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Design and Implementation of Improved Image Compression Algorithm Using Hybrid Approach

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ABSTRACT:Image compression is widely popular research area. Image takes more time to transmit and storage space. So it is necessary to represent image with minimum no of bits. Image compression technique must be able to reconstruct image same as original image. This is done by robust and efficient image compression techniques.
The aim of this research is to develop an image compression technique that works for image of any resolution and size. The DCT, DWT and SVD are the most commonly used algorithms. These methods have their own advantages and limitations. So take advantages of these methods, the combination of these methods will be used in this research. In first stage SVD has been applied to remove Singular value from original Image. In Second stage the 3-DWT has been applied. And at last, the property of DCT has been applied. we also used the lossless technique to maintain the quality of Image.

KEYWORDS*:* SVD,DCT,DWT,CompressionRatio,Image Compression

I. INTRODUCTION

The process of image compression is shown in fig.2.4.1. There are three main steps: reduce correlation between pixels, Quantization and source encoding (entropy coding). Image decompression is done at receiver end by reversing the process of image compression.

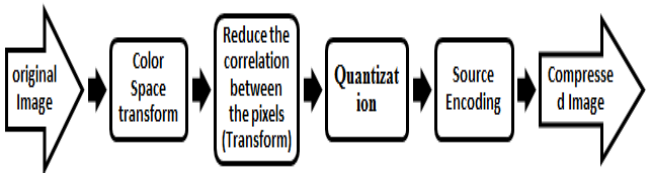

Fig. Process of Image Compression[3]

The original image is in RGB color space. According to medical research, human eyes are very sensitive to color and brightness. So the color space transform is needed. In image, RGB to ycbcr color space transform is performed. Detail study about the RGB to ycbcr color space transform is discussed further.

II. PROPOSED METHODOLOGY

SVDSingular Value Decomposition (SVD) is a linear allegorical numerical technique. SVD is applied to an image A of size M x N, three matrices are U, V and S.

$$A = USV^T$$

Where, U – Unitary matrix having size M x M
V – Unitary matrix having size N x N

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S – Diagonal matrix having size M x N

S matrix is containing singular values and these values are arranged in ascending order. The singular values are very much stable. This is an important characteristic of singular values. The change made in singular value does not make significant change. The singular values represent brightness of image pixels. There is no noticeable change in reconstructed image if some singular values are made zero. SVD is used in image compression to maintain quality.

DWTDiscrete Wavelet Transform is process of decomposition of image. This transformation is a function of small wave is called wavelet functions. DWT decompose image data in set of low pass and high pass coefficients. The image is passed through high pass and low pass filters. DWT gives information about both spatial and frequency domain. Wavelet is a spatial representation of image according to frequency. Wavelet function decomposed image in four sub-bands:

- LL – low pass filtering of both horizontal and vertical
- LH –horizontal low pass filtering and vertical high pass filtering
- HL – horizontal high pass filtering and vertical low pass filtering
- HH – High pass filtering of both vertical and horizontal.

DCT Discrete Cosine Transform (DCT) is used in image processing widely. The standard image compression method JPEG is based on DCT. DCT is used in many applications of image processing and signal processing. DCT takes less energy consumption. DCT is converted a signal to frequency components. DCT decomposed signal into harmonic cosine function series. DCT decomposed signal into high, low and medium frequency blocks. First, is divides in numbers of blocks. Second, DCT is applied on each block left to right horizontally and top to bottom vertically. The result is the matrix of DC coefficient. The quantization is applied on DC matrix to reduce no. of bits to transmit.

Encoding The encoding is applied after zig-zag scanning. Encoding is used to reduce number of bits to represent image. The work of Encoding is to remove repeated bit patterns to remove redundancy. Encoding is also known as lossless compression. There are many encoding techniques is used.

- **Arithmetic Coding[8]:**

Arithmetic coding is a form of entropy encoding used in lossless data compression. Normally, a string of characters such as the words "hello there" is represented using a fixed number of bits per character, as in the ASCII code. When a string is converted to arithmetic encoding, frequently used characters will be stored with fewer bits and not-so-frequently occurring characters will be stored with more bits, resulting in fewer bits used in total. Arithmetic coding differs from other forms of entropy encoding, such as Huffman coding, in that rather than separating the input into component symbols and replacing each with a code, arithmetic coding encodes the entire message into a single number, an arbitrary-precision fraction n where $[0.0 \leq n < 1.0]$. It represents the current information as a range, defined by two numbers.

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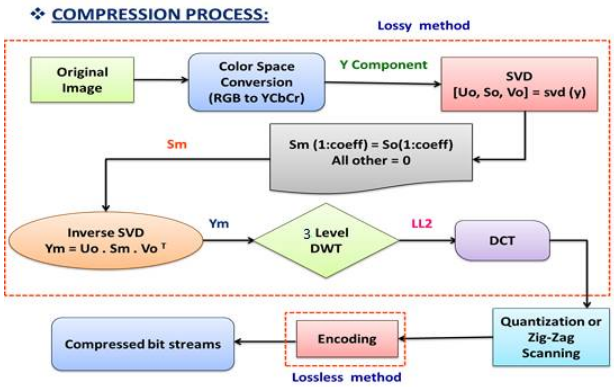
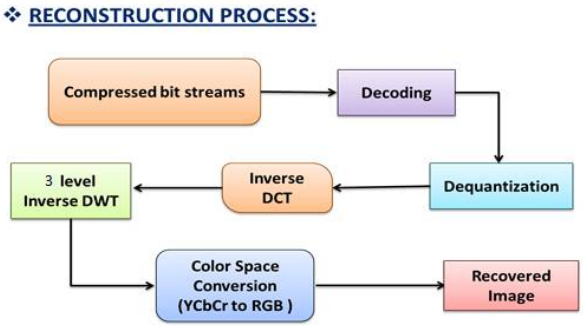
III. ARCHITECTURE OF PROPOSED SYSTEM

Fig shows the Architecture of proposed system. Fig a shows the compression process and fig b shows the reconstruction process.



(a) Compression process



(b) Reconstruction Process

Proposed Algorithm

- **Compression Algorithm:**

Step 1: Take an Image with any resolution
Step 2: Pre-processed Image, if image is rectangle image than convert it into square image.
Step 3: RGB to YCbCr color space conversion.
Step 4: Apply SVD**.**
Step 5: Apply 3-level DWT on Y component.
Step 6: Apply DCT on LL3 component.
Step 7: Scan DCT matrix in Zig Zag manner.
Step 8: Encodes with Arithmetic Coding
Step 9: Get Compressed Image

- **Reconstruction Algorithm:**

Step 1: Decoding
Step 2: Apply inverse DCT on Compressed Image.
Step 3: Apply inverse 3-level DWT
Step 4: YCbCr to RGB color space conversion

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Step 5: Reconstructed image is get.

IV. PERFORMANCE CRITERIA IN IMAGE COMPRESSION

There are two criteria to estimate performance: 1) Compression Ratio and 2) the quality of measurement of reconstructed image (PNSR).

- **Compression Ratio (CR) [1]:**

  The Ratio between reconstructed image and original image size is called Compression Ratio. The value of compression ratio should be increased.

  CR = n1/n2

  Here, n1 is number of bits to store original image and n2 is number of bits to store compressed image.

- **Mean Square Error (MSE) [1]:**

  Mean Square Error is distortion rate in reconstructed image.

  MSE

$$= \frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}[X(i,j) - X'(i,j)]2$$

  Here, the M, N is dimension of image. X (i,j) is the pixel value of (i,j) corresponding to original image and X'(i,j) is the pixel value of reconstructed value.

- **Peak Signal – to – Noise Ratio [1]:**

  This is widely used quality measurement parameter. PSNR is most commonly used to measure the quality of reconstruction of lossy compression. A higher PSNR generally indicates that the reconstruction is of higher quality.

$$\text{PSNR} = 10\log_{10}\frac{2552}{MSE} \text{ (dB)}$$

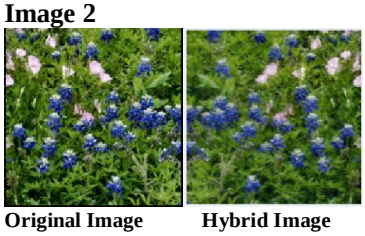
V. RESULS OF HYBRIDIZATION

Image1

original Image Hybrid Image

	SVD,DWT,DCT	DWT	SVD	DCT
CR	96.5176	96.7565	93.9695	96.3422
ET	1.5	0.5	0.8	1.6
MSE	40.23	246.94	40.28	41.69
PSNR	32.084	24.048	32.0798	31.9299

Image 2



Original Image **Hybrid Image**

	SVD,DWT,DCT	DWT	SVD	DCT
CR	92.94	93.02	91.55	93.18
ET	2.7	1.7	0.9	4.45
MSE	70.98	160.0459	46.3994	72.75
PSNR	29.61	26.08	31.46	29.51

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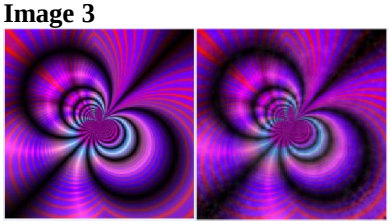
Image 3



Original Image **Hybrid Image**

	SVD,DWT,DCT	DWT	SVD	DCT
CR	95.39	95.47	93.26	94.95
ET	1.92	1.56	0.89	2.09
MSE	32.3	107.75	32.43	36.39
PSNR	33.03	27.8	33.02	32.52

VI. CONCLUSION

With the above result we conclude that,Since we have seen all three techniques have their own attributes like quality is better in DWT, CR is high in DCT and SVD compress the image with less complexity and good quality.
In this research, we have used the combination of SVD, DWT and DCT for image compression. Using the SVD, DWT and DCT combination we gather High compression ratio with less complexity and good quality.
We also apply the lossless technique. Lossless technique is efficient technique for compression and maintains quality without alteration.In further research we will work on the quality of image.

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BIOGRAPHY

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