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# EFFICIENT LOSSLESS COMPRESSION USING H.264/AVC INTRA CODING AND PWSIP PREDICTION

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***Abstract***

**The growth of medical image processing increases the demand of lossless compression and it became a topic of interest. The basic formatting H.264/AVC contains inefficiency in compression ratio it should be improved to give better compression ratio. The proposed method use the concept of lossless compression in H.264/AVC category using pixel-wise spatial interleave prediction (PWSIP) and context adaptive interpolation (CAI).this scheme produces the interpolation in bi-directional and multi-directional modal. In addition this paper uses H.264/AVC basic prediction modes such as horizontal, vertical and mean modal, so totally 7 types of modes are used to increase the performance of H.264/AVC scheme. This proposed prediction scheme can be applied jointly with many previous methods and it is very friendly to many practical applications. The analysis section proves that their proposed method provides higher compression ratio in the lossless category.**

***Keywords*-- H.264/AVC; PWSIP; lossless; intra coding; CAI;**

## I. INTRODUCTION

Today image compression is one of the most required processes in internet data communication world and also it plays a vital role in several important and diverse applications, including remote sensing, medical imaging and magnetic resonance imaging and many more. The main purpose to reduce the amount of memory needed to represent the image and reduces the redundancies in image and It is important when selecting the most appropriate technology for a specific application to consider not only the image quality required, but also any limitations that exist in respect of bandwidth consumption, latency and frame rate. There are two basic categories of compression; lossless and lossy. Lossless compression is a class of algorithms that will allow for the exact original data to be reconstructed from the compressed data, lossy compression means that the compression data is reduced to an extent where the original information cannot be obtained when the video is decompressed. The higher the compression ratio is, the smaller is the bandwidth consumption. The market need for better image quality, higher frame rates and higher resolutions with minimized bandwidth consumption. These can be achieved the H.264/AVC format becomes more broadly available in network cameras, video encoders and video management software, system designers and integrators will need to make sure the Products and vendors they choose support this new open standard.

To develop the compression schemes with high compression ratio to achieve the better image quality, but the compression ratio is not at significant level in old compression standard like JPEG, JPEG –LS, JPEG2000, H.261, H.262, H.263, H.264.In this paper, the mainly focus on to increase the compression ratio of video frames and to increase the performance of H.264/AVC based on three algorithms, pixel-wise spatial interleave prediction to apply three modes,H.264/AVC video coding standard to uses three modes and context adaptive interpolation(CAI),so totally 7 modes type of modes are used to increase the performance of H.264/AVC.

## II. RELATED WORK

Image compression is used to minimize the amount of memory needed to represent the image. Image often requires large number of bits to represent them and it requires the high compression ratio, to get better image quality. This paper mainly concentrates on to increase the compression ratio. The compression of video frames [1] using H.264/AVC format with PWSIP Method for prediction and the prediction process includes blocks decomposition and PWSIP based multidirectional prediction. The LOCO-I algorithm [2] has been developed for JPEG-LS standard. This algorithm attains better compression ratios at lower complexity level. But the performance of this mechanism is less even for smooth images.

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The compression of video frame using H.264/AVC format[3] is developed based on lossy mode of compression and it use some of the coding tools to enhance the coding efficiency of various applications and Fidelity range extensions are new set of extensions to this standard. But it supports only for lossy compression. The lossless intra coding [4] based on residual DPCM and the residual DPCM is performed using pixel by pixel prediction, it achieves better coding efficiency. But it reduced the bit rate approximately 12.53%. The new lossless intra coding methods [5] is developed such as DPCM and Residual Transform, which includes Horizontal and Vertical prediction. This method reduces the bit rate by approximately 12% without increasing complexity. The Recursive and BMA prediction schemes [6] are proposed to improve the performance of intra prediction in H.264/AVC. These schemes achieve better image quality and it reduces the bit rate 30 to 40 percent. By the BMA technique for sub-pixel accuracy wise it provides high complexity. The CAVLC Technique[7] is used for lossless video coding in H.264/AVC, which finds the statistical characteristics of residual data between the original and predicted values .This method provides only 10% of Bit saving. The hybrid video coding is applied with Motion-compensated prediction technique [8], to reduce the Bit rate of video signals and the effect of aliasing in Motion-compensated prediction is analyzed and compensated and the Technique used for reducing impact of aliasing is implementation of interpolation filters .It corresponds to a Bit-rate saving of only 30% and 40%.the CAI method[9] is used to increase the compression ratio it uses Median Edge Detector(MED) and the Gradient Adaptive Predictor(GAP) are the two successive predictors. The CAI achieves the compression ratio based on interpolation techniques to find the target sub-image using the neighbour geometrically closer to the pixels to be interpolated. Hence the previous compression standard achieve better compression ratio it achieve better image quality during the codec. In our method to mainly concentrate to improve the compression ratio and it achieves high image quality during codec.

## III. PIXEL-WISE SPATIAL INTERLEAVE PREDICTION (PWSIP)

The compression of video frames using H.264/AVC format with PWSIP Method for prediction and to compress the video frames with higher compression ratio based on H.264/AVC in lossless type compression and the prediction process includes blocks decomposition and PWSIP based multidirectional prediction.

The H.264/AVC improves the performance in both coding efficiency and flexibility foe effective use over a broad variety of network types and application domains. These video formats achieve bit rate savings of 50% and equal perceptual image quality is achieved. This H.264/AVC uses nine modes to improve the compression ratio and it prediction based on unidirectional prediction. So these formats achieve better compression ratio because of unidirectional prediction and it take more time to process. To improve the performance of H.264/AVC based on lossless compression types such as H.264/AVC with compression of video frames and the prediction process includes block decomposition and PWSIP based multi directional prediction. So, these PWSIP prediction based H.264/AVC achieves high compression ratio, Because of multi-directional prediction. These prediction process takes less time based on three modes compared to H.264/AVC .It achieved the high compression ratio with low complex city and it suitable for suitable for texture images.

This is the step to be followed for compression and decompression and we shown this on flowchart representation

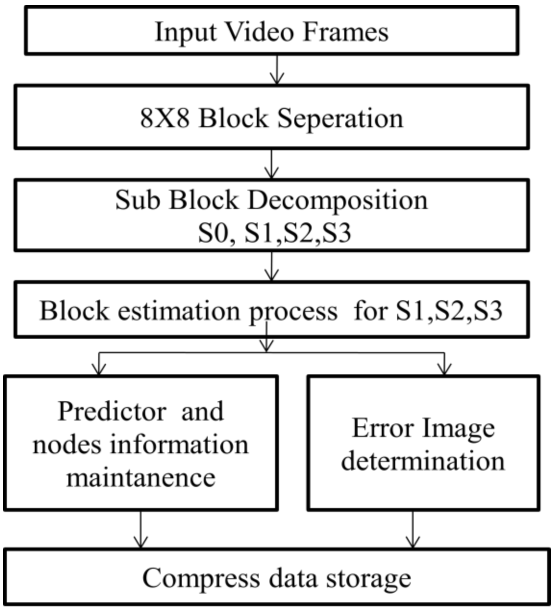


**Fig.1 Flow Chart for Compression**

The figure 1.1 and 2.1 represent the compression and decompression steps for improving the compression ratio of images. So, we get better image quality at low bit rates. In Figure1 compression step as video frame is given as input and read the matrices of image and finally display the image and 8X8 block is decompose into 4 sub-blocks such as $S_{0,}$ S1, S2, S3.

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Here $S_0$ is keep as it in original sub-image and remaining sub-blocks $S_{1,}$ S2, S3 apply the prediction techniques to find the predicted $S_{1,}$ S2, S3 sub-images.

For $S_1$ sub-image prediction ,Compute the three modes such as Hybrid mode(Mode 0) ,horizontal mode(Mode 1),Vertical mode(Mode 2) and find out the PSNR for three mode and find out the best PSNR mode, that mode is selected for $\mathbf{S_1}$ sub image prediction. For finding these modes we need to find horizontal prediction and vertical prediction.

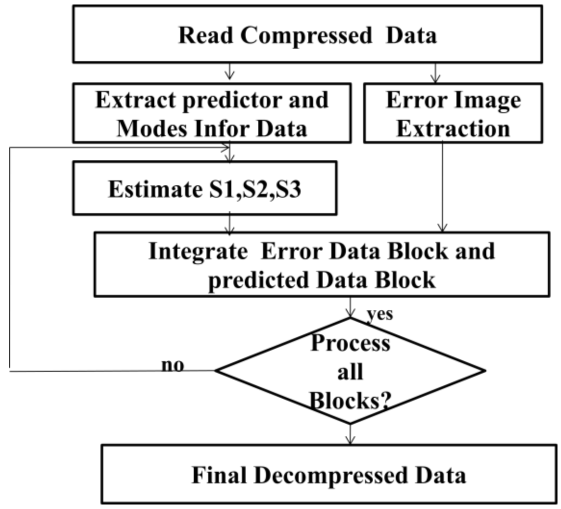


**Fig.2 Flow Chart for Decompression**

If we find,

$P_h[i, j] = S_0[i - 2, j] - 5 S_0[i - 1, j] + 20 S_0[i, j]+20 S_0[i + 1, j] - 5 S_0[i + 2, j] + S_0[i + 3, j]$

And

$P_V[i, j] = S_0[i, j-2] - 5S_0[i, j-1] +20S_0[i, j] +20S_0[i, j + 1] - 5 S_0[i, j + 2] + S_0[i, j + 3]$

Then prediction values for $S_1$ [i, j] in each mode can be calculated. If we find

Mode 0:

$Pred_{HB}[i,j]=clip((p_h[i,j-25p_h[i,j1]+20p_h[i,j]+20p_h[i,j+1]-5p_h[i,j+2]+ p_h[i,j+3]+512)>>10)$

Mode 1:

$Pred_H[i,j]=clip((p_h[i,j]+ p_h[i,j+1]+32)>>6)$

Mode 2:

$Pred_v[i,j]=clip((p_v[i,j]+p_v[i+1,j]+32)>>6)$

The remaining $S_{2,}$ S3 sub-image prediction applies this same prediction technique as you predicted in $_{S1}$ sub-image prediction.

In figure 2 represent the decompression steps, here the process is same as compression. Final reconstruct image is displayed with high compression ratio to achieve high image quality at low bit rates.

## IV. Lossless Intra Coding Of H.264/AVC

H.264/AVC is the newest video coding standard has achieved a significant improvement in compression performance and it achieved a significant improvement in rate-distortion efficiency compared to existing standards. Three modes of prediction are used to increase the performance of compression ratio such as horizontal mode, vertical mode and mean mode and predict the blocks using unidirectional intra prediction method. It is the best video frame compression scheme and it deliver good quality of video at low bit rates.

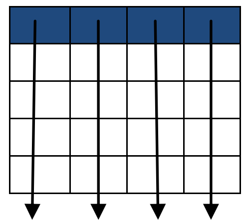

**Fig.3 Mode 0-Vertical**

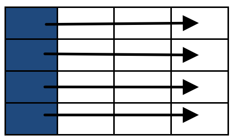

**Fig.4 Mode 1-Horizontal**

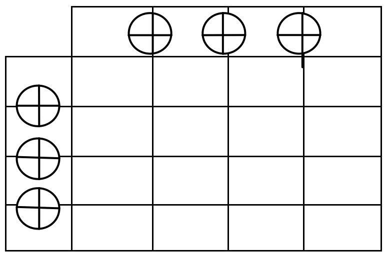

**Fig.5 mean mode (DC mode)**

The figure 3.1 indicates the vertical mode to find the samples above the 4x4block are copied into the block as indicated by the arrows and the figure 4.1 indicates the horizontal mode to find the samples to the left of the 4x4 block are copied and the figure 5.1 indicates mean mode to find the average of adjacent samples. Since it is unidirectional prediction it achieve less compression ratio compared to PWSIP prediction method.

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## V. CONTEXT ADAPTIVE INTERPOLATION

Context adaptive interpolation is the method to increase the compression ratio. It uses only four horizontal and four vertical neighbours or the four diagonal neighbours to find the target sub-image. For lossless image compression it uses Median Edge Detector (MED) and gradient adaptive predictor (GAP) are the two successive predictors. Here the interpolator is classified into four types such as smooth, horizontal-edged, vertical-edged and other. In smooth region a mean filter is applied and horizontal/vertical edge region, the interpolation is done along the edges otherwise we use the median filter.

The CAI is calculated as,

$$S=\begin{cases} Mean(t), & (\max(t)-\min(t)\leq 20) \\ \frac{(t_1+t_2)}{2}, & (|t_3-t_4|-|t_1-t_2|>20) \\ \frac{(t_3+t_4)}{2}, & (|t_1-t_2|-|t_3-t_4|>20) \\ Median(t), & (otherwise) \end{cases}$$

In smooth region a mean filter is applied and horizontal/vertical edge region, the interpolation is done along the edges otherwise we use the median filter.

The figure 6.1 represents how the interpolation take place in context adaptive interpolation. here first sub-image 11 is interpolated from sub-image 00 and after decode the sub-image 11.we use both sub-image 00 and 11 to interpolate 01 and 10.these concept is two step interpolation.consider s be the pixel value to be interpolated, t={t1,t2,t3,t4}be the vector of neighbour pixels and use the conecpt of interpolator techniques they find out the neighbour pixels using these four types such as smooth region, horizontal-edged, vertical-edged and other. These method achieve high compression ratio because of interpolation with neighbour pixels and pixels are geometrically correlate each other, so, we achieve high compression ratio at low bit rates.

In this paper mainly focus on to improve the performance of H.264/AVC for that they use the three modes from H.264/AVC such as horizontal, vertical and mean mode and another standard is PWSIP (Pixel-Wise Spatial Interleave Prediction) it uses three modes such as horizontal, vertical and mean mode and prediction based on multidirectional prediction and we achieve high compression ratio, finally use the context adaptive interpolation method it uses the four types of interpolator predictors to find out the neighbour pixel.

The totally seven modes are to improve the performances of H.264/AVC and achieve high compression ratio compared to previous H.264/AVC standard.

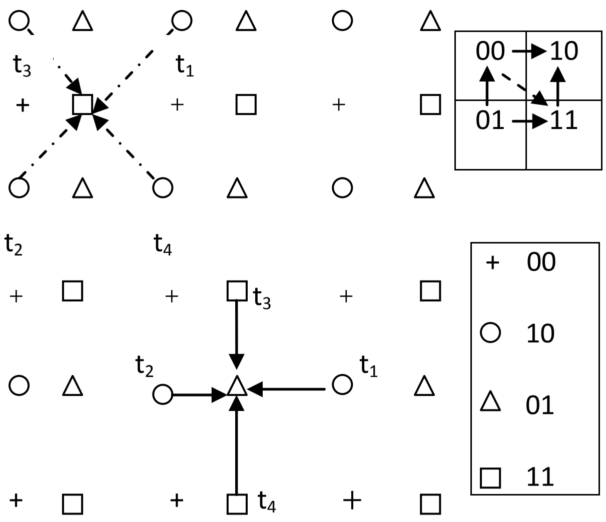


**Fig.6 two step interpolation.the dashed arrow indicate first step interpolation and solid arrow indicate second step**

Here we construct the graph for existing PWSIP and proposed method CAI. The compression ratio will increase compared to PWSIP method.

## VI. EXPEERIMENTAL RESULTS

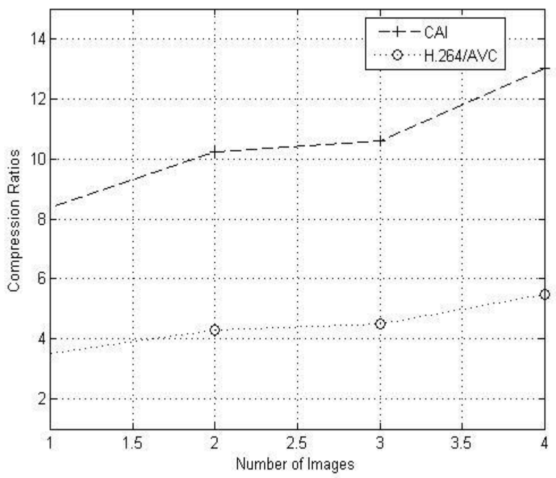


**Fig.6 Compression Ratio for H.264/AVC and CAI**

**(352x288)**

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For finding the compression ratio using this formula, it has been calculated

$$\text{Compression Ratio}=\frac{\text{Original File Size(Bits)}}{\text{Compressed File Size(Bits)}}$$

The Figure 6.1 represents the graph for compression ratio between H.264/AVC and CAI.A sequence of image is taken as X-axis such as bus, football, foreman, mother and daughter(1,1.5,2,2.5,3,3.5,4) with same pixel size of images as (352x288) and Y-axis is taken as compression ratio for these images. Compared to H.264/AVC standard our proposed method achieve high compression ratio with percent increase of 4%.So, we achieve high image quality at low bit rates.

## VII. CONCLUSION

In this paper mainly to achieve high compression and to increase the performance of H.264/AVC.In existing video coding standard, uses the compression of video frames using H.264/AVA and PWSIP method for prediction. These prediction techniques use three modes to achieve high compression ratio. In this paper, we are motivate to increase the compression ratio of video frames to increase the performance of H.264/AVC based on three algorithms, pixel-wise spatial interleave prediction to apply three modes, H.264/AVC video coding standard to uses three modes and context adaptive interpolation (CAI), so totally 7 modes type of modes are used to increase the performance of H.264/AVC and to achieve high compression ratio and finally to get achieve high image quality at low bit rates.

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