

An Hybrid Approach of Lossless Compression for Color Images

¹N. Subhash Chandra, ¹M. Balraju, ²S. Mahaboob Basha and ¹A. Govardhan

¹Department of Computer Science and Engineering, JNTU, Hyderabad, India

²Department of Computer Science and Engineering,

Al-Habeeba College of Engineering, Chevella, Ranga Reddy Dt, Hyderabad, India

Abstract: With the increasing use of multimedia techniques, image compression requires higher performance as well as new features and also with the expansion of the telemedicine through the internet, the necessity of transmission of a great volume of images through medias of low speed, making impracticable to some applications, like cooperative diagnosis. A solution can be the use of hybrid techniques of compression as proposed in this study. This study deals with BDH technique, which is used to the compression of color images. In BDH technique, Huffman coding and Difference coding with Binary Plane Technique are combined. The BDH technique is compared with Binary Plane Technique (where no difference coding is used) and JPEG. Experimental results show that BDH improves compression rate compared to Binary Plane Technique.

Key words: BPT, Huffman coding, difference coding, JPEG, bit plane, data table

INTRODUCTION

Nowadays, image data coding is a key component of multimedia communication and storage systems. Uncompressed multimedia (graphics audio and video) data requires considerable storage capacity and transmission bandwidth. Despite rapid progress in mass storage density, processor speeds and digital communication system, the demand for data storage capacity and data-transmission band width continues to outstrip the capabilities of available technologies (Abramson, 1963). This is a crippling disadvantage during transmission and storage. So there arises a need for data compression of images. Image compression techniques aim to reduce the amount of data necessary to represent a digital image.

In this study, the effect of using the difference coding (Gonzalez and Woods, 2007) in between the binary plane technique and Huffman coding technique (Salmon, 2007) is studied for color images and we named this technique as BDH. This technique is spatial domain technique we found it better than the binary plane and Huffman coding combination and difference and Huffman coding combination.

The compression can be lossless or with loss of information (Shannon, 2001). In the first case in general, the result is a low compression ratio and in the second

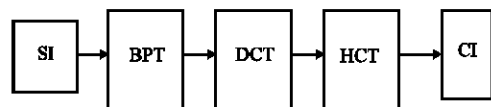
case is possible to reach high compression ratios. Lossless methods are typically chosen for applications where small image details can be of paramount importance, such as medical and space imaging or in remote sensing. The BDH given in this study is lossless technique because all 3 techniques involved namely binary plane technique, difference coding and Huffman coding are lossless techniques.

BDH ENCODING

The BDH encoding is involved with 3 stages, binary plane, difference coding and Huffman coding in that order as given the Fig. 1.

The difference coding and Huffman coding are popular and very widely used techniques (Jayan, 1992).

Binary plane technique: The BPT technique is used in the first stage. In this technique after applying the BPT 2



SI: Source Image
 BPT: Binary Plane Technique
 HCT: Huffman Coding Technique
 DCT: Difference Coding Technique
 CI: Compressed Image

Fig. 1: BDH image compression model

files namely bit plane and data table are created. The bit plane is collection of 1's and 0's to represent whether a pixel is repeated or not. The data table, holds only the necessary pixel values. The bit plane and data table are later merged into one file. On the data generated from BPT, the Difference and Huffman coding are applied in that order to further compress.

The main objective of this technique is to take advantage of repeated values in consecutive pixels positions. For a set of repeated consecutive values only one value is retained.

In the Binary plane technique the first part 'bit plane' holds the bit 0 for each a pixel similar to previous pixel and the bit 1 for each pixel different from previous pixel. The second part 'data table' holds only the necessary pixel values, i.e., for a set of consecutive repeated values, one value is stored in the data table. After merging the bit plane and data table Huffman coding is applied and final form of compressed file is generated.

For color images, the image is first separated into 3 planes red, green and blue. For each plane the Binary Plane Technique used for monochrome images is applied. The processing of the pixels of the 3 planes is done together (Fig. 2).

BDH algorithm:

```
PROCEDURE BDH // Main Procedure
BEGIN
// Generates bit plane and data tables
call BinaryPlaneColor()
call MergeColor()
// Merges the Bit Plane and Data Table
call DiffereceCoding()
call HuffmanCode()
END
PROCEDURE BinaryPlaneColor()
//subroutine to generate bit plane and data
rprev_pixel // holds red previous pixel
rcur_pixel // holds red current pixel
gprev_pixel // holds green previous pixel
gcur_pixel // holds green current pixel
bprev_pixel // holds blue previous pixel
bcur_pixel // holds blue current pixel
red_bit_plane /* red bit plane */
green_bit_plane /* green bit plane */
blue_bit_plane /* blue bit plane */
BEGIN
open raw_image file
open redbitplane file
open redata table file
open greenbitplane file
open greendata table file
open bluebitplane file
open bluedata table file
rcur_pixel=read (image)
write rcur_pixel to redata table file
append bit 1 to red_bit_plane
rprev_pixel=rcur_pixel
gcur_pixel=read (image)
write gcur_pixel to green_data table file
```

```
append bit 1 to greenbit_plane
gprev_pixel=gcur_pixel
bcur_pixel=read (image)
write bcur_pixel to data table file
append bit 1 to blue_bit_plane
bprev_pixel=bcur_pixel
while((rcur_pixel=read(image))!=eof)
Begin
gcur_pixel=read(image)
bcur_pixel=read(image)
if (rcur_pixel = rprev_pixel) then
append bit 0 to red_bit_plane
else
Begin /*otherwise append 1 to bit plane to indicate that pixel is
different so retained */
append bit 1 to red_bit_plane
write rcur_pixel to redata table file
rprev_pixel=rcur_pixel
End
if red_bit_plane is full then
write red_bit_plane to redbitplane file
End
if (gcur_pixel = gprev_pixel) then
append bit 0 to green_bit_plane
else
Begin
append bit 1 to green_bit_plane
write gcur_pixel to greendata table file
gprev_pixel=gcur_pixel
End
if green_bit_plane is full then
write green_bit_plane to greenbitplane file
End
if (bcur_pixel = bprev_pixel) then
append bit 0 to blue_bit_plane
else
Begin
append bit 1 to blue_bit_plane
write bcur_pixel to bluedata table file
bprev_pixel=bcur_pixel
End
if blue_bit_plane is full then
write blue_bit_plane to bluebitplane file
End
if red_bit_plane not empty then
write red_bit_plane to redbitplane file
if green_bit_plane not empty then
write green_bit_plane to greenbitplane file
if blue_bit_plane not empty then
write blue_bit_plane to bluebitplane file
close raw_image file
close redbitplane file
close redata table file
close greenbitplane file
close greendata table file
close bluebitplane file
close bluedata table file
END
```

BDH decoding: In the reconstruction of the image the Inverse Difference Coding Technique, Inverse Huffman Technique and Inverse BPT are applied on compressed file, respectively as in the Fig. 3.

Inverse Binary Plane Technique (BPT): In the reconstruction of the image first, the intermediate file is generated from the compressed file. The bit plane and

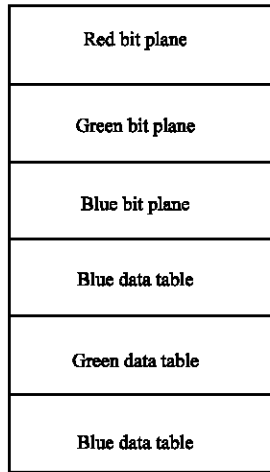


Fig. 2: Format of intermediate file for color images

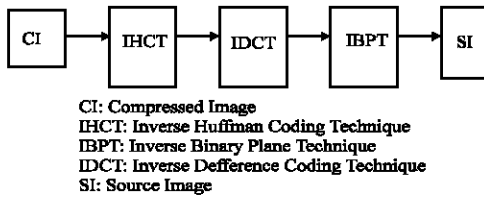


Fig. 3: Reconstruction model in BDH technique

Data tables for red, green and blue planes are extracted from the intermediate file. By checking each bit of bit plane for every color plane separately the image is reconstructed.

RESULTS

From the Table 1, which is generated from the results of the execution of the BPT and BDHT programs, It is clear that BDH technique gives much better compression rate than BPT.

The memory requirement for both BPT and BDHT techniques is very less because the processing is done byte by byte. In case of the JPEG (Skodras *et al.*, 2001), the entire image needs to be brought into memory. As per as process complexity is concerned BPT and BDHT are simple to implement compared to JPEG.

Table 1: Size and compression rates of BPT, BDHT and JPEG

Image name	RAW		JPEG	
	Size	Comp rate	Size	Comp rate
T32.RAW	196608		22276	8.826001077
HWA_07.RAW	57132		31991	1.785877278
HWA_39.RAW	57132		20687	2.761734423

Image name	BPT		BDHT	
	Size	Comp rate	Size	Comp rate
T32.RAW	58007	3.38938404	43875	4.48109401
HWA_07.RAW	31898	1.791084081	26877	2.12568367
HWA_39.RAW	15330	3.726810176	12653	0.515292815

CONCLUSION

The compression rate of BPT and BDHT is better than JPEG not in all cases. We have taken only the medical images where BPT and BDHT are better. The BDHT technique can be easily extended to color images by changing the algorithm accordingly.

REFERENCES

Abramson, N., 1963. Information Theory and Coding. McGraw-Hill Education, pp: 101-112. ISBN-10: 0070001456.

Gonzalez, R.C. and R.E. Woods, 2007. Digital Image Processing. 2nd Edn. Pearson Education, Printice Hall, pp: 462-478. ISBN: 81-7758-168-6.

Jayan, N., 1992. Signal compression: Technology targets and research directions. IEEE. J. Selected Areas in Commun., 10 (5): 796-818. http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?tp=&arnumber=138986&isnumber=3760.

Skodras, A., C. Christopoulos and T. Ebrahimi, 2001. The JPEG 2000 still image compression standard. IEEE. Signal Processing Mag., 18 (5): 36-58. <http://iss.bu.edu/jkonrad/Publications/refs/pdf/refs/unfiled/JPEG2000-tutorial.pdf>.

Shannon, C.E., 2001. A Mathematical theory of communication ACM SIGMOBILE. Mobile Comput. Commun. Rev., 5(1): 3-55. <http://doi.acm.org/10.1145/584091.584093>.

Salmon, D., 2007. Data Compression, the complete Reference Springer-Verlag London Ltd. 4th Edn. pp: 265-280. ISBN: 10:1-84628-602-6.