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Breast Cancer Detection by Using Deep Learning

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ABSTRACT

Breast Cancer is the most popular and growing disease in the world. Breast Cancer is mostly found in women. Early detection is a way to control breast cancer. There are many cases that are handled by the early detection and decrease the death rate. Many research has been done on the breast cancer. The Most common technique that is used in research is machine learning. There are many previous researches that were conducted through machine learning. Machine learning algorithms like decision tree, KNN, SVM, naïve bays etc. gives the better performance in their own field. But nowadays, 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 the present paper, reviews of all authors are conducted.

INTRODUCTION

Cancer arises when the abnormal body's cells start to separate and come in contact with normal cells and making them malignant. Breast cancer is the most frequently occurring and harmful disease in the world. Breast cancer is considered either invasive or non-invasive. Invasive is cancerous, malignant and spreads in other organs. Non-invasive is pre-cancerous and remains in its original organ. It eventually develops into invasive breast cancer. The portion of body that contains the breast cancer is the glands and milk ducts that carry the milk. Breast cancer spreads 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 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. The second type of breast cancer is most popular disease and contains up to 70-80% of diagnosis. The 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.

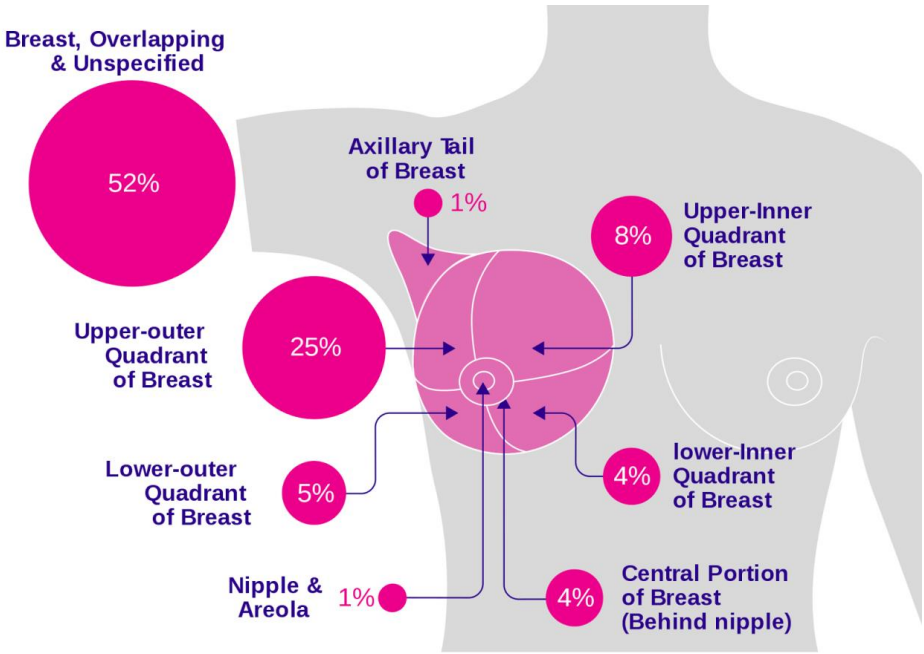

FIG NO. 1 (BREAST CANCER)

DIAGNOSIS

There are many diagnosis tests like Mammograms, Ultrasound, MRI and Biopsy that provided the images for the classification. A mammogram is used to test the breast cancer with the help of X-ray. While screening 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 the doctor demand an ultrasound. During symptomatic examination, if the tests are not convincing then the doctor prefers 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 breast cancer. There are many diagnosis processes that have been 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 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 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

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 the 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, a 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 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 a 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 class of the output.

TABLE NO.: 1 (PATHOGENESIS AND DIAGNOSIS)

S.No	Author Name	Method	Input	Output
1	Cuong Nguyen et al. 2013	Random forest classifier	Breast cancer dataset	breast cancer diagnosis and prognostic
2	Ahmad LG et al. 2013	Decision Tree (C4.5), SVM classifier and Artificial Neural Network (ANN)	Breast cancer dataset	Predicts least error rate and highest accuracy of breast cancer recurrence.
3	S. AytacKorkmaz et al. 2014	Jensen Shannon, Hellinger, Triangle Measure (JHT) & Discrete Wavelet Entropy Energy (DWEE) Classifier	Microscopic breast cell images	Accuracy diagnosis of breast cancer cell
4	AngelCruz-Roaa et al. 2014	Handcrafted image features, Random Forest	whole slide images	Differentiate IDC or non-IDC
5	HongminCai et al. 2014	feature selection algorithm	magnetic resonance images	Differentiate malignant vs benign
6	Jahanvi Joshi et al, 2014	pattern knowledge discovery framework, random tree classification technique.	BREST CANCER DATASET	Predicted the best classifier that finds the healthy breast cancer patients.
7	Jia-Long Wu, et al 2014	support vector machine (SVM)	pathologic information	to predict ALN (Axillary lymph nodes) status for breast cancer counselling
8	Rajkamalkaur Grewal et al. 2014	receiver operating characteristic (ROC) curve	Breast Cancer dataset	Diagnosis type of lymp and subtype of cancer if it is malignant lymp
9	Jouhyun Jeon et al. 2014	Support vector machines (SVM), radial basis function (RBF) kernels, grid-search, text-mining method	integrates a variety of genomic & systematic datasets	validates novel anti-cancer drug targets
10	Albert Gubern-M´erida et al. 2014	Linear discriminant analysis classifier (LDA), Gentleboost classifier (GB), Support vector machine classifier with radial basis function kernel (SVM): LIBSVM, k-nearest neighbors classifier (kNN),	magnetic resonance images	Automated localization of breast cancer in DCE-MRI
11	Bin Zheng et al. 2014	Logistic regression method	Mammogram images	predicting near-term risk of breast cancer development

Deep learning for Mammography

The section presents the recent literature on ML and DL for four discernible Mammography tasks: breast density classification, calcification detection and classification, breast asymmetry detection and classification, mass detection and classification. A tremendous number of Mammogram datasets are available, that can be used to analyze the hidden new patterns for the early detection of diseases [67]. Support vector Machine (SVM) is a supervised ML algorithm and has been widely employed for image.

Deep learning for Histopathology imaging

Histopathology is the golden measure of all imaging modalities. DL models in Histopathology accomplished better performance in segmentation, classification, and localization tasks. Some publicly available datasets as shown in Table 4 are being frequently used for the detection of BC by employing HI with DL models. In this section, we study various DL techniques that have been practiced on the available Histopathological datasets. Then, we epitomize the methods and results of our review work in 5.

Deep learning for ultrasound

In this section, our focus is the automatic detection and classification of BC using ultrasound-imaging modality. DL has found its applications in the segmentation and classification of ultrasound BC images. [121] presented the CNN-based “U-Net” [122] architecture (encoder–decoder style neural network) to capture the context and precise localization of lesions. To improve the performance of “U-Net” architecture, [123] designed a CNN architecture based framework for the segmentation and

Deep learning for MRI

Similar to other imaging modalities, Deep Learning in MRI is mostly employed for the segmentation, classification and detection of Breast Cancer. However, the significant distinction between MRI and other imaging modalities is the dimensionality. MRI generates 3D scans as opposed to Digital Mammography, Histopathology, and Ultrasound that produce 2D images. Furthermore, MRI sequences also observe variations throughout time. To address these issues, a number of strategies have been developed (as

Deep Learning for Nuclear Medicine Imaging

Nuclear Medicine Imaging (NMI) including PET/CT scans have the ability to precisely stage Whole Body (WB) meta-static disease and evaluate therapy response [155], [156], which had a tremendous impact and has enabled Breast Cancer patients to get care that is more personalized to their specific needs. PET/CT scans are more effective in identifying distant metastasis due to their high sensitivity and specificity and therefore, these techniques are not well suited for resolving the axillary nodal.

Deep learning for thermal imaging

Thermography is a painless and low-cost medical imaging modality used for early detection of BC. Deep Learning (DL) models have also been utilized for the segmentation and classification of thermal images. Segmentation is a very challenging task for disease diagnosis. Accurate segmentation of medical images can improve diagnostic performance. A two-stage novel segmentation model has been proposed by [162] to improve the BC diagnosis. The proposed model uses the amalgamation of "Gaussian Mean".

Deep Reinforcement Learning for breast cancer diagnosis

Deep Reinforcement Learning (DRL)is the amalgamation of DL architectures and Reinforcement Learning (RL) algorithms to produce efficient algorithms that can be used to solve problems in robotic engineering, healthcare maintenance, gaming applications, financing, etc. In medical imaging, DRL can be used for landmark detection, image registration, lesion localization, and detection view plane localization, etc. DRL has been much less explored in BC diagnosis. A novel technique based on DRL.

Future directions and challenges

This section discusses the future scope of the research that can be employed for the BC diagnosis. Despite the success achieved by DL models, there are some challenges and limitations about DL that need to overcome for BC detection and classification. The key challenges identified throughout our study are discussed below:

The major challenge is the lack of a comprehensive dataset for training the DL algorithms for medical imaging. DL models are data-hungry because the efficacy of these.

Application of Deep Learning

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

DISCUSSION

Breast Cancer cases are rising at an alarming rate all over the world. Death rates in developed countries are significantly higher and they are rising in every region of the world. Early detection and diagnosis of BC is critical in improving long-term survivability. Medical Image Analysis (MIA) using CAD has proven to be the most effective approach for the early diagnosis of BC and treatment. The usage of DL models for Breast Cancer diagnosis greatly assists doctors in making a final decision.

CONCLUSION

Breast cancer detection is a challenging problem because it is a most popular and harmful disease. Breast cancer is growing every year and there is less chance to recover from this disease. For the detection of breast cancer, machine learning and deep learning techniques are used. It is concluded from the previous research, that 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 is 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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