Location Based Adaptive Block Wise Lossless Image Compression

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Abstract **-Lossless image compression retains the same image after compression [2].The proposed method is adaptive, not taking complete image but accessing row major order of the block of the image to reduce the size of the pixel and adaptive transmit the pixel data at receiver side and at the same side simultaneously decode the pixel and display the same pixel. In this method we use a concept of dynamic allocation for generating variable length of each pixel after subtracting from the original pixel as a maximum intensity pixel in the block .In the proposed method, one can adaptively select either row wise or column wise scan within a block of a matrix. This method can be applied on grey scale images.**

Keywords: **Spatial domain, non-uniformity, spatial domain, lossless compression, image compression**

I. INTRODUCTION

Image is a rectangular array of pixel. The pixel value of a grayscale image has positive value which can be considered as intensity [1].Range of image pixel intensities are [0, 2N-1].Each pixel on the screen has position M and N in two dimensional window. (0, 0) corresponds to the upper left corner of the image.

An image is a two dimensional digitized function f(x, y) [5] [8].The smallest unit of image is pixel [6] which contains number of bits according to the resolution of the computer. In 8-bit computer each pixel is 8 bit wide, have an intensity range from 0 to 2n-1 .A model is a measurement of the probability distribution of inputs to a compressor. Model is represented as a sequence of predictions of symbols like bits, bytes or words. Coding is a solution after modeling. A model can be static or dynamic. The best compressor uses dynamic model. Lossless compression algorithms are divided into line based and block based according to how the spatial locality information of pixels is used to compress[3],[4].A line based algorithms contains one to several pixel at a line as a basic unit and compresses each pixel using only the neighboring pixel in the same line while a block based algorithms contains a block in a frame e.g.8*8,16*16 etc. and compresses each pixel in a block using the neighboring pixel in the same block .Image data contains much more values than simple text or document files, transmission of raw image over any network claims extra demand on bandwidth and how much compression ratio is achieved by preserving maximum possible quality .In Digital mastering of movies and telemedicine, lossless compression methods are to be used. Arithmetic coding [9], [10] schemes are to be used to transmit the residues to further reduce the size of the overhead data per block. The maximum distance between pixels in the same block is not fixed. It can be up to 255.Link list is used here for dynamic allocation due to its advantage of easy insertion and deletion dynamically.

II. PROPOSED ALGORITHMS OF ENCODING AND DECODING PROCEDURE

Adaptive lossless image compression algorithms are one pass procedure algorithm in which encoding and decoding procedure occurs simultaneously and happened in one pass unlike Huffman coding or any other algorithm of compression.

1) Encoding procedure: Let us take an image of lena. Matrix representation of this image is depicted in fig1

166	162	159	163	176	163
161	162	160	168	172	156
162	164	164	170	165	159
164	166	172	168	165	158
165	172	162	163	167	159
168	169	140	165	170	161

Fig-1: Matrix representation of the Block of 6X6 of Lena image

This method is depending on location of intensity of image. Firstly, it chooses the maximum intensity as a base intensity in this block. By adopting the row major order, this method selects one by one intensity of this block and subtracts it from the base intensity .For reducing the transmitting time we try to reduce its bit length by generating a node for the remainder after dividing by 2 and repeat the same steps until exponent becomes 0. Incoming remainders are linked in backward manner. One Pointer points to the linked list, for scanning one by one bit in the current intensity and then transmitting whole variable length bits to the receiver side .lets us take one example to understand the method. In fig -1, maximum intensity is 172 as a base intensity. First intensity is 166 which are 8 bits wide. Now subtract it from the base intensity, resultant is 6. For reducing the bits divide 6 by 2 remainder is 0 and exponent is 3.Create a node, store remainder in it a pointer point to this node. Again 3 is divided by 2 and remainder is 1 and exponent is also 1. Now create a next node and store 1 in it and link this node with previous node as a linked list and pointer point to the whole linked list. Repeat this step until exponent become 0. In this way 0 1 1 as a three node is created. Transmit only these three bits instead of 8 bits towards receiver side.

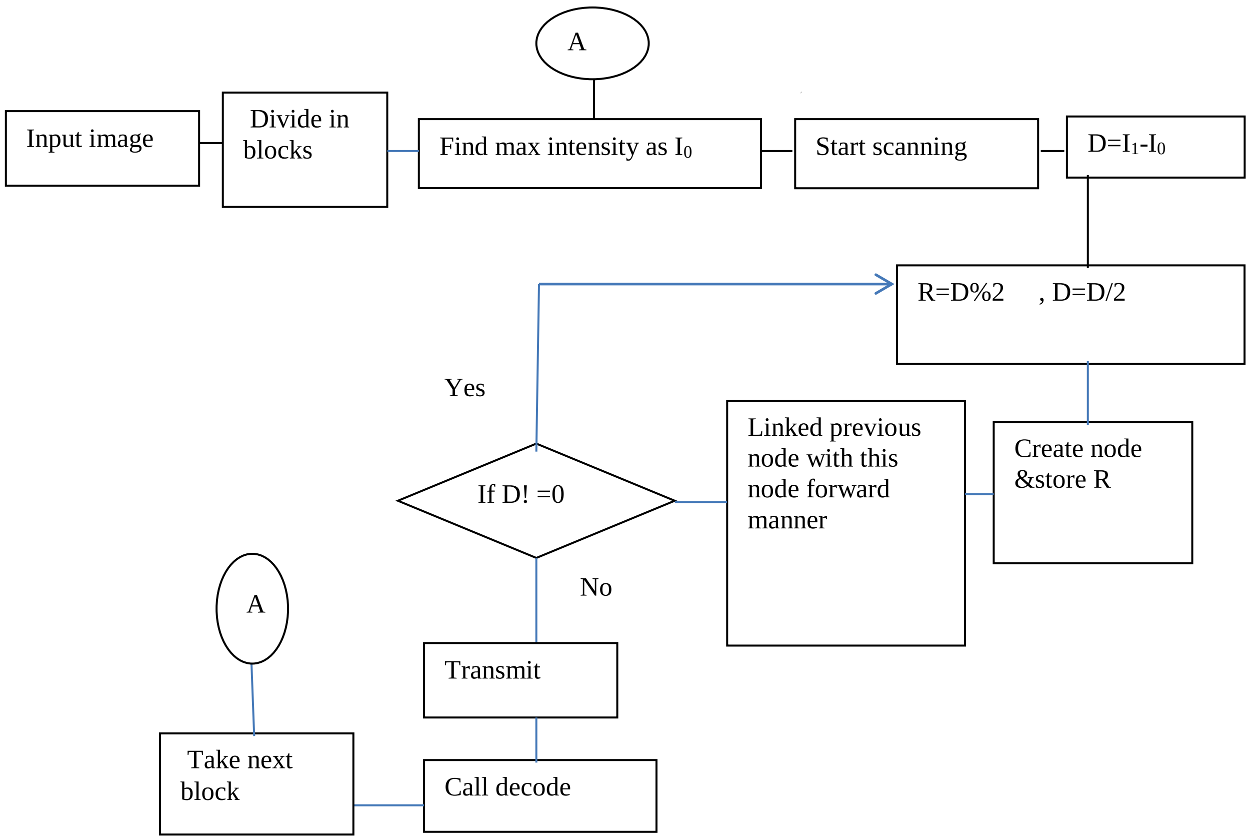

Fig-3: Encoding process

This method is adaptive [9] so encoding and decoding happen simultaneously. In decoding phase, Store the transmitted bits one by one in the linked list forward manner dynamically. Start from the first node, contents of first node bit is multiply by 2^0, second node is multiply by 2^1 and third node is multiply by 2^3 and so on if more nodes. Sum all the resultant value to find the bits to the decimal value. Now subtract this number from the base intensity to find the required previous intensity as a decoded pixel. In the fig 4, N1 is the first bits N2 is second bits and so on.

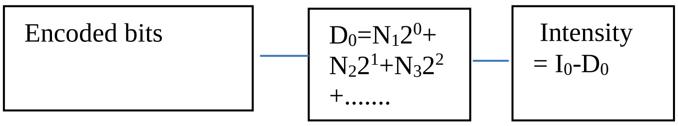

Fig-4: Decoding Process

2) Algorithm of Encoding Procedure

1. Input image
2. Divide image into blocks
3. Take first block
4 Find maximum intensity of First block as I_0 as base intensity
5. Read First intensity value
6. Calculate difference between current intensity with base intensity
7. $D = I_1 - I_0$
8. Repeat while D! = 0
   R=D%2 && D = D/2

9. If it is first node
   Start is point to this node

else
   Previous node is point to current node to make linked list

10. Repeat the step from 4 to 7 for the next block after transmitting and decoding

3) Algorithm of Decoding Procedure

1. Take encoded bits at receiver side
2. $D0=N_1 2^0+N_2 2^1+N_3 2^2+$.......
3. Decoded intensity= I_0-D_0

III. EXPERIMENTAL ANALYSIS

For Experimental analysis, maximum intensity of the block is 176.Start scanning the first row. First data is 166 subtract it from 176 which is equal to 10.Number of bits is 0101 instead 8 bits is transmitted at the side of receiver side from the linked list adaptively generated. At receiver side, use a decoding process to find the same intensity. Figure 5 shows the bits require to transmit towards receiver side.

166(1010)	162(1110)	159(10001)	163(1101)	176()	163(1101)

Figure 5: Bits representation encoded intensity

Same as above all the variable length bits of rest of the row can be determined.

Table1: Performance analysis of images in terms of compression ratio and MSE

Images	Before compression	After compression	Compression ratio	Mean Square Error
Lena(256*256)	524288	86785	6.03	0
Barbara(258*258)	532512	89567	6.48	0
Boat(300*300)	720000	288500	2.49	0
coins(432*432*)	1492992	507196	2.94	0
Texture(450*450)	1620000	648000	2.50	0
Circuit(500*500)	2000000	800000	2.50	0

Compression ratio can be determined as Number of bits transmitted before compression/ Number of bits transmitted after compression

Number of bits before compression in a block=36 * 8 = 288 bit

Number of bits after Compression in a block

=(4+4+5+4+1+4)+(4+4+4+4+3+5)+(4+4+3+4+5)+(4+4+3+4+4+5)+(4+3+4+4+4+5)+4+3+5+4+3+4)

= 44

Compression ratio=288/44=6.5

By analysis, image size is reduced to 6 times by applying this method of adaptive compression. In this way transmission time is reduced which yield faster processing of the image file. Other parameters of lossless image compression are Mean Square error and peak signal to noise ratio. For the Lossless image compression MSE is zero and PSNR value is calculated from MSE. So it gives infinite value.

PSNR and MSE are given below:

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

PSNR = $10\log_{10}[255*255/MSE]$ (2)

IV. RESULTS

For experimental verification of digital image compression we collected 6 different images of different size and apply the above adaptive compression on that images [7] Table-1 shows that compression ratio, mean square error and peak signal to noise ratio. Experimental result shows that compression ratio is nearly equal to 6. These methods compress the image data 1/6 of that original size of image data or some case ½ of the size of the image. Mean square error of all images is zero because reconstructed image is same as the original image due to lossless image compression. Another parameter is peak signal to noise ratio which has infinite value because it is inversely proportional to mean square error.

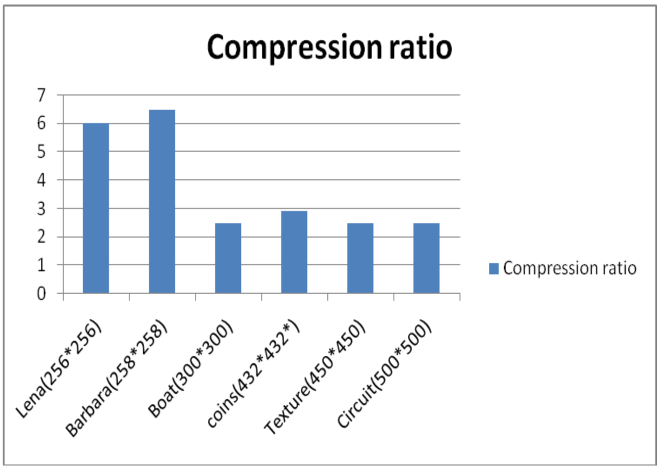

Fig-6 Compression ratio of different images

V. CONCLUSION

We presented adaptive lossless image compression using location based. Our proposed algorithm is completely lossless. We achieved 60% reduction in gray scale images when compared with some existing image compression techniques. Mean square error has the value zero and peak signal to noise ratio has the value infinite because it is the inversely proportional to mean square error.In future we will apply this method to colored image compression and video compression.

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