ABSTRACT

Compression of image data is vital because of the requirement for faster transmission and efficient storage in applications like multimedia, which is exponentially growing in all communication areas such as internet and mobile. Among various lossless and lossy compression schemes available, Vector Quantization is successful, effective, efficient, secure, and widely used compression technique over two decades. The strength of it lies in higher compression ratio and simplicity in implementation. The quality and compression performance using VQ lies in optimum design of Vector Quantizer (VQ) or codebook. Early researchers proposed several design methodologies, but still there is room at top to develop more efficient codebook.

Self Organizing Feature Maps (SOFM), an unsupervised class of artificial neural networks is one of the successful techniques in Vector Quantizer design. An investigation of the drawbacks of SOFM based codebook design is carried out in order to optimize performance of the compression. SOFM is trained by varying their parameters according to the results of mathematical operations performed on the image samples. Different codebooks are designed through training of SOFM network by combination of different images. These images are selected through rigorous statistical study of matching probabilities of image samples from images with various characteristics. The codebooks designed through these techniques are named as "**Enhanced**" and "**Generic**" codebooks. The quality analysis of the decompressed images is carried out by application of different quality measures like image fidelity, structural content, normalized cross correlation, normalized absolute error, average and maximum difference, entropy, mean structural similarity index and universal quality index. The subjective quality measure such as mean opinion score is also taken into consideration for quality evaluation. Design of "**Generic with error codebook**" serves as one of the major contribution, in which error information of certain samples is also stored during training of SOFM itself. The quality analysis of decoded images using this codebook proves that the quality is very good and the gap between quality and compression ratio is narrowed. The performance of the vector quantizers is also compared with the VQ's designed using transform coding.

During encoding process using simple VQ or even with image compression using "Generic" and "Generic with error" codebook, minimum distortion is obvious which accounts for loss of information or degrades quality of reconstructed images. **A novel**

idea of loss prediction is implemented using well-trained back propagation artificial neural networks. Results show marked improvement in the quality of decompressed images. The entire algorithms are thoughtfully designed, such that they can be easily implemented using FPGA, making low cost real time imaging solution.

Results obtained after compression of medical images such as CT scan, digital X-ray, MRI, using enhanced and generic codebooks are presented. Doctors often use the "texture" in medical images for proper diagnosis .In lossy compression schemes the texture gets degraded. In order to evaluate performance of such images, the textural analysis is also presented along with the quality analysis.

The same design techniques are used in compression of color images. **The major contribution in this experimentation is design of VQ's over different linear and non-linear color spaces such as YCbCr, YIQ (NTSC), HSI and HSV other than RGB and carrying out quality analysis with all codebooks designed.** The performance of compression with respect to quality and storage of "Enhanced", "Generic 1" and "Generic 2" VQ's designed over RGB color space is compared with JPEG of 70% quality .The advantage of "Generic " VQ is its simplicity in design and implementation with respect to the complexities involved in implementation of JPEG in hardware. The HSI and HSV based codebook presents better performance. The proposal of HSI or HSV based codebooks attempts to investigate the possibility of using the co relational properties between the color planes, so that the scheme of having one or two codebooks at encoder side and three codebooks at decoder side can be implemented. This will reduce the bit rate and storage size further by keeping the same quality of reconstructed images.