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An Hybrid Approach of Lossless Compression for Color Images

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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 rations. 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

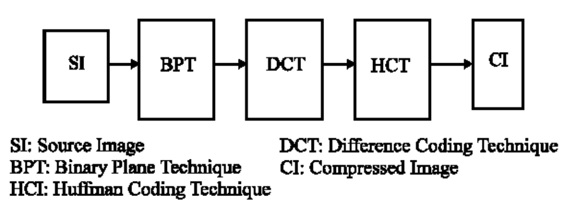

Fig. 1: BDH image compression model

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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 reddata table file
  open greenbitplane file
  open greendata table file
  open bluebitplane file
  open bluedata table file
  rcur_pixel=read (image)
  write rcur_pixel to reddata 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_planee
    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 reddatatable 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_planee
    else
     Begin
       append bit 1 to green_bit_plane
       write gcur_pixel to greendatatable 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 bluedatatable 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 reddata 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

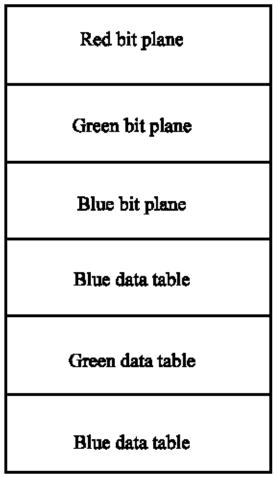

Fig. 2: Format of intermediate file for color images

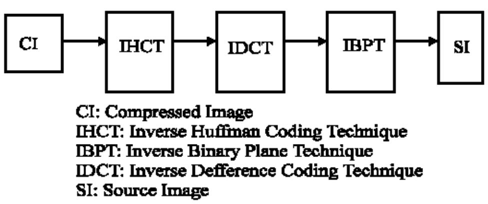

Fig. 3: Reconstruction model in BDH technique

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

	RAW	JPEG		BPT		BDHT	
Image name	Size	Size	Comp rate	Size	Comp rate	Size	Comp rate
T32.RAW	196608	22276	8.826001077	58007	3.38938404	43875	4.48109401
HWA_07.RAW	57132	31991	1.785877278	31898	1.791084081	26877	2.12568367
HWA_39.RAW	57132	20687	2.761734423	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.

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