Chapter 7

CONCLUSION AND FUTURE WORKS

7.1 Conclusion and Major Contributions

The thesis presents an image classification and retrieval system using Machine Learning techniques. It uses Digital Mammograms and Placental Sonograms for analysis. Mammogram Images are classified into normal, benign and malignant. Placental Images are classified into different grades according to the calcification content. The use and development of new algorithms and techniques could overcome many challenges that exist in conventional classification and retrieval systems.

A series of preprocessing operations are conducted on the low contrast high noisy mammogram and sonogram images. Different filters such as Mean, Median, Weiner and Diffusion are applied for removing the noises. Use of a new filter based on Local Binary Patterns gives good result in removing the speckle noise in ultrasound images by preserving the edges and small details in images. To remove the background information and pectoral muscle in mammogram, a two level segmentation is carried out, whereas in placental images the segmentation of region of interest is done manually.

Development and use of appropriate preprocessing operation helps in the extraction of intelligible features which give at most accuracy in classification and retrieval. The proposed work extracts different intensity, texture and shape features which include Histogram statistics, Autocorrelation, Spatial Grey-Level-
Dependence Matrix Features, Grey Level Difference Statistics, Neighbourhood Grey-Tone-Difference Matrix–Features, SFM - Features, Local Binary Patterns, Wavelet Energy Descriptors, Moment Invariants and Regional Shape Descriptors. Identification of the best feature combination for the classification and retrieval of mammogram and placental sonogram images is a major contribution of this work.

In the classification stage, supervised classification using the entire feature set and reduced feature set, which is obtained after Principal Component Analysis are done. Different classifiers such as Multi Layer Perceptrons (MLP), Decision Trees, Support Vector Machines (SVM) and Extreme Learning Machines (ELM) are used. Use of ensemble increases classification accuracy. The novelty in the classification process is the use of ELM for classifying placental images into different grades.

The work also includes the design and use of a CBIR system for retrieving similar images. A general CBIR system is developed and tested with mammograms, sonograms, handwritten Malayalam characters and facial images and thereafter a specific system that can be used for medical applications is designed. The use of CBIR systems with multiple image queries for retrieving desired images is the major contribution here. Multiple images are combined using relational logical operators such as AND, OR and NOT. Most of the existing systems support single image queries or image queries with single ROI. Therefore the use of CBIR system with multiple images is a landmark in the theoretical framework of CBIR.
7.2 Future Suggestions

The proposed work has the potential for further developments because of its simplicity and encouraging results that will motivate its incorporation into real time scanning systems.

- Use of larger database with non visual features attached to the images can also be tried.
- Extraction of more localized features from digital mammograms and placental sonograms.
- Further investigation would be needed in the study of the clinical utility of placental maturity analysis.
- CBIR system should have the ability to track temporal information because most of the diagnosis and treatment process involve a series of follow ups.
- New user interfaces for annotating, browsing and searching based on image content need to be investigated. Research in this area will require usability studies with practitioners.