# CONTENTS

<table>
<thead>
<tr>
<th>Abstract</th>
<th>ix</th>
</tr>
</thead>
<tbody>
<tr>
<td>List of Figures</td>
<td>xii</td>
</tr>
<tr>
<td>List of Tables</td>
<td>xv</td>
</tr>
</tbody>
</table>

## Chapter 1  INTRODUCTION

1.1. Introduction                      | 1   |
1.2. Problem Statement                 | 2   |
1.3. Motivation                        | 3   |
1.4. Thesis Structure                  | 8   |

## Chapter 2  LITERATURE SURVEY

2.1 Related Work                       | 10  |
2.2 Anatomy of the liver                | 26  |
2.3 Liver Functions                     | 28  |
2.4 Liver Diseases                      | 29  |
2.5. Methods of Investigating Liver diseases | 35  |
   2.5.1. Physical Examination           | 35  |
   2.5.2. Laboratory Testing            | 36  |
   2.5.3. Diagnostic Imaging            | 37  |
      2.5.3.1. Ultrasonography           | 37  |
      2.5.3.2. Computed Tomography       | 40  |
      2.5.3.3. Magnetic Resonance Imaging| 43  |
2.5.3.4. Cathode Angiography
2.5.3.5. Positron Emission Tomography
2.5.4. Liver Biopsy

2.6. Wavelet Transform

2.7. Texture Description Methods
2.7.1. Statistical Texture Description Methods
2.7.1.1. Histogram Features
2.7.1.2. Second Order Statistical Features

2.8. Feature Selection Methods

2.9. Neural Networks
2.9.1. Probabilistic Neural Network
2.9.2. Learning Vector Quantization Neural Network
2.9.3. Back Propagation Neural Network

Chapter 3 SYSTEM OUTLINE

3.1. Proposed System

3.2. Methodology
3.2.1. Liver Extraction from CT abdominal Image
3.2.2. Tumor Extraction from Liver Image
3.2.3. ROI Selection from Ultrasonic Liver Images
3.2.4. Biorthogonal Wavelet Based Statistical Texture Feature extraction
3.2.5. Feature Selection
3.2.5.1. Sequential Forward Search Algorithm 71
3.2.5.2. Sequential Backward Search Algorithm 72
3.2.5.3. Sequential Forward Floating Search Algorithm 72
3.2.5.4. Genetic Algorithm 73
3.2.6. Neural Network Classifiers 74

Chapter 4 SYSTEM EVALUATION
4.1. Classification Performance Evaluation 75

Chapter 5 IMPLEMENTATION AND RESULTS
5.1. Implementation and Result Analysis using CT images 78
5.1.1. Liver segmentation results from CT abdominal image 78
5.1.2. Tumor Extraction results from extracted Liver region 81
5.1.3 Results for Classification of fatty and cirrhosis liver 84
5.1.4 Results for Classification of benign and malignant tumor 100
5.1.5 Results for Classification of tumor as hepatocellular carcinoma, cholangio carcinoma, hemangeoma and hepatocellular adenoma 111
5.2 Results for Classification of ultrasonic liver images as normal, fatty and cirrhosis 115

Chapter 6 CONCLUSION AND FUTURE PERSPECTIVE
6.1. Conclusion 122
6.2. Future Perspective 126