Abstract

Cancer is one of the most virulent diseases in the modern world that still remains a challenge, yet to be fully understood and conquered. Since exact cause of this disease still remains an enigma, preventive measures remain non-existent. It has been reported by several medical scientists that modern day lifestyles, pollution and exposure to hazardous environment may result in mutation of healthy living cells causing cancer. Genetic disorder is also known to cause cancer. Cancer can be found in different parts of the body and is named after the region of their origin like brain cancer, breast cancer, cervical cancer to name a few. Late detection fallouts in higher grade cancer detected with very poor prognosis, consequences into high mortality within few months. Early detection is the only hope for better prognosis and treatment.

Breast cancer affecting the women is known to cause high mortality unless detected in time. Detection requires a simple procedure of Mammography followed by biopsy of the tumour or lesions present in the breast tissue. Contemporary Mammographic hardware has incorporated digitization of output image accordingly increasing the scope for implementation of computational methods towards Computer Aided Diagnostics. CAD systems require Medical Image Processing, a multi-disciplinary science that involves development of computational algorithms on medical images.
This thesis is an endeavour with focus towards identification of abnormalities from digital mammogram images utilizing medical image processing. It contributes towards development of an affective, robust, real time and fully automated CAD system for better diagnosis. Preliminary study of digital microscopic image of histopathological slide is performed in the latter part of the thesis with future scope for detailed investigation. The primary goal of this thesis is to devise new techniques that will assist radiologist, pathologist, oncologist and physicians identify tumour, micro-calcifications and other mass or masses if present within the breast region and determine other markers like asymmetry, density analysis, volume measurement that are indicative of potential abnormality.

The digital mammogram image pair is initially pre-processed, the right oriented mammogram is flipped and any unwanted artifacts are removed from the image. This is followed by the crucial step of noise removal using the Gaussian kernel. The image registration and homogeneity enhancement are performed using Divide and Conquer Homogeneity Enhancement algorithm (DCHEA) and registration algorithm. Pectoral muscle holds the breasts to the body and needs to be suppressed as it mimics the intensities exhibited by tumour. This challenging task is accomplished implementing autonomous algorithm and the pectoral region is masked out leaving behind the breast region of interest (ROI). This is followed by the proposed Edge Detection Algorithm (EDA) that produces a single pixel thick edge map of the image. Breast contour detection is performed by the proposed Breast Border Detection Algorithm (BBDA) to separate the ROI from the background. The anatomical segmentation of the breast image is performed utilizing a modified travelling algorithm that traces each edge path in clockwise direction.
to isolate all closed objects within the breast ROI. Statistical $3\sigma$ is used to identify suspected region and any region exhibiting intensity values greater are abnormal regions.

Sometimes it becomes necessary to identify and monitor high risk patients to prevent fatality. Certain known markers are present requires computational methods to establish these markers. Asymmetry Analysis, is one such marker, is performed both morphologically and anatomically. The proposed algorithm uses a geometric triangle to represent each breast. The two obtained triangles are registered on their centre of mass and morphological asymmetry percentage is deduced. Density Estimation is performed using the proposed fully autonomous progressive elimination method that utilizes established statistical methods to successively suppress low intensity regions. The resulting high intensity region is measured and compared with BI-RADS scale to establish risk factor. Breast volume calculation was initially performed only after surgical removal of breast called mastectomy. A new geometric model having one elliptical paraboloid inverted over another is proposed to model the breast delivering highly accurate breast volume measures.

Histopathological slides are examined for determination of malignancy after biopsy is performed. Digital Images are required to be registered and enhanced prior to application of any deterministic algorithm. This thesis has introduced a new registration and enhancement processes by performing Colour Polarization of the digital image. Elaborate processing of histopathological slides is left for future research.