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Lossless Image Compression Using Differential Pulse Code Modulation and Its Application

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Abstract

Images include information about human body which is used for different purpose such as medical examination security and other plans Compression of images is used in some applications such as profiling information and transmission systems. Regard to importance of images information, lossless or loss compression is preferred. Lossless compressions are JPEG, JPEG-LS and JPEG2000 are few well-known methods for lossless compression. We will use differential pulse code modulation for image compression with Huffman encoder, which is one of the latest and provides good compression ratio, peak signal to noise ratio and minimum mean square error. In real time application which needs hardware implementation, low complex algorithm accelerate compression process. In this paper, we use differential pulse code modulation for image compression lossless and near-lossless compression method is introduced which is efficient due to its high compression ratio and simplicity. This method is consists of a new transformation method called Enhanced DPCM Transformation (EDT) which has a good energy compaction and a suitable Huffman encoding. After introducing this compression method it is applied on different images from Corel dataset for experimental results and analysis. Also we compare it with other existing methods with respect to parameter compression ratio, peak signal noise ratio and mean square error.

Keywords*: Lossless Compression, Image Transformation, Prediction Method, Encoding Technique, DPCM*

1. Introduction

Images are important documents nowadays; images include various information *e.g.*, human bodies in medical images which are used for different purpose such as medical security and other plans. Compression of images is used in some applications such as profiling data and transmission system. To work with them in a few applications they need to be compressed more or less depending on the purpose of the application. Regard to importance of images information lossless or loss compression is preferred. Lossless compressions are JPEG, JPEG-LS and JPEG2000 are some well-known methods for lossless compression. We will use differential pulse code modulation for image compression with Huffman encoder, which is one of the latest and provides good compression ratio, peak signal noise ratio and minimum mean square error.

Image compression, more or less depends on the purpose of the user interests. There are some algorithms that perform this compression in different ways; some are lossless and keep the same information as the original image, some others loss information when compressing the image. Some of these compression methods are designed for specific kinds of images, so they will not be so good for other kinds of images. Some algorithms even let you change parameters they use to adjust the compression better to the image. There are different formats works for each of the images. There are some formats that match some images better than others depending in what you are looking for to obtain,

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and the type of image you are working with. The image compression technique is mostly classified into two techniques depending whether or not an exact copy of the original image could be reconstructed using the compressed image [1]. These are: (1). Lossless techniques (2). Loss techniques

1.1. Lossless Compression:

In lossless compression techniques, the original image can be perfectly recovered form the compressed or encoded image. These are also called noiseless since they do not add noise to the signal image. It is also known as entropy code since it uses statistics/decomposition technique to eliminate/minimize redundancy. Lossless compression is use only for small number of applications with strict necessities such as medical imaging [2, 3].

1.2. Lossy Compression:

Lossy schemes provide much high compression ratios than lossless schemes. Lossy scheme are usually used since the quality of the reconstruct images is adequate for most application. By this method the decompressed image is not the same to the original image but logically close up to it [2, 3].

2. Related Work

In [1] presented a new hierarchical approach to resolution scalable, lossless and near-lossless (NLS) compression. It combines the adaptability of DPCM schemes with new hierarchical oriented predictors to provide resolution scalability with better compression performances than the usual hierarchical interpolation predictor or the wavelet transform. Which are dynamically optimized using a least-square criterion. Lossless compression results, which are obtained on a large-scale medical image database, are more than 4% better on CTs and 9% better on MRIs than resolution scalable JPEG-2000 (J2K) and close to non scalable CALIC. The proposed algorithm is, providing an interesting rate–distortion tradeoff compared with JPEG-LS and equivalent or a better PSNR than J2K for a high bit rate on noisy (native) medical images

In [2], Authors presented that DPCM (Sibs DPCM) is an essential prediction technique for H.264/AVC lossless intra compression. A latest prediction technique that is more efficient than the conventional Sibs DPCM, in this manner improving the overall compression performance The proposed method prepares five partition patterns for every 4×4 block such as 4×4 (no partition) 4×2, 2×4, 2×2, 1×1 The pixels in each partition is intra predicted by Sibs DPCM and the excellent partition which produces minimum bit is selected as the partition pattern for the 4×4 block. Also the number of available intra prediction direction is determined according to the partition pattern to avoid too much side-information transmission. They conclude that proposed technique gives 3.62 % point bit rate save on average and 4.74 % point bit rate save at highest compare to the conventional Sibs DPCM and concludes that new prediction scheme for improving the performance of H.264/AVC lossless image compression. Unlike the conventional methods that use 4×4 block only, the proposed method partitions the block and applies different prediction guidelines depending on the block properties. The partition pattern and the prediction direction for each sub-block are found based on the rate minimization considering the side information.

In [3] work Authors Presented that image compressed sensing (CS) often focus on improving the rate-distortion sensing performance but have less consideration of the effect of channel errors on the transmission of CS measurements. Authors explore how the transmission channel errors affect the PSNR performance of the quantized sensing measurements and then increases the resistance of the transmitted data to the noisy channel. We show that the multi-scale block based compressed sensing (MSBCS) using

quantization with differential phase code modulation (DPCM), though achieves compression efficiency higher than the regular scalar quantization-based CS, and is more vulnerable to channel errors, and concludes that DPCM-based method in CS though can produce better rate-distortion performance compared to simple SQ-based CS, is more vulnerable to channel errors. Optimal energy allocation methods using both MSE and MAE criteria are proposed and the effect on CS image reconstruction is investigated.

In [4], Author Presented that the DPCM and LMS may be used to eliminate the unused bit in the picture for image compression. In this paper author compare the compressed image results for 1 and 3 bits DPCM Quantization and DPCM with LMS Algorithm and also compare the histogram prediction mean square using DPCM Quantization and DPCM with LMS Algorithm for approximately same distortion levels. The LMS may provide almost 2 bits per pixel reduction in transmit bit rate compare to DPCM when distortion levels are around the same distortion for both methods The LMS Algorithm may be used to adapt the coefficients of an adaptive prediction filter for image source coding. In the method used in this paper we reduce the compressed Image size distortion and also the estimation error and conclude by using weight coefficient DPCM and the LMS uses the adaptive coefficient for image compression with same distortion level. A comparison on using DPCM and using DPCM with LMS algorithm with respect to image compression has been carried out based on their coefficient and the number of bits.

In [5] Authors Presented that the transformation methods such as Differential Pulse Code Modulation (DPCM), and prediction improved DPCM transformation step of compression and introduced a transformation which is efficient in both entropy reduction and computational complexity. A new method is then achieved by improving the prediction model which is used in lossless JPEG. The prediction improved transformation increases the energy compaction of prediction model and as a result reduces entropy value of transformed image. After transforming the image Huffman encoding used to compress the image. As a result, the new algorithm shows a better efficiency for lossless compression of medical images, especially for online applications and conclude that different transforms namely DPCM and improved DPCM transformation method and the compression percentage could be evaluated. It also helps in the secure transmission of data.

In [6] Authors Presented a latest lossless compression method. One of these methods is adaptive and powerful for the compression of hyper spectral data, which is based on separating the bands with different specifications and compressing every one efficiently. The new proposed methods progress the compression ratio of the JPEG standards, save storage space and speed up the transmission system. The proposed methods are apply on different test cases and the results are evaluate as well as compared with other state-of-the-art compression method, such as lossless JPEG and JPEG2000 and concludes that the specification of the Hyper spectral data two novel methods NLCM and ENLCM for lossless compression of Hyper spectral data have been introduced. Compared with NLCM, the ENLCM is based on separating the corrupted bands from the others, acts on each band depending on its specification, and compresses the corrupted and the uncorrupted bands with different schemes.

3. Proposed Method

Proposed Algorithm divide input image into a smaller block, because analysis on smaller block is very easy. Here we will assume some predicted error during transmission and compression all the smaller image is arranged on the basis of quotient and reminder. After calculating error in image we apply Huffman Encoding Techniques on that out coming sample. After that we compare previous sample and compressed sample on the some basic criteria. By doing repetition we

can enhanced our image compression ratio that show our technique is better that others.

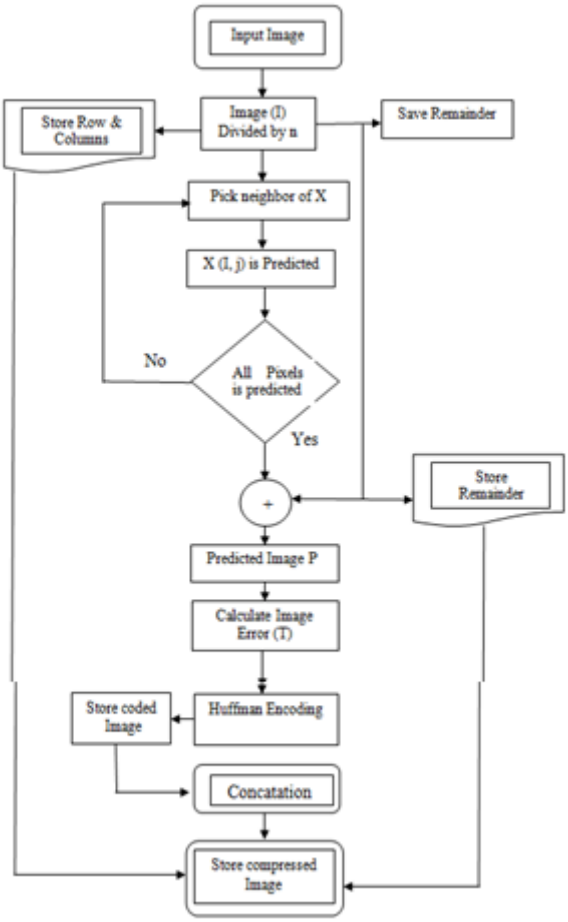

Figure 3.1. Block Diagram of Proposed Method

In Figure 3.1we are showing how our algorithm is working. According to our Algorithm we divided our image into a smaller block, because analysis on smaller block is very easy. Here we will assume some predicted error during transmission and compression all the smaller image is arranged on the basis of quotient and reminder. After calculating error in image we apply Huffman Encoding Techniques on that out coming sample. After that we compare previous sample and compressed sample on the some basic criteria. By doing repetition we can enhanced our image compression ratio that show our technique is better that others.

4. Experimental Results

In this section we are showing our results in GUI format. Here we are implementing our result in a four blocks which is explaining one by one. In Input Block we can browse an image from any location and put it into a variable. When image is stored in variable then we can apply any image operation. In the same block we will find the entropy of an image. In DPCM Encoding Block we apply DPCM Encoding technique, since we know that in our methods we have to apply quantization to a given image. During quantization process we will have an error. In Quantization Function: A function which is used to

change a sampled image into a digital value is known as Quantization Function. Most of the digital image processing devices are quantisation into K equal intervals. If b bits are used the number of brightness level is $K = 2^b$.

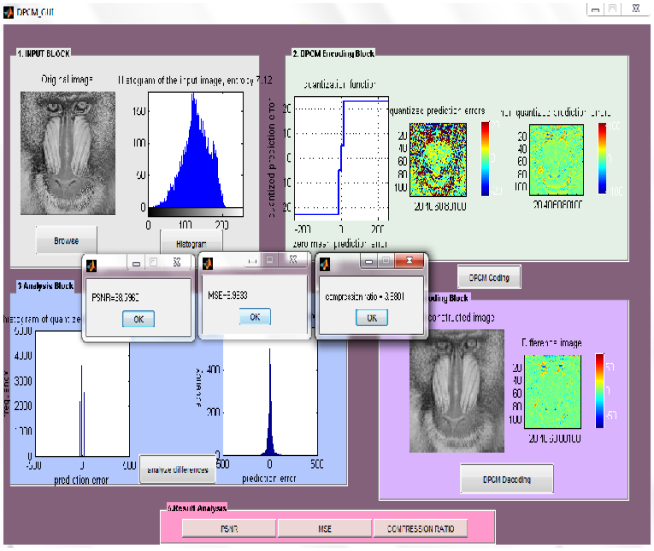

Figure 4.1. Analysis of Baboon Image as Input

In Figure 4.1 we analyze the overall result for image Baboon. In this figure we have 4 blocks each block have different work. By this method we find PSNR, MSE & CR parameters. This helps us for further analysis among different algorithm like JPEG 2000, JPEG- LS and many more. Similarly, we analyze the overall result for image Horne. In this figure we have 4 blocks each block have different work. By this method we find PSNR, MSE & CR parameters. This helps us for further analysis among different algorithm like JPEG 2000, JPEG- LS and many more.

Table 4.1. Comparison of Various Images

Methods/Images	Lossless JPEG	JPEG2000	DPCM
Baboon	**10.98**	**9.05**	**8.98**
Barbara	**15.54**	**13.65**	**13.48**
Lena	**9.43**	**8.01**	**7.88**

Table 4.2. Compression of PSNR of Different Images

Methods/Images	Lossless JPEG	JPEG2000	DPCM
Baboon	**30.25**	**36.45**	**38.59**

Barbara	**31.35**	**34.2**	**36.83**
Lena	**34.54**	**35.02**	**39.16**

5. Conclusion

In this paper, we introduced a new method of compression which is based on EDT and Huffman entropy encoding. However compression ratio of the proposed method is more powerful than few previous methods such. This method is suitable for real Time applications. Comparison was based on compression efficiency which is compression ratio and computational complexity. To understand the efficiency of the new method for medical compression and real time application of medical imaging such as telemedicine and online diagnosis, we test our method on medical test cases either. Therefore, it can be efficient for lossless compression and implementation for lossless or near-lossless medical image compression.

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