Chapter 5
Conclusions and Future Scope

5.1 Conclusion
In this thesis security based image processing using state of art mathematical concepts has been discussed. Key concepts used are given below:

1. Singular Value Decomposition
2. Discrete Fourier Transform
3. Wavelet Transform
   (a) Time frequency Analysis
   (b) Time Scale Analysis
   (c) Discrete Wavelet Transform
4. Lifting Scheme
5. Linear Bivariate Splines

A novel approach to image watermarking has been given. The watermark is embedded in the transform domain. Lifting Wavelet scheme with singular value decomposition has been proposed. The algorithm for watermark embedding has been developed. The algorithm has been experimentally evaluated. The water extraction algorithm has also been developed. The extraction algorithm has been experimentally tested. The results have been found to be very promising. The scheme for watermark embedding and extraction has also been tested against all known attacks. The watermark has survived all attacks. The scheme can therefore be construed as robust and secure.
In the thesis we also proposed an intelligent recursive algorithm for 95% salt and pepper noise removal. Lifting scheme has been used in the proposed algorithm. The algorithm has been experimentally tested for varying noise levels. Key features of the algorithm include less time complexity, intelligent threshold determination and superior operation at high noise levels.

We also propose a progressive image transmission algorithm using linear bivariate splines. The image representation is segmented in phases using progressive significant sample point selection. Coarser data using Sobel and Canny edge detector filters is generated in phase one. Finer details of weaker edges are included in subsequent phases. An image reconstruction algorithm using progressive transmission scheme has been developed. The algorithms have been experimentally tested to have resulted in superior performance.

To sum up, the main objectives of the thesis can be summarized as follows:

1. The lifting wavelet transform (LWT) and singular value decomposition (SVD) techniques for robust digital watermarking.
2. Intelligent Recursive Algorithm (IRA) based on lifting filter that can efficiently remove noise.
3. Progressive image reconstruction scheme based on the multi-scale edge representation.

Following Algorithms have been proposed.

1. Watermark Embedding using LWT and SVD
2. Watermark Extraction using LWT and SVD
3. Impulse Noise Removal
4. Progressive Image Transmission Scheme
5. Image Reconstruction Scheme

5.2 Future Scope

The watermark embedding scheme can be extended to include encrypted watermarks. Watermark extraction algorithm can be extended to perform watermark validation automatically. Suitable feature extraction and matching techniques have to be explored.

The noise removal scheme has been implemented for stationary images. This can be extended to noise removal in case of non-stationary images for dynamic denoising.

In case of the progressive image transmission the schemes for optimizing the data for each phase needs to be studied. The phasewise data compression and decompression schemes need to be evaluated.