A Novel Image Compression Scheme with Wavelet Packets Optimization Using Artificial Bee Colony Algorithm

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***Abstract*- With advance in technology many applications came up which requires images in compressed form. Compression is necessary since storage of images required large space and money. Also transmission of such images can take longer time and more distortion. So image compression technique is required. The wavelet packet transform is one of the successful tools for image compression. In wavelet packet transform approximation and detail coefficients are extracted from the image by filtering. After coefficients are estimated threshold values can be calculated.**

In this study we have implemented Artificial Bee Colony (ABC) algorithm for estimating the values for Thresholding, Best wavelet packets with Huffman and Modify Huffman encoding and decoding process. The ABC is recent and successful optimization tool to produce the best compressed image in terms of their compression ratio (CR), Peak Signal Noise ratio (PSNR) and quality.

Keywords: Wavelet packet transform, ABC algorithm, CR, PS

1.INTRODUCTION

Image compression techniques are essential to reduce size of the image for primary and secondary storage purpose. Image compression techniques fall under two categories, namely Lossless and Lossy. In Lossless techniques the image can be reconstructed after compression, without any loss of data in entire process. Lossy techniques, on the other hand, are irreversible, because they involve performing quantization/thresholding, which results in loss of data. More recently, the wavelet packet transform has emerged as a cutting edge technology, within the field of image compression. Wavelet-based coding provides substantial improvements in picture quality at higher compression ratio. In wavelet packet transformation the image can filtered to obtain approximation and detail coefficients. Both approximation and detail coefficients are re-decompose up to some level to increase the frequency resolution.

Artificial Bee Colony(ABC) algorithm, proposed by Karaboga in 2005 for real parameter optimization, is a recently introduced optimization algorithm and simulates the foraging behavior of bee colony for unconstrained optimization problems. For solving constrained optimization problems, a constraint handling method was incorporated with the algorithm.

Swarm Optimization (PSO) algorithm on the same benchmarks that are presented in and some other multilevel thresholding algorithms. ABC and PSO algorithms are population-based optimization algorithms and they have been inspired by the social behavior of animals and swarm intelligence, which classify them in the same class of swarm-based optimization algorithms. There are many other optimization algorithms proposed in literature such as which are used in other fields such as thermal units, discrete optimization or continuous optimization. In this paper, ABC algorithm is used to solve compression problem.

II..Wavelet Packet Transformation

The wavelet transform is actually a subset of a far more versatile transform, the wavelet packet transform .Wavelet packets are particular linear combinations of wavelets. They form bases which retain many of the orthogonality, Wavelet packet transform
Quantization Inverse smoothness, and localization properties of their parent wavelets. The coefficients in the linear combinations are computed by a recursive algorithm making each newly computed wavelet packet coefficient sequence the root of its own analysis tree. Wavelet packet decomposition (WPD) (sometimes known as just wavelet packets) is a wavelet transform where the signal is passed through more filters than the discrete wavelet transform (DWT).
From the point of view of compression, the standard wavelet transform may not produce the best result, since it is limited to wavelet bases that increase by a power of two towards the low frequencies. It could be that another combination of bases produce a more desirable representation for a particular signal. The best basis algorithm by Coifman and Wickerhauser finds a set of bases that provide the most desirable representation of the data relative to a particular cost function (e.g. entropy). The wavelet decomposes the image, and generates four different horizontal frequencies and vertical frequencies outputs. These outputs are referred as approximation, horizontal detail, vertical detail, and diagonal detail. The approximation contains low frequency horizontal and vertical components of the image. The decomposition procedure is repeated on the approximation sub-band to generate the next level of the decomposition, and so on. It is leading to well known pyramidal decomposition tree. Wavelet packets are better able to represent the high frequency Information. Wavelet packets represent a generalization of Multi resolution decomposition. In the wavelet packets decomposition, the recursive procedure is applied to the coarse scale approximation along with horizontal detail, vertical detail, and diagonal detail, which leads to a complete binary tree. After wavelet packet decomposition, the image will produce a complete tree. Wavelet packet decomposition will have various forms because of the wavelet packet library including a number of wavelet packet components. The two level binary tree structures can show in figure 1. The basic wavelet packets introduced by Coifman and wickerhauser are defined by equation bellow

$$\Psi^{2n}(x) = \sqrt{2}\sum_{k} h_k \Psi^n(2x-k)$$

$$\Psi^{2n+1}(x) = \sqrt{2}\sum_{k} g_k \Psi^n(2x-k)$$

In order to obtain high compression ratio proper thresholding process can take place. For this global threshold value can assign to construct a compressed image. Another thresholding technique uses different threshold values at each level to obtain best reconstruct image.

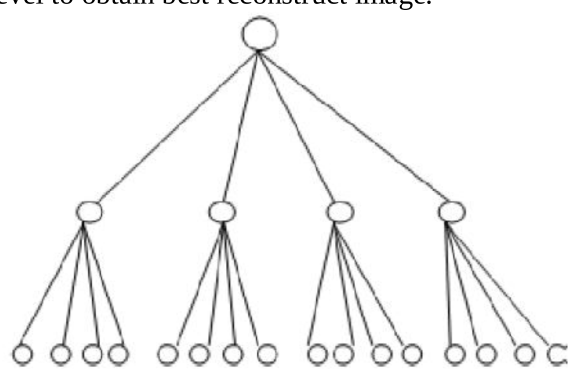
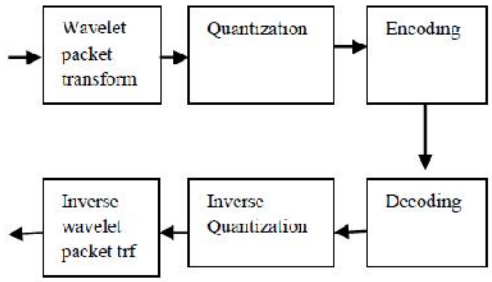


Figure1

III.EXISTING SYSTEM

The existing system block diagram is shown in figure.2

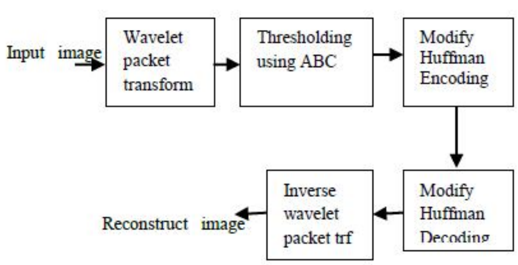


In the above image compression model the input image is given to wavelet packets transformation block. The image transformed in to packets. Then it is passing through quantization block. In the process of quantization each sample is scaled by the quantization factor. These methods are responsible for introduction of error and it leads in degrading the quality. After encoding this using any encoding technique. The encoded image is decoded and inverse quantization takes place. Finally the reconstructed image is getting through the inverse wavelet packet transform.
In the encoding phase overall number of bits reduces to represent the data set. An entropy encoder further compresses the quantized values to give better overall compression. The decoder performs the inverse operation of encoder.

It receives the variable length code words from encoder output and reconstructs the prediction error.

IV. PROPOSED SYSTEM

In the proposed system after wavelet packet transformation best packets can calculated using Artificial Bee Colony(ABC) algorithm and also thresholding process take place instead of quantization. The threshold process can done by same ABC algorithm the block diagram is shown in figure.3a &3b.



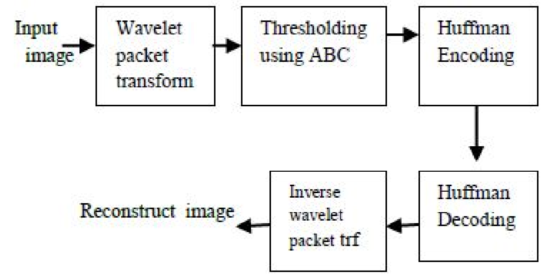


Figure 3a & Figure 3b

We know after three degree complete wavelet packet decomposition, the image will get four layer coefficients. The 0th layer is original image, the first layer has3 high-frequency coefficients, the second layer has 3+3*4=15 high frequency Coefficients, and the third layer has 3+3*4+3*4*4=63 high frequency coefficients. We select high frequency components based on ABC to get the best wavelet packet basis and compress image with it. Next thresholding process takes place the samples are eliminated if the value of sample is less than the defined threshold value.

Huffman Coding

This phase of compression reduces the overall number of bits needed to represent the data set. An entropy encoder further compresses the quantized values to give better overall compression. This process removes the redundancy in the form of repetitive bit patterns in the output of quantizer. It uses a model to accurately determine the probabilities for each quantized value and produces an appropriate code based on these probabilities so that the resultant output code stream will be smaller than most commonly used entropy encoders are Huffman encoder and the Arithmetic

encoder. The Huffman algorithm requires each code to have an integral number of bits, while arithmetic coding methods allow for fractional number of bits per code by grouping two or more such codes together into a block composed of an integral number of bits. This allows arithmetic codes to outperform Huffman codes, and consequently arithmetic codes are more commonly used in wavelet based algorithm.

Before starting the compression of a data stream, the compressor (encoder) has to determine the codes. It does that based on the probabilities (or frequencies of occurrence) of the symbols. The probabilities or frequencies have to appear on the compressed stream, so that any Huffman decompressor (decoder) will be able to decompress the stream. This is easy, since the frequencies are integers and the probabilities can be written as scaled integers. It normally adds just a few hundred bytes to the compressed stream. It is also possible to write the variable-size codes themselves on the stream, but this maybe awkward, since the codes have different sizes. It is also possible to write the Huffman tree on the stream, but this may be longer than just the frequencies. In any case, the decoder must know what's at the start of the stream, read it, and construct the Huffman tree for the alphabet. Only then can it read and decode the rest of the stream. The algorithm for decoding is simple. Start at the root and read the first bit off the compressed stream. If it is zero, follow the bottom edge of the tree; if it is one, follow the top edge. Read the next bit and move another edge toward the leaves of the tree. When the decoder gets to a leaf, it finds the original, uncompressed, code of the symbol that code is emitted by the decoder. The process starts again at the root with the next bit.

Modified Huffman Codes

The image to be transmitted is scanned into lines of 1728 pixels, for up to 3912 lines. Each line of the image is translated into runs of white and black pixels, which are coded, in accordance with CCITT Group 3 recommendations, by modified Huffman codes. This modified Huffman scheme allocates two sets of codes,One for the white runs and one for the black runs. The reason for this is that the distribution of the number of successive white pixels in a scanned text document differs substantially from the distribution of the number of successive black pixels since there are usually black pixels only where there is text. Using a unique codebook for both distributions would be inefficient in terms of compression. The codes are "modified Huffman" codes because instead of allocating a code for each possible run length 0 6 l < 1728, codes are allocated for all 0 6 l < 63, then for every l that is a multiple of 64, up to 2560. The codes for 0 6l< 63 are termed Termination Codes because they always encode the number of pixels at the end of a run, while the codes for the runs of lengths multiple of 64 are termed Make-Up Codes, since they encode the body of the runs. The reader interested in the intricacies of facsimile coding is referred to the chapter on Facsimile compression. After complete of encoding and decoding an inverse wavelet packet transform takes place. It is a process of recovering the input of system from output

V.PROPOSED ALGORITHM

In existing method, decomposing the image using wavelet transform, whereas in proposed method, decomposing the image using wavelet packets and then apply the artificial bee colony algorithm in the update process to get a considerable quality.

Step 1: Acquire Input Gray scale Image.

Step2: Apply 3-level wavelet packet Decomposition to the image.

Step 3**:** using ABC algorithm for each and every wavelet packets data to obtain best packets**.**

Step 4**:** In the ABC algorithm, we are generating random food sources and calculate fitness for the wavelet packets data and store available food source.

Step 5: Employed bee phase: food source determines a neighbour source, the evaluates its nectar amount.

Step 6: Abandoned food sources are determined and are replaced with the new food sources discovered by scouts.

Step 7: The best pixel value is registered.

Step 8: Encode the co-efficient to get a final compressed image by using modified Huff-man encoding.

Step 9: Decode the compressed image.

Step 10: Get re-constructed image by inverse wavelet packet transform

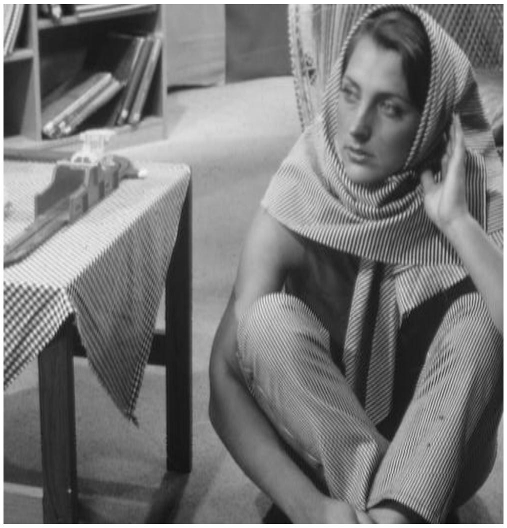
VI.EXPERIMENTAL RESULTS

In this study, ABC algorithm is used to optimally choose the best packets and the level-dependent thresholds to determine the wavelet packets coefficients to be used in the compression with high quality and increase PSNR

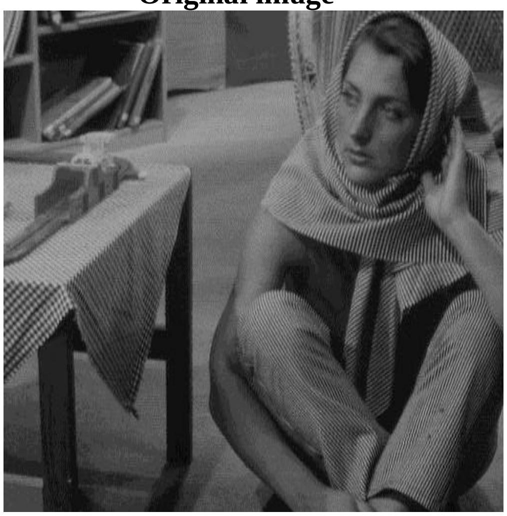
Original image

Output of modified Huffman with PSNR 34.4241

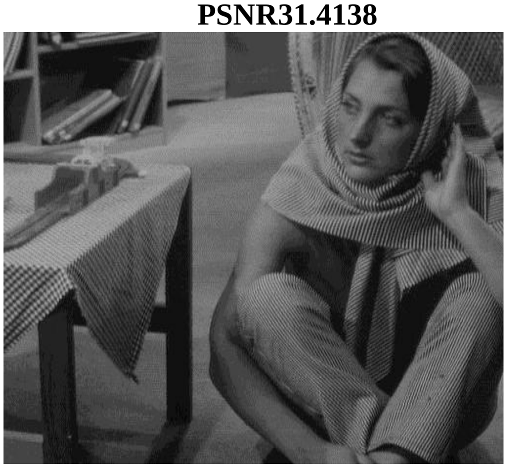
Output of Huffman coding with PSNR 31.4138



Original image



Output of Huffman coding with PSNR31.4138



Output of modify Huffman with PSNR 34.4241

LENA IMAGE:

Bit rate	Existing PSNR	PSNR with huffman	PSNR with modify huffman
0.1	23.1208	24.8817	27.8920
0.2	23.6323	25.3932	28.4035
0.3	24.2122	25.9731	28.9834
0.4	24.8817	26.6426	29.6529
0.5	25.6735	27.4344	30.4447
0.6	26.6426	28.4035	31.4138
0.7	27.8920	29.6529	32.6632
0.8	29.6529	31.4138	34.4241

BARBARA IMAGE

Bit rate	Existing PSNR	PSNR with huffman	PSNR with modify Huffman
0.1	22.9788	24.7397	27.7500
0.2	23.4903	25.2513	28.2616
0.3	24.0703	25.8312	28.8415
0.4	24.7397	26.5006	29.5109
0.5	25.5315	27.2925	30.3028
0.6	26.5006	28.2616	31.2719
0.7	27.7500	29.5109	32.5212
0.8	29.5109	31.2719	34.2822

VII. CONCLUSION

Technological developments increase the data amount and the redundant data is required to be eliminated. For this purpose, data reduction or compression techniques are used. Wavelet transform is used as a compression technique by extracting the approximation and detail coefficients. Some of these coefficients are selected and the compressed image is reconstructed. While selecting the coefficients, a threshold technique is used. ABC algorithm can be applied to find the optimal threshold values to obtain PSNR and quality in a multi-objective manner. The effect of mother wavelet functions and comparisons with other techniques are future works.

References

[1] B. Akay and D. Karaboga, Parameter tuning for the artificial bee colony algorithm, ICCCI 2009 (R. Kowalczyk N.T. Nguyen and S.-M. Chen, eds.), LNAI, vol. 5796, 2009, pp. 608–619.

[2] J. Chen, M. Yang, Y. Zhang, and X. Shi, Ecg compression by optimized quantizationof wavelet coefficients, ICIC 2006, LNCIS,vol. 345, Springer-Verlag Berlin Heidelberg, 2006, p. 809814.

[3] R.R. Coifman and M.V. Wickerhauser, Entropy-based algorithms for best basis selection, IEEE Transactions on Information Theory 38 (1992), no. 2, 713–718.

[4] D. karaboga and B.Akay, Wavelet Packets Optimization using Artificial Bee Colony Algorithm Artificial Intelligence Review 31 (2009),no. 1, 68–55.