzzaman and others [8] have developed a model named Boosting Breast Cancer Detection Using Convolutional Neural Network. It explains the CNN architecture for automatic detection of IDC breast cancer. It produces 86% as the highest accuracy in the planned model.

Naresh Khuriwal and Nidhi Mishra [9], have performed a feature selection oriented Breast Cancer Diagnosis Using Deep Learning Algorithm. The number of features types that were considered was 12. Almost of 99% has been achieved in the model. It has to be verified on different data sets and different medical images.

Shubham Sharma and Archit Agarwal [10] have done an experiment on Wisconsin Diagnosis Breast Cancer data set of 569 images. It is proved the KNN classifier has shown better performance compared with random forest and naive bayes. KNN model has produced 97% of accuracy as a classifier. R.Chtihakkannan and P.Kavitha [11] have presented a model with Wavelet Transform is useful to identified first order features and GLCM based second order features are extracted. It has produced 96.3%.

Rhaylander Mendes de Miranda Almeida [12] has compared XGBoost and VGG16 algorithms for breast cancer detection. AUC scores of approximately 0.68 with XGBoost. Gemechu Keneni and Raghavendra R [13] have done a comparative study on Logistic Regression, Decision Tree and Random Forest. Random Forest has shown impressive results on accuracy (96%), precision (97%) and recall (97%).

Shashidhar R and Arunakumari B N [14] have did a comparative study on Logistic Regression, KNN, SVM, Naïve Bayes, Decision tree and Random Forest. The proposed model has produced remarkable accuracy of 97%.

Meerja Akhil Jabbar [15] has presented a novel method to detect breast cancer by ensemble machine learning. The proposed ensemble machine learning has shown the best accuracy of 97.42% in the same segment.

Meteb M. Altaf [16] has completed a good research work on a hybrid model for breast cancer diagnosis based on pulse-coupled neural networks and transfer learning. The hybrid method produced impressive results of accuracy of 97% to 99%. Shafaq Abbas and Zunera Jalil [17] have demonstrated a cancer detection using whale optimization based efficient features and extremely randomized tree algorithm. A comparative study has done with all possible classification models. It accuracy of 99% has been reached.

Serena Pacile and January Lopez [18] have used a Concurrent Use of an Artificial Intelligence Tool for Breast Cancer Detection. The AUC, precision and recall values have tested on different age group cancer images.

Shakkeera L and Rahul Raj Pandey [19] have explained the cancer detection with different machine learning models and their performances. XGBoost has given 96.5% as the best accuracy. All the latest machine learning models have been considered for quality checking in detection of breast cancer. Li Shen and Laurie R [20] have proposed a novel method for breast cancer detection and compared with state of art techniques. AUC, sensitivity and sensitivity were considered for comparison.

The following are the different stages in the breast cancer detection

1. Stage 0
2. Stage 1A
3. Stage 1B
4. Stage IIA
5. Stage IIB
6. Stage IIIB
7. Stage IIIC
8. Stage IV

The detection of the cancer is the main point to saving the patient or giving the treatment.

3.RESULTS AND DISCUSSION

Different latest image processing techniques are available to detect the breast cancer like

1. Convolutional Neural Networks
2. Artificial Neural Network
3. Support Vector Machine
4. Bi-Clustering Ada Boost Techniques
5. RCNN Classifier
6. Bidirectional Recurrent Neural Networks
7. Random Forest
8. K-Nearest Neighbors
9. Naive Bayes
10. Rotation Forest
11. Logistic Regression
12. Recurrent Neural Network
13. Decision Tree
14. Bayesian Networks
15. etc

The following are the Machine Learning Techniques that are very popular in the last decade

1. Supervised Learning
2. Unsupervised Learning
3. Semi Supervised Learning
4. Reinforcement Learning

The general features considered while detecting the breast cancer in image processing

1. Wavelet Features
2. Statistical Feature
3. Hog Features
4. Curvature Feature
5. Local Binary Patterns

6. Inverse Difference Movement
7. Geometrical Feature
8. Hu Invariant Moment
9. Completed Local Binary Pattern
10. Gabor
11. Average Pixel Value Of Each Channel
12. Gray Level Co-Occurrence Matrix On Four Directions
13. Gray Level Co-Occurrence Matrix On One Direction and Etc

The general quality parameters that are involved in detecting breast cancer detection

1. Confusion Matrix
2. Accuracy
3. Sensitivity/ Recall
4. Specificity
5. F1-score
6. Precision
7. AUC
8. SNR
9. PSNR
10. Matthews Correlation Coefficient
11. Dice Correlation
12. FPR
13. TPR
14. Standard Deviation and etc

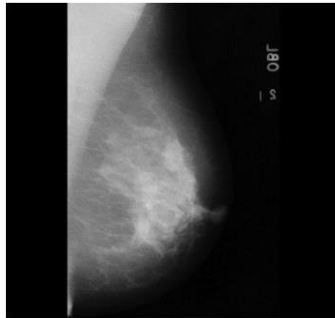


Fig. 1. Preprocessed Breast mammogram



Fig. 2. Noise-free image converted in binary

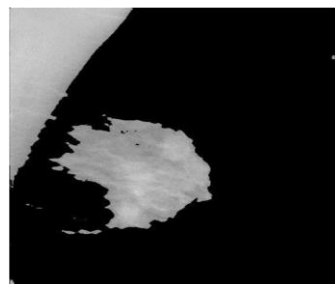


Fig. 3. Tumor highlighted picture



Fig. 4. Segmented Breast image

Fig.1 to figure 4 shows different stages in the breast cancer detection and Table 1 shows different breast cancer techniques and quality parameters involved in the process.

Table 1. Quality Parameters Considered

Citation	Confusion Matrix	Accuracy	Sensitivity/ Recall	Specificity	F1-score	Precision	AUC	Miscellaneous
[1]	√	√						SNR, PSNR
[2]			√	√		√		Matthews Correlation Coefficient, Dice Correlation, FPR, TPR
[3]		√	√		√		√	FPR, TPR
[4]			√	√			√	
[5]	√	√	√	√		√	√	NPV, FPR, TPR
[6]								Average Dice (standard deviation) & Average IOU (standard deviation)
[7]		√	√	√				
[8]	√	√	√	√	√			
[9]		√	√	√	√			Loss, Value of Loss, Value of accuracy
[10]	√	√	√	√	√			
[11]		√	√	√				
[12]			√	√	√		√	
[13]	√	√	√	√	√			
[14]	√							
[15]	√	√	√	√	√			NPV, FPR, TPR, Matthews Correlation Coefficient, Execution Time
[16]		√						Standard Deviation
[17]	√	√	√	√		√		FPR, TPR
[18]			√	√			√	FPR, TPR
[19]		√	√	√		√		
[20]	√		√	√			√	

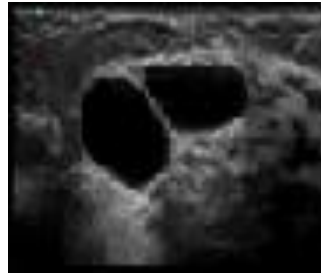


Fig. 5. Input image of breast cancer

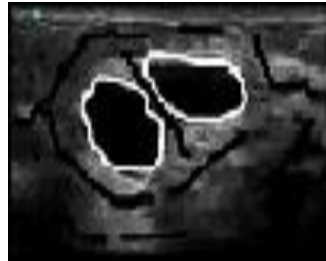


Fig. 6. Images with highlighted area

Fig.5 to figure 8 shows different stages in the breast cancer detection and simulation results

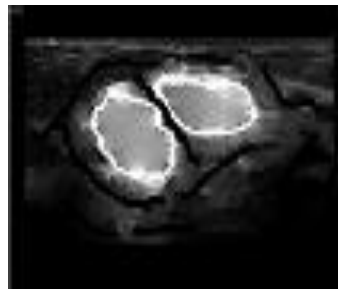


Fig. 7. Output image of breast cancer

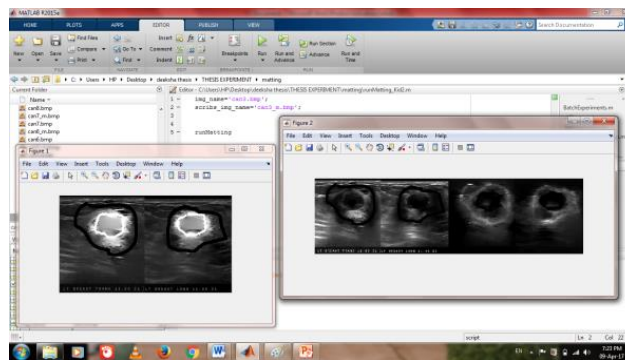


Fig. 8. Simulation Results of Breast cancer detection

4.CONCLUSION

Breast cancer is growing every year and there is less chance to recover from this disease. Evolving methods in the area are effective in detecting and improving cancer mass in breast cancer images. Breast cancer detection is a challenging problem because it is most popular and harmful disease. For detection of breast cancer, machine learning and deep learning techniques are used. The previous research is conducted through many machine learning techniques with some enhancement and augmentation in dataset for the better performance.

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