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Image Compression using DPCM

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Abstract

In this paper we uses The Differential pulse code modulation (DPCM) to remove the unused bit in the image for image compression. In this paper we compare the compressed image for 1 and 3 bit/pixel using DPCM and also compare the estimation error. We decrease the compressed image distortion and the estimation error. The PMSE in 3bit/pixel DPCM less 9-10 dB compare to 1bit/pixel DPCM.

Keywords- Nyquist Sampling, Quantization, Prediction Error, DPCM, PMSE

I. INTRODUCTION

The Differential pulse code modulation (DPCM) [1,2] may be used to remove the unused bit in the image for image compression In analog messages we can make a good guess about a sample value from knowledge of past sample values. The sample values are not independent, and generally there is a great deal of redundancy in the Nyquist samples. Proper exploitation of this redundancy leads to encoding a signal with fewer bits. If x(n) is the nth sample, instead of sending x(n), we send the differentiation e(n) = x(n) – x(n-1). At the output (receiver), knowing e(n) and several earlier 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. If this estimation is y(n), then we transmit the difference (prediction error) e(n)=x(n)-y(n). At the receiver also, we determine the estimated value y(n) from the previous sample values, and then generate x(n) by adding the received e(n) to the estimate y(n). Thus, we reconstruct the samples at the receiver iteratively. 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. Consequently, this scheme, known as the differential pulse code modulation (DPCM) [3], 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).

II. ANALYSIS OF DPCM

In DPCM we send e(n) (the difference between x(n) and its predicted value y(n)), not the present sample x(n). We generate y(n) from the past sample value, from the received x(n). However one difficulty associated with this scheme. We have their quantized version $x_s(n-1), x_s(n-2), \ldots$ At the receiver, instead of the past samples x(n-1), x(n-2),.., as well as e(n). This will increase the error in reconstruction. In such case, a better strategy is to determine y(n), the estimate of $x_s(n)$ (instead of x(n)), at the transmitter the quantized samples $x_s(n-1), x_s(n-2), \ldots\ldots\ldots$ The difference error e(n)=x(n)-y(n) is now transmitted via PCM [4]. At the receiver, we are generating y(n). We can reconstruct $x_s(n)$ from the received e(n). Figure 1 is shows a DPCM predictor. We shows that the predictor input is $x_s(n)$. its output is y(n), the predicted value of $x_s(n)$.

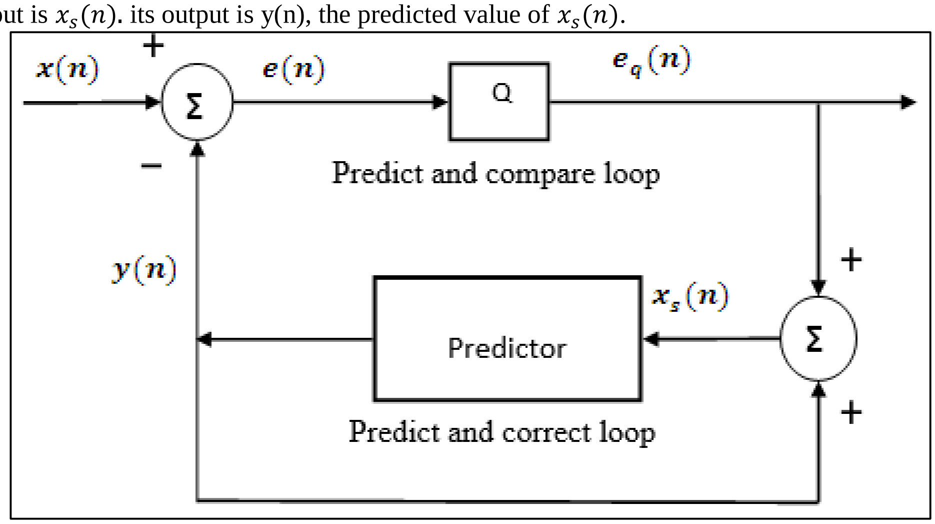

Fig. 1: N tap predictive differential pulse code modulator (DPCM)

The difference of the original image data $x(n)$, and prediction image data y(n) is called estimation residual, $e(n)$. So

$$e(n) = x(n) - y(n) \quad 3.1$$

is quantized to yield

$$e_q(n) = e(n) + q(n) \quad 3.2$$

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

$$q(n) = e_q(n) - e(n) \quad 3.3$$

$$q(n) = \frac{I_{max}}{2^b} = \frac{(simg)_{max}}{2^b} \quad 3.4$$

Here b is number of bit. I_{max}, $(simg)_{max}$ is an image signal.

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

$$x_s(n) = y(n) + e_q(n) \quad 3.5$$

$$= x(n) + q(n) \quad 3.6$$

The prediction input is certainly$x_s(n)$, as assumed. The quantized signal $e_q(n)$ is now transmitted over the channel. Flowchart diagram of DPCM system is shown below.

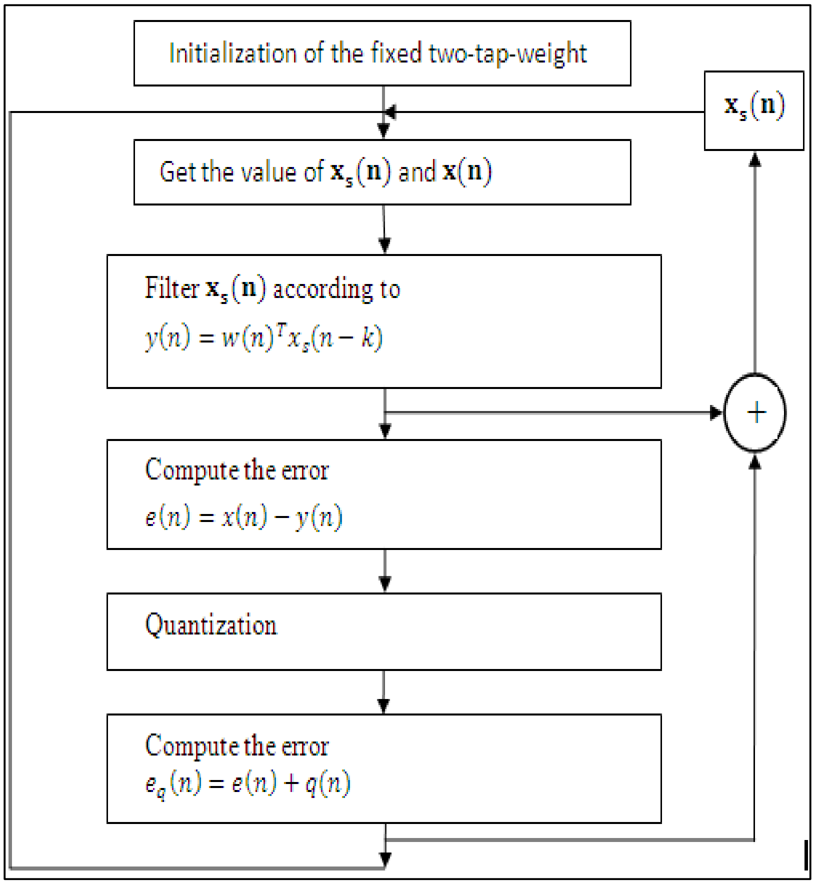

Fig. 2: Flowchart Diagram of DPCM system

III. SIMULATIONS AND ANALYSIS

The DPCM image quantization [4, 5] and application of image compression of MATLAB are used. Simulations involving real image input signal displayed in figure3. This image has been saved by the name of leena.png in MATLAB. Figure 4 shows the histogram plot between.

Fig. 3: Original image with 256×256 matrix dimension

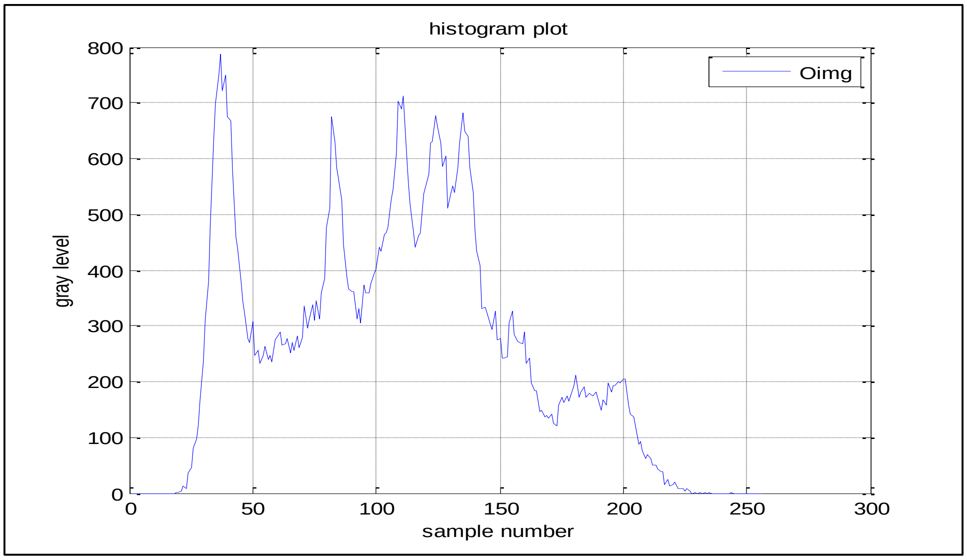

Fig. 4: Histogram plot Original Lena image

IV. SIMULATION RESULT OF IMAGE COMPRESSION FOR 1 AND 3 BIT'S DPCM COMPARISON

MATLAB was used to simulate The DPCM using the application 1bit/pixel and 3bit/pixel image compression comparison. The 256×256 novel image is shown in figure 3. This image size is 96.5 kB. This original image pass with 1 and 3 bit/pixel DPCM with fixed coefficient w [.495 .456] fixed 2taps. Figure 5a shows the reconstructed 1 bit/pixel image. This is a bright image. It is reducing approximately 13.5kb (13,840bytes) respect to original image for these parameters and the recovered image size 83.0kb (85,075bytes). Figure 5b shows the reconstructed 3bit/pixel image. This is a dark image. This image was approximately same the original image. It is reduce approximately 6.4kb (8,672bytes) for these parameters and the recovered image size 88.0kb (90,243bytes). We can say 1bit/pixel DPCM image reduction was more compare to 3bit/pixel DPCM. But the distortion of 1 bit/pixel DPCM is more compare to 3bit/pixel DPCM. This has been showed in figure 6 and the figure 7 shows histogram plot comparison between gray label and sample number. The PMSE in 3bit/pixel DPCM less 9-10 dB compare to 1bit/pixel DPCM. This has been showed in figure 8.

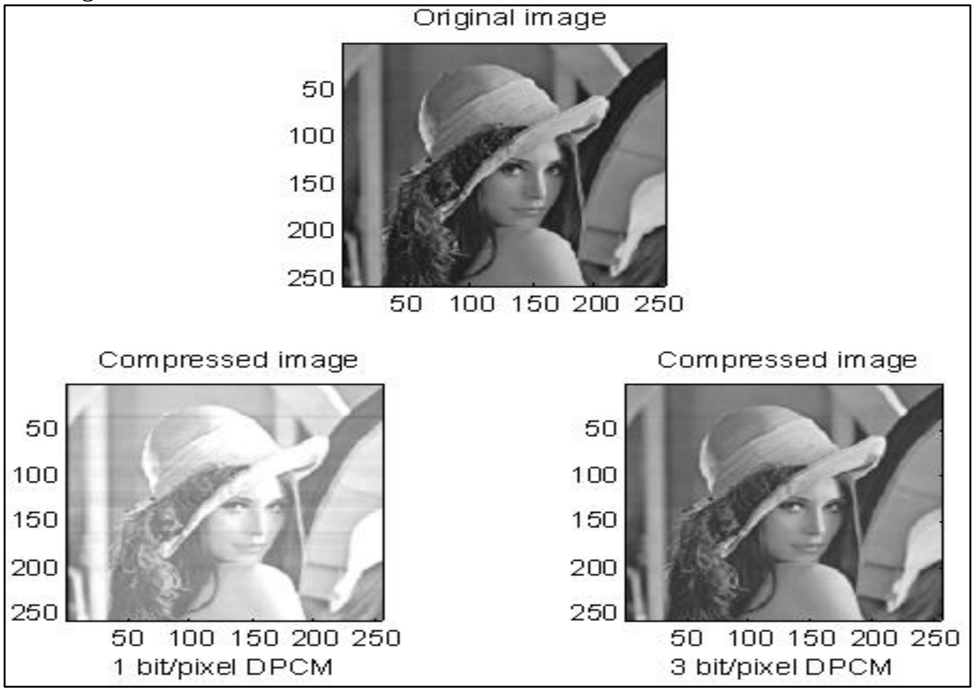

Fig. 5 a, b: Visual results for processing Lena image using DPCM

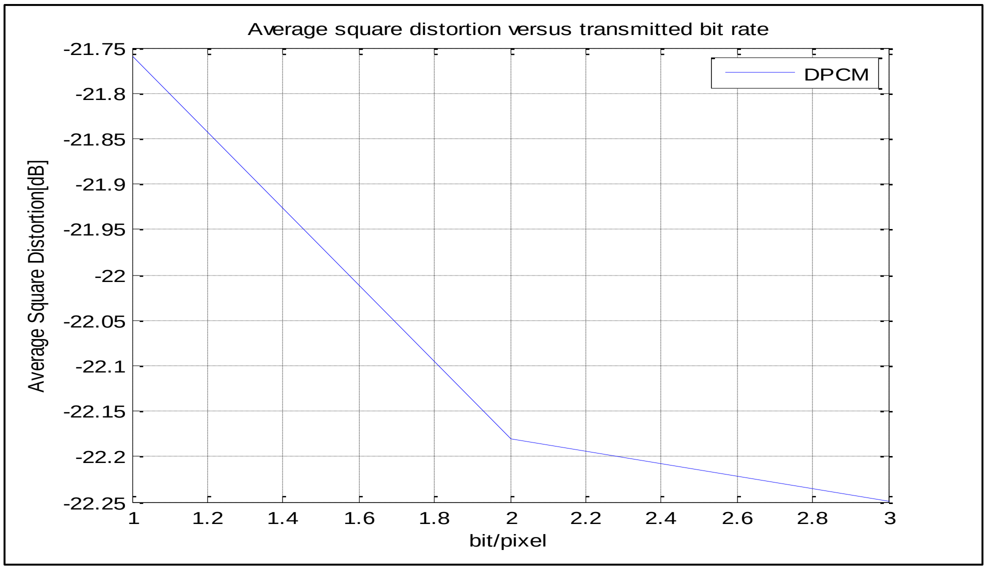

Fig. 6: Average square distortion versus transmission bit rate using DPCM

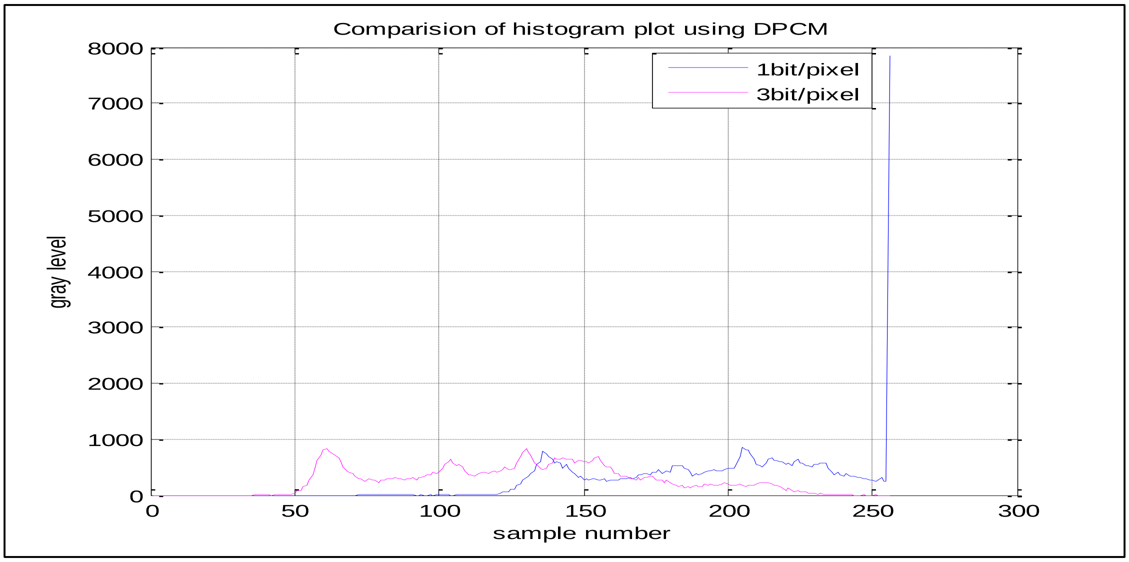

Fig. 7: 1, 3 bit/pixel comparison of histogram using DPCM

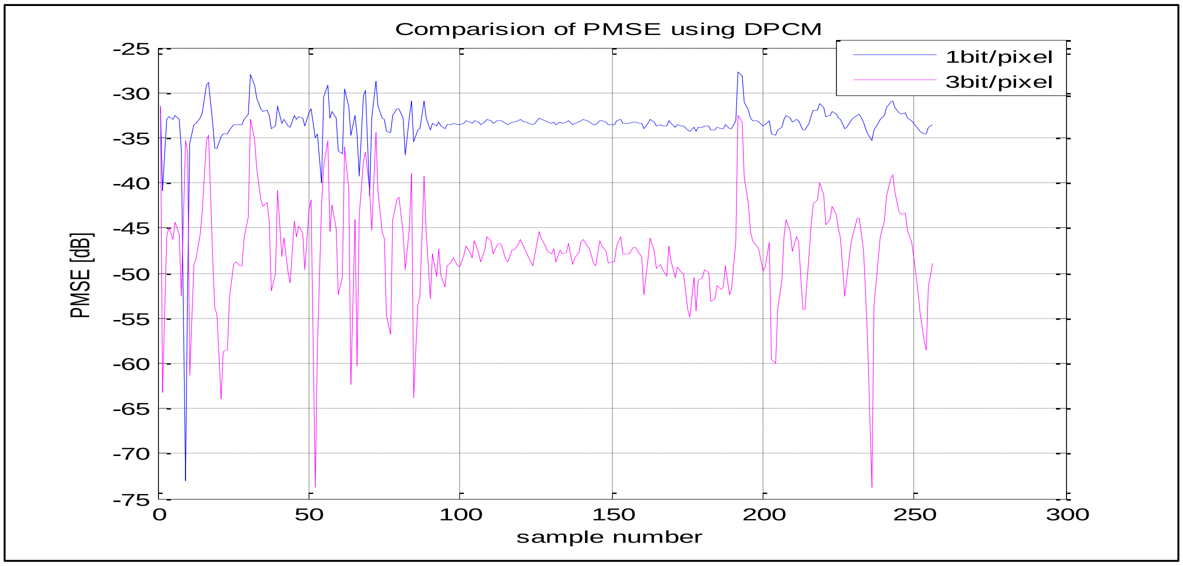

Fig. 8: 1, 3 bit/pixel comparison of PMSE using DPCM

V. CONCLUSION

We can say 1bit/pixel DPCM image reduction was more compare to 3bit/pixel DPCM. But the distortion of 1 bit/pixel DPCM is more compare to 3bit/pixel DPCM. The PMSE in 3bit/pixel DPCM less 9-10 dB compare to 1bit/pixel DPCM.

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] R. R. S. Tomar; K. Jain, “Lossless Image Compression Using Differential Pulse Code Modulation and its Application” IEEE Conference Publications on Communication Systems and Network Technologies (CSNT), 2015 Fifth International Conference, Pages: 543 – 545, Year: 2015 DOI: 10.1109/CSNT.2015.192.
[3] B. P. Lathi and Zhi ding “Modern Digital and Analog Communication Systems” International Fourth Edition. New York Oxford University Press-2010, pp.292.
[4] J. E. Modestino, and D. G. Daut, “Source-channel coding of images,” IEEE Trans. Commun., vol. COM-27, pp. 1644-1659, Nov. 1979.
[5] W. K. Pratt, “Digital Image Processing,” New York: Wiley, 1978.
[6] B. P. Lathi and Zhi ding “Modern Digital and Analog Communication Systems” International Fourth Edition. New York Oxford University Press-2010, pp.292