Abstract

Fully Automated Real Time Computer Aided Diagnosis System of Human Breast Cancer using Digital Mammogram and Digitized Histopathological Slide

Cancer is one of the most lethal diseases in the modern world that still remains a challenge, yet to be fully understood and conquered. It has been reported that modern day lifestyles, pollution and exposure to hazardous environment may result in mutation of healthy living cells causing cancer. They are found in different parts of the body and are named after the region of their origin like breast cancer, cervical cancer to name a few. Breast cancer is prevalently found among women and is known to cause high mortality unless detected in time. Detection requires radiological investigation involving Mammography followed by biopsy of the tumour or lesions present in the breast tissue. 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.

Pre-processing is performed for effective response to subsequent algorithms and is done by flipping the right oriented mammogram on the vertical axis, removal of unwanted artefacts and noise removal using the Gaussian kernel. The image registration and homogeneity enhancement is performed using Divide and Conquer Homogeneity Enhancement algorithm (DCEHA) and registration algorithm. Pectoral muscle holds the breasts to the body and performs purely mechanical function. It mimics high intensity region exhibited by tumour and its removal is accomplished autonomously by the proposed method where a rectangle is defined to limit the elimination zone and uses modified seeded region growing algorithm with seed pixels obtained from a specific path. 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 Region of Interest (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. To classify intensity characteristics of the obtained regions statistical 3σ is used to identify suspected region.

Asymmetry Analysis is potential risk marker, is performed both morphologically and anatomically where both the left and right breast are compared and any major asymmetry detected can indicate abnormality. Density Estimation is performed using the proposed fully autonomous progressive elimination method and the resulting high intensity region is measured and compared with BI-RADS scale to establish risk factor. Volumetric analysis is performed using image rather than mastectomy. A new geometric model having one elliptical paraboloid inverted over another is proposed to model the breast, delivering highly accurate breast volume.

Biopsy is performed on extracted diseased tissues and the histopathological slides are examined for determination of malignancy and staging of cancer. This thesis has introduced a new registration and enhancement process by performing Colour Polarization of the digital image. Elaborate processing of histopathological slides is left for future research.