A NOVEL ALGORITHM FOR EARLY DETECTION OF BREAST CANCER USING MRI

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Annotation

Breast cancer became the most commonly diagnosed cancer type in the world in 2020. IARC estimates that there were more than 2.26 million new cases of breast cancer and almost 685 000 deaths from breast cancer worldwide in 2020. Breast cancer was the most common cause of cancer death in women and the fifth most common cause of cancer death overall. It is still unclear why some women without risk factors can develop breast cancer, while some women with very high risk do not. Unfortunately, there are ways to completely eliminate breast cancer not yet. Risk factors such as genetics alteration in specific genes (BRCA1 and BRAC2), family history and so on are beyond our control. According to world cancer report 2020, the best way to control breast cancer is early detection of the same. The treatment should start immediately upon detection. The only problem in early detection is that the women do not feel any pain in the early stages when tumor is being formed. This limits the scope for early detection and control of the cancer cells. This paper aims at developing a new algorithm for the detection of breast cancer.

1. INTRODUCTION

A group of cells which perform similar function is called a tissue. These very cells are the origin of cancer also. Cells divide themselves to form new cells. The new cells formed like this replace the old or damaged or dead cells. Sometimes this process may go wrong when new cells don't replace the old or dead cells. These extra cells might form a lump and forms tumor. These tumors are responsible for cancer. If these tumors begin in the breast it is called as breast cancer. It may begin in one or both breasts. Both men and women are susceptible to breast cancer but it is more common in women. There are two types of tumors benign or malignant based on the location and spread of these cancer cells. A benign tumor is limited within the breast and does not spread outside of it. The benign tumors can increase a women's risk of

getting cancer. So, any breast lumps or changes need to be checked by a professional healthcare physician to know whether these lumps are benign or malignant.

Breast cancer is the most common cause of cancer death in women. Also, it is the fifth most common type of cancer death overall. Breast cancer is the most commonly diagnosed type of cancer in the world. According to IARC estimates in the year 2020, 2.26million of new cases of breast cancer were detected and almost 6,85,00 cases reported death.

Cancer is one such type of disease which not only affects the individual but the family as a whole both emotionally and financially. The costs of treatments are such that it can drain out the families' resources heavily. Early detection not only helps in cost- effectiveness but also increases the chances of survival. SITU breast cancer (ductal carcinoma in situ or DCIS) is a type of precancer that starts in a milk duct and has not grown into the rest of the breast tissue.

The term INVASIVE (or infiltrating) breast cancer is used to describe any type of breast cancer that has spread (invaded) into the surrounding breast tissue.

The Tumor Node Metastasis (TNM) is used to describe the size of the primary tumor and spread (outs of cancer) to lymph nodes. Tumor size is measured in millimeters or centimeters.

2. MOTIVATION:

The actual reason for breast cancer are Unknown. Medical researcher are identified several risk factors. It remains unclear why some women with no risk factors develop breast cancer while some women at very high risk do not.. Unfortunately there are no ways to get rid of breast cancer completely. Risk factors such as genetic changes in certain genes (BRCA1 and BRAC2), family history and so on are beyond our control.

3. REVIEW OF LITERATURE 3.1Medical Imaging Modalities

Numerous medical Imaging modalities are there like positron emission tomography/computed tomography (PET/CT) imaging, ultrasound, magnetic resonance

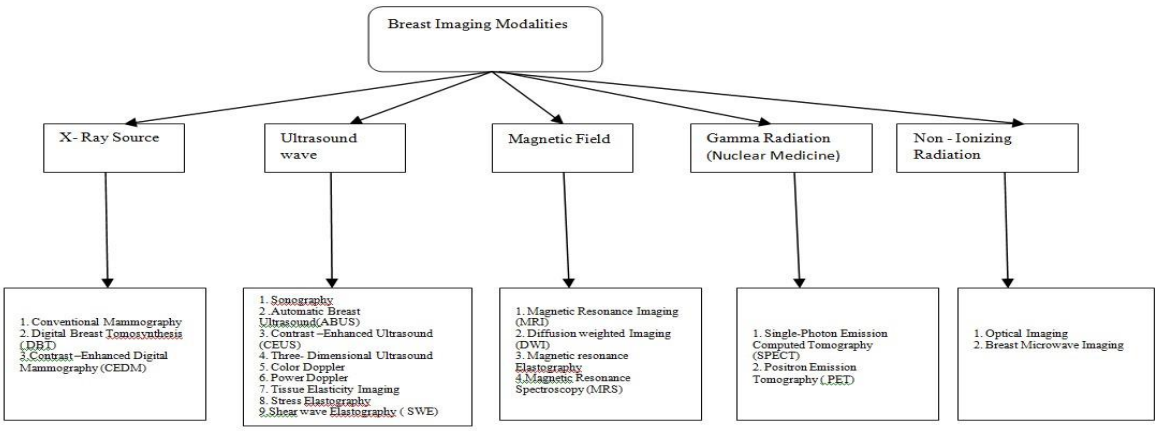


Fig 1.Different Imaging Methods in the Diagnosis of Breast Cancer

imaging (MRI), thermography, electrical impedance tomography and few others with recent developments.

MRI is best for diagnosis of Breast Cancer because

1. It is not involving any harmful radiations.
2. MRI Imaging is a more sensitive mammography. Here Ultrasound is used in the diagnosis of Breast Cancer. It is also cost effective.

3 MRI has detected 14.7 of new cases for every 1000 people when used as a Complimentary Method in people who have already been diagnosed using Mammography and Ultrasound .

4. In Computer Aided Diagnosis (CAD) Systems, the examiners study images from a Single Sequence Imaging mode. But in MRI system the radiologist observes several sets of

parameters and several imaging modes of breast simultaneously. This results in detection of Breast Cancer, if any, very easily.

3.2 Image Preprocessing Techniques

Preprocessing is one important step in which the data is prepared for the next stage, Segmentation. The purpose of preprocessing is to remove noise while not losing any critical information, like edges. Preprocessing is used to correct in homogeneities present in the images. In this step the images are normalized, resized and ensured that all images shall be of same size.

Photos are broken down to a base layer and one or more layers in detail during image processing. The base layer defines image intensity variations that are obtained by applying the image filter. The detail layer is taken by the original image and the base layer differences. The layers can be processed with different approaches to get the desired result depending on the application requirement. The blurred input picture is the base layer output. Edge preserving decompositions are used in different image processing techniques namely detail enhancement, HDR compression, details fusion and soon.

There are different ways to process both the base and detailed layer and recombined in the image enhancement operation. The process of enhancement enhances the efficiency of images for human viewing. The directed filter has many different sets of parameters.

To eliminate noise from the picture and improve the images, Gabor filtering is used. Anisotropic diffusion based on the Gabor filter is a technique that aims to minimize image noise without removing important parts of the image material, usually edges, lines or other information that are important for image interpretation.

Tapas Si et al. as discussed about the noise and intensity homomogenities (IIHs) that are present in MRI images and proposed a Anisotropic Diffusion filter to denoise and Max filter used to correct the IIHS . (4) Ravindr a sonavane et al. proposed a Isotropic filter and this will balances the edge reservation and image smoothening. This will maintain standard physical or basic properties with good morphological terms.(5) Ribes S et.al as proposed the Anisotropic diffusion scheme to noise removal and also used a nonlinear filter to remove the artifacts from the images. For less computational cost and for good accuracy we can use the Anisotropic filter suitable for imaging modalities. (1, 19)

3.3 Segmentation Techniques

Image segmentation is a method of dividing a digital image into subgroups called image segments. This reduces the complexity of the image which enables for further processing or analysis of each image segment. This is commonly used in object detection. Instead of processing the entire image, we use an algorithm of Image Segmentation to find which objects are of interest us within that image.

The method of segmenting a digital image into many sections is known as image segmentation (sets of pixels, also known as super-pixels). By simplifying and/or changing an image's representation, segmentation aims to make it easier to understand and more meaningful. Photo segmentation is a method for locating points and lines in images. The practice of assigning a label to each pixel in an image, such that pixels with the same label have similar characteristics is known as image segmentation. Picture segmentation produces either a sequence of segments that span the entire image or a collection of contours derived from it (see edge detection). In terms of any characteristic or computed property, such as color, power, or texture, each pixel in a region is identical. The neighboring regions vary substantially in terms of the same characteristic. The contours from image segmentation can be used to create 3D reconstructions when applied to a stack of images, which is popular in medical imaging.

Swati Nadkarni et al reviewed the papers and Gabor filter is capable of non visible transitions between various tissues of same MRI signals magnitude and they have discussed various segmentation methods like Active contour models , Markov random field model, Fuzzy C-means (FCM), Atlas based approach . After observing all these method segmentation using Active contour model gives the best result. (8) Bassama El. Sherbiny et. al. Proposed the

Average threshold method applied on the breast part and he has used median filter to get the segmented part to classify in the images. (9) Jing Zheng et. al proposed the deep Learning assisted Efficient adaboost algorithm for breast cancer proposed. This method is based on a supervised learning algorithm for a binary classification and method is suitable for dividing positive and negative cases. (10) Moch Syahrir et. al. Has proposed a High pass filter to improve the image to get a very good edge. (11) Aasia Rehman et. al. reviewed so many papers and he has discussed about their disadvantages and then demonstrated that UNet++ architecture is the most preferable when compared to all other models. This model gives result for semantic segmentation as well as for instance segementation.(12)

3.4 Feature Extraction Techniques

Feature Extraction Technique is one in which an initial set of raw data is divided and reduced to more manageable groups. The advantage of having large data sets is that they will be having a large number of variables. We require a lot of computing resources to process these variables. Feature Extraction Technique helps in reducing the amount of data by selecting and combining variables into features. These features are not only easy to process but also describe the actual data set of without sacrificing the originality and accuracy.

Features are taken and then sent to the classifier unit to increase the accuracy of classification. Set of features are used to predict the presence of lesions. There are so many features like shape features, texture features, statistical features, intensity features, morphological features and so on. Texture and Morphological features are the commonly used features by the researchers. Morphological features focuses on features like compactness, elongation and speculation. Texture features are taken from Histogram statistics, Co-occurrence matrix and Run Length matrix. Deep Learning is also used for feature extraction. Deep learning improves the accuracy to a greater extent.

Bassma El-sherbiny et. al. .has used the Beta and Gamma are used to calculated to classify the tumor or non-tumor. And one more feature used is Mean Equation, standard deviation equation, Skewness equation and Kurtosis equation. Wenham Lu et. al. proposed the backbone in this the images of the four sequences are passed through the Convolution neural Network model (CNN). Here in this author uses the four CNN layers. Each feature is extracted by each layer denoted by F1, F2, F3 and F4. Combining the features F1, F2, F3and F4 taken from each feature map and then converting into a high dimensional feature. Jing Zheng et. al. has taking the use of high deep learning from the convolution Neural network learning model proposed the DLA –EBA. This will helps to improve the performance. From this method the performance of the system is increased compared to other existing models. Harsha Priya et al. Used the IMAQ read file. By using the IMAQ histograph VI histogram of the picture is calculated and will be presented in graph. This graph will be presenting the parameters like start value, incremental value, mean value and standard deviation. And watershed algorithm used to detect the tumor position. Kavya N et. al. Has used the Haralick feature to extract the features

3.5 Classification Techniques

Classification algorithm plays a important role in the image processing technique. This technique is used to classify the features that are extracted from the images into different classes based on different features. There are several classification algorithms available for different applications such as Naive- Bayes, Support Vector Machine, k-Nearest Neighbour algorithms, Shadow algorithms, Minimum Mean Distance (MMD), Neural Networks, Decision Trees, Hidden Markov Model, K-means clustering algorithms, Machine Learning. These algorithms are suitable for various applications and the selection of classifier is based on the performance of the algorithm in a different kind of application domain.

Wenhuan Lu et al has proposed the CNN to Medical image classification. The author uses random XSize cropping and random horizontal flipping is adopted as a standard augmentation scheme. Kavya N et al. has used the method of Linear Support Vector Machine (SVM) .B y using this the images are classified. The features extracted from the images labeled

as normal and abnormal images. Jun Zhang proposed the Molecular subtype classification. This method is based on the features extracted from biopsied tumors.

3.6 Input Images

The Methodology proposed requires the Input Images as MRI Images which plays very important role. The model's first and foremost requirement is labeling of the images. Randomly taken images are not useful for research because by using these we get low accuracy which defeats the very purpose of our research. Hence we require a standard Dataset. Cancer Imaging Archive is the Best source for obtaining cancer images.

3.7 Preprocessing

Preprocessing is one important step in which the data is prepared for the next stage, Segmentation. The purpose of preprocessing is to remove noise while not losing any critical information, like edges. Preprocessing is used to correct in homogeneities present in the images.

In this step the images are normalized, resized and ensured that all images shall be of same size.

3.8 Segmentation

After Preprocessing the data is given to the Segmentation Block. The segmentation process involves extracting the region of interest from the MRI Images which are preprocessed by a filter. This segmented region will be having Breast Portions and Tumor portions. These are the region of interest which are required to detect Breast Cancer.

3.9 Feature Extraction

Feature Extraction Technique helps in reducing the large number of pixels of the images by capturing only the interesting part. The irrelevant data is removed from the main database. We can then easily classify into Cancerous or Non–cancerous tumor.

3.10 Classification

The last and the critical stage of Image processing is the Classification stage. In this stage we use Machine Learning, Deep Learning and Hybrid algorithms for better results. These are trained with the features of MRI Images. Thus by using our Proposed model we can classify cancerous and non- cancerous image

4. Conclusion

The process of detection of Breast cancer involves many challenges from acquiring the images to classification. Hence a standard approach has to be prepared for this. The proposed work focuses on proposing a standard model. So that it will overcome all the challenges in all the stages and also increases the accuracy and prediction rate. This standard approach to decrease the mortality and increase the life extent.

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