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Review - A Detection of Breast Cancer by using different type of Neural Network method

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Abstract- Breast Cancer is the most common malignancy in women and is the second most common leading cause of cancer deaths among them. Medical image recognition plays a crucial role in computer diagnostics and has been greatly enhanced by the advancements in deep learning techniques, particularly neural networks. This comprehensive review delivers an overview of recent advances in medical imaging using different neural networks. In addition to the comprehensive literature review, a summary of openly available data sources and future research directions are outlined. This comprehensive review delivers an overview of recent advances in medical imaging using neural networks. . By examining research examples from different medical fields, this review demonstrates the effectiveness of neural networks in medical image recognition and their potential to revolutionize healthcare by improving diagnostic accuracy and patient outcomes

Keywords: Breast Cancer, Neural Network based method, Artificial Neural Networks, Back Propagation Neural Network Method, Multistage Neural Network method and Probabilistic Neural Network.

I. Introduction

Cancer is the most vicious disease, the cure of which must be the prime target through scientific investigation. The early detection of cancer can be helpful in curing the disease completely. There are several techniques available in the literature for the detection of cancer. Many researchers have contributed their ideas in the detection of cancer. The literatures mainly discuss about the existing cancer detection techniques. Several domains and concepts are used in the detection of cancer. The main domains used in this detection technique Neural Network based method, Artificial Neural Networks, Back Propagation Neural Network Method, Multistage Neural Network method and Probabilistic Neural Network.

II. Neural Network Methods.

A. Neural Network based method

Zhang et al (1994) developed a Computer-Aided Diagnosis (CAD) scheme for the detection of clustered microcalcifications in digital mammograms. In their study, they have applied a shift- invariant neural network to eliminate false-positive detections reported by the CAD scheme. The shift-invariant neural network is a multilayer back- propagation neural network with local, shift-invariant interconnections. The advantage of the shift-invariant neural network is that the result of the network is not dependent on the locations of the clustered microcalcifications in the input layered. The neural network was trained to detect each individual microcalcification in a given region of interest reported by the CAD scheme. A ROI was classified as a positive ROI if the total number of microcalcifications detected in the ROI is greater than a certain number. The performance of the shift-invariant neural network was evaluated by means of a holdout method and ROC analysis using data base of ROIs, as reported under the ROC curve (Az of 0.91. Approximately 55% of false-positive ROIs were eliminated without any loss of the true-positive ROIs.

Land et al (1998) proposed an approach based on a modified form of Fogel's evolutionary programming approach for evolving neural networks for the detection of breast cancer using fine needle aspirate data. Data visualization and preprocessing description portrays he gentle and cruel raw data in graphical interpretative form. Moreover, it portrays a symmetrized dot pattern of this same data which may be used to corroborate the classification provided by the network. These evolved architectures routinely achieved a classification accuracy of greater than 96% while, at the same time, achieving a much smaller type of error. These results were obtained with different data sets using the same architecture, and were also obtained with the same data set over a family of evolved architectures.

Lo et al (2002) with a Multiple Circular Path Convolution Neural Network (MCPCNN) architecture specifically designed for the analysis of tumor and tumor like structure. First each suspected tumor area was divided into sectors. The defined mass features for each sector was computed independently. These sectors features were used on the input layer and were coordinated by convolution kernels of different sizes that propagate signals to the second layer in the neural network systems.

Zhang et al (2004) proposed a system where a neural-genetic algorithm was used for feature selection and a neural network was used for classification. It also combined the computer-extracted statistical features from the mammogram with human extracted features for classifying types of small size breast abnormalities.

Gustavo Ferrero et al (2006) presented an experimental application for the detection of possible breast lesions by means of neural networks in medical digital imaging. This application broadens the scope of research into the creation of different types of topologies with the aim of improving existing networks and creating new architectures which allow for improved detection.

Hernandez-Cisneros (2006) proposed a technique for the classification of microcalcification clusters in mammograms using sequential Difference of Gaussian filters (DoG) and three Evolutionary Artificial Neural Networks (EANNs) compared against a feed forward Neural Network (NN) trained with back propagation. The use of Genetic Algorithms (GAs) is mainly for finding the optimal weight set for an NN. Finding an adequate initial weight set before starting a back propagation training algorithm to design its architecture and altering its parameters, so as to improve the overall accuracy, sensitivity and specificity of a NN, compared to other networks trained with simple back propagation.

Karahaliou et al (2007) stated that diagnosis of microcalcifications (Mcs) is challenged by the presence of dense breast parenchyma, resulting in low specificity values and thus in unnecessary biopsies. They investigate whether texture properties of the tissue surrounding Mcs can contribute to breast cancer diagnosis. A case sample of 100 biopsy proved Mc clusters from 85 dense mammographic images, included in the Digital Database for Screening Mammography, was analyzed. Regions of Interests (ROIs) containing the microcalcifications were pre-posed using a wavelet-based contrast enhancement method, followed by local thresholding to segment microcalcifications; the segmented microcalcifications were excluded from original image ROIs, and the remaining area (surrounding tissue) was subjected to texture analysis. Four categories of textual features (first order statistics, co-occurrence matrices, run length matrices features and Law's texture energy measures) were extracted from the surrounding tissue. The ability of each feature category in discriminating malignant from benign tissue was investigated using a k-Nearest Neighbor (kNN) classifier. An additional classification scheme was performed by combining classification outputs of three textual feature categories (the most discriminating ones) with a majority voting rule. Receiver operating characteristic (ROC) analysis was conducted for classifier performance evaluation of the individual textural feature categories and the combined classification scheme. The best performance was achieved by the combined classification scheme yielding an area under the ROC curve (Az) of 0.96. Texture analysis of tissue surrounding Mcs shows promising results in Computer Aided Diagnosis of breast cancer and may contribute to the reduction of unnecessary biopsies.

Mammography plays a vital role in breast cancer detection which can be credited largely to the technical improvements and dedication of radiologists to breast imaging. Research is being done to ensure that these diagnosing steps are more accurate in classifying whether the abnormalities seen in mammogram images are benevolent or malignant. Elhamdi et al (2010) introduces a Hybrid Evolutionary Neural Network Classifier (HENC) combing the evolutionary algorithm, which has a powerful global exploration capability, with gradient –based local search approach, which can exploit the optimum off spring to develop a diagnostic aid that accurately differentiates malignant from benevolent pattern. From the computational experiments, it is clear that proposed technique can obtain better generalization and much lower computational cost than the conventional approaches reported recently in the literature using the widely accepted Wisconsin Breast Cancer Diagnosis (WBCD) database with some improvements.

Dheeba and Tamilselvi (2012) attempted early detection of microcalcification clusters in breast tissue will significantly increase the survival rate of the patients. Radiologists use mammography for breast cancer diagnosis at early stage. It is a very challenging and difficult task for radiologists to correctly classify the abnormal regions, because mammograms are noisy images. To improve the accuracy rate of detection of breast cancer, a novel intelligent computer aided classifier is used, which detects the presence of micro calcification clusters. An innovative approach for detection of microcalcifications in digital mammograms using Swarm Optimization Neural Network (SONN) is used. Prior to classification Laws texture features are extracted from the image to capture descriptive texture information. These features are extracted from the image to capture descriptive texture information. These features are used to extract texture energy measures from the Region of Interest (ROI) containing micro calcification. A feed forward neural network is used for detection of abnormal regions in breast tissue optimally designed using particle Swarm Optimization algorithm. The proposed intelligent classifier is evaluated based on the MIAS database where 51 malignant, 63 benign and 208 normal images are utilized. The classification results prove that the proposed swarm optimally tuned neural network highly contribute to computer-aided diagnosis of breast cancer.

Dheeba et al (2014) stated that breast cancer is the second leading cause of cancer death in women. Accurate early detection can effectively reduce the mortality rate caused by breast cancer. Masses and micro calcification clusters are an important early signs of breast cancer. However, it is often difficult to distinguish abnormalities from normal breast tissues because of their subtle appearance and ambiguous margins. Computer- Aided Diagnosis (CAD) helps the radiologist in detecting the abnormalities in an efficient way. They have investigated a new classification approach for detection of breast abnormalities in digital mammograms using Particle Swarm Optimized Wavelet Neural Networks (PSOWNN). The proposed abnormality detection algorithm is based on extracting Laws Textures Energy Measures from the mammograms and classifying the suspicious regions by applying a pattern classifier.

B. Artificial Neural Networks

Woten and El-Shenawee (2007) have represented a numerical investigation in to the improvement of artificial neural network detection of breast cancer using a planar broadband antenna and a three –region breast model. Modified four-point antennas were used, which were capable of producing various wave polarizations. The effect of wave polarization on statistical detection was also investigated.

Fooladi et al (2008) proposed that the sensitivity to the induction of chromosomal damage by ionizing gamma exposure is an average, higher in breast cancer patients than of normal healthy controls. The gamma effect in each person's lymphocytes and the comparison between two groups was examined, seventy-two hours after blood sample clustering, by exposing the samples to gamma rays and then they were harvested. The exposure of gamma rays causes abnormality in chromosomes. The database used in this proposed approach includes chromosome breakage in seven chromosome groups and the age of patients. In this technique Principle Component Analysis (PCA) is used for feature section stage. Then Artificial Neural Networks (ANN) is used for classification of normal cases from abnormal cases.

Shukla et al (2009) proposed a novel technique to simulate knowledge-based system for diagnosis of breast cancer using soft computing tools like Artificial Neural Networks (ANNs) and Neuro Fuzzy systems. The feed-forward neural network has been trained using three ANN algorithms namely Back Propagation Algorithm, Radial Basis Function (RBF) networks, Learning Vector Quantization (LVQ) networks and Adaptive Neuro Fuzzy Inference System (ANFIS). The simulation was done using MATLAB and performance was evaluated by considering the matrices like accuracy of diagnosis, training time, number of neurons, number of epochs etc., and these parameters can be very effective for early detection of breast cancer.

Jasmine et al (2009) proposed a new approach for detecting micro calcification in digital mammograms by using the combination of wavelet analysis of the image by applying Artificial Neural Networks (ANN) for building the classifiers. The microcalcification belongs to high frequency components and the detection of microcalcification was obtained by extracting the microcalcification features from the wavelet analysis was obtained by extracting the microcalcification features from the wavelet analysis of the image and these results are used as an input of neural network for classification. The neural network consists of one input, two hidden and output. The experimental observation shows that the proposed approach can provide true detection rate approximately 87% and zero false detection per image.

Banik et al (2009) examined the detection of architectural distortion, in mammograms of interval-cancer cases taken prior to the diagnosis of breast cancer, using Gabor filtering, phase portrait analysis, fractal dimension and texture analysis. The techniques were used to detect initial candidates from sites of architectural distortion in prior mammograms of interval-cancer and also normal cases. A total of 4212 regions of interests were automatically attained from 106 prior mammograms of 56 intervals-cancer cases, including 262 ROIs related to architectural distortion, and from 52 prior mammograms of 13 normal cases. For each ROI, the fractal dimension and Haralick's texture features were calculated. Feature selection was achieved using stepwise logistic regression and in terms of the area under the receiver operating charactering (ROC) curve.

Islam et al (2009) an algorithm, called Adaptive Merging and Growing Algorithm (AMGA), in designing Artificial Neural Networks (ANNs). This algorithm merges and adds hidden neurons during the training process of ANNs. The merge operation introduced in AMGA was a kind of a mixed mode operation, which prunes two neurons and adds one neuron. The adaptive strategy merges or adds hidden neurons based on the learning ability of hidden neurons or the training progress of ANNs. In order to reduce the amount of retraining after modifying ANN architectures, AMGA prunes hidden neurons by merging correlated hidden neurons and adds hidden neurons by splitting existing hidden neurons.

C. Back Propagation Neural Network Method.

Sung-Nien Yu and Yu-Kun Huang (2010) investigated the performance of clustered microcalcification recognition in digital mammograms by using combined model-based and statistical textural features. Twenty mammogram images containing twenty five areas of microcalcification from the MIAS database. In the first stage, a wavelet filter and two thresholds were used to detect suspicious microcalcification from the mammograms. In the second stage, textual features based on Markov random field (MRF) and fractal models together with statistical textural features based on surrounding region- dependence method (SRDM) were extracted from the neighborhood of the suspicious micro calcification and were classified by a three-layer Back Propagation Neural network (BPNN). The free-response operating characteristic (FROC) curve was used to evaluate the performance of classification and compare our results with that presented in the literature from four other studies. The results of the experiments suggested that the combined model based and statistical textural features were suitable for characterizing micro calcification and capable of supporting reliable and effective microcalcification detection.

Dheeba and Wiselin Jiji (2010) presented a new classification approach for detection of microcalcification clusters in digital mammograms. Two stages are used for detecting the micro calcification clusters. In the first stage, features are extracted to discriminate between textures representing clusters of microcalcifications and texture representing normal tissue. The original mammogram image was decomposed using wavelet decomposition and gabor features were extracted from the original image region of interest (ROI). With these features individual microcalcification clusters were detected. In the second stage, the ability of these features in detecting micro calcification was done using Back Propagation Neural Network (BPNN). The proposed classification approach was applied to database of 322 dense mammographic images, originating the MIAS database. Results showed that the proposed BPNN approach gives a satisfactory detection performance.

Sivakumar and Karnan (2012) described a new approach for detection of microcalcification using Evolutionary algorithms. The proposed system consists of two steps: First the mammogram image is enhanced using median filter normalized the image, pectoral muscle region is removed and the border of the mammogram is detected for both left and right images. Second, using the border points and nipple position as the reference, the mammogram images are aligned and subtracted to extract the suspicious region. The Artificial Bee Colony Optimization Algorithm (ABC) algorithm is used to detect breast border and nipple position. In bilateral subtraction, the asymmetries between corresponding left and right breast images, are considered for extracting the suspicious region from the background tissue. The textural features were extracting from the segmented mammogram image to classify the micro calcification into benign, malignant or normal. Textural analysis methods such as Spatial Gray Level Dependency Matrix (SGLDM) and Gray-Level Run - Length Method (GLRLM) were used to extract the fourteen Haralick features from the segmented image. The normalized feature values were given as input to a three-layer BPN to classify the microcalcifications in to benign, malignant or normal. The BPN classifier was validated using Jack-Knife method.

D. Multistage Neural Network method

Baoyu Zheng et al (1994) proposed a novel Multistage Neural Network (MSNN) for locating and classifying micro calcification in digital mammography. MSNN was trained using Back Propagation (BP) with Kalman Filtering (KF). A novel non liner decision approach to enhance the performance of the classification was proposed. From the experimental observation, it is clearly observed that the sensitivity of this classification is 100% with the false positive detection rate of less than one micro calcification clusters per image. The proposed approaches are automatic or operator independent and offer realistic image processing time as required for breast cancer screening programs.

Zheng and Wei (1996) proposed a computationally Mixed Feature based Neural Network (MFNN) for the detection of cancer in digitized mammograms. The MFNN employs features computed in both the spatial and spectral domain and uses spectral entropy as a decision parameter. Back Propagation with Kalman Filtering (KF) was employed in network training for evaluation of different features and related error analysis.

Dhawan et al (1996) used two categories of correlated gray level image structures features for classification of difficult to diagnose cases. The first category of features included second order histogram statistics-based features representing the global texture and the wavelet decomposition based features representing the local texture of the area of interest. The second category of features represented the first order gray level histogram-based statistics of the segmented regions and the size and the distance features of segmented region. Various features in each category were correlated with the biopsy examination results of difficult to diagnose cases for the selection of the set of features representing the complete gray level image structure information. The selection of the features was performed using the multivariate cluster analysis as well as Genetic Algorithm (GA) based search method. The selected features were used for classification using back propagation neural network and parametric statistical classifiers. The back propagation neural network classifier yielded results using the set of features through the GA based search method for classification.

Nuryanti Mohd Salleh et al (2008) stated that rapid technology advancement has contributed towards achievement in medical applications. Cancer detection in its earliest stage is definitely very important for effective treatments. Innovation in diagnostic features of tumors may play a central role in development of new treatment methods. Thus, the purpose of this study was to evaluate proposed morphological features to classify breast cancer cells and the morphological features were evaluated using neural networks. The features were presented to several neural networks architecture to investigate the most suitable neural network type for classifying the features effectively. The performance of the networks was compared based on resulted mean squared error, accuracy, false positive, false negative, sensitivity and specificity. The optimum network of classification of breast cancer cells was found using Hybrid Multilayer Perception (HMLP) network. The HMLP network was then employed to investigate the diagnostic capability of the features individually and in combination. The features were found to have important diagnostic capabilities. Training the network with a larger number of dominant morphological features was found to significantly increase the diagnostic capabilities. A combination of the proposed features gave the highest accuracy.

Imad Zyout et al (2009) stated that detection of clustered microcalcifications in mammograms represents a significant step towards successful detection of breast cancer, since their existence is one of the early signs of cancer. A new framework that integrates Bayesian classifier and a pattern synthesizing scheme for detecting microcalcification clusters is proposed. This proposed work extracts textual, spectral and statistical features of each input mammograms and generates models of real Mcs to be used as training samples through a simplified learning phase of the Bayesian classifier. Followed by an estimation of the classifier's decision function parameters, a mammogram is segmented into the identified targets against background. The proposed algorithm has been tested with average true positive and false positive. Results also indicate that the modeling of the real microcalcifications plays a significant role in the performance of the classifier and thus should be given further investigation.

E. Probabilistic Neural Network

Al-Timemy et al (2009) presented the classification of benign and malignant breast tumor based on Fine Needle Aspiration Cytology (FNAC) and Probabilistic Neural Network (PNN). Five hundred and sixty-nine sets of cell nuclei characteristics obtained by applying image analysis technique to microscopic slides of FNAC samples of breast biopsy have been used in this study. These data were obtained from the University of Wisconsin hospitals, Madison. The data set consist of thirty features which represent the input layer to the PNN. The PNN will classify the input features into benign and malignant.

Mass spectrometry-based proteomics offers a capable technique for the accurate diagnosis of different diseases. But there are certain problems in the mass spectral data such as huge volume, data complexity and the presence of noise which make the analysis of the proteomic pattern very difficult. In this proposed approach, a neural network-based system is proposed by Xu et al (2009) for proteomic pattern analysis for prostate cancer screening. The technique is mainly of three stages namely feature selection based on statistically significant test, classification by a Radial Basis Function Neural Network (RBFNN) a probabilistic neural network (PNN) and finally results in optimization through ROC analysis. The experimental observation shows that the proposed approach is very effective when compared with the existing approaches. The proposed approach has high sensitivity and specificity when combined with prostatic biopsy and is expected to help in early detection of prostate cancer.

III. CONCLUSIONS

The use of neural networks for medical image recognition is a powerful tool that can significantly improve the accuracy and speed of diagnosis and treatment outcomes. Much ongoing research is aimed at helping medical practitioners by providing automated systems to analyze images and diagnose acute diseases, such as brain tumors, bone cancer, breast cancer, bone fracture, and many others. Further research and development of neural network training methods will help overcome these obstacles and improve results in medical diagnostics. Overall, neural networks have enormous potential for improving healthcare and reducing diagnosis time. The article focuses on the research work done in the field of Neural networking in order to assist the healthcare worker in offering treatment for diseases. Materials are divided according to the organs. This thorough analysis provides a summary of current developments in neural network-based medical imaging. This article provides a comprehensive review of the application of neural networks in medical image recognition, highlighting their advantages and disadvantages. The achievements of deep learning are significant, but there are still many problems with its application in healthcare.

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