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Breast cancer detection techniques using medical image processing

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Abstract
Breast cancer is the second most common tumor in the world and more prevalent in the women population, not only a women disease its present in men even. Since the rootcause of the disease remains unclear, early detection and diagnosis is the optimal solution to prevent tumor progression and allow a successful medical intervention, save lives and reduce cost. Mammography is an x-ray of the breasts performed in the absence of symptoms. Very small tumors are detected, even before they are tangible or they manifest other symptoms. Conducted as part of a screening program, mammography is currently the recommended method for early detection of breast cancer in women 50 to 70 years. In the present scenario it is immediate need for best pre-screening tool to identify the abnormality of the mammogram images in the earlier stage itself. The purpose of this paper is to provide an overview of recent advances in the development breast cancer diagnosis. We begin with a brief introduction to some basic concepts related to breast cancer detection and diagnosis. and later paper will discuss the recent work done in this field.

Keywords: breast cancer, mammography, medical image processing

Introduction

Medical Image Processing

Imaging technology in Medicine helped the doctors to view the interior structure of the body for easy diagnosis. It made keyhole surgeries possible by the doctors for reaching the interior parts without really opening too much of the body. CT Scanner, Ultrasound and Magnetic Resonance Imaging surpassed x-ray imaging making the body's elusive third dimension visible to the doctors. All these techniques are comfortable and painless to the patient. Furthermore, it fastens the treatment process. Researchers are in constant process trying to develop the automatic procedures using the tools from computer vision, pattern recognition and machine learning

The usefulness of image analysis in different stages of medical treatment process can be categorized as: • Enhancement: The medical images are required to be processed to remove noise such as out of focus and salt and pepper noise, with a set of image processing techniques to enhance or restore the image for meaningful interpretation and diagnosis.

- **Segmentation:** Sophisticated algorithms based on image processing and computer vision are being developed to segment the region of interest from medical images.
- **Registration:** Image processing and linear algebra based techniques have been developed to accurately align the captured images from insidious of the body, with the existing model. In case of computer assisted surgeries, accurate estimation of the position of inserted tools with respect to the organ is important for a successful surgery.
- **Visualization:** Complex image modalities provide large information to be observed and analyzed. Therefore, visualization algorithms are developed. These algorithms project the high dimensionality image on to a computer screen for better visualization as well as they may also indicate important regions to be investigated.
- **Fusion:** Image fusion algorithms are being developed to combine the information from different modality images like CT scan, MRI, XRAY etc.
- **Storage:** However, two important issues need to be addressed while storing such a valuable data: vast storage space, variable formats and the security of data. These issues can be addressed by developing lossless image compression techniques.

Breast Cancer

When cells in the breast begin to grow out of control, marks the beginning of Breast Cancer. These outnumbered cells usually form a tumor that can often be felt as a lump in breast or can be seen on an x-ray. Breast cancer occurs almost entirely in women, but men can get breast cancer, too. Cells in nearly any part of the body can become cancer and can spread to other areas of the body. Breast cancer is the most frequent tumor in women and is the leading cause of cancer deaths among women. Early detection of breast cancer increases the survival rate where as late diagnosis results in patient to a critical stage and later to death. Digital Mammograms are the images of breast, which are used to find potential signs of breast cancer like tumors and abnormal changes in the skin.

As a result, the issue of adverse consequences of screening for women who do not have breast cancer, as well as women who have an early stage of breast cancer that will not progress, has become one of the core issues in recent database.

Literature Survey

This section provides a survey about various methods and techniques applied for image processing, tumor detection and tumor classification.

Author Fatima Eddaoudi *et al.* [1]. Proposed Mass detection threshold and classified using SVM classifier. The work says

that the segmentation of mammograms is the basic job in isolating areas which can be potentially tumors. To identify such zones a three stage process is followed by the researcher. Initially, pectoral muscle segmentation is done, further hard density zone detection and lastly texture analysis of regions of interest. In this work, researcher focused on masses detection using SVM classification and textures analysis. As for the first stage, pectoral muscle an approach based on contour detection using snakes with an automatic initialization. For the second stage, they used an approach based on maxima thresholding. The region of interesting segmented are classified to normal and abnormal tissue using Haralick features calculated from the cooccurrence 368 F. Eddaoudi *et al.* matrix. The test of these methods on mammograms of MIAS databases showed better performance in detecting masses compared to the methods proposed in the literature.

Tingting Mu *et al.* [2] proposed a new approach strict two-surface proximal (S2SP) classifier for tumor classification where this method uses 22 features of the segmented tumor portion. The proposed approach consists of four step by step procedures namely preprocessing of breast images, image enhancement, feature extraction and classification. Two dimensional principal component analysis is used to obtain the features of the preprocessed and enhanced image. The reason for selecting two dimensional principal component analysis is it is easier to evaluate the covariance matrix accurately and less time is required to determine the corresponding features. Finally, Back propagation neural network is used to classify whether the given mammogram image is normal or abnormal. Simulation results are carried out using the proposed approach by considering MIAS data base. From the results, it is observed that proposed approach provide better accuracy.

BhagwatiCharan Patel [3] proposed he earlier detection of breast cancer using self-similar fractal method. Researcher proposed a method for medical image enhancement based on the well-established concept of fractal derivatives. The concept of a fractal is most often associated with geometrical objects satisfying two criteria: self-similarity and fractional dimensionality. The method was tested over several images of image databases taken from BSR APPOLO for cancer research and diagnosis, India.

Olfati. E *et al.* [4] discussed Eigen factors for comparison and classification and the results were compared with GA based results. A swarm intelligence technique based support vector machine classifier (PSO_SVM) is proposed for breast cancer diagnosis. In this paper, researcher challenged that feature selection depending on top of eigenvalue certainly is not proper because they may not encode useful information for classification purposes, also suggested that features should be selected form all the components by feature selection methods. Therefore, a Genetic Algorithm (GA) is used in the most favorable selection of principal components instead of using classical method. PCA has been applied for dimension reduction, genetic algorithms for feature selection and support vector machines for classification. This approach affords optimal classification which is capable to minimize amount of features and maximize the accuracy sensitivity, specificity and receiver operating characteristic (ROC) curves. The average classification accuracy of the developed PCA+GA+SVM system is obtained 100% for a subset that contained two features.

Patel, BC, *et al.* [6]. Karthikeyan Ganesan *et al.* [7] proposed Mammography feature analysis and mass detection in breast cancer images. In this work, a comparison of the performance between the features of Discrete Wavelet Transform (DWT) and Spherical Wavelet Transform (SWT) based on the classification results of normal, benign and malignant stage was studied. Classification was performed using Linear Discriminant Classifier (LDC), Quadratic Discriminant Classifier (QDC), Nearest Mean Classifier (NMC), Support Vector Machines (SVM) and Parzen Classifier (ParzenC). We have obtained a maximum classification accuracy of 81.73% for DWT and 88.80% for SWT features using SVM classifier.

Pritee Khanna &Shubhi Sharma directed toward the development of a computer-aided diagnosis (CAD) system to detect abnormalities or suspicious areas in digital mammograms and classify them as malignant or nonmalignant. Original mammogram is preprocessed to separate the breast region from its background. To work on the suspicious area of the breast, region of interest (ROI) patches of a fixed size of 128×128 are extracted from the original large-sized digital mammograms. For training, patches are extracted manually from a preprocessed mammogram. For testing, patches are extracted from a highly dense area identified by clustering technique. For all extracted patches corresponding to a mammogram, Zernike moments of different orders are computed and stored as a feature vector. A support vector machine (SVM) is used to classify extracted ROI patches. The experimental study shows that the use of Zernike moments with order 20 and SVM classifier gives better results among other studies.

Mohammad I. Daoud, In this study, a new CAD system is developed to enable accurate BUS image classification. In particular, an improved texture analysis is introduced, in which the tumor is divided into a set of nonoverlapping regions of interest (ROIs). Each ROI is analyzed using gray-level cooccurrence matrix features and a support vector machine classifier to estimate its tumor class indicator. The tumor class indicators of all ROIs are combined using a voting mechanism to estimate the tumor class. In addition, morphological analysis is employed to classify the tumor. A probabilistic approach is used to fuse the classification results of the multiple-ROI texture analysis and morphological analysis. The proposed approach is applied to classify 110 BUS images that include 64 benign and 46 malignant tumors. The accuracy, specificity, and sensitivity obtained using the proposed approach are 98.2%, 98.4%, and 97.8%, respectively. These results demonstrate that the proposed approach can effectively be used to differentiate benign and malignant tumors

Mohammad Sameti Rabab *et al.* [12] applied feature extraction method which was used to check the tumor is benign or malignant. Image feature extraction was utilized to retrospectively analyze screening mammograms taken prior to the detection of a malignant mass for early detection of breast cancer. The mammograms of 58 biopsy proven breast cancer patients were collected. In each case, the mammograms taken 10 to 18 months prior to cancer detection were evaluated. For each of the two mammographic projections of the abnormal breast, two regions were marked: 1) region one, which

corresponded to the site where the malignant mass subsequently developed and 2) a region which appeared similar to region one on the same mammogram. On each projection of the normal breast a third region which corresponds to region one but on the opposite breast was also marked (mirror-image site). Sixty-two texture and photometric image features were then calculated for all of the marked areas. A stepwise discriminant analysis showed that six of these features could be used to best distinguish between the normal and abnormal regions. The best linear classification function resulted in a 72% average classification.

A Fuzzy SVM method was used in a CAD system for mass detection by Xiangjun Shi *et al.* in [13]. If breast ultrasound can reach a high level in the diagnosis of simple benign cysts and reduce the number of false positives. a novel CAD system is developed by the researcher for mass detection and classification in breast ultrasound images based on the fuzzy SVM. The experimental results show that the proposed CAD system greatly improves the five objective indices in comparison with other classification methods and the radiologist assessment.

Amir Fallahi *et al.* in [14] proposed an automatic system for detection of breast cancer using data preprocessing and Bayesian network where in this study, Relief algorithm is used for reducing the dimension of breast cancer database then a pre-processing is done on the data and ultimately Bayesian network classifier is used for classification. This paper presents an automatic system for detection of breast cancer using data preprocessing and Bayesian network. In this study, Relief F algorithm is used for reducing the dimension of breast cancer database then a pre-processing is done on the data and ultimately Bayesian network classifier is used for classification. The system performance has been compared with model NN (neural network) and AR + NN (neural networks combined with association rules). The dimension of input feature space is reduced from nine to eight by using ReliefF. In test stage, 3-fold cross validation method was applied to the Wisconsin breast cancer database to evaluate the proposed system performance. The correct classification rate of proposed system is 98.1%.This research offered that the preprocessing is necessary on this data and combination of ReliefF and Bayesian network can be used to obtain fast automatic diagnostic systems for breast cancer.

Osareh, A. Shadgar B. [9], Machine learning techniques to diagnose breast cancer. In this paper, support vector machines, K-nearest neighbors and probabilistic neural networks classifiers are combined with signal-to-noise ratio feature ranking, sequential forward selection-based feature selection and principal component analysis feature extraction to distinguish between the benign and malignant tumors of breast. The best overall accuracy for breast cancer diagnosis is achieved equal to 98.80% and 96.33% respectively using support vector machines classifier models against two widely used breast cancer benchmark datasets.

Hossein Rabbani *et al.* proposed speckle noise removal method for enhancing the image for better mass detection in [15]. The overall literature survey says that there are various methods are already used on medical images. The various classification techniques applied are classifying the images with less number of features. Due to less number of features the classification accuracy is also less and it is limited on the type of input images.

Conclusion

The overall literature survey says that there are various methods are already used on medical images. The various classification techniques applied are classifying the images with less number of features. Due to less number of features the classification accuracy is also less and it is limited on the type of input images.

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