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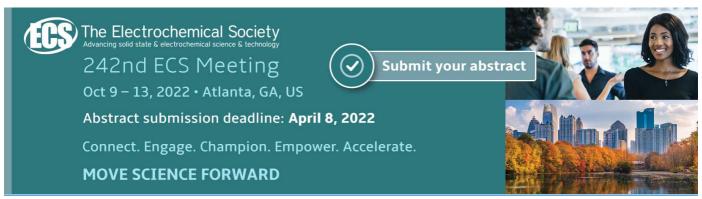
To cite this article: Kumar Sanjeev Priyanka 2021 *IOP Conf. Ser.: Mater. Sci. Eng.* **1022** 012071

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A Review Paper on Breast Cancer Detection Using Deep Learning

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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. There are many cases that are handled by the early detection and decrease the death rate. Many research works have been done on the breast cancer. The Most common technique that is used in research is machine learning. There are many previous researches that conducted through the machine learning. Machine learning algorithms like decision tree, KNN, SVM, naïve bays etc. gives the better performance in their own field. But now days, a new developed technique is used to classify the breast cancer. The new developed technique is deep learning. Deep learning is used to overcome the drawbacks of machine learning. A deep learning technique that is mostly used in data science is Convolution neural network, Recurrent neural network, deep belief network etc. deep learning algorithms gives the better results as compared to machine learning. It extracts the best features of the images. In our research, CNN is used to classify the images. Basically our research is based on the images and CNN is most popular technique to classify the images. In present paper, reviews of all authors are conducted.

Keywords. Breast Cancer, Machine Learning, Deep Learning, Convolutional Neural Network, SVM.

1. Introduction

Cancer arises when the abnormal body's cells start to separate and come in contact with normal cells and make them malignant. Breast cancer is most frequently occurring and harmful disease in the world. Breast cancer considered either invasive or non-invasive. Invasive is cancerous, malignant and spreads in other organs. Non-invasive is pre-cancerous, remains in its original organ. It eventually develops into invasive breast cancer. The portion of body that contains the breast cancer is glands and milk ducts that carry the milk. Breast cancer spread to other organs frequently and make them malignant. It also spreads through the bloodstream to other organ. Breast cancer has many types and the rate of growing is also different. According to WHO, 627,000 women died from the breast cancer in 2018. Breast cancer is the main problem that spreads everywhere in the world but mostly found in United State of America. There are four types of breast cancer. First type of cancer is Ductal Carcinoma in Situ that found in the coating of breast milk ducts and it is pre-stage breast cancer. Second type of breast cancer is most popular disease and contains upto 70-80% diagnosis. Third type of breast cancer is Inflammatory breast cancer which is forcefully and quickly developing breast cancer in this disease cells penetrate the skin and lymph vessels of the breast. The fourth type of breast cancer is Metastatic breast cancer which is spreads to other parts of the body.

There are many diagnosis tests like Mammogram, Ultrasound, MRI and Biopsy that provided the images for the classification. Mammogram is used to test the breast cancer with the help of X-ray. While screenings mammogram, if any suspicious outcomes are found then informs the doctor to tests the tissues. Ultrasound is done after the mammogram. When the suspicious site is detected in your breast then the doctor demand an ultrasound. During symptomatic examination, if the tests are not convincing then the doctor prefer the breast MRI. It shows the picture and point of view of your illness. A biopsy is the main symptomatic system that can decide whether the suspicious region is carcinogenic. Fortunately 80% of ladies who have a breast biopsy don't have breast malignant growth.

Machine learning plays an important role for the classification of the breast cancer. There are many diagnosis processes that have discussed above provides the images. These types of diagnosis images are used for the classification using machine learning. Machine learning is a sub-field of AI. Many developers uses the machine learning to re-train the existing models and for the better performance. Machine learning is used for the linear data. If the data is small then machine learning gives better results but when the data is too large then it doesn't gives the better results. There are three main types of machine learning that are used to train the model. Supervised machine learning works on the known data and with the help of the supervisor. Unsupervised machine learning is taken without any supervision. Reinforcement machine learning is less in use. These algorithms catch the ideal information from past understanding to settle on the exact choices.

Deep learning is a sub-field of the machine learning. Deep is an unsupervised learning that learns from the data. The data may be unstructured or unlabeled. Deep neural network contains more than two hidden layers then it is called deep network. Basically, the first layer is input layer and second is output layer. The intermediate layer is called hidden layer that has more layers as compared to neural network. The node contains the layer is called neurons. The difference between machine learning and deep learning is that deep learning is closer to its goal as compared to machine learning. For the classification of the breast cancer dataset, Convolution Neural Network is used. Convolutional Neural Network is used to classify the images. It takes the images of the breast cancer dataset as an input. CNN takes the images as an input associated with their corresponding weights. The weights are adjusted to minimize the error and enhance the performance. CNN contains the many layers such as convolution layer, pooling layer, ReLU layer and fully connected layer. In the convolution layer, a feature map is used to extract the features of the given image and makes the original image more compact. Pooling layer is used to reduce the dimensions of image. ReLU layer is used as an activation function in which it checks the value of activation function lies in given range or not. Fully connected layer is the last layer of the model. It combines the results of the all layers and applied the softmax function to give the probability to each classes of the output.

The review paper is divided into some parts that are given below. Section 1 contains the introduction, section 2 contains the related study, section 3 conclusion and at last references.

2. Literature Review

This section gives the information about the related work of the research that has been already done. Basically two techniques are used to detect the breast cancer. First one is machine learning and second is deep learning. There are many researches that are conducted through the machine learning. But machine learning techniques have some problems that are removed through the deep learning. This section gives the information about machine and deep learning techniques.

Megha Rathi et al. [1] proposed the model based on hybrid approach using machine learning. It implemented this approach using MRMR feature selection with four classifiers to find out the best results. The author used the four classifier SVM, Naïve Bays, Function tree and End Meta and done the comparison between all. It found that SVM was a good classifier. To find out the better

results, **M. Tahmooresi et al. [2]** proposed the another hybrid model based on machine learning. According to that, SVM was a good classifier that gave the better accuracy among the all. It had done the comparison between SVM, KNN, ANN and decision tree. It implemented on the images and blood dataset. As the consequence, **Muhammet Fatih Aslan et al. [3]** proposed the model on machine learning but used the different classifier. The classifier used by the author was Extreme Learning Machine, SVM, KNN and ANN. There was a bit change in classifier to find out the better results. According to that, Extreme Learning Machine gave the better results. **Anusha Bharat et al.[4]** proposed the model based on machine learning. It used the four classifier like SVM, decision tree (CART), KNN, Naïve bayes. According to author, KNN gave the better accuracy. There was limitation in SVM. SVM gave the better results for binary variables. So that's why Multi-SVM was used. **Ebru Ayndindag Bayrak et al. [5]** done the comparison on machine learning techniques. The comparison was implemented on the WEKA and dataset was Wisconsin breast cancer dataset. According to author, SVM showed the better results in performance matrices. After the machine learning, deep learning techniques were developed to solve the problem of machine learning.

Shewtha K et al. [6] proposed the model on deep learning based convolution neural network. There were many models that came under the CNN but the used Mobile Net and Inception V3. The author had done the comparison on both models and found Inception V3 gave the better Accuracy. But there was a still chance to use machine learning for breast cancer. **Ch. Shravya et al. [7]** proposed the model on supervised machine learning. This research was implemented on classifier like Logistic Regression, SVM and KNN. The dataset was downloaded from UCI repository and results were conducted with respect to performance. According to this, SVM was a good classifier that gave 92.7% accuracy on python platform. **Sivapriya J et al. [8]** proposed the model on machine learning but on different classifier. The author used the Random Forest, SVM, Logistic Regression and Naïve bays. The implantation was done on Anaconda Platform for python. The author found Random Forest was a good classifier in terms of performance and gave 99.76% accuracy. When there was some bit change in network with classifier then there was a possibility to improve the accuracy. In this paper, **Kalyani Wadkar et al. [9]** proposed the model based on ANN and performance was analyzed by SVM classifier. According to author, ANN gave 97% accuracy and SVM 91%. The author also told without SVM, it gave the better accuracy. **Vishal Deshwal et al. [10]** proposed the model based SVM and Grid search. The author implemented the research first on SVM and then SVM with Grid search. The author done the comparison and find out the best one. According to comparison, the new model was built. The better accuracy was achieved with grid search. **S. Shamy et al. [11]** proposed the model based on k-mean GMM and CNN. The author first find out ROI and then applied the texture feature extraction method. At last, He applied the CNN algorithm to find out the better results. The accuracy achieved by the author was 95.8%. The MIAS dataset used by the author. **V Sansya Vijayam et al. [12]** proposed the model based on deep learning . The author focused on Lloyd's algorithm for clustering and CNN for classification. The 96% accuracy was achieved by the proposed methods. It used the histopathology images for the diagnosis purpose. This paper also explained the image processing and deep learning. **Puspanjali Mohapatra et al. [13]** proposed the model based on the enhancement of histopathological images using deep learning. In this paper, many methods were used for feature extraction like PCA and LDA. The author also talked about machine learning techniques but there were large dataset so machine learning techniques don't give better results. That's why deep learning was used for that purpose.

Using CNN, it achieved 81% accuracy. But when the images were trained on GPU then it gave better accuracy up to 89%. **Chandra Churh Chatterjee et al**. **[14]** proposed the method for IDC prediction based on deep residual neural network. The dataset used by the author was histopathology images. The accuracy achieved by the author was 99.29% with AUROC score of 0.9996**. Canh Phong Nguyen et al. [15]** proposed the model based on deep learning in which the dataset was extended to find out the better accuracy. **R.Divya et al. [28]** performed the survey on breast cancer detection using neural network. Through the survey, she studied many techniques and

found that the machine learning algorithm increased the accuracy level of the system. **Ayush Dogra et al. [29]** proposed the model based on the reviews. The model was based on the computer aided deep learning methods. This paper gave the brief review of the all recent trends of deep learning [29]. **M. Sornam et al. [30]** had done the survey on image recognition based on deep learning algorithm. It highlighted the main features of the deep learning application. It gave the essential information about all fields and also showed why deep learning algorithm gave better result. **Andrik Rampun et al. [31]** classifying the breast mass using diagnosis method such as mammogram. It used the convolution neural network for classification. It worked on the modify AlexNet and according to his research simple modification could give the better results. It used activation function PReLu that gave the better results as compared to Relu. The author worked on previous present results based on decision support and information management system for breast cancer. The dataset used by the author was CBISDDSM**. Ahmet Kadir Arslan et al. [32]** was done the work on breast cancer classification. It compared all the CNN models and gave the better accuracy. According to this, Inception Recurrent Residual Convolutional Neural Network gave the better results. It also used the web as an interface. The work was done in R programming. **Yawen Xiao et al. [33]** proposed the research based on the unsupervised feature extraction algorithm that was based on deep learning. This approach was only for the feature extraction. Another thing used by author was stacked auto-encoder that basically reduced the dimensions and gave more compact forms of original data. The classifier used by the author was SVM. Analyzed data was obtained by the University of California. **Alokkumar Jha et al. [34]** studied based on the genes. It used the signatures of genes to predict the relapse in breast cancer. The model used by the author was GCNN(Graph Convolution Neural Network). According to this, GCNN gave the best result as compared to existing algorithm. **S. Srirambabu et al. [35]** proposed the model based on the SVM classifier. This research was done through the many steps like image enhancement, segmentation, feature extraction and at last applied the SVM classifier. MIAS database was used for that model. Median filtering approach was used for noise reduction and thresholding used for segmentation. **Seyyid Ahmed Medjahed et al. [36]** proposed the model based on the k-nearest neighbors. The dataset used by the researcher was Wisconsin Breast Cancer dataset and evaluated performance according to their distances. The author used two distances formula and got the accuracy according to their distance formula. It obtained accuracy 98.70% for Euclidian distance and 98.48 for Manhattan distance. **BASAVRAJ HIREMATH et   al. [37]** proposed the model based on the SVM classifier. This model was based on the mammogram images and the difference of Gaussian filter and Gaussian filters were used for detection. Only 75 mammographic images were used from mini-mias dataset. The accuracy achieved form this method was 89.33%. **Varsha J. Gaikwad et al. [38]** proposed the model based on mammogram using SVM classifier. This research was done through the many stages. First was preprocessing, segmentation of ROI extraction, feature extraction and classification. MIAS dataset used for this purposed and showed the SVM gave the better accuracy. It achieved the 83% accuracy. **Tina Elizabeth Mathew et al. [39]** proposed the model based on Decision Tree classifier on breast cancer. The Wisconsin breast cancer dataset was implemented by decision tree. The paper also talked about naïve Bayes tree, rotation forest for classification. The research was done on the WEKA environment. It also studied adaptive boosting, bagging, boosting and REPtree and showed the accuracy. **Deepa B G et al. [40]** proposed the model based on the augmentations of classifiers. The dataset used by the author was breast cancer dataset and applied classification techniques on that dataset. The author used the five classifiers with and without the feature selection method. Mainly these feature selection methods based on correlation and information. At last, it showed the accuracy of these five classifiers with and without feature selection methods. **Badal Soni et al. [41]** proposed the model based on the classifications techniques. It used the random forest and support vector machine implemented on the Wisconsin breast cancer dataset. The results were based on the train-test ratio and obtained accuracy was 99.714%. **Amandeep Kaur et   al. [42]** proposed the model based on the Gene-Back propagation neural network algorithm. It also used KPCA for the feature extraction. It downloaded

the dataset from the UCI Repository. The results were obtained on the basis of their performance metrics like sensitivity, specificity etc. The performance was calculated according to their true positive and true negative parameters.

Table 1 Existing Related Work

Author & Ref.	Method	Findings	Dataset
Shubham Sharma et al. [16]	Random Forest, KNN and Naïve Bayes.	KNN was a good classifier in terms of accuracy.	Wisconsin Breast Cancer dataset from UCI Repository.
R. Preetha et al. [17]	Data Mining techniques	Detect the hidden cancer associated for classification.	Wisconsin breast cancer dataset.
Majid Nawaz et al. [18]	Deep Learning Convolution neural network	It got 95.4% accuracy when compared with state-of-art models and DenseCNN model used for this.	BreakHis Dataset is used
NareshKhuriwal et al. [19]	Deep learning	It achieved 98% accuracy by using CNN.	Mammogram MIAS database.
Ajay kumar et al. [20]	Classification techniques like SVM, KNN, Naïve Bayes and Decision Tree.	By using BCDW11, it gave 97.13% accuracy and using WBCD32, SVM gave 97.89% accuracy.	BCDW11 and WBCD32 dataset from UCI Repository.
Sri Hari Nallamala et al. [21]	Machine learning techniques	It achieved the 98.50% precision.	Wisconsin Breast Cancer dataset.
R.Chtihrakkannan, P.Kavitha et al. [22]	Machine learning techniques	It achieved 96% accuracy by using DNN.	Mammogram images.
Weal E.Fathy et al. [23]	Deep learning	It achieved 96% area under ROC and 99.8% sensitivity and 82.1% specificity.	Digital Database for Screening Mammography dataset.
Nikita Rane et al. [24]	Machine learning techniques	According to this, enhancement in machine learning gave better results.	Wisconsin Breast Cancer Dataset.
PanuwatMekha et al. [25]	Deep learning	The author compared the machine learning techniques and deep learning. It achieved the 96.99% accuracy with deep learning.	Breast Cancer Wisconsin dataset.
Mahmoud Khademi et al. [26]	Probabilistic Graphical models and deep belief network	It used the graphical model and deep belief network with manifold learning to find out the better accuracy.	Netherlands Cancer Institute dataset, METABRIC breast cancer dataset, Ljubljana breast cancer dataset and WDBC.

HUNGLE MINH et al. [27]	Deep feature fusion method	It achieved 95% accuracy in comparison of 4 cancer classes and 97.5% for differentiating two combined groups of classes.	Histopathology images dataset.

2.1. Discussion of Findings from Literature

From the table 1, it is concluded that the deep learning technique gives better results as compared to machine learning. The results are calculated in the different dataset that have different outputs. For the tabular dataset, the machine learning techniques gives the better results but in the images dataset it don't give better results. The research work is conducted using some enhancement that is a way for better performance. Some augmentation in the dataset , is also lead for the better performance. In this section, the research work is conducted using enhancement and augmentation in dataset. It concluded from the [1] that SVM was a good classifier and compared with the hybrid techniques. It concluded from [3] that extreme learning machine performed better in among of the all used. From [4], it showed that SVM doesn't give the better results on multiple data. It gave better results on the binary data. From [6], the author compared the two CNN models and found that Inception 3 gave better results as compared to Mobile Net. In paper [7], the author worked on supervised machine learning and found SVM was a good classifier in terms of performance. From [8], the author worked on the many machine learning techniques and found that Random forest technique gave the better result. It achieved the 99.76% accuracy. From [9], the author worked on two techniques ANN and SVM and found the ANN gave better results as compared to CNN. In paper [10], the research work was conducted on SVM and SVM with grid search and achieved better result through the grid search approach. In the paper [11], the author proposed the model on CNN and found the better result through the feature extraction method. In the paper [13], the author proposed the model on CNN and compared it with the machine learning techniques and achieved better performance through CNN. In the paper [14], the author worked on the deep residual network and achieved the better performance. In the paper [16], the author worked on machine learning technique and concluded that KNN was a good classifier.

3. Application of Deep Learning

- Automated speech recognition
- Object detection
- Handwritten digit recognition
- Recommendation system
- Cancer detection
- Image recognition

4. Conclusion

Breast cancer detection is a challenging problem because it is most popular and harmful disease. Breast cancer is growing every year and there is less chance to recover from this disease. For detection of breast cancer, machine learning and deep learning techniques are used. It is concluded from the previous research, the machine learning techniques give better results in their own field. The previous research is conducted through many machine learning techniques with some enhancement and

augmentation in dataset for the better performance. But it is concluded that machine learning gives better results on linear data. It is also concluded from the previous research, when the data is in the form of images where the machine is failed. To solve the problem of machine learning techniques, an innovative technique is used. Deep learning is recently developed technique that frequently used in data science. For the classification of the breast cancer images data, a deep learning based technique CNN is used. CNN mostly works on the images dataset. In the previous research, it is also concluded that CNN gives better results as compared to machine learning techniques.

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