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ETC System Design Using QUADTREE & HUFFMAN Coding

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Abstract— *image compression is the need of modern data management system. A fundamental shift in the image compression approach came after the popularity of discrete wavelet transform (DWT). JPEG standard serves the emerging area of mobile and internet communication. This work explores the various encryption and compression techniques. The image compression is achieved using Quadtree and Huffman coding. Encoding and decoding uses arithmetic coding methods. Text is hidden using LSB.*

Keywords— ***Arithmetic coding, DWT, JPEG standard, Huffman coding, Quadtree coding.***

I. INTRODUCTION

Image compression can be categorised as:

1. Lossless type
2. Lossy type

This depends upon the method of redundancy. The lossless method preserves the original information. The image content is reodered on the basis of statistical redundancy alone like Huffman coding and arithmetic coding. The lossy method involves removing some contents of the image based on psycho-visual redundancy and sometimes statistical redundancy is also used to compress the image. The popular techniques are vector quantization, fractal, transform coding and JPEG.

The image is subdivided into separate blocks of fixed or variable size. Fixed partition method is popular as it is easy to use. There are certain drawbacks of this method and these drawbacks are eliminated by applying quadtree algorithm, HV (horizontal-vertical) and triangular which yield quite satisfactory results. There is a trend to use the polynomial approximation representation.

II. RELATED WORK

I have drawn inspiration from the research conducted by **jiantao zhou & xianming liu [1].**

In this research work, author has designed **" ETC system via prediction error clustering & random permutation."** We have simulated the entire work of the above mentioned authors using MATLAB 2010 a version. The results are compared with our proposed system as under:

2.1 The proposed methodology: Flow chart

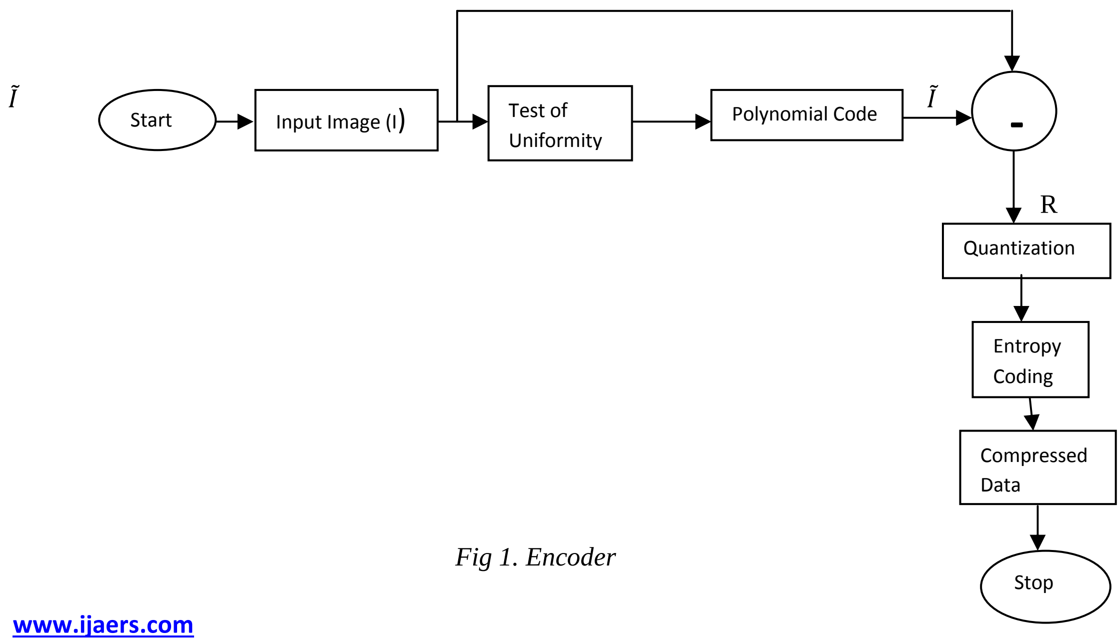

Fig 1. Encoder

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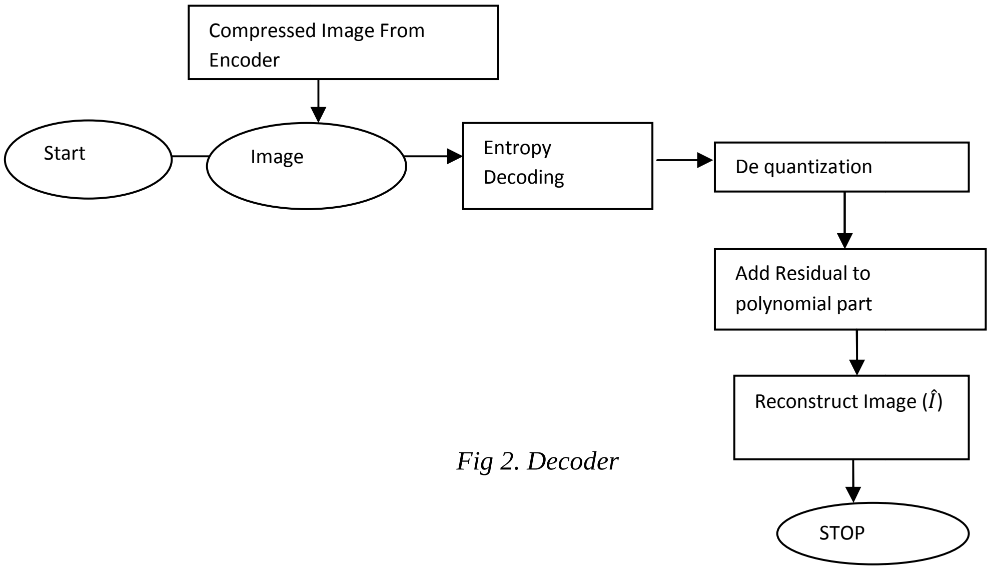

Fig 2. Decoder

2.2 ALGORITHM QUADTREE PARTITIONINGS

1. Input image of size N×N
2. Select the minimum and maximum block size
3. Test the uniformity criteria

(a) If(region<= $minimum\ block\ size$) then uniform

(b)Else if (region> $maximum\ block\ size$) then nonuniform

(c)Else

If(region> $standard\ deviation\ threshold\ value$)and (region> $minimum\ mean\ threshold\ value\ and\ region maximum\ mean\ threshold\ value$) then non uniform Else uniform

Step 1: load the original image I.

Step 2: partition the image into non-overlapped blocks of variable size n×m using a quadtree partitioning scheme. If the block os not uniform then partitioning is repeated on its four quadrants in the hierarchical manner till uniformity is achieved.

Algorithm I summarizes the quadtree partitioning.

Step 3: perform the polynomial representation to the variable blocks sizes.

Step 4: apply uniform scalar quantization to quantize the polynomial approximation coefficients.

Step 5: evaluate the predicted $\tilde{I}$ image value using the dequantized polynomial coefficient s for each encoded block.

Step 6: find the prediction error to find the original image.

Step 7: apply scalar uniform quantization to quantize the residual part, this improve image compression and quality.

Step 8: Huffman coding is applied to remove the rest of the residual and polynomial coefficients.

III. OBSERVATION

proposed system is applied on standard images. The test have been performed using variable block size.

(a) (b)

Fig 3.1 overview of tested images (a) leena (b) peppers of size 256×256, gray scale.

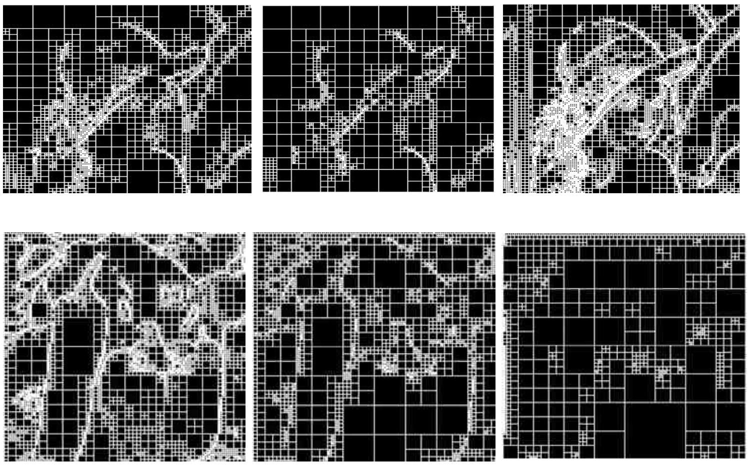

Fig.3.2 quadtree partitioning applied on leena and pepper with different block sizes.

3.1 **Compression quality measures:**

(a) PSNR(peak signal to noise ratio)

PSNR is a measure of the peak error.

$$PSNR = 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right) = 20 \cdot \log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right) = 20 \cdot \log_{10}(MAX_I) - 10 \cdot \log_{10}(MSE)$$

(b) MSE(mean square error)

The **MSE** is the cumulative squared error between the **compressed** and the original **image.**

$$MSE = \frac{1}{m\,n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

(c) CR (compression ratio)

Compression ratio is defined as the ratio of an original image and compressed image.

$$\text{Compression ratio} = \frac{original\ image}{compressed\ image}$$

IV. RESULTS

s.no.	Images	PSNR	MSE	CR	BPP
1	Leena	33.359	30.004	9.8114	0.7849
2	Baboon	25.881	167.863	10.6586	0.8527
3	Barbara	28.013	102.742	7.6733	0.6139
4	Peppers	31.323	47.948	2.7023	0.2162
5	Image42	29.535	72.381	3.4321	0.2746

Table 4.1 Base work

s.no.	Images	PSNR	MSE	CR	BPP
1	Lenna	78.234	0.001	38.229	2097152.00
2	Baboon	78.234	0.001	30.519922	2097152.00
3	Barbara	75.224	0.002	29.600723	2097152.00
4	Peppers	78.234	0.001	38.332852	2097152.00
5	Image42	78.234	0.001	43.117562	2097152.00

Table 4.2 proposed work

V. CONCLUSION

The close inspection of base paper related result and proposed results establish the fact that the quality of decoded image improves with the number of quantization levels of both the approximation representation coefficients and residual image increase. The image quality improves because of polynomial approximation.

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