Computer-Aided Identification of the Pectoral Muscle in Mammograms

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Due to drastic growth in mammography, a huge number of high quality and diverse images are available for analysis. At this juncture, usage of computer vision techniques, which includes artificial systems to analyze these medical images, is indispensable. However, the usage of artificial systems for mammogram analysis is not new to this field. Though Computer-Aided Detection (CAD) for breast cancer is available in the market, studies demonstrate that further development is required in this field to produce more effective CAD. In CAD, removal or suppression of the pectoral muscle in screening mammograms is one of the preprocessing steps as its presence within a mammogram may influence the breast cancer detection. Through this research, we have attempted to obtain efficient automatic methods to identify the pectoral muscle, which appears as a homogeneous region, in mediolateral oblique view mammograms using a proposed segmentation method, the graph cut based merging.

We are proposing two different approaches to identify the pectoral muscle in a mammogram using the proposed graph cut based merging method. Most of the existing methods in the literature identify the pectoral muscle edge as a straight line. However, mammograms can have curved pectoral muscle edges. In the first approach, we attempt to extract the pectoral muscle edge as a curve for the accurate identification of the pectoral muscle. The pectoral muscle is smoothly represented using a Bezier curve which uses the control points obtained from the pectoral muscle edge using the graph cut based merging method. The proposed work was tested on a public dataset of mediolateral oblique view mammograms obtained from the mammographic image analysis society database, and its performance was compared with that of the state-of-the-art methods

reported in the literature. The mean false positive and the mean false negative rates of the proposed method over randomly chosen 84 mammograms were calculated, respectively, as 0.64% and 5.58%. Also, with respect to the number of results with small error, the proposed method out performs the existing methods.

The second approach uses watershed transform. The watershed transformation of a mammogram shows interesting properties including the appearance of a unique watershed line corresponding to the boundary of the pectoral muscle. In addition to this, it is observed that the pectoral muscle is over-segmented (divided into many small regions) due to the existence of several irrelevant catchment basins within the pectoral muscle. Hence a modified graph cut based merging algorithm is proposed to combine the appropriate catchment basins to obtain the actual pectoral muscle boundary. The mean false positive and the mean false negative of this approach are 0.85% and 4.88% respectively. With respect to the mean false negative, the performance of the proposed method is better than the existing methods.

These results demonstrate that the two proposed approaches can be used effectively as a preprocessing step in the detection of breast cancer in CAD.