CHAPTER 7

CONCLUSIONS AND FORESEEABLE ENHANCEMENTS FOR FURTHER RESEARCH

This chapter concludes the dissertation with a summary of research contributions and a concise discussion of the algorithms and techniques developed for a typical Video CODEC. It throws open some possible avenues for further research.

7.1 Conclusions

Conventional Video CODEC contains the combined characteristics of predictive and transform coding modules. Predictive coding modules such as Motion Estimation (ME) and Motion Compensated Prediction (MCP) techniques remove the temporal redundancy existing in the interframes of video sequence. Transform coding modules such as transformation, quantization and entropy encoding modules are removing the spatial and statistical redundancies that existing in the intraframes of video sequence.

Literature survey reveals that the block matching motion estimation along with motion compensated prediction techniques are efficient for reducing the temporal redundancy present in the interframes of video sequence. The sub-optimal and fast block matching algorithms determine the best candidate block of the current frame from the reference frame with a fixed number of searching steps within a search window. Alternatively, the best candidate block is also determined by different search patterns that are not restricted to a number of searching steps.

By making use of these features, a new DBM algorithm has been developed to reduce the number of searching points in the search window. Instead of searching
the candidate block in the entire area within the search window, corresponding motion vector is obtained from the previous frame for the prediction of the current frame. Various searching patterns and methods are applied in the refinement procedure of DBM algorithm. The experiments were conducted on various bit rate standards and non-standard video sequences. The results show that the DBM algorithm developed in this research work outperforms the brute-force Full Search (FS) and gives better performance than the other existing fast BMAs used in current video coding standards.

In hybrid MCP/DCT/DPCM transform coding standards, DCT is used as the defacto transformation method. This transformation generates blocking artifacts around edges of 8x8 blocks of reconstructed frames. These frames are retained in the frame memory to predict the subsequent interframes either by using forward or backward prediction methods. This type of blockiness in the reconstructed frame is continued in other frames that are to be processed. This leads to generate more energy contents in the residual frames, which are applied to transform coding modules for spatial redundancy techniques. Hence, the effectiveness of DWT for intraframes and prediction characteristics of DCT for interframes are applied as a hybrid transformation technique. Experimental results indicate that the hybrid transformation gives better performance in terms of PSNR for the luminance and chrominance values of macroblocks of video sequence.

Prediction of intraframes in the video sequence is presumed as the next issue in the research. In the conventional MPEG and ITU-T video coding standards, a couple of frames are considered as intraframes per second to obtain flicker free motion in a video sequence. In these standards, P-frames are predicted either from I-frames or previously processed P-frames. Moreover, B-frames are also predicted from the combination of either I- and P-frames, two P-frames or two B-frames. The blocking artifacts encountered in the transformation module are easily carried over into ME and MCP modules. To overcome this problem, a new GoF scheme has been developed and implemented. The new scheme minimizes the prediction error consistently and reduces the frame memory storage.
Entropy encoding module in the transform coding normally eliminates the statistical redundancy existing in the quantized transform coefficients in addition to the motion vectors inferred from ME and MCP modules. Entropy encoding generally takes more time due to its reversible characteristics. The existing encoding algorithms are either computationally expensive or transmit huge amount of additional information for decoding. To overcome this shortcoming, a rank coding algorithm has been developed to minimize the computational complexity and communication overhead.

The hybrid algorithms and techniques have been developed and incorporated to provide a framework for a typical Video CODEC. The experimental results show that the developed framework outperforms the existing counterpart modules of Video CODEC in terms of quality, searching speed, encoding time and compression ratio.

7.2 Foreseeable Enhancements for Further Research

Though the algorithms and techniques developed in this research work are improving the performance of the modules of Video CODEC, certain limitations are also identified and presented. To overcome these limitations, the following extensions are suggested for further research.

(i) Sub-pixel motion vector prediction in addition to full-pixel motion vector may be considered for accurate motion compensated prediction. Bidirectional interpolation may also be taken for prediction of GoF. These two extensions lead to computation and storage overhead in motion estimation and compensation modules. To minimize this limitation, an angle of movement along with direction of the motion vector of the interframes can be considered.

(ii) Combination of multi level filters at various levels of decompositions may be taken into consideration for better energy compaction and decorrelation in intraframes of video sequence.
(iii) Scalability in video coding can be achieved by applying recursive procedure in entropy encoding along with quantization.

The above suggestions are inferred from this research work. There are more directions for research in this area such as scalable video coding, medical video compression and so on.