Image compression and enhancement by using the LZW and BHEPL

[*]Saumya Mishra& [**]Mr. Avinash Singh

[*]Master in Technology, Computer Science, Department of CSE, SRSMUniversity, Lucknow
[**]Assistant Professor, Department of CSE,SRSM University, Lucknow

***Abstract*-** This paper describes the lossless data compression techniques LZWand also discuses about its enhancement. In lossless data compression there is no loss in original information, means that the Pre-compressed and decompressed information is same. The BHEPL is use to short processing time for image enhancement.Bi-Histogram Equalization with a Plateau Value(BHEPL) is similar to Brightness Preserving Bi-Histogram Equalization (BBHE). BHEPL enhancement method is the combination of two methods first one is BBHE and second one is clipped histogram. In BBHE we first calculate the average intensity of input image. And in BHEPL enhancement method we divide the input image into two parts or two sub images and then decide the plateau value of each sub part of the image. This paper discus about LZW, BHEPL, original enhancement image and compressed enhancement image.

***Index Terms*-** LZW compression, Histogram equalization, clippedhistogram equalization, Bi-histogram equalization with a plateau value(BHEPL).

I. INTRODUCTION

(A)LZW data compression

Lzw is the lossless data compression method which is used for minimizing the numbers of bits in original information. LZW was proposed in 1984 by '**Welch**''. its Output contains pointers that indicates a previously parsed substring, and these are of fixed size. It is dictionary based method. It's introduced by Lempel-Ziv. First method introduced in dictionary based is LZ77and then second one is LZ78, some improvement was done in LZ78 by **'Welch' and** named it LZW. In this paper LZW compression and decompression algorithm is applied on gray level image. this method, one by one read the gray level pixel of input image and check in dictionary or table the input pixel is present or not. Pixelispresent, then provide the location of same pixel as a output or same code provide as a output of previous same pixel.

LZW compression Algorithm

Start
lastcode=NIL
LOOP
read the input image c
if ((lastcode ,c) in the dictionary
lastcode=location of (lastcode,c)
else
output=lastcode
add the lastcode and c in the dictionary
lastcode=c
End

LZW decompression Algorithm

Start
Read the output of compression (c)
lastcode=c
LOOP
Read the input length::J<-2:length(input)
element=dictionary entry for c
add(lastcode,c)in dictionary
lastcode=element
END

(B) Histogram equalization

Histogram equalization is used to contrast enhancement of image. Enhancement is the important area of image processing. It is used for human and computer vision. Contrast enhancement is also used in medical area, speechrecognition and also used in many applications of image and video processing. There are many methods developed for image enhancement. Some of these methods make use of simple linear/nonlinear gray level transformation functions [1] while some of the others use complex analysis of different image features such as edge [2], connected component information [3].

Histogram equalization is used for enhancement in any type of image but it is not compulsory, it always increase the contrast enhancement. In many cases contrast enhancement will be decreased by using histogram equalization.

There are two important concepts used in histogram equalization: -
PMF (Probability mass function)
CMF (cumulative mass function)
Image histogram is used for graphical representation of the gray values in digital image. By using the image histogram,that can analyze the frequency of appearanceof the different gray levels of an image.

(c)Clipped histogram equalization

Clipped histogram equalization methods areable to control the enhancement rate [4]. The enhancement rate is proportional to the rate of cumulative density function. We want to control the enhancement rate, so limiting or controlling the value of probability density function. clipped histogram equalization modifies theshape of the input histogram by reducing or increasing thevalue in the histogram's bins based on a threshold

limit beforethe equalization is taking place [4]. Threshold value also called the plateau value.

(D) Bi-histogram equalization with a plateau value(BHEPL)

In this method first of all divide the input pixel into two subgroups. Histogram created by these two subgroups and find plateau value of these two sections of input. It is the best method for contrast enhancement compare to BBHE. This HE method is the combination of two methods, these two method are clipped HE and BBHE.

II. Overview of the Research

[A] Manpreet Kaur et al[5]Image enhancement is the very important part of image processing. Process involves in this enhancement technique, the intensity of pixels' changes in original image. The purpose of image enhancement is to improve the interpretability or perception of information contained in the image for human viewers, or to provide a "better" input for other automated image processing systems [5].This paper shows the different types of Histogram Equalization on the bases of higher brightness preservation and the quality of output image. In this paper different types of HE are discuss like BBHE, DSIHE, RMSHE, MMBEBHE etc.

[B]Taekyung Kim et al [6] the paper proposes the adaptive contrast enhancement algorithm that is gain controllable clipped Histogram equalization (GC-CHE). It uses the clipped histogram to preserve the brightness of the original image. And also proved this proposed method on various types of input images. Compare to other HE based method, GC-CHE is the simple, regular computation structure, and also implemented in real time or embedded system.

[C] Seungjoon Yang et al [7] paper discuses about the mechanism to control the rate of enhancement. The HE is used in image processing for enhancement method. The gradient of the mapping function is controlled by putting constraints on the probability density function with the bin underflow (BU) and bin overflow (BO) [7]. The BUBO method used for enhancement rate in whole HE with the use of only one parameter. Put the constraints on pdf of input image, the minimum and maximum gradients function used for enhancement rate, and also provide the black and whitelevel automatic brightness control.

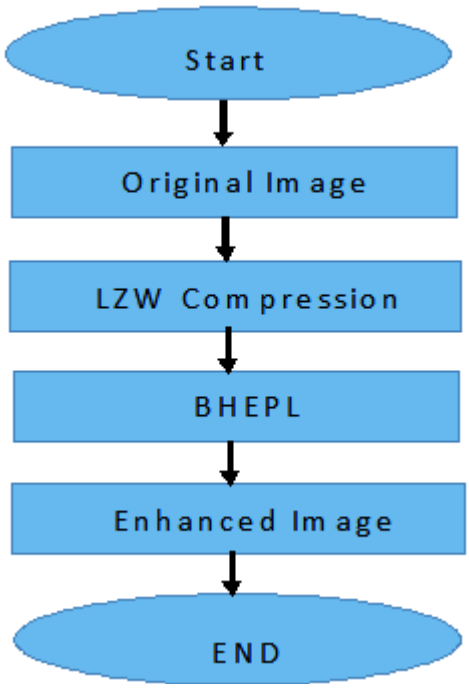
[D]Smitha Rao et al [8] inthis paper discus the various types of lossless technique in data compression. And also discuss the various challenges in compression of various types of data in many applications.

In paper, discuss the dictionary based method and statistical method for text compression. And in the dictionary based method discuss the LZW as compare LZ77andLZ78.The arithmetic algorithm provides the better result as compare then the Huffman and RUN algorithm in the statistical method. And also discuss the DWT etc.

[E] Gaurav Gupta et al [9] in this paper discuss the image compression using lossless data compression. In this lossless data compression used in image compression there are no loss in the original image. And also discuss in paper threefactors aboutcompression there are quality of image, amount of compression bits, and speed of compression.

III. Methodology

In this paper the methods for combination of data compression and enhancement of image is proposed. LZW lossless technique is used for compression of pixels and BHPEL method of HE used for enhancement of an image. The original image change into the gray level and also change in unit 8 and pass the LZW algorithm this algorithm is based on dictionary based and finally apply BHPEL for enhancement to the output of LZW decompression. The BHPEL is the combination of two HE method 1st is clipped HE and 2nd is BBHE.



IV. Experimental Results

This paper discusses about the enhancement before lzw compression and after lzw compression. The BHEPLE is used for enhancement because it is used the short processing time for enhancement. And compression technique lzw is the lossless compression technique. The output of this technique, number of bits is minimizing in original image.

There are three sample images for results of compression and enhancement. first image is Lenna.png, second image is of bird2.bmp and third image is of panda.jpeg. And these three sample images are used in gray level image.

Evaluate the enhancement to maintain the brightness, and measure the performance by using Average Absolute Mean Brightness Error (AAMBE).
Define…. [4]

$$AAMBE = \frac{1}{S}\sum_{n=1}^{S}\left|\tilde{\mathbf{X}} - \tilde{\mathbf{Y}}\right|$$

Where S=total number of sample image
$\tilde{\mathbf{X}}$ =average intensity of test image n

=av e intensity of the corresponding Output image.

Absolute Mean Brightness Error (AMBE)

AMBE= |A(x)-A(y)|

Where A(x)=average intensity of input image.
A(y)=average intensity of enhanced image.

Table 1 show the Enhancement before Compression Table 2 shows the Enhancement after Compression and Table 3 shows the LZW Compression. All these three Tables shows the performance measure and compress bits in original image. Compress bits shows the minimizing the pixels of an original image pixels.

AMBE is used for measurement of performance of image.

Before Compression

Figure 1(a)
After Compression

Figure 1(b)

Before Compression

Figure 2(a)

After compression

Figure 2(b)

Before Compression

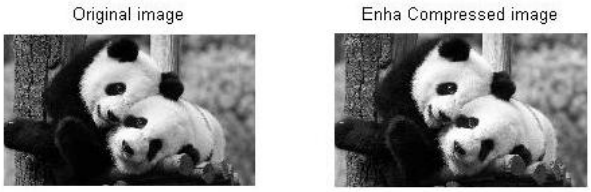


Figure 3(a)
After Compression

Figure 3(b)

Table 1: Enhancement Before Compression

Name of image	Size of image	Performance measure AMBE=A(x)-A(y))
Lenna.png	512 x 512	1.5332
Bird2.bmp	80 x 80	7.5395
Panda.jpeg	1600 x 2560	5.8042

Table 2: Enhancement After Compression

Name of image	Size of image	Performance measure AMBE=A(x)-A(y))
Lenna.png	512 x 512	1.6150
Bird2.bmp	80 x 80	5.8962
Panda.jpeg	1600 x 2560	5.8037

Table 3:LZW compression

Name of image	Size of original image	Size of compressed image	Compressed bites=original size-Compressed size
Lenna.png	512 x512	1 x 181867	80277
Bird2.bmp	80 x 80	1 x 3984	2416
Panda.jpeg	1600x1600	1 x 2913899	1182101

V. Conclusion

This paper discusses about the LZW compression and BHEPL method for enhancement. Apply the BHEPL on the output of LZW decompression. This paper also discusses the enhancement method without compression and with compression on three sample input image on the bases of performance.Absolute Mean Brightness Error (AMBE) is used to measure the performance of enhancement on the input images. And also discuss the compression bits of these three input images.

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Authors

First Author – Saumya Mishra, Master in Technology, Computer Science, Department of CSE, SRSMUniversity, Lucknow

Second Author – Mr. Avinash Singh, Assistant Professor, Department of CSE,SRSM University, Lucknow