ABSTRACT

Every day, a huge amount of digital information is stored, processed and transmitted on internet. Most of the on-line information is still or video picture in nature. In multimedia, the uncompressed still or video picture requires considerable storage capacity and occupies more transmission bandwidth. Due to the development in very large scale integration (VLSI) technology, there is a rapid progress in mass-storage density, processor speed and digital communication system performance. But, the requirements for digital data storage capacity and digital data transmission bandwidth exceed the capabilities of the available technologies.

Image compression is the art of efficiently coding the digital images to reduce the number of bits required in representing a digital image. The color image compression algorithms exploit the redundancy in an image, such that the image is represented in smaller number of bits; an acceptable visual quality for the decompressed image is also maintained. Color image compression techniques usually reduce the redundancy between color channels. The RGB color image is transformed into a de-correlated color space, such as YC_bC_r, YIQ, YUV, etc. The human visual system is more sensitive to luminance details than to chrominance details. Hence, the chrominance components are compressed at high rate.
Instead of de-correlating the color channels, high correlation between the color channels of images is used as a basis for a new coding technique. A localized polynomial relation between the color channels is used to develop the new color image coding technique. One of the color channels is considered as a base color and the others are taken as dependent or subordinate colors. The subordinate colors are approximated as functions of the base color. Instead of coding each color planes, only the base color is coded and for the subordinated colors only the polynomial coefficients are coded.

The correlation between the color channels for various color spaces are analyzed and it is found that the CIE (International Commission on Illumination) UVW color space is the most correlated one and that the U channel is more correlated than other color channels. Due to high correlation between color channels, the CIE UVW color space is used. As a first step, the color channels of the RGB image are transformed into CIE UVW color channels. Two correlation based algorithms are proposed. In the first algorithm, among the three color components, one component is chosen as base color and other two are consider as subordinate colors. Each color channel is divided into N*N blocks. The most correlated channel U is considered as base color, the other two channels are approximated as linear functions of the base color. Only two parameters are transmitted for each block N*N of V and W. In the second algorithm, for every NxN block the correlation between the color components are calculated and the most correlated color component is taken as base color and the other two are
consider as subordinate colors. The Cohen-Daubechies-Feauveau wavelet filter (CDF 9/7) and Set Partitioning in Hierarchical Tree (SPIHT) coder are used for encoding the base color.

Both the algorithms are implemented using MATLAB 7.0. The performance of the correlation based compression algorithm - I is analyzed and the same is compared with the traditional decorrelation based SPIHT algorithm. A significant Peak Signal to Noise Ratio improvement is achieved compared to the traditional coding scheme for the same compression rate. Also, the proposed compression technique reduces the complexity in coding and decoding algorithm. It is observed that there is significant Central Processing Unit (CPU) time saving during the coding and decoding of the color images.

The effect of decomposition level on the reconstructed output is analyzed for both the correlation based and decorrelation based SPIHT algorithms. It is found that correlation based approach algorithm reconstructs the chrominance details in the lower level of decomposition compared to the decorrelation based approach. At all levels of decomposition, the proposed algorithm-I is superior in constructing chrominance detail than the traditional one. The performance of the proposed algorithm-I is evaluated by varying the block size. According to rate distortion theory, the compression ratio is increased for large block size with the reduced peak signal to noise ratio (PSNR) values.
The algorithm-I is tested in other color spaces like RGB, XYZ, YUV, YIQ and YCbCr. It is found that the algorithm is performed the best in the CIE UVW color space and results in a significant gain in PSNR values for all the test images. The performance of the algorithm - I is compared to the image compression standards JPEG (Joint Photograph Expert Group) and JPEG2000 (Joint Photograph Expert Group 2000). For the same compression rate the proposed algorithm-I is better in terms of a considerable increase in PSNR values.

Comparisons between the two proposed algorithms are also discussed. The PSNR values of individual color channels and the overall PSNR values obtained in both the algorithms are calculated and compared for some of the test images. It is observed that the PSNR values are the same for both of these algorithms when the test images are Lena and Mandrill. Because, for these images in all blocks, the most correlated color block is U channel. Hence the PSNR values remain the same. For other images, the PSNR values of U channel is decreased and PSNR values are improved in V and W channel. The gain in overall PSNR values is calculated and the range of gain varies from 0.2284dB (for the image Beach) to 0.8548dB (for the image Peppers). The mean value of the overall gain is calculated and found to be 0.3752 dB. For most of the color images the algorithm-II further improves the PSNR values.