

Lossless Decomposition of Image Using Haar Wavelet Transform

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Abstract— Image decomposition is the emerging era of research in today's life. When image is compressed various parameters that may vary and that affect the quality of compressed image. Harr wavelet transform is used for decomposition of image that reduces MSE and improves PSNR and SNR.

Keywords— DWT, HAAR, CR

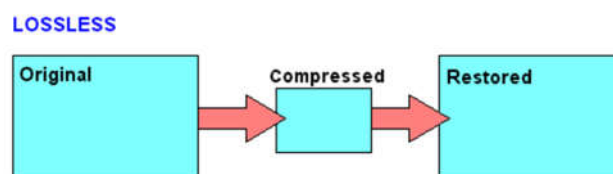
I. INTRODUCTION

Image compression is minimizing the size in bytes of a graphics file without degrading the quality of the image to an unacceptable level. The reduction in file size allows more images to be stored in a given amount of disk or memory space. It also reduces the time required for images to be sent over the Internet or downloaded from Web pages.

The compression ratio is defined as follows:

$$C_r = \frac{n1}{n2}$$

Where $n1$ is the data rate of original image and $n2$ is that of the encoded bit-stream.



II. RESULTS AND ANALYSIS

Analysis is carried for four different human test images 1 to 4 namely neuron, skull, jaw and leg joints.

Compression of image 1:

In test 1 human image taken for compression.

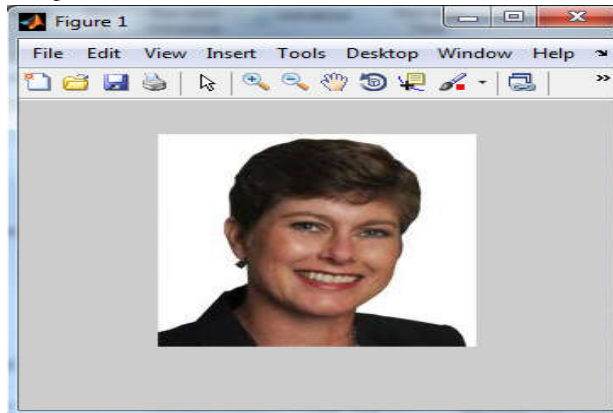


Figure 1: Original image of test 1

Fig 1 shows the original image for test 1. This image is compressed using dwt technique. Remove redundancy data technique with DWT is used for lossless image compression. This technique provides the best compression ratio of the image.

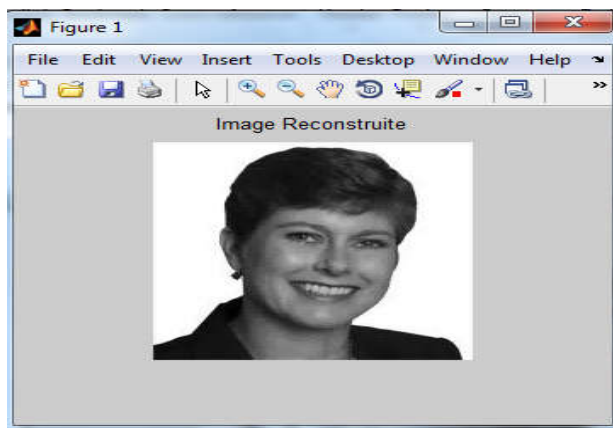


Figure 2: Decompressed image

Fig 2 shows the decompressed image after applying 'harr' wavelet. Compressed image is further decompressed using dwt technique with level 2" and threshold value of 10.

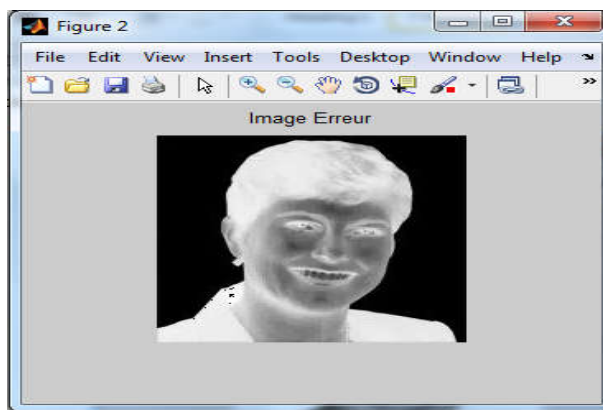


Figure 3: Error image

Fig 3 shows the Error image of the test 1. After the decomposing of image MSE and PSNR is calculated using dequantification and idwt.

Compression of image 2

In the test 2 human image taken for compression. It protect brain parts and give shape them.

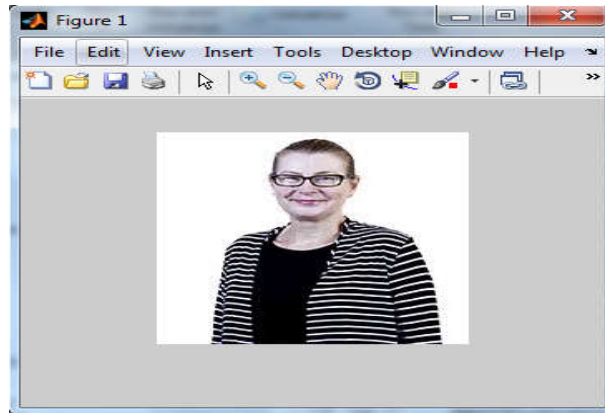


Figure 4 Original image of test 2

Fig 4 shows the original image of the test 2. This image is compressed using dwt technique. Remove redundancy data technique with DWT is used for lossless image compression. This technique provides the best compression ratio of the image.

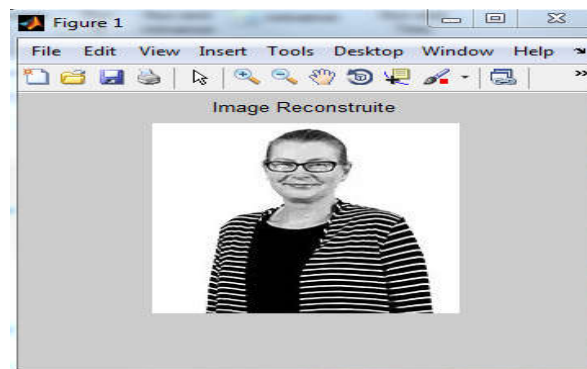


Figure 5: Decompressed image

Fig 5 shows the decompressed image after applying 'harr' wavelet. Compressed image is further decompressed using dwt technique with level 2" and threshold value of 10.

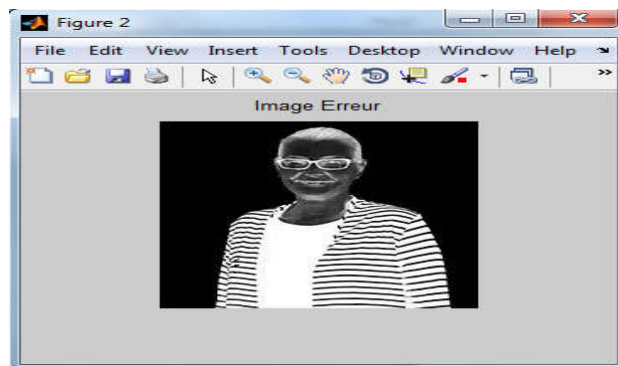


Figure 6: Error image

Fig 6 shows the Error image of the test 1. After the decomposing of image MSE and PSNR is calculated using dequantificatin and idwt.

Compression of image 3

In the test 3 bird image taken for compression. It shows the jaw structure

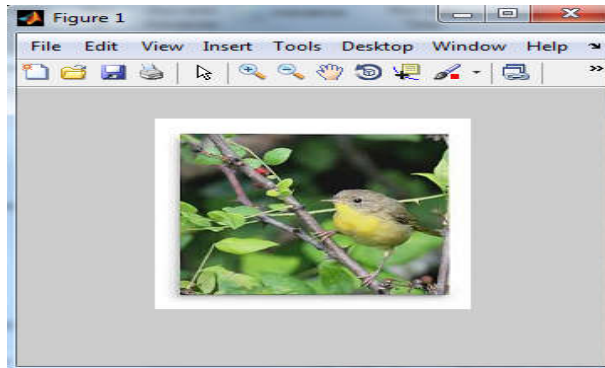


Figure 7: Original image of test 3

Fig 7 shows the original image of the test 3. This image is compressed using dwt technique. Remove redundancy data technique with DWT is used for lossless image compression. This technique provides the best compression ratio of the image.



Figure 8: Decompressed image 3

Fig 8 shows the decompressed image after applying 'harr' wavelet. Compressed image is further decompressed using dwt technique with level 2" and threshold value of 10.

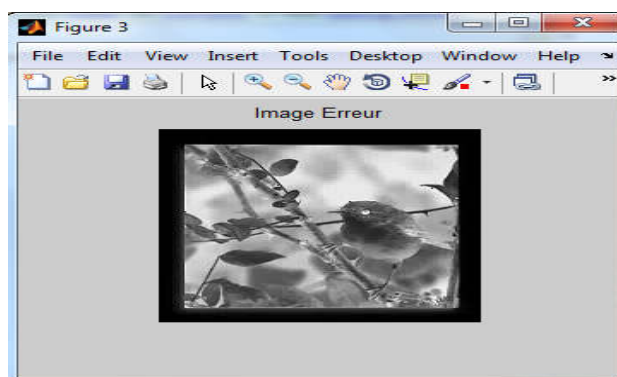


Figure 9 shows the Error image of the test 3

Fig 9 shows the Error image of the test 3. After the decomposing of image MSE and PSNR is calculated using de-quantification and idwt.

Compression of image 4

In the test 4 human neuron image taken for compression. Neuron helps to send the signals to the brain.

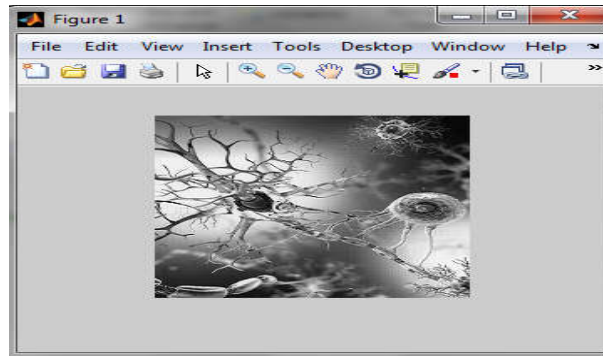


Figure 10: Original image of test 4

Fig 10 shows the original image for test 4. This image is compressed using dwt technique. Remove redundancy data technique with DWT is used for lossless image compression. This technique provides the best compression ratio of the image.

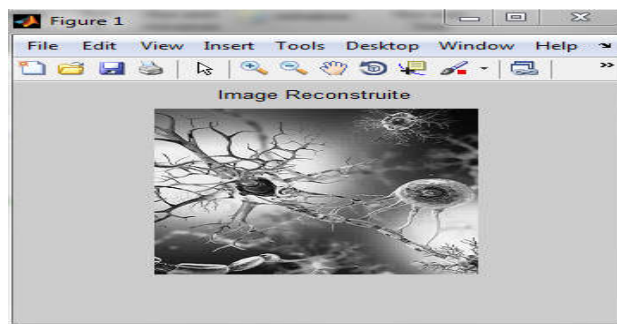


Figure 11: Decompressed image

Fig 11 shows the decompressed image after applying 'harr' wavelet. Compressed image is further decompressed using dwt technique with level 2" and threshold value of 10.

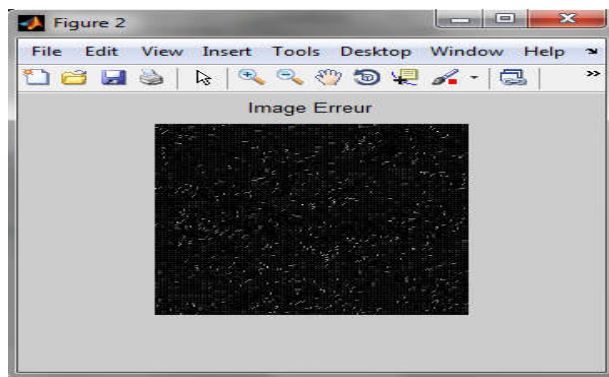


Figure 12: Error image

Fig 12 shows the Error image of the test 4. After the decomposing of image MSE and PSNR is calculated using dequantificatin and idwt.

Compression of image 5

In the test 5 human skull image taken for compression. It protect brain parts and give shape them.

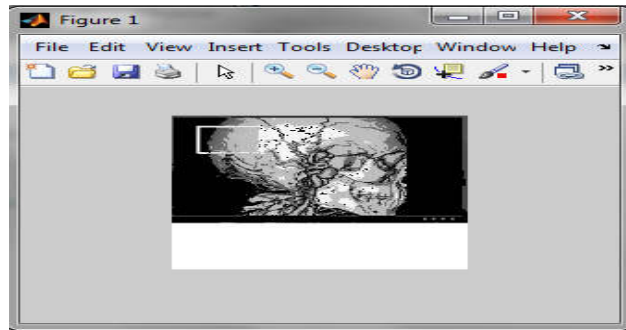


Figure 13 Original image of test 5

Fig 13 shows the original image of the test 5. This image is compressed using dwt technique. Remove redundancy data technique with DWT is used for lossless image compression. This technique provides the best compression ratio of the image.

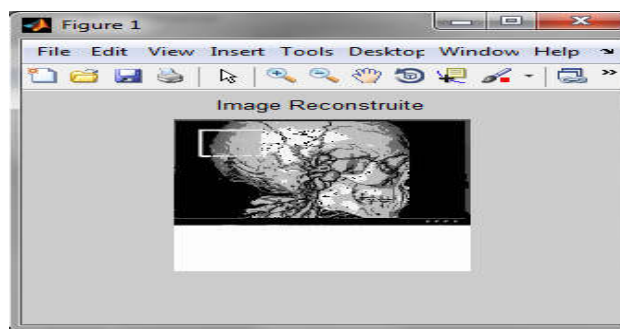


Figure 14: Decompressed image

Fig 14 shows the decompressed image after applying 'harr' wavelet. Compressed image is further decompressed using dwt technique with level 2" and threshold value of 10.

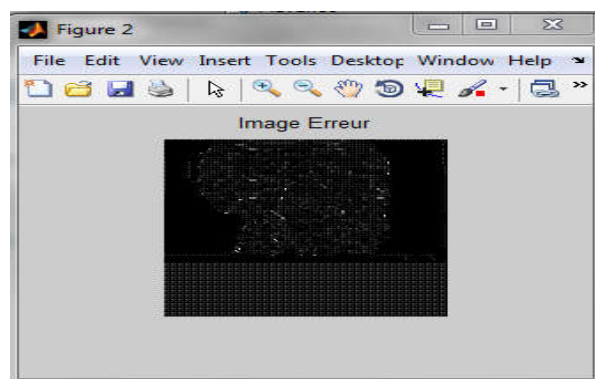


Figure 15: Error image

Fig 15 shows the Error image of the test 5. After the decomposing of image MSE and PSNR is calculated using dequantificatin and idwt.

Compression of image 6

In the test 6 human mouth image taken for compression. It shows the jaw structure

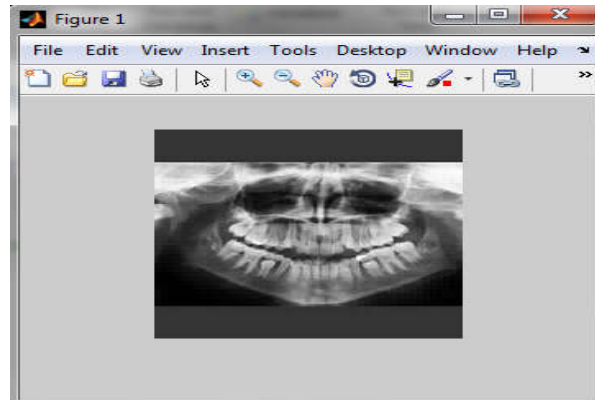


Figure 16: Original image of test 5

Fig 16 shows the original image of the test 6. This image is compressed using dwt technique. Remove redundancy data technique with DWT is used for lossless image compression. This technique provides the best compression ratio of the image.

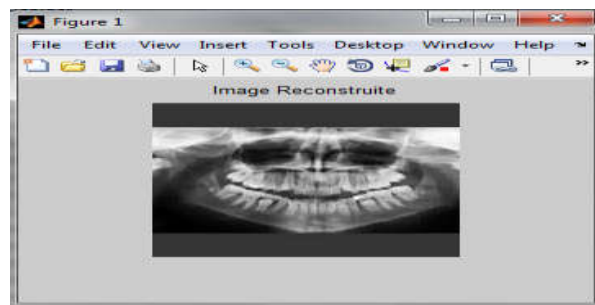


Figure 17: Decompressed image 6

Fig 17 shows the decompressed image after applying 'harr' wavelet. Compressed image is further decompressed using dwt technique with level 2" and threshold value of 10.

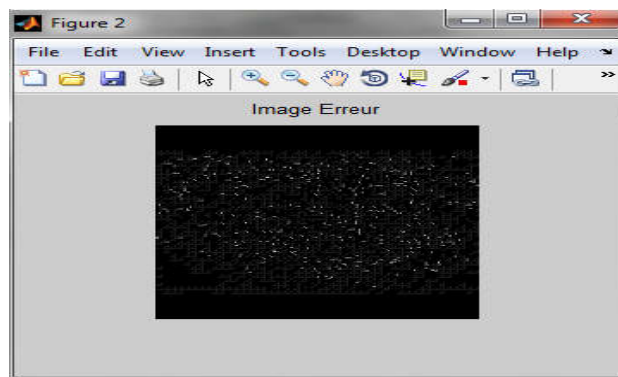


Figure 118 shows the Error image of the test 6

Fig18 shows the Error image of the test 6. After the decomposing of image MSE and PSNR is calculated using de-quantification and idwt.

Compression of image 7

In the test 7 human leg joint image taken for compression.

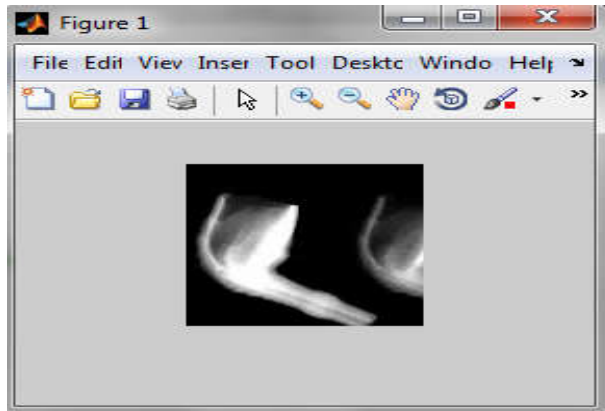


Figure 5. 19: Original image of test 7

Fig 5.19 shows the original image of the test 7. This image is compressed using dwt technique. Remove redundancy data technique with DWT is used for lossless image compression. This technique provides the best compression ratio of the image.

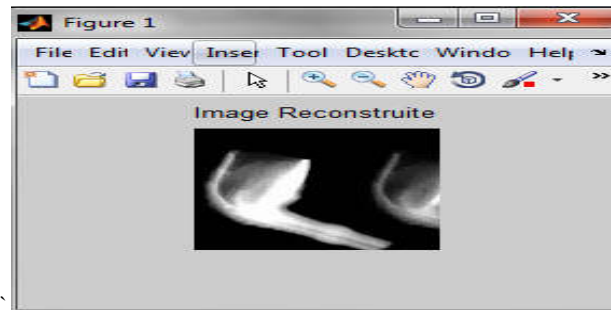


Figure 20: Decompressed image 7

Fig 20 shows the decompressed image after applying 'harr' wavelet. Compressed image is further decompressed using dwt technique with level 2" and threshold value of 10.

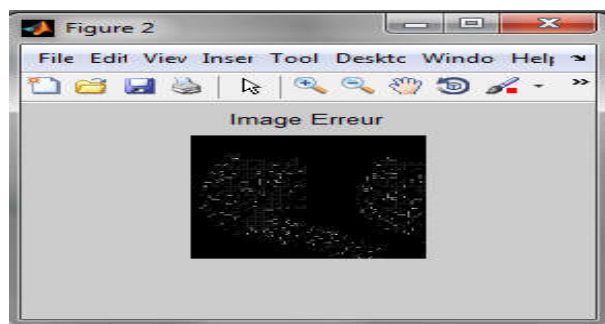


Figure 21: Error image

Fig 21 shows the error image of the test 7. After the decomposing of image MSE and PSNR is calculated using dequantificatin and idwt.

Compression of image 8

In the test 8 human skeleton image taken for compression. It shows the chest and hand structure

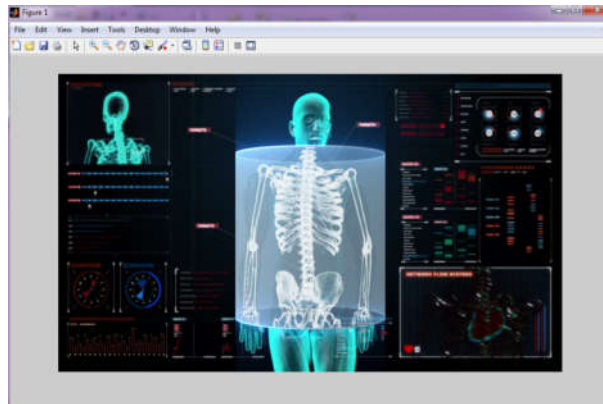


Figure 22: Original image of test 8

Fig 22 shows the original image of the test 8. This image is compressed using dwt technique. Remove redundancy data technique with DWT is used for lossless image compression. This technique provides the best compression ratio of the image.

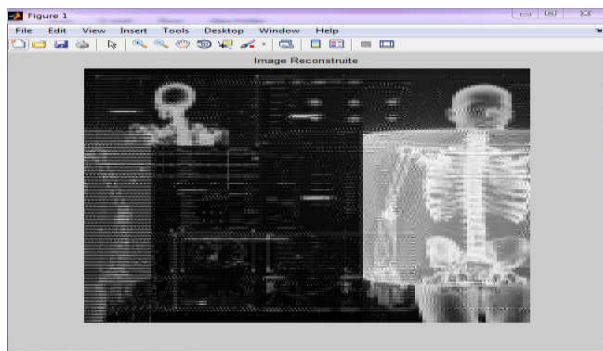


Figure 23: Decompressed image 8

Fig 23 shows the decompressed image after applying 'harr' wavelet. Compressed image is further decompressed using dwt technique with level 2" and threshold value of 10.

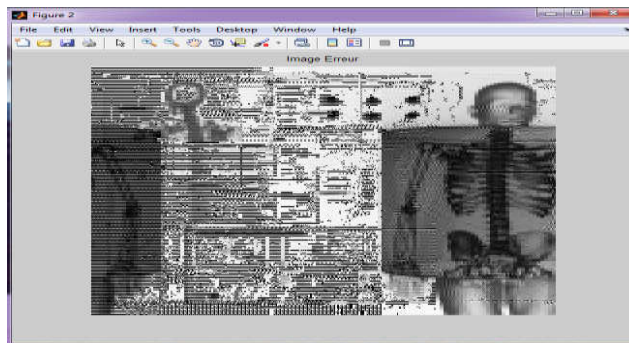


Figure 24: shows the Error image of the test 8

Fig 24 shows the Error image of the test 8. After the decomposing of image MSE and PSNR is calculated using dequantificatin and idwt.

Compression of image 9

In the test 9 human skeleton image taken for compression. It shows the chest and hand structure

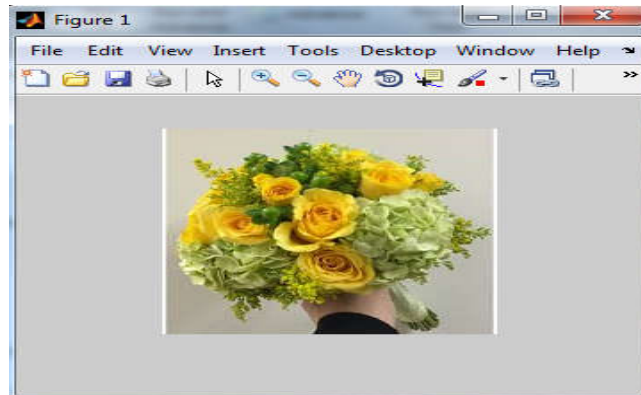


Figure 25: Original image of test 9

Fig 25 shows the original image of the test 9. This image is compressed using dwt technique. Remove redundancy data technique with DWT is used for lossless image compression. This technique provides the best compression ratio of the image.

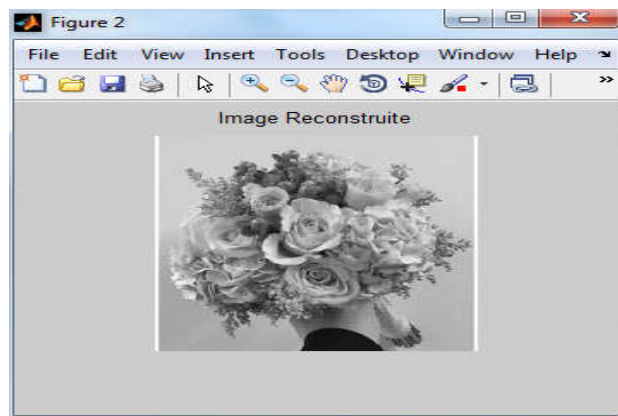


Figure 26: Decompressed image 9

Fig 26 shows the decompressed image after applying 'harr' wavelet. Compressed image is further decompressed using dwt technique with level 2" and threshold value of 10.

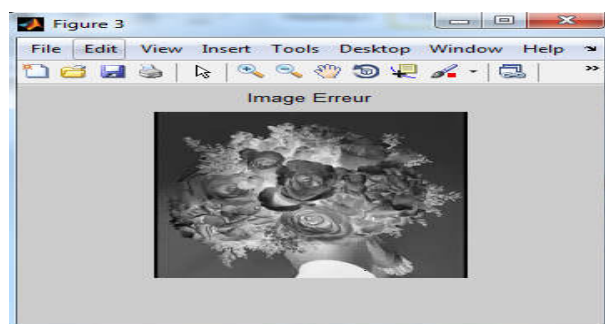


Figure 27: shows the Error image of the test 9

Fig 27 shows the Error image of the test 9. After the decomposing of image MSE and PSNR is calculated using dequantificatin and idwt.

Compression of image 10

In the test 10 human skeleton image taken for compression. It shows the chest and hand structure

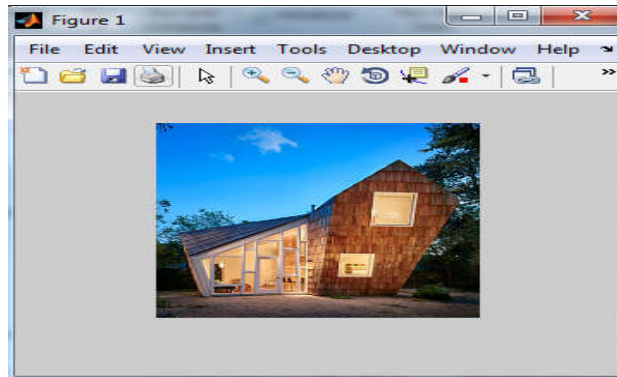


Figure 28: Original image of test 10

Fig 28 shows the original image of the test 10. This image is compressed using dwt technique. Remove redundancy data technique with DWT is used for lossless image compression. This technique provides the best compression ratio of the image.

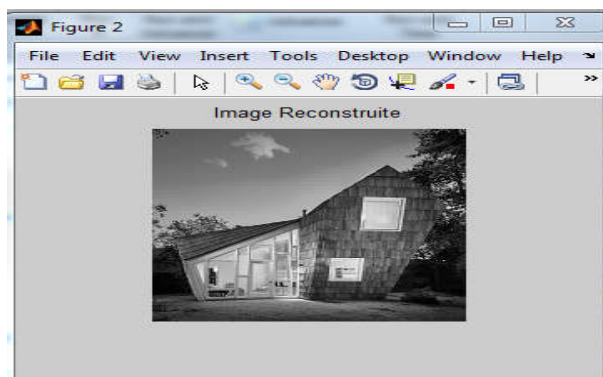


Figure 29: Decompressed image 10

Fig 29 shows the decompressed image after applying 'harr' wavelet. Compressed image is further decompressed using dwt technique with level 2" and threshold value of 10.

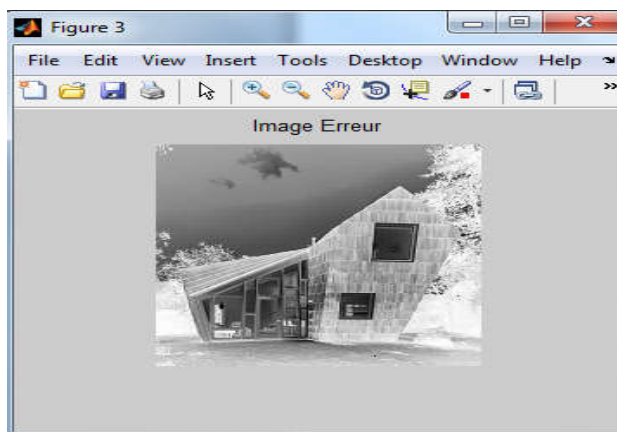


Figure 30: shows the Error image of the test 10

Table 1: comparative table of all results

Test	Original Size(kb)	New Size(kb)	PSNR	CR	MSE
1	104	35.5	55.15	65.87	1.83
2	104	36	56.85	65.38	1.76
3	104	36.1	57.05	65.29	1.75
4	36	17.6	47.28	51.11	1.23
5	27	8.37	49.12	69	0.8
6	36	11	49.54	69.44	0.72
7	14	4	49.81	71.42	0.68
8	1160	226	42.28	51.33	2.4
9	104	36.7	74.43	64.71	1.17
10	104	35.3	39.14	66.06	2.64

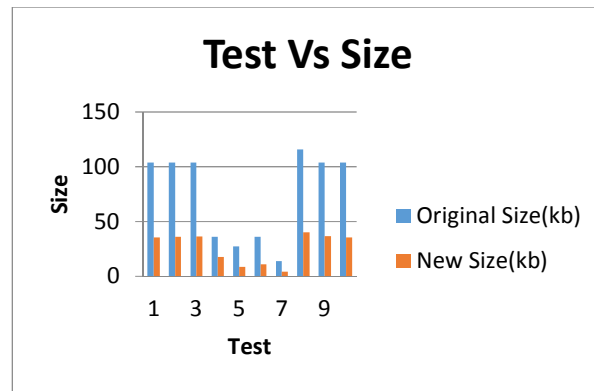


Figure 31: comparative graph of compression

Figure 31 shows comparative graph of compression of image size. Blue color shows original size of image and brown shows new size.

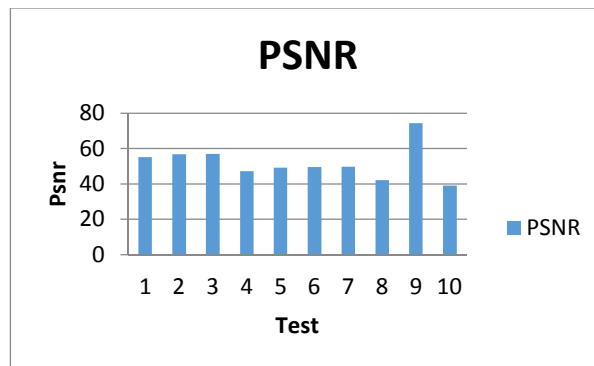


Figure 32: comparative graph of psnr

Figure 32 shows comparison of PSNR. Test 10 has least PSNR value.

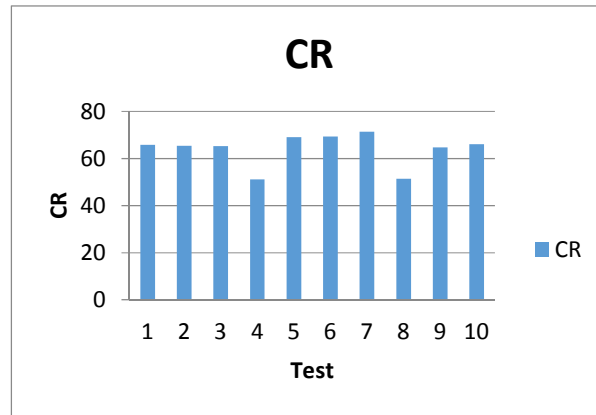


Figure 33: comparison of CR

Figure 33 shows comparison of CR. Test 4 has least CR value.

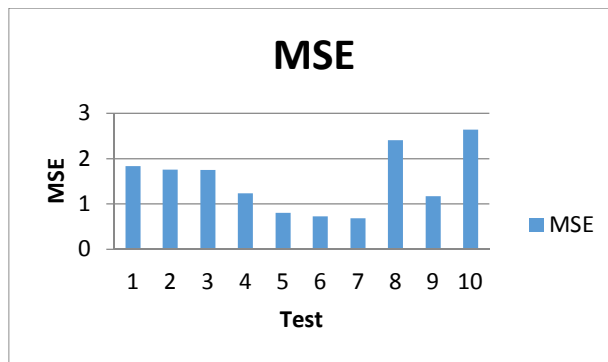


Figure 34: comparative graph of MSE

Figure 34 shows comparison of MSE. Test 7 has least MSE value.

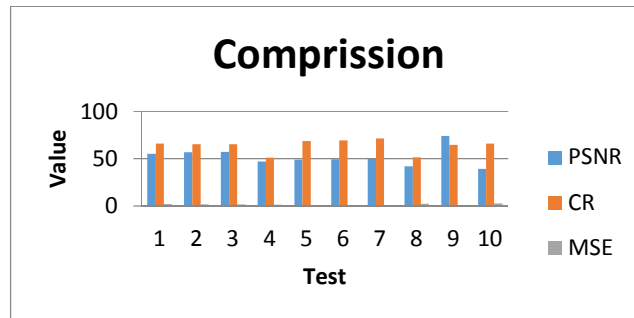


Figure 35: comparison

Figure 35 shows comparison of noise. Test 4 has least Noise value as compared to all others.

III. CONCLUSION

Image decomposition is very important in today's life. For this decomposition some factors that affect the compression. It is concluded that higher the CR ratio of the compression i.e. 74:4 gives the better image quality. PSNR of image max goes to 57.05. Due to this compression ratio, image quality is improved when MSE should be low for the better results as it goes to maximum 124.6.

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