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LOSS LESS COMPRESSION OF IMAGES USING BINARY PLANE, DIFFERENCE AND HUFFMAN CODING (BDH TECHNIQUE)

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ABSTRACT

This paper deals with BDH technique, which is used to the compression of digital images. In BDH technique, Huffman coding[6] and Difference coding[7] with Binary Plane Technique[1] are combined. The BDH technique is compared with Binary Plane Technique and JPEG[4]. Experimental results show that BDH improves compression rate compared to Binary Plane Technique[1]. The same algorithm can be extended to color images.

Keywords: *BPT, Huffman Coding, Difference Coding, JPEG, Bit Plane, Data Table*

1. INTRODUCTION

The History of image data compression started probably about a half of century ago with the works on predictive coding and variable length codes. The technological breakthrough that took place in 60's, 70's and 80's resulted in efficient compression algorithms that have been standardized in early 1990's and currently are in common use together with the improvements achieved during the last decade. These advances have brought substantial increase in efficiency of earlier basic techniques. Nevertheless, the last decade was also a period of strenuous search for new technologies of image data compression.

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. This is a crippling disadvantage during transmission & storage. So there arises a need for data compression of images.

In this paper the effect of using the Difference coding[7] in between the Binary Plane technique[1] and Huffman coding technique[6] is studied 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 & Huffman coding combination.

Traditionally, image coding techniques have been classified into one of two categories: lossless or lossy. 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 paper is lossless technique because all three techniques involved namely Binary Plane Technique, Difference coding and Huffman coding are lossless techniques.

2. BDH ENCODING

The BDH encoding is involved with three stages i) binary Plane ii) Difference Coding iii)Huffman coding in that order as given the figure1

The Difference coding and Huffman coding are popular and very widely used

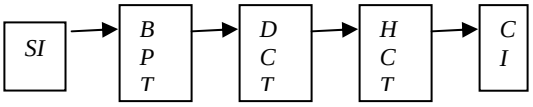
2.1 BINARY PLANE TECHNIQUE (BPT)

The BPT technique[1] is used in the first stage. In this technique after applying the BPT two 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[1], the Difference[7] and Huffman coding[6] 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[6] coding is applied and final form of compressed file is generated.

techniques, so they are not explained here. But the Binary Plane Technique which is new explained in detail here.



SI- Source Image

BPT-Binary plane Technique

HCT-Huffman coding Technique

DCT-Difference coding Technique

CI- Compressed Image

Figure 1: BDH Image Compression Model

2.2 BDH ALGORITHM

```
PROCEDURE BDH // Main Procedure
BEGIN
        // Generates bit plane and data tables
        call BinaryPlane()
        call Merge()
        // Merges the Bit Plane and Data Table
        call DiffereceCoding()
       call HuffmanCode()
END

PROCEDURE BinaryPlane()
 //subroutine to generate bit plane and data
 prev_pixel   // holds previous pixel
 cur_pixel    // holds current pixel
 bit_plane    /* 8 bit number to hold the status bits to indicate whether pixel is
                 retained or not retained. */
 BEGIN
 open raw image file
 open bitplane file
 open data table file
 cur_pixel=read (image)
 write cur_pixel to data table file
 append bit 1 to bit_plane
 prev_pixel=cur_pixel
 while((cur_pixel=read(image))!=eof)
 Begin
  /* if repeated consecutive pixel value append 0 to bit plane to
                 indicate that pixel duplicate so not retained */
```

```
   if (cur_pixel = prev_pixel) then
      append bit 0 to bit_planee
   else
    Begin /*otherwise append 1 to bit plane to indicate that pixel is
                          different so retained */
       append bit 1 to bit_plane
       write cur_pixel to datatable file
        prev_pixel=cur_pixel
    End
    if bit_plane is full then
      write  bit_plane to bitplane file
    End
    if bit_plane not empty then
       write bit_plane to bitplane file
   close raw image file
   close bitplane file
         close data table fil
END
PROCEDURE Merge()
 /*To merge Bit Plane and Data Table  & generate intermediate compressed file */
cur_byte
BEGIN
    open bitplane file
      open data table file
      open bpds file
      while          ((cur_byte=read(bitplane file))!=eof)
      Begin
              write cur_byte to bpds file
      End
      while      ((cur_byte=read(data      table file))!=eof)
```

3.1 INVERSE BINARY PLANE TECHNIQUE (BPT)

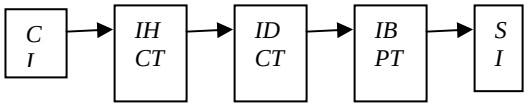
In the Inverse Binary Plane Technique first the Bit Plane and Data Tables are extracted. by checking each bit of Bit Plane either a fresh byte from the data table is read and written or earlier byte itself is written to the reconstructed image file based on the current bit checked.

3.2RECONSTRUCTION ALGORITHM

```
PROCEDURE BDH_Reconstruction
BEGIN
   // To retrieve intermediate file from Huffman format
     call InverseDifferenceCoding()
     call InverseHuffmanCode()
   // To separate the Bit Plane and Data Tables
      Begin
              write cur_byte to bpds file
      End
      close bitplane file
      close data table file
      close bpds file
END
```

3. 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 figure 2.



CI-Compressed Image

IBPT-Inverse Binary plane Technique

IHCT-Inverse Huffman coding Technique

IDCT-Inverse Defference coding Technique

SI- Compressed Image

Figure 2: Reconstruction Model in BDH Technique

```
      call BinaryPlaneDemerge ()
    // To build original image from Bit Plane and Data Table
    call InverseBinaryPlane()
END

PROCEDURE BinaryPlaneDemerge ()

/* Subroutine to separate the Bit Plane and Data Tables
//  Data Items
left            // holds the no of bits in the last byte of the bit plane
bpcount         // holds no of bytes of bit plane
cur_byte

BEGIN
 open bitplane file
  open data table file
  open bpds file
  left=read(bpds file)
```

```
bpcount=read(bpds file)
for i=1 to bpcound
    Begin
        cur_byte=read(bpds file)
        write cur_byte to bitplane file
    End
    while ((cur_byte=read(bpds file)!=eof)
    Begin
        write cur_byte to datatable file
    End
    close bitplane file
    close data table file
    close bpds file
END

PROCEDURE
BINARY_PLANE_DECOMPRESS ()
// Subroutine to build original image from Bit
Plane and Data Table
//Data Items
    cur_ pixel
    bit_plane

    aBit                    //the    current
bit of current bit plane
BEGIN
    open bitplane file
    open data table file
    open image file.
    cur_pixel=read(data table file)
    while((bit_plane=read(bitplane
file))!=eof)
        Begin
            for i=1 to 8
            Begin
            move i^th bit of bitplane to aBit
            // read fresh byte/pixel only when
the bit is 1
                if aBit=1 then
        Begin
                cur_pixel=read(data table file)
        End
        write cur_pixel to image file.
            End
    End
    close raw image file
    close bitplane file

    close data table file
END
```

4. 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 & BDHT techniques is very less because the processing is done byte by byte. In case of the JPEG 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. The graph in Figure 3 is drawn based on the table1

Image	RAW	JPEG		BPT		BDHT	
Name	Size	Size	Comp Rate	Size	Comp Rate	SIZE	Comp Rate
Brain	12610	15109	0.8346019	7609	1.6572479	6421	1.96386856
chest x-ray	18225	16180	1.1263906	17207	1.0591619	11965	1.52319265
knee joint	18225	17193	1.0600244	13245	1.3759909	11636	1.56625988
Head Scan	15625	15184	1.0290437	12532	1.2468081	10178	1.5351739
Shoulder	18225	16962	1.0744606	12562	1.450884	10382	1.75544211

Table 1: BPT vs BDHT vs JPEG

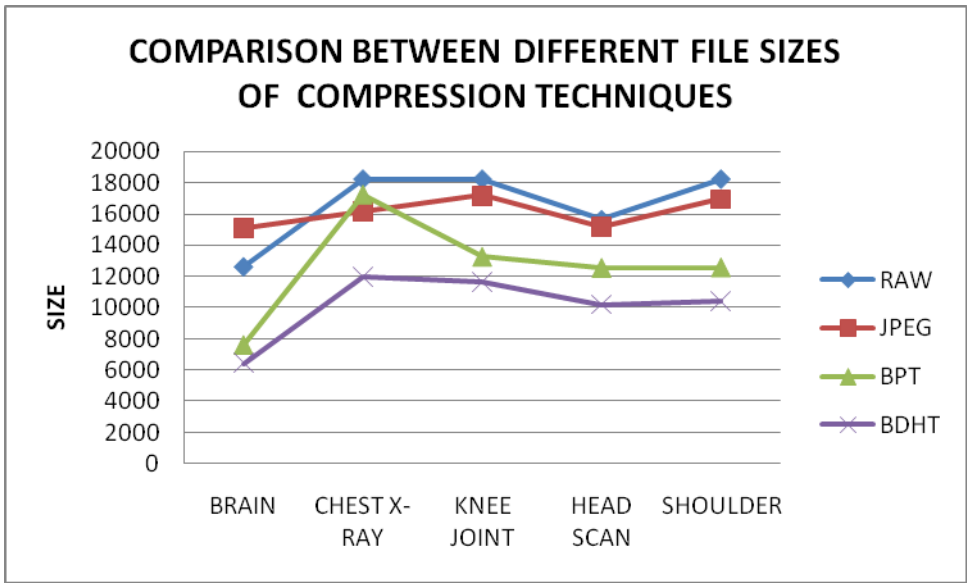


Figure 3: Graph

5. CONCLUSIONS

The compression rate of BPT and BDHT is better than JPEG not in all cases. We taken only the medical images where BPT & BDHT are better.

The BDHT technique can be easily extended to color images by changing the algorithm accordingly.

6. REFERENCES

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