Impact Factor (SJIF): 5.301

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 5, Issue 2, February-2018

EFFICIENT LOSSLESS IMAGE COMPRESSION USING DPCM WITH NORMALIZED LMS ALGORITHM

Sowmiya D[1] , Gopalan R[2]

Student, Electronics and Communication Dept, Velalar College of Engineering and Technology, Erode[1]. (sowmiya957@gmail.com)

Assistant Professor, Electronics and Communication Dept, Velalar College of Engineering and Technology, Erode[2].(gopalan.rp@gmail.com)

ABSTRACT

This paper proposes a novel image compression based on DPCM with Normalized LMS algorithm. An image files hold some redundant and improper information. So an image compression is used to reduce the amount of data required to represent an image. A proposed technique is very easy to implement and reduce the complexity of memory. The Differential Pulse Code Modulation (DPCM) is used to remove the unused bit in the image for compression. The Normalized LMS algorithm is used to adapt the coefficient of an adaptive prediction filter for image source coding. In this paper we compare the compressed image for 1,2,3,4 bits and evaluate the performance metrics (compression ratio, PSNR, MSE) for reconstructed image.

Keywords: Adaptive filter,DPCM, NLMS Algorithm,Quantization,

1. INTRODUCTION

1.1 IMAGE COMPRESSION

In general the reduction of image data is performed by the removal of redundant data. In mathematics, compression is defined as transforming the two-dimensional pixel array into a statistically uncorrelated data set. Usually image compression is applied prior to the storage or transmission of an image data. Later the compressed image is decompressed to get the original image.

Compressing an image is different than compressing raw binary data. Obviously, General purpose compression programs can be used to compress images, but the result is less than optimal. This is because images have certain statistical properties which can be exploited by encoders. Also, some of the finer details in the image can be sacrificed for the sake of saving a little more bandwidth. This also means that lossy compression techniques can be accustomed in this area. Lossless compression included with compressing data which, when decompressed, will be an exact replica of the original data. They need to be accurately reproduced when decompressed. On the other hand, images are need not be reproduced 'exact'. An approximation of the original image is enough for most purposes, as long as the error between the original image and the compressed image is tolerable.

2.PROPOSED WORK

In communication environment, the difference between adjacent samples for image is small, coding techniques have been based on transmitting sample-to-sample differences rather than actual sample value. Successive differences are in fact a special case of non-instantaneous converters called N-tap linear predictive coders. These coders also called predictor-corrector coders, predict the next input sample value based on the previous input sample values. This structure is shown in block diagram. In this type of converter, the encoder forms the prediction error as the difference between the next measured sample value and the predicted sample value.

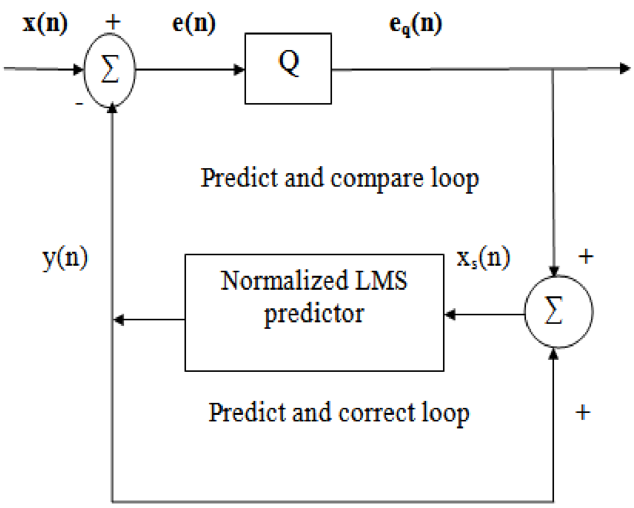

Figure1: Basic Block diagram of DPCM with NLMS Algorithm image compression system

The equation for the prediction loop is

$$e(n) = x(n) - y(n)$$

Where, x (n) is the nth input sample, y (n) is the predicted value, and e (n) is the associated prediction error. This is performed in the predict-and-compare loop, the loop shown in block diagram.

$$e_q(n) = \text{quant}\,[e(n)]$$

$$x_s(n) = y(n) + e_q(n)$$

Where, quant (.) represents the quantization operation, $e_q(n)$ is the quantization version of the prediction error, $x_s(n)$ and is the corrected and quantized version of the input sample. This is performed in the predict-and-correct loop.

2.1 THE BASIC IDEA OF DPCM

DPCM compression method can be conducted for intra-frame coding and inter frame coding. Intra-frame coding is for spatial redundancy and inter-frame coding temporal redundancy. Difference is formed between the neighboring pixels of the same frame then it is called as Intra-frame coding, while in the inter-frame coding it is formed between two consecutive frames. Proper exploitation of redundancy leads to encoding a signal with fewer bits. Considering a simple sample values, we transmit the difference between the successive sample values. Thus, if x(n) is the nth sample from the given samples, instead of transmitting x(n), we transmit the difference e(n) = x(n) – x(n-1). At the receiver end, knowing e (n) and several previous sample value x(n-1), we can reconstruct x(n). Thus, from knowledge of the difference e(n), we can reconstruct x(n) iteratively at the receiver end. Now the difference between successive samples is much smaller than the sample values. The predicted (estimated) value y(n) will be close to x(n), and their difference (prediction error) e(n) will be even smaller than the difference between the successive samples. This scheme, known as the differential pulse code modulation , which is a special case of DPCM, where the estimate of a sample value is taken as the previous sample value, that is, y(n) =x(n-1).

2.2 ANALYSIS OF DPCM

In DPCM we transmit e(n) (the difference between x (n) and its predicted value y(n)). At the receiver, we generate y(n) from the past sample value to which the received x(n) is added to generate x(n). There is,however, one difficulty associated with this scheme. At the receiver, instead of the past samples x(n-1),x(n-2),……as well as e(n) we have their quantized version x_s (n-1),x_s (n-2),…… this will increase the error in reconstruction. In such a case, a better strategy is to determine y(n), the estimate of x_s(n) , at the transmitter also from the quantized samples x_s (n-1),x_s (n-2),…… difference e(n) = x (n) – y (n) is now transmitted via PCM. At the receiver, we can generate y(n), and from the received e (n), we can reconstruct x_s (n). Figure 1 shown a DPCM predictor. We shall soon show that the predictor input is x_s(n). Naturally, its output is y (n), the predicted value of x_s (n). The difference of original image data, x (n), and prediction image data, y (n), is called estimation residual, e (n).so

$$e(n) = x(n) - y(n)$$

is quantized to yield

$$e_q(n) = e(n) + q(n)$$

Where q(n) is the quantization error, e_q(n) is quantized signal

$$q(n) = e_q(n) - e(n)$$

The prediction output y (n) is fed back to its input so that the predictor input x_s (n) is

$$x_s(n) = x(n) + q(n)$$

This shows x_s (n) is quantized version of x (n). The prediction input is indeed x_s (n), as assumed. The quantized signal e_q (n) is now transmitted the channel.

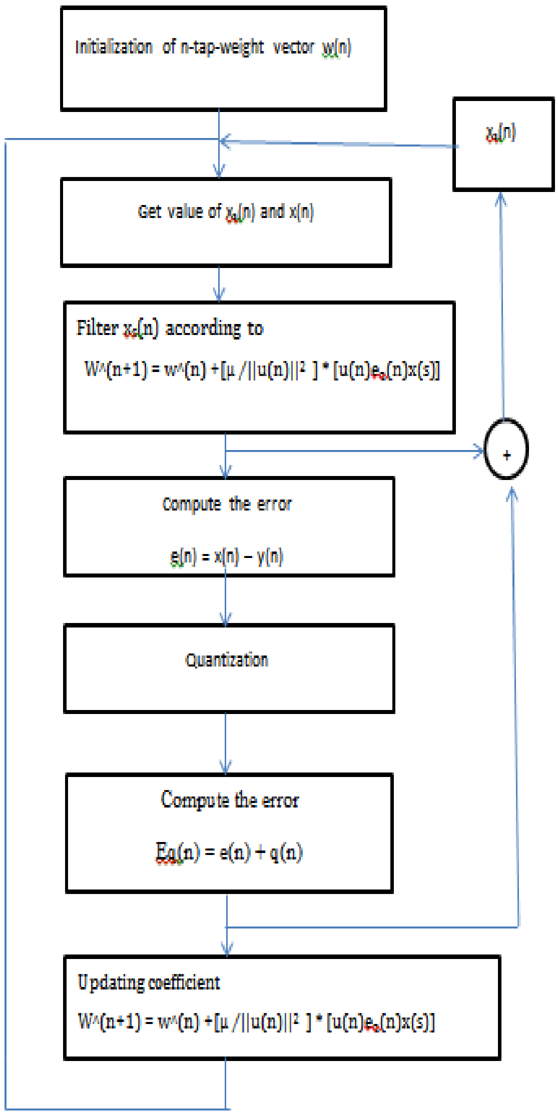

Figure2 : Flow Chart For DPCM With NLMS Algorithm

3. SIMULATION RESULT

The proposed algorithm was simulated using matlab7.5.we use 256×256 image in figure 3 were used in experimental work to show the performance advantages of using NLMS as an adaptive predictor. The image of figure 3 was processed with the residual quantizer having bits value of 1, 2 and 3 (2, 4 and 8 quantization levels respectively) the DPCM image quantization. The dynamic range value of data was eight bits from grey level 0 to 255._The figure 8 plots prediction mean square versus transmitted bit rate for the compressed image. The bit rate is in bits/pixel.It is controlled by the number of levels in the quantizer. If number of bit increased and distortion will be decreased. Figure 4, 5, and 6 is shown the compressed image of 1,2,3 bits per pixels for nlms algorithm.

Figure3 : Original image

Figure 4 : 1 bit/pixel nlms image

Figure 5 : 2 bits/pixel nlms image

Figure 6 : 1 bits/pixel nlms image

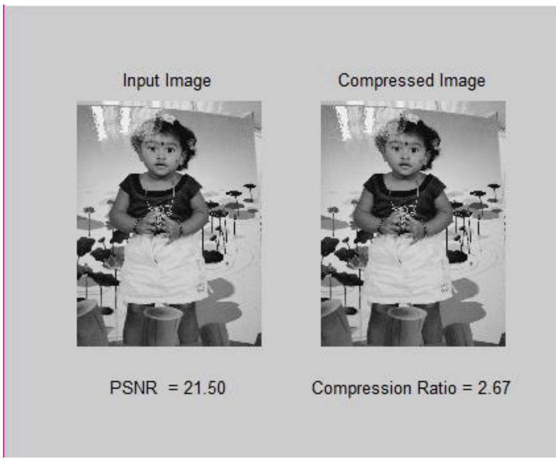

Figure 7 : psnr and compression ratio for compressed image

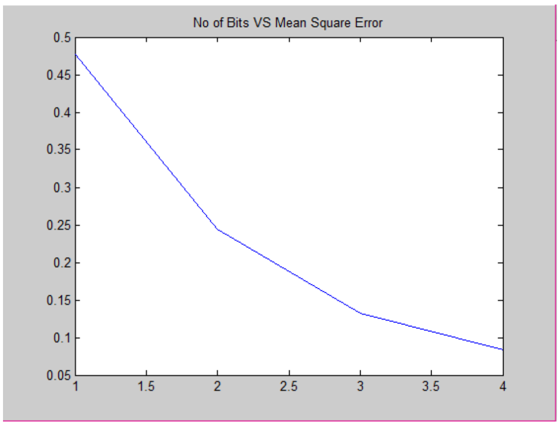

Figure 8 : Mean Square Error versus Transmitted Bit Rate

Table 1: Condition in Simulation Experiment

Image Matrix size	256×256
No of Filter Taps	5
No of Bits	1, 2, 3 bits
Quantization level	2, 4, 8 quantizer
Lms parameter	μ = 0.005

4. CONCLUSION

The proposed system of the project is based on DPCM compression technique which uses NLMS algorithm for prediction. The NLMS is a simple adaptive algorithm. At last the distortion is reduced for 1, 2, 3 bits and also reduce the estimation mean square error. This difference is 7- 9 dB respectively for 1, 2, 3 bits as shown in figure 8. The distortion and the estimation mean square error is very less for compressed image. The compressed image is lossless. The PSNR and CR is measured for the compressed image. DPCM with NLMS algorithm provide reasonable SNR with low Bit Rate and at low complexity.This work can be carried out for colour image in future.

REFERENCES

[1]. A. Habbi, "Comparison of Nth-order DPCM encoder with linear transformation and block quantization techniques," IEEE Trans. Commun., vol. COM-19, pp. 948- 956, Dec. 1971.

[2]. S. T. Alexander and S. A. Rajala, "Analysis and simulation of an adaptive image coding system using the LMS algorithm," in Proc. 1982 IEEE Int. Conf. Acoust., Speech Signal Processing, Paris, France, May 1982.

[3]. Sayed.A.Hadei and M.lotfizad, "A Family of Adaptive filter Algorithms in Noise Cancellation For Speech Enhancement", International Journal of Computer and Engineering, vol.2, No.2, April 2010, 1793-8163.

[4]. J. E. Modestino, and D. G. Daut, "Source-channel coding of image," IEEE Trans. Commun., vol. COM-27, pp. 1644-1659, Nov1979.

[5]. Rime Raj Singh Tomar and Kapil Jain "Lossless Image Compression Using Differential Pulse Code Modulation and Its Application" , International Journal of Signal Processing, Image Processing and Pattern Recognition Vol.9, No.1, pp.197-202, 2016.

[6]. S.Hay kin and T.Kailath, "adaptive filter theory",fourth edition. prentice hall, pearson education,2002.

[7] A. K. Jain "Fundamental of Digital Image Processing", PHI Publication, Year of Publication,2002.

[8] J. H. Pujar and L. M. Kadlaskar, A New Lossless Method Of Image Compression And Decompression Using Huffman Coding Technique Journal of Theoretical and Applied Information Technology 2010 JATIT.

[9] S. H. Lee, J. Ryu and N. I. Cho, "Improved H.264/Avc Lossless Intra Compression Using Multiple Partition Prediction For 4×4 Intra Block," IEEE International Conference on Image Processing, 2011.