VIDEO COMPRESSION USING DPCM AND WT

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ABSTRACT

Digital images are widely used in computer applications. Uncompressed digital images require considerable storage capacity and transmission bandwidth. Efficient image compression solutions are becoming more critical with the recent growth of data intensive, multimedia-based web applications.This paper develops hybrid technique which employs combines differential pulse code modulation (DPCM) with wavelet transform. The wavelet transform is applied to the difference signal instead of direct applying it to the original images, because difference signal is almost nearly stationary. The difference signal is determined using interframe and intraframe DPCM. Intraframe method has given smoother difference signal because the frames used in the interframe prediction were not successive. The difference signal is then wavelet transformed and encoded using predictive edge detection from the LL band of the lowest resolution level to predict the edge in LH, HL and HH bands in the higher resolution levels. If the coefficient is predicted as an edge it is preserved; otherwise, it is discarded. In the decoder, the location of the preserved coefficients can also be found as in the encoder. Therefore, no overhead is needed. Instead of complex vector quantization, which is commonly used in subband image coding for high compression ratio, simple scalar quantization is used to code the remaining coefficients. A remarkable compression ratio of about 30:1 has been achieved without noticeable degradation in the decompressed images.

الخلاصة

تستعمل الصور الرقمية على نحو واسع في تطبيقات الحاسبة, والصورة الرقمية غير المضغوطة تتطلب سعة خزن كبيرة ومساحة انتشار واسعة. ومع النمو الأخير لبيانات تطبيقات الصورة الرقمية أصبح من الضروري كبس الصور الرقمية. هذا البحث يهتم بنوع محدد من كبس الصور والذي يستعمل تقنية الدمج بين التشكيل التفاضلي النبضي المرمز وتحويل المويجة . والتحويل المويجي سوف يكون موضوع على الفرق بين أشارتي الإدخال بدلا" من وضعه مباشرة" على الصورة الأصلية, لأن أشارة الفرق تكون ثابتة تقريبا". وإشارة الفرق يتم حسابها بطريقتين هما التشكيل التفاضلي النبضي المرمز بين أثنين من الصور(**frames**) والتي تسمى (**inter frame**) أو بأستعمال نفس ال(**frame**) والتي تسمى (**intra frame**). ونلاحظ أن طريقة ال (**intra frame**) تعطي تنعيم (**smoother**) لإشارة الفرق بسبب أن الصور (**frames**) المستعملة في تنبأ ال (**inter frame**) لا تكون متسلسله. ويتم عمل تحويل المويجه(**WT**) لإشارة الفرق , حيث يتم تقسيم الصورة إلى مستويات متعددة, حيث أن هذه المستويات تكون مترابطه فيما بينها ليتم تحويلها بأستعمال التنبؤ بموقع الحافات للجسم من خلال الحزمة **LL** الموجودة في المستوى الأصغر لتعيين الحافات في الحزم **LH , HL, HH** الموجوده في المستويات الأعلى. أذا كانت المعاملات قد تم التنبؤ بها كحافات فسوف يحتفظ بها, فيما عدا ذلك فسوف تهمل المعاملات . وفي جهة الاستقبال(**decoder**) فأن المواقع التي تم الاحتفاظ بها سوف تكون موجودة أيضا" كما في جهة الإرسال(**encoder**). لذلك لا يوجد هناك حاجه لل(**overhead**). بدلا من استخدام المكمم الاتجاهي المعقد الشائع الاستخدام في تشفير الصور حيث انه يعطي نسبة كبس عالية ، في هذا البحث تم استخدام المكمم العددي لتشفير المعاملات التي تم الاحتفاظ بها.وقد تم الحصول على نسبة كبس جديرة بالملاحظة حوالي **30:1** بدون اضمحلال ملحوظ في الصور بعد إزالة الكبس عنها.

KEYWORDS

Discrete Wavelet Transform (DWT), Inverse Discrete Wavelet Transform (IDWT), differential pulse code modulation (DPCM)

INTRODUCTION

Mathematical transformations are applied to signals to obtain further information that is not readily available in the raw signal which is usually expressed in time domain. There are a number of transformations that can be applied, among which the Fourier transforms are probably by far the most popular [Umbaugh, S.E,1998].The Fourier Transform can decompose any periodic function into a linear combination of sines and cosines. The

varies with the frequency. A longer time window is used for a lower frequency and a shorter window is used for a higher frequency**.** In the case of wavelets, we normally do not speak about time-frequency representation but about time-scale representations. Scale being in a way the opposite of frequency, because the term frequency is reserved for the Fourier transform [Kaarna, A., 2002]. One area in which wavelets have become an especially

From statistical study we found that the prediction coefficients are best chosen as follows:-

$$a_1 = a_2 = 0.75$$

$$a_3 = -0.5$$

When the inter frame coding is used, the pixel used for the prediction is the pixel in the previous frame at the same position, that is:

$$\hat{S}_o(t_1) = a \dot{S}_o(t_o) \qquad (2)$$

Where the:

and one nice feature of the Haar wavelet transform is the transform is equal to its inverse. The result of applying the wavelet transform is a set of coefficients of which most have very small amplitudes and only few have significant values. In order to get compression, we map the set of wavelet transform coefficients to a new set of discrete values .This process of mapping from a continuous set of real values to a set of discrete values is called quantization [Max, J., 1960]. In this paper, we used scalar quantization, where each corresponding $2*2$, $4*4$ and $8*8$ blocks in all the other band are discarded. When an edge is detected in a $2*2$ block in the LL band the corresponding $4*4$ and $8*8$ blocks are detected [O'NEAL, J.B., 1966]. All the bands are coded with scalar quantization [quantizer 3-bit] except the LL band in level 1, level 2, and level 3 which coded with scalar quantization [quantizer 5-bit]. The block dots in the subbands are the coefficients which are predicted edges and are preserved; otherwise, the coefficients which are not predicted as

DISCUSSION

1-If the signal is non stationary or quasi stationary as shown in fig. (4-a), their treatment with wavelet transform or even when 3-bit or 5-bit quantization is effected, the results are not good in view of the poor transform efficiency, shown by the high information content of the signal which cannot be removed even if quantized is inserted or transformation is effected as shown in fig. (4-c).This situation necessitates the transform of the original image to predictive difference by frame rate (frame/sec.) is high and the successive frames cannot be obtained.

5-For figures(4-d) which represent the wavelet transform, we can see in the resulting images the transform containing spatial information because the image itself is still visible in the transform domain. Compare this to the spectrum of the other transforms, where there is no visible correlation to the image itself.

6-From the previous tables, we find that the results of group image were proven better than that of Foot image because the number of

difference represented nearly stationary image.

The intra frame coding provides better results than the inter frame coding and this is because that the speed of moving objective, image sequences are high and because the prediction is found in the intra frame (the difference image is smaller than the inter frame), so that it is better to use the successive frames to get the good results for inter frame. The discrete wavelet transform is used, this transform provides an attractive tradeoff between spatial and frequency resolution. This unique property

Fry, T. W., (2001), Hyperspectral Image Compression on Reconfigurable Platforms, M.Sc. thesis, University of Washington.
Alexander, S. K.,(2001), Two – and Three dimensional Coding Schemes for Wavelet and Fractal – Wavelet Image Compression, Department of Applied Mathematics, University of Waterloo, Canada.
Michael, D. A., (2002), Reversible Integer-to-Integer Wavelet Transforms for Image Coding, Ph. D. thesis, Department of Electrical and Computer Engineering, University of British

Table (1): Quantizer parameters for signals with 3, and 5-bit quantizes

3 bits		**5 bits**	
d_i	$\hat{r}_i$	d_i	$\hat{r}_i$
0		0	
	0.222		0.072
0.504		0.147	
	0.785		0.222
1.818		0.302	

Table (2-a):- Results for the intra frame coding when the image used is Foot0.

	Compression ratio (%)	**Bit / pixel**	**PSNR (db)**	**Threshold**
3-Level	31.1384	0.3654	35.4733	0.95,0.95,0.95 8,8,8,10,10,10

Table (2-b):- Results for the inter frame coding when the images used are Foot0 and Foot1.

	Compression ratio (%)	Bit / pixel	PSNR (db)	Threshold
3-Level	22.3786	0.3842	24.5479	0.05,0.05,0.05, 10,10,10,50,50,50

Table (3-a):- Results for the inter frame coding when the images used is group0.

	Compression ratio (%)	Bit / pixel	PSNR (db)	Threshold
3-Level	29.8324	0.1264	40.6145	0.6, 0.6, 0.6, 0.6 6, 6, 8, 8, 8, 8, 8, 8

Table (3-b):- Results for the inter frame coding when the images used are group0 and group1.

	Compression ratio (%)	Bit / pixel	PSNR (db)	Threshold
3-Level	25.8855	0.3219	39.9049	1.5,1.5,1.5, 4,4,4,10,10,10

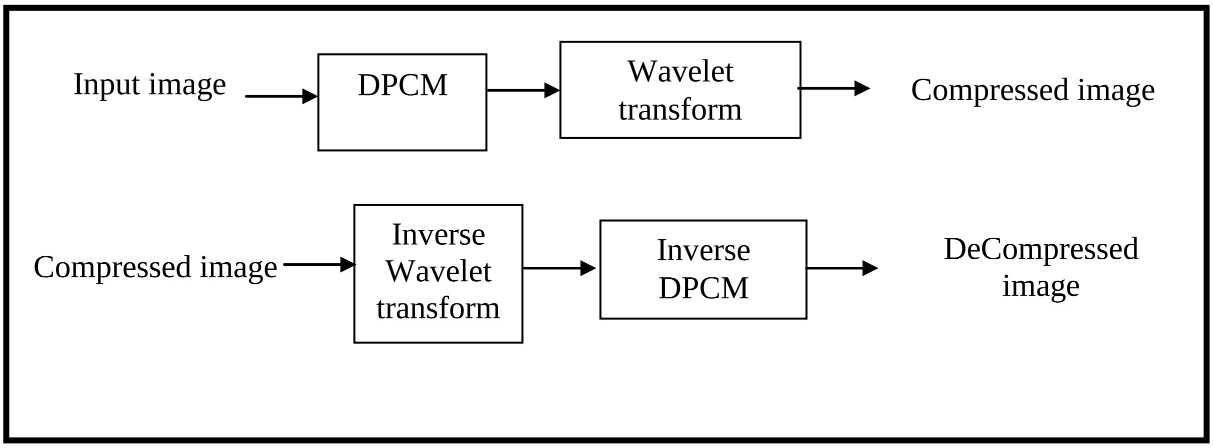


Fig. (1):- The block diagram for the compression system

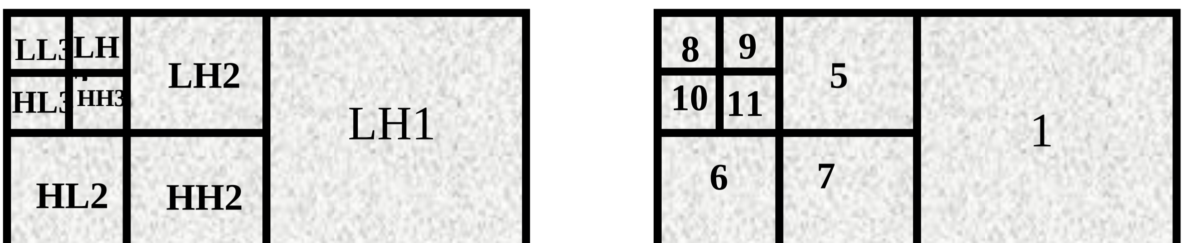


Fig. (2-a)
Structure of wavelet decomposition

Fig. (2-b)
The data structure for the corresponding subbands.

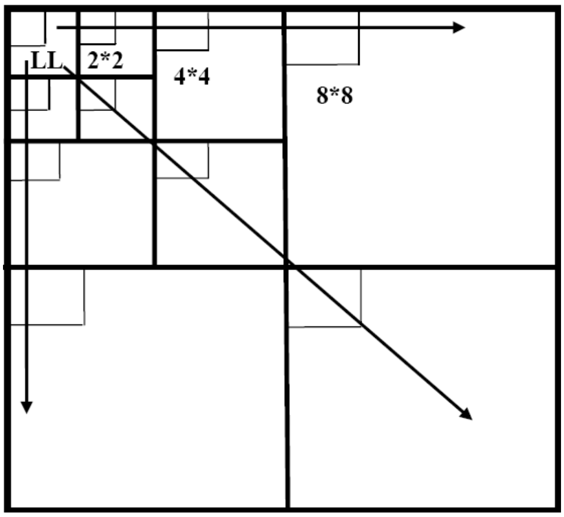
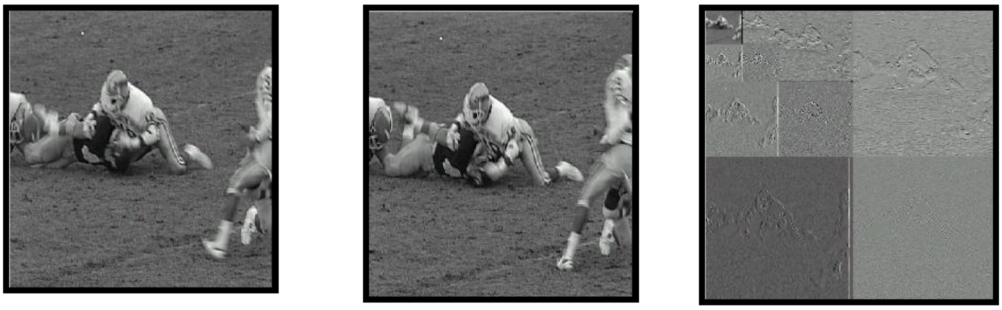
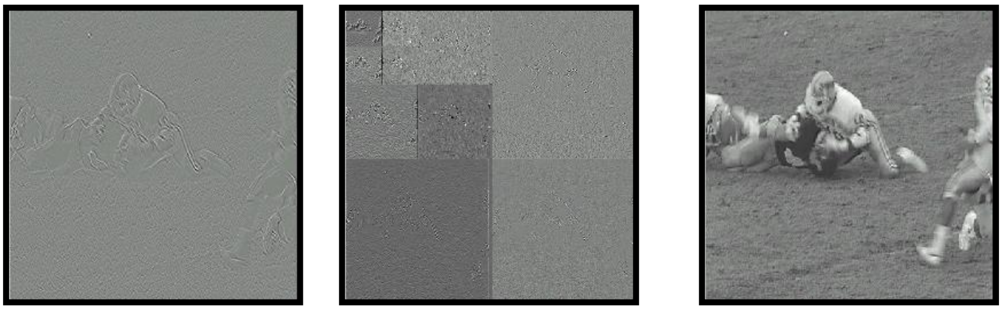


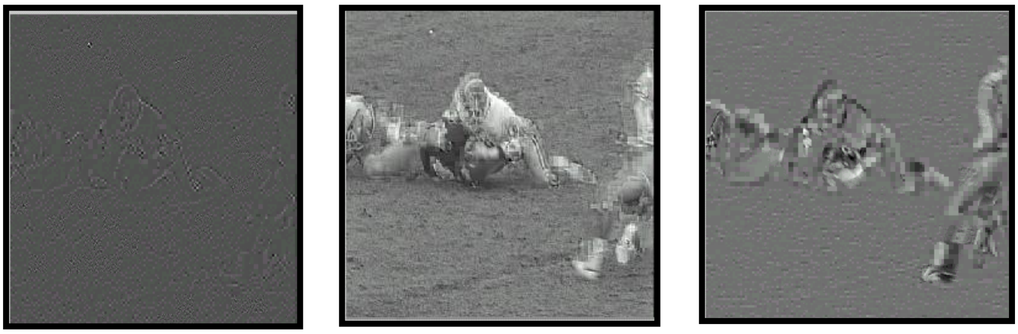
Fig. (3) Illustration of predicting the edges of Level 1 and Level 2 using Level 3



(a) (b) (c)



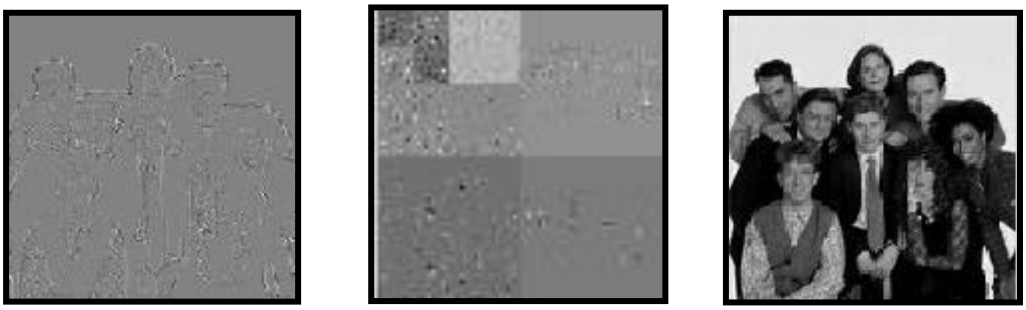
(d) (e) (f)



(g) (h) (i)

Fig.(4) (a)original image for foot 0. (b) original image for foot 1.(c) wavelet transform for original image.(d) Predictive Difference for Foot0. (e)wavelet transform for Predictive Difference for Foot0.(f)Reconstructed Image to(c). (g)Error between the Original and reconstructed Image.(h) Reconstructed Image to(e). (i)Error between the Original and reconstructed Image

(a) (b) (C)



(d) (e) (f)

(g) (h) (i)

Fig.(5) (a)original image for group 0. (b) original image for group 1.(c) wavelet transform for original image.(d) Predictive Difference for group0. (e)wavelet transform for Predictive Difference for group0.(f)Reconstructed Image to(c). (g)Error between the Original and reconstructed Image.(h) Reconstructed Image to(e). (i)Error between the Original and reconstructed Image