EFFICIENT HYBRID TECHNIQUES FOR MULTI MODAL MEDICAL IMAGE COMPRESSION

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Abstract- Digital image compression innovation is of basic significance for quick transmission and relevant preparing of computerized picture data on the web. The principal fundamental point of image compression is significantly to decrease the quantity of picture pixcel components with the primary intention not to influence the original quality of the original image that is to be compacted. It is usually done by removing the redundancy present in the image. The principle objective of this paper is to compare some compression techniques such as DWT coding, SPIHT technique, Back Propagation Neural Network, new hybrid techniques for compression. Back-propagation method be extensively used as a learning algorithm in Artificial Neural Networks. BPNN comes under Feed-Forward Neural Network Architecture. This type of architecture can be used in approximation of all the problems which is having high precision. Error correction learning rule is particularly used by this Neural Network. This is very efficient algorithm for Image Compression which works with the architecture of Artificial Neural Network. There are different types of parameters which includes Compression ratio, Peak signal to noise ratio, Bits per pixel and Mean Square error. The compressed image quality can be obtained by using different types of parameters. Then the performance analysis of different images by these three different algorithms is done in this paper. The result explains that hybrid Image Compression using hybrid DWT-NNBP (Discrete Wavelet Transform-Neural network Back Propagation) gives better Compression ratio and Peak Signal to noise ratio, compare with Hybrid SPIHT with NNBP. The algorithms explained above like DWT, SPIHT, NNBP, Hybrid SPIHT-BP and Hybrid DWT-BP. The input image of size
256×256 is given where the compressed image is obtained by these above algorithms. After the comparison of both Hybrid SPIHT with NNBP and Hybrid DWT with NNBP concluded that the Compression Ratio (CR) in hybrid DWT-BP gives efficient results. The algorithm explained in this paper is getting used for medical image compression and conjointly using these algorithms we compressed the image in both lossless and lossy Techniques. In future the picture pressure strategies should be conceivable by utilizing diverse techniques like Neural Networks cross breed procedures and Fuzzy rationale.

Keywords—Image Compression, DWT algorithm, Back Propagation, DWTBP, SPIHT, PSNR, BPP, MSE

II. RELATED WORK

The objective of image compression strategies is to root up the excess present in information in a way that empowers image compression system. There are various lossy and lossless image compression procedures. Wavelet-based image compression gives considerable upgrades in picture quality at higher pressure proportions. In spite of conventional systems for image compression, neural systems can likewise be utilized for information or image compression. [8] The exceptional high phantom determination has been utilized as a part of an expansive scope of logical research, for example, landscape grouping, horticultural checking, and military reconnaissance. In this way, pressure of the hyper ghostly image is important to encourage stockpiling and transmission. [1] A cross breed range picture coding calculation which predicts the outspread separation of every pixel utilizing beforehand encoded neighbors adaptively as a part of one of three direction spaces: range image area, tallness picture area, and 3D area. [2] It is surely understood that the ghostly vitality in common images is gathered in the low-recurrence district. In this manner, a critical rate of the aggregate yield vitality for the high-recurrence channel originates
from associating. Lessening the associating vitality by narrowing the move band would viably diminish the aggregate yield vitality for the high-recurrence channel. [3] The distinctive twists a image connected incorporate picture shooting, image compression, transmission, and post handling. For instance, when taking a photograph utilizing a computerized camera, wrong concentrate, low-quality lens, or camera shake make obscure image, even in a top notch camera. Long shade introduction or high ISO speed (with higher electric current) presentation builds the commotion tainting of an image [4] Multi determination implies synchronous presentation of image on various arrangement levels. Wavelet change speaks to a image as an entirety of wavelets capacities, with various area and scales. The 2D wavelet investigation utilizes the same 'mother wavelets' yet requires. [7] The Hybrid (DWT+DCT) change fulfill both the upsides of DWT and DCT so that in this change stockpiling size diminished with higher compression proportion and The image is dissected by DWT up to three level, thus we get estimate pictures of size 8 x 8 and make point of interest coefficients image is equivalent to zeroes. The 2-D DCT is connected on estimate image. At that point quantized and send for coding. [10] Lossless versus Lossy image: In lossless pressure conspires, the recreated image, after compression, is numerically indistinguishable to the first image. Lossless compression is favored for authentic purposes and regularly therapeutic imaging, specialized drawings, cut workmanship or funnies. This is on account of lossy compression strategies, particularly when utilized at low piece rates, present compression ancient rarities. [11] Whenever image is resized then it gives storage room to alternate documents. Another methodology for image compression, where multilayer wavelet is to be utilized, by utilizing double tree complex wavelet change with multilayer that safeguard the predominant brilliance level and force of the focused on image in layers, which brings about layered wavelet coefficients near zero. The thresholding additionally can alter the coefficients to create more zeros which permit a higher pressure proportion. [12] Based on the two strategies, quantizing the images DCT coefficients and entropy coding the quantized coefficients, DCT-based image pressure minimizes the information required to speak to a image. Quantization process minimizes the quantity of bits required to speak to an amount by minimizing the quantity of conceivable estimations of the amount. [13] Discrete wavelength Transform (DWT) is used as one section change which adds to overall properties of a photo. Second section change that adds to neighborhood properties of image is moved moreover its size is vacillated. For 256x256 size image, cross breed wavelet change of size 256x256 is created. It can be created using two section changes of size 8x8 and 32x32 independently both portion changes of 16x16 and first of 64x64 and second of 4x4. [15] SPIHT is utilized for image weight. The RGB parts are at initially changed over into YCbCr areas. The encoding is performed through DWT, and from there on SPIHT calculation is related. After this weight process, interpreting is performed through IDWT. Last stage combines the change of weak scale picture into shading image [16, 17].

III. DIFFERENTALGORITHMS USED FOR COMPRESSION TECHNIQUES
A. Discrete Wavelet Transform (DWT)
There are two types of compression viz., lossy and lossless methods. Here DWT is one of the
algorithms in lossless method. Thus, this DWT is considered as one of the important method for image compression where there is no loss of information during the compression of image. Wavelets have more advantages over compressing signals. DWT can be applied to the process of Image Compression by using the threshold value. Applying DWT can be able to get different levels of bands. After deciding the threshold value, these values will neglect the certain wavelet coefficients. Value of threshold affects the quality of compressed image. [9] There may be different types of Image Processing techniques in which this DWT can be of successive high pass and low pass filter where the images can be divided in to pixels. [13] In wavelet change, the disintegration of a specific picture comprises of two sections, one is lower recurrence or estimate of a picture (scaling capacity) and another is higher recurrence or itemized part of a picture (wavelet capacity).

SPIHT is a productive wavelet-based image compression technique that tries the innate similarities over the sub groups in a wavelet deterioration of a photo. SPIHT itself is lossless when the full piece rate is encoded, however the fundamental wavelet change is every now and again confined by settled point accuracy, unless a lossless (whole number based) change is used. The SPIHT method is reliant upon three ideas:

- Partial requesting of the changed picture components by scale, with zero request transmission by a subset dividing calculation that is multiplied at the decoder,
- Ordered bit plane transmission of refinement bits,
- Manipulation of likeness toward oneself of the picture wavelet transform crosswise over distinctive scales.

Fig. 1 Example of parent-offspring dependencies in the spatial-orientation tree

The fractional requesting is a result of correlation of change component (coefficient) extents to an arrangement of effectively lessening limits. An element is noteworthy or inconsequential regarding a given threshold, contingent upon whether it surpasses that limit. The key some portion of coding technique is that the route subsets of coefficients are parcelled and how the centrality information is gone on.

B. Neural Network Back Propagation (NNBP)

Neural Network is nowadays an important emerging tool that can be very applicable particularly to image processing techniques. There will be many training pairs in NNBP, the most important and useful training pair is input-output pair. This NNBP algorithm can be able to give the procedures for varying the weights after giving the input; this input to output pair will categorize the given input patterns. Gradient-descent method is one of the apt methods for this weight updating in NNBP. In NNBP, the weight can be calculated during the learning period of the network, in this way it’s different from all other algorithms. Back propagation algorithm involves three different types of layers namely input layer, output layer and more than one hidden layer. Hidden layer is connected to
input output pair of the NNBP algorithm. The value of neurons in NNBP can be evaluated where both input layer and output layer neurons less than the hidden layer neuron, in order to perform the compression algorithm.

Fig 2. General Structure of NNBP

The first step of Image Compression in NNBP is to decompose the input images in pixels; this can be done by the algorithm of NNBP. These pixels which are encoded in previous step can be given as an input to the network. Now, this image is transmitted and recovered in the receiver side. There are three important layers in NNBP which is named as input layer, hidden layer, output layer where this hidden layer can be more than one. The next process is to encode spatial coordinates of the pixel. This encoding process will convert the image from two to one dimensional value and then the image is compressed. After getting the compressed image, the error can be calculated in all the three layers.

C. Hybrid Discrete Wavelet Transform-Back Propagation (DWT-BP)

Nowadays in the developing world, there are so many researches done on wavelet representation and transforms. The areas which will be having no noise can be represented as plain areas in an image. These areas will have very high degree of redundancy.[5]Since in this proposed method we hybrid both the combinations of DWT and BP. The main advantage of neural network can be predicted as it can adapt itself from the training data. [6] This section involves hybrid image Compression using Discrete Wavelet Transform and Back Propagation Neural Network Algorithm. As in the previous section there is a clear description about DWT and BPNN algorithm. In order to get better Compressed Image without degrading the quality of Image there should be very less Compression Ratio (CR) and high Peak Signal to Noise Ratio (PSNR). Thus in our research we hybrid these two algorithms viz., DWT and BP this gives better CR and PSNR. The block diagram of this proposed method is described as follows:

Fig 3. Block Diagram of proposed work

This figure 3 represents the block diagram of the proposed method. Here the input images which of size 256x256 is given in order to get the compressed image. First these images can be given to DWT algorithm which undergoes image compression process and the image which gets from DWT algorithm is given as an input to Back Propagation Neural Network in order to get further compression. Thus this output image from BPNN is the final compressed image which gives better CR and PSNR.

By referring to the paper [14], we can be able predict that our proposed method will be having efficient CR and PSNR. Thus the comparison chart for both existing method and proposed method is given as follows:
Fig 4. Comparison chart of proposed work and existing method

IV. PERFORMANCE METRICS

For image compression there are certain parameters which are listed below

- Mean Square error ,
- Peak Signal to Noise Ratio,
- Compression Ratio,
- Bits Per Pixel

A. Mean Square Error

MSE is utilized to appraise the nature of compacted picture. Lesser the estimation of MSE higher the nature of packed picture. It can be communicated as takes after:

\[ \text{MSE} = \frac{1}{M \times M} \sum_{x=1}^{M} \sum_{y=1}^{M} [f(x,y) - f^*(x,y)]^2 \]

B. Peak Signal to Noise Ratio

It is characterized as the measure of the data picture to the MSE. The nature of the picture gets increments when the PSNR is high.

\[ \text{PSNR} = 10 \log_{10} \left( \frac{M \times M}{\text{MSE}} \right) \]

Where, M\times M is the size of an input image.

C. Compression Ratio

It is characterized as the compressed between the uncompressed image measure and compacted image size.

\[ \text{CR} = \frac{\text{UNCOMPRESSED IMAGE SIZE}}{\text{COMPRESSED IMAGE SIZE}} \]

D. Bits Per Pixel (BPP)

BPP is defined as the number of bits store in a single pixel of image.

\[ \text{BPP} = \frac{\text{SIZE OF COMPRESSED FILE}}{\text{TOTAL NO. OF PIXEL IN THE IMAGE}} \]

V. RESULTS

The outcomes for the picture pressure alongside the pressure tables which procures better pressure execution with the better CR and PSNR are clarified underneath.

Fig.5. Original Images

Fig6. Compressed Images using DWT algorithm

Fig7. Compressed Images using BPNN algorithm

Fig8. Compressed Images using Hybrid DWT-BP

The figures recorded above demonstrates that the first and compacted pictures by utilizing diverse algorithms. 256\times256 is the span of the picture utilized for compression.

Fig9. Compression Ratio for various Input Images
The figure mentioned above explain about the compression ratio for various input images after the compression we conclude that Hybrid DWT-NNBP algorithm gives better CR.

The above figure demonstrates that Compression Ratio for Hybrid DWT with NNBP calculation is high when contrasted with the Hybrid SPIHT with NNBP strategies and from the diagram we infer that half and half DWT-NNBP calculation gives better CR.

The following tables listed below can be depicted for three different algorithms DWT, BP and Hybrid DWT-NNBP.

### TABLE I Distinctive Parameters got for DWT algorithm

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Distinct Wavelet Transform(DWT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameters</td>
<td>CR</td>
</tr>
<tr>
<td>Brain Image</td>
<td>1.85</td>
</tr>
<tr>
<td>CT Image</td>
<td>2.76</td>
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<tr>
<td>MRI Image</td>
<td>3.86</td>
</tr>
<tr>
<td>PET Image</td>
<td>4.73</td>
</tr>
</tbody>
</table>

*Original Image, Compressed Image

### TABLE II Distinctive Parameters got for BPNN Algorithm

<table>
<thead>
<tr>
<th>Parameters</th>
<th>CR</th>
<th>PSNR</th>
<th>MSE</th>
<th>BPP</th>
<th>O(^*) Size (KB)</th>
<th>C(^*) Size (KB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain Image</td>
<td>0.36</td>
<td>19.51</td>
<td>77.7</td>
<td>22.09</td>
<td>36</td>
<td>7.56</td>
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<tr>
<td>CT Image</td>
<td>0.88</td>
<td>35.69</td>
<td>17.65</td>
<td>9.024</td>
<td>10.8</td>
<td>10</td>
</tr>
<tr>
<td>MRI Image</td>
<td>0.44</td>
<td>61.42</td>
<td>0.108</td>
<td>7.263</td>
<td>48.2</td>
<td>19</td>
</tr>
<tr>
<td>PET Image</td>
<td>0.66</td>
<td>17.99</td>
<td>0.001</td>
<td>11.96</td>
<td>30.8</td>
<td>8.56</td>
</tr>
</tbody>
</table>

*Original Image, Compressed Image

### TABLE III Distinctive Parameters obtained for Hybrid DWT-NNBP Coding

<table>
<thead>
<tr>
<th>Parameters</th>
<th>CR</th>
<th>PSNR</th>
<th>MSE</th>
<th>BPP</th>
<th>O(^*) Size (KB)</th>
<th>C(^*) Size (KB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain Image</td>
<td>0.34</td>
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<td>0.51</td>
<td>2.30</td>
<td>38.5</td>
<td>7.35</td>
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<tr>
<td>CT Image</td>
<td>0.72</td>
<td>64.88</td>
<td>1.67</td>
<td>8.01</td>
<td>71.7</td>
<td>9.41</td>
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<tr>
<td>MRI Image</td>
<td>0.43</td>
<td>76.10</td>
<td>1.59</td>
<td>8.40</td>
<td>84.0</td>
<td>9.94</td>
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<tr>
<td>PET Image</td>
<td>0.35</td>
<td>57.90</td>
<td>1.05</td>
<td>6.23</td>
<td>46.9</td>
<td>5.79</td>
</tr>
</tbody>
</table>

*Original Image, Compressed Image

Table IV Distinctive Parameters obtained for Hybrid SPIHT with NNBP
Table I, II, III and IV shows image quality parameters of various Input Images by using DWT, BP and Hybrid DWT-NNBP. The PSNR esteem for DWT calculation is exceptionally poor when contrasted with the two distinct methods. From the outline we presume that Hybrid DWT-BP calculation gives better PSNR values.

Table V Compression Ratio obtained while comparing with two Hybrid Algorithms

VI. CONCLUSION

The algorithms explained above like DWT, SPIHT, NNBP, Hybrid SPIHT-BP and Hybrid DWT-BP. The input image of size 256×256 is given where the compressed image is obtained by these above algorithms. Different types of parameters are calculated in order to know the quality of compressed image. After the comparison of both Hybrid SPIHT with NNBP and Hybrid DWT with NNBP concluded that the Compression Ratio (CR) in these algorithms hybrid DWT-BP gives efficient results. The algorithm explained in this paper is being used for medical image compression and also by using these algorithms we compressed the image in both lossless and lossy Techniques. In future the picture pressure strategies should be possible by utilizing diverse techniques like Neural Networks cross breed procedures and Fuzzy rationale.

VII. ACKNOWLEDGMENT

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VIII. REFERENCES


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