CHAPTER 8

CONCLUSION AND FUTURE ENHANCEMENT

The Mammogram Image Classifications System (MICS) for early detection of breast cancer using Mammogram Image is proposed in this thesis in order to overcome the issues faced in the existing diagnosis system. The main objective of the proposed MICS is to diagnose breast cancer at early stage by providing suitable and efficient model using hybrid soft computing models. The main contributions of this thesis are summarized here under.

In Chapter 2, different types of image modalities of breast cancer are analysed and the comparative analysis is tabulated. A new taxonomy of MICS is suggested, similar to the general taxonomy of the traditional diagnosis system.

In Chapter 3, the need for a preprocessing phase is indicated in order to improve the image quality and make the segmentation results more accurate. In this thesis five processing steps are used. In the first and second steps, after Image Acquisition, unwanted portions like artifacts such as labels, and X-ray marks are remove from the mammogram image. The given images are identified as left or right breast image. If it is a left breast image then, it is flipped horizontally called transformation. In the Third step, five filtering techniques have been studied based on statistical approaches to remove high frequency components from mammogram images without affecting edge component. The experimental results show that one of the proposed filters is the best for removing the high frequency components from
mammogram images compared to others. In the fourth step, the mammogram images are normalized to avoid the difference in brightness and contrast between the mammograms. The enhanced image is used as an input image for further image processing steps of pectoral muscle suppression and image segmentation.

The hybridization of Fuzzy, CCL, and Straight Line methods are proposed for pectoral muscle detection and suppression. The results obtained over MIAS database show excellent output. The Hybridization of Fuzzy and CCL (HFCLM) method is used to detect pectoral muscle accurately and suppress the pectoral muscle successfully without losing any information from the rest of the mammogram.

In Chapter 4, the fuzzy rule and fuzzy based on Canny, Relative Pixel and Gradient with Standard Deviation value methods are proposed to edge detection of the mammogram images. Experimental results show the higher quality and superiority of the extracted edges compared to the other methods in the literature such as Sobel, Robert, and Prewitt. To achieve good result, more help is required to remove the breast skin of the mammogram images. The Fuzzy Entropy and Weighted Fuzzy Entropy methods are proposed for the breast region segmentation. These methods are extracted from the breast region successfully and segmented without losing any information from the mammogram. The performances of the proposed algorithms are measured and compared by using entropy index value and classifier with Otsu Multi-threshold method (OMT). The Modified Ant Colony Optimization (MACO) method is used microcalcification segmentation
(ROI) in Mammogram images. The area under the ROC curve ($A_z$ value) is an important criterion for evaluating diagnostic performance. The $A_z$ value for the MACO algorithm is 95%.

In Chapter 5, there are four data sets which are extracted from the 322 mammogram images and they were classified using SVM. The statistical Haralick features from the textural description methods such as Surrounding Region Dependency Matrix (SRDM), Spatial Grey Level Dependency Matrix (SGLDM), and Grey Level Difference Matrix (GLDM), and run length features from the texture description method Grey Level Run Length Matrix (GLRLM) are extracted from segmented mammogram images for further analysis. And each texture method is studied separately and the comparative analysis is made to identify the best textural model for identifying breast cancer from mammogram images. The performance of the classifiers for texture analysis methods is evaluated using various statistical parameters such as sensitivity, specificity, and accuracy. The experiment results demonstrate the performance of textural methods and provide evidence that the texture features based on SRDM for the threshold value $\theta = 150$ distinguish between normal, benign, and malignant on mammogram images, with accuracy levels higher than texture features based on others.

In Chapter 6, three unsupervised attribute reduct algorithms using tolerance rough set theory and particle swarm optimization algorithm are proposed. Textural features are extracted for classification of microcalcifications. The feature set may contain irrelevant or redundant information. These features are eliminated to
improve the accuracy and to reduce the time complexity of the classifier. The reduced feature sets from each selection algorithms are combined to form the reduced feature set, which is used for classification. The classifier tool is used to classify the data and the classification performance of the proposed feature selection method is evaluated using the two measure classification accuracy and RMSE. Further, the reduced datasets are used for the proposed mammogram image classification method.

In Chapter 7, the FK-NNE is proposed for mammogram image classification. The values of the features available in the reduced feature set, constructed from the feature selection algorithms are normalized and given as input to the classifier. The performance of four classifiers namely FK-NNE, K-NNE, FK-NN, and K-NN have been constructed, and these are investigated for the task of breast cancer classification using mammogram images. The proposed FK-NNE classification accuracy is higher when compared to the existing K-NNE, FK-NN and K-NN classifiers. The experimental result reveals that the K-NNE classifier achieves better classification accuracy than others. The FK-NNE classifier produces 97% for overall classifying accuracy which is higher than the remaining algorithms K-NN (91%), FK-NN (93%), and K-NNE (95%).

In this thesis, the hybridization of fuzzy set theory, rough set theory, tolerance rough set, and swarm particle optimization methods are used to remove pectoral region, edge detection, breast region segmentation, microcalcification, feature selection, and classification. In future, much work still needs to be done to develop a more efficient
Intelligent Diagnosis System for breast cancer. It is still a problem in identifying region of interest from mammogram images. Hence, by introducing preprocessing steps the efficiency of the proposed system can be improved. An adaptive Fuzzy, Rough, Neural Networks, Swarm Optimization, and fractals with AI approaches may be used in-order to improve the accuracy of the mammogram image segmentation, feature selection, and classification.