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Survey on – Premature detection breast cancer using CAD (computer aided diagnosis)

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Abstract: Breast cancer is the second most common cancer in the world and more prevalent in the female population. Since the cause of the disease remains unknown, 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. Mammography is the most contemporary option for the premature detection of breast cancer in women. Extraction of features like micro calcifications and mass lesions in mammograms for early detection of breast cancer is necessary. Nevertheless, the opinion of the radiologist has a remarkable influence on the clarification of the mammogram. The sensitivity of screening mammography is affected by image quality and the radiologist's level of expertise. Computer-aided diagnosis (CAD) technology can improve the performance of radiologists, in cost effective manner.

Keywords: Mammogram, Breast Cancer, Microcalcifications, Mass lesion, Digital mammography, Feature extraction, Segmentation.

I. INTRODUCTION

Breast cancer is considered as one of the primary causes of women mortality. The mortality rate in asymptotic women can be brought down with the aid of premature diagnosis. Despite the increasing number of cancers being diagnosed, the death rate has been reduced remarkably in the past decade due to the screening programs. Premature detection of breast cancer increases the prospect of survival whereas delayed diagnosis frequently confronts the patient to an unrecoverable stage and results in death. Breast cancer tops the list of the cancers that American women suffer from. The Indian metropolises of Mumbai, Calcutta, and Bangalore display 23% of all the female cancers as breast cancers followed by cervical cancers (17.5%). Despite the fact that the incidence of breast cancer in India is comparatively lower than that of the western countries, the issue is highly alarming. High quality images and mammographic interpretation are mandatory for the detection of premature and delicate symptoms of breast cancer. Mammogram (breast X-ray) is the medical image essential for the diagnosis of breast cancer and is considered to be the most dependable technique for premature detection.

The widely recognized tool for the early detection of breast cancer in women with no symptoms; and to detect and diagnose breast disease in women experiencing symptoms like a lump, pain or is mammography Contemporarily, screening mammography and radiographic imaging of the breast are the most effective tools for premature detection of breast cancer. Still, studies have proved that all breast cancers that are retrospectively detected on the mammograms are not detected by radiologists. Computer assisted schemes that work on image processing and pattern recognition techniques can be utilized to enhance the diagnostic efficiency and for the location and classification of probable lesions and thereby alerting the radiologist to observe these areas with specific attention. Computer-Aided Detection (CAD) systems can be utilized for the enhancement of the sensitivity of screening mammography. CAD has been developed greatly during the past few years to enhance the diagnostic accuracy of both the recognition and categorization of masses and clustered micro calcifications symptoms that may signify the existence of breast cancer. A space-occupying lesion that is visible at more than one projection is referred to as a mass. Masses are illustrated with the aid of shape and margin features. Tiny deposits of calcium those are visible as minute bright spots on the mammogram are called as calcifications. A majority of the researches on computer analysis of mammograms have focused on the detection of small abnormalities.

II. LITERATURE REVIEW

An algorithm comprising of numerous phases to attain automatic detection of clusters was developed by Cairns et al. [1]. Initially, the following presumptions are made in order to represent micro calcifications in digital mammograms: micro calcifications are small in size, generally linear or round in shape, they are typically brighter than the neighbouring pixels, their brightness value is relatively unvarying across their surface, and all of them possess well-defined edges. Ultimately they also projected that micro calcifications are vital only if they occur in groups or clusters. Upon this presumption, an algorithm comprising of the subsequent phases was utilized: edge detection, contour hue generation, location of potential micro calcifications with the aid of graph searching, Feature extraction, categorization of the potential micro calcifications, and cluster detection.

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A computerized methodology for the automatic identification of clustered micro calcifications was proposed by Nishikawa et al. [2].Their methodology comprises of three phases: First the signal-to noise ratio of the micro calcifications is improved by filtering the image to decrease the normal background structure of the mammogram.

Second, signals are recognized with the aid of global gray-level thresholding, morphological erosion and subsequently by a local adaptive gray-level thresholding. Third the number of falsely identified signals is brought down by a) probing the power spectrum of individual signals, b) computing the spatial distribution of the signals, and c) examining the relationship between sizes, shape and background pixel value of micro calcifications.

A technique for the adaptive thresholding of the gray-level mammographic images was proposed by Zhao et al [3]. This approach merges the filtering operations with a rule-base. The extraction of the apprehensive areas from a mammogram and proffering the location information on certain micro calcifications of predefined shapes and sizes to radiologists for future assessment are the motives behind the proposed research. An adaptive threshold function was derived by the authors from the morphological operations: The granular form, casting form, micro calcification size, and Microcalcifications density were some of the relevant factors for the derivation of an adaptive threshold function. The index number in the skeleton of shapes that denote the micro calcifications in mammograms control the threshold set. The parameters of the adaptive threshold sets are acquired through the interpretation of umbra shadows from an image function.

A micro calcification detection algorithm that works on digital mammograms by merging morphological image processing with arithmetic processing was proposed by Mascio et al. [4]. The algorithm starts with the application of two high-frequency assessments to the original digital mammogram. The first assessment highlights any detail in the image that transforms sharply in intensity and is greater than several pixels in size. Details that are minute and textured are highlighted by the second assessment. Areas common to both the assessments are saved for thresholding. This resulted in the identification of micro calcifications and apprehensive areas.

Barman et al. [6] utilized a low-pass filter to detect Microcalcifications while analyzing digital mammogram. Besides the fact that their system is still under development the preliminary results were satisfactory yet with further modifications still to be carried out. Methodologies based on wavelet are image-processing techniques that can be utilized in the identification of micro calcifications in digital mammograms. The KNN algorithm was tailored by Woods et al. [7] postulating that an unidentified test pattern is consigned to a particular class if at least of the KNNs is in that class. The NN rule will be highly responsive to the micro calcification detection and less responsive to non micro calcifications. Bayesian approaches to classification have been employed productively in their application for the diagnosis of micro calcifications [5], [8]. Its decision making process works on basis of opting for the most probable class when a certain feature vector is provided. A likelihood of class membership is determined and utilized for the classification of an area or object.

A system that was built on fuzzy logic that comprises of image fuzzification enhancement, irrelevant structure removal segmentation, and reconstruction was projected by Cheng et al. [9]. Chan et al. [10] examine a convolution neural network based approach that is efficient of bringing down false positive detections. Three feature analysis methods based on rules, artificial neural networks, and a combination of both were compared by Nagel et al. [11]. They report that the combined method performs best because each filter eliminates different types of false positives in mammogram analysis. McGarry and Deriche [12] use a hybrid model combining knowledge of mammographic imaging process and anatomical structure and Markov random fields.

The application of SVM for detection of MCs in digital mammograms was proposed by Issam El-Naqa et al [13]. In their technique, an SVM classifier was trained with the aid of supervised learning to examine at every location in a mammogram for the presence or absence of MC. The principle of structural risk minimization formed the basis for the formulation of SVM learning. The decision function of the trained SVM classifier is computed in terms of support vectors that were recognized from the examples throughout the training. Results illustrated that the SVM classifier attains low generalization error upon application for the classification of samples that were excluded in training. Additionally, their proposed SEL system was capable of leading to the enhancement of the performance of the trained SVM classifier.

Masala et al. [14] presented a comparison of different algorithms used in a Computer Aided Detection (CAD) system for classification of masses. Pre-processing and segmentation, region of interest (ROI) search, and feature extraction and classification is the three step procedure based on which the CAD system was designed. Testing was performed on a very large mammographic database. The classification step of their algorithm starts from eight features extracted from a co-occurrence matrix in which second-order spatial statistics information on ROI pixel grey levels is present. Multi Layer Perceptron, Probabilistic Neural Network, Radial Basis Function Network and the K-Nearest Neighbors' classifiers are the algorithms they implemented and tested as classifiers. Radial Basis Function and a Multi Layer Perceptron provide the best results and outperform other classification algorithms in terms of the area under the ROC curve by almost 8%.

III. CONCLUSION

The contemporary preference for the premature detection of breast cancer in women is Mammography. Nevertheless, the elucidation of mammograms greatly depends on radiologist's opinion. In this paper, we have presented a novel approach to detect premature detection of breast cancer using computer aided diagnostic tools.

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