A SURVEY: VARIOUS TECHNIQUES OF LOSSY VIDEO COMPRESSION

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Abstract— Video Compression is the process of representing the original video in a compressed way by minimizing the number of bits than it originally has. Video compression has been extensively used to reduce the data redundancy by preserving the required information. There has been an increasing demand for digital video technology in various fields of telecommunication, entertainment, medicine etc. and hence the need for Video Compression[2].In this paper five lossy technique GPU based real time video compression, Hybrid Hierarchical Search Motion Estimation technique,edges based intra prediction in HEVC[1][2][5] and transform coded pel recursive and an enhanced macro block classification[3][4] techniques have been used to compress the video.

Index Terms - video compression ,motion estimation ,prediction ,macro block classification

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I. INTRODUCTION

Demand of video applications such as video telephony, high definition television (HDTV), video conferencing, online streaming of video, streaming on mobile, TV, 24 hours surveillance system and many others are increasing exponentially, to fulfil this demand continuous evolution in video compression standard is required for more compression. The video data compression is the process of reducing the amount of data required to represent a video sequence. Video coding is a process of video encoding and decoding together. New video compression standard needed to satisfy growing demand of video applications and it must be more effective than previously developed standards. There are two organization namely ITU-T (VCEG) (international telecommunication union – telecommunications (video coding experts group)) and ISO (international standardization organization)/IEC (international electro-technical committee) MPEG (moving picture experts group), they introduce many video coding standards. ITU-T (VCEG) and ISO/IEC (MPEG)collaborated and formed the Joint Collaborative Team on Video Coding (JCT-VC) in April 2010 to develop the next generation video coding (NGVC) standard and several meetings were held and the first TMuC (test model under construction) was High Efficiency Video Coding (HEVC)[3].

TYPE OF VIDEO COMPRESSION

1. Lossless compression-it is a type of compession in which represent data without losing any information so that the process is reversible.
2. Lossy compression-it is a type of compression in which Dropping nonessential detail from the data source can save storage space.

In this paper five lossy techniques are described.

THE NEED FOR COMPRESSION [6]

Fortunately, digital video has significant redundancies and eliminating or reducing those redundancies results in compression. Video compression can be lossy or loss less. Loss less video compression reproduces identical video after de-compression. We primarily consider lossy compression that yields perceptually equivalent, but not identical video compared to the uncompressed source. Video compression is typically achieved by exploiting four types of redundancies: 1) perceptual, 2) temporal, 3) spatial, and 4) statistical redundancies.

VIDEO COMPRESSION TECHNIQUES [7]

A. JPEG

For single-frame image compression, the industry standard with the greatest acceptance is JPEG (Joint Photographic Experts Group). JPEG consists of a minimum implementation (called a baseline system) which all implementations are required to support, and various extensions for specific applications.

B. MPEG

MPEG is the “Moving Picture Experts Group”, working under the joint direction of the International Standards Organization (ISO) and the International Electro-Technical Commission (IEC). This group works on standards for the coding of moving pictures and associated audio.

C. H.261

H.261 (last modified in 1993) is the video compression standard included under the H.320 umbrella (and others) for videoconferencing standards. H.261 is a motion compression algorithm developed specifically for videoconferencing, though it
Regions of the image, while maintaining low complexity and adaptability to the receivers’ resources. Allowing the video stream to contain various resolutions enables the receiver to select the desired quality by dropping the components referring to higher quality than needed. This may be employed for any motion video compression task.

D.H.263

H.263 is a structurally similar refinement (a five year update) to H.261 and is backward compatible with H.261. At bandwidths under 1000 kbps, H.263 picture quality is superior to that of H.261. Images are greatly improved by using a required 1/2 pixel new motion estimation rather than the optional integer estimation used in H.261.

E.H.264

H.264 is the latest generation standard for video encoding. This initiative has many goals. It should provide good video quality at substantially lower bit rates than previous standards and with better error robustness – or better video quality at an unchanged but rate.

F.MPE G-21

MPEG-21 is a standard that defines means of sharing digital rights, permissions, and restrictions for digital content. MPEG- 21 is an XML-based standard, and is developed to counter illegitimate distribution of digital content.

G.H.265

H.265 is also known as HEVC(High Efficiency Video Coding) standard this is latest video compression standard. This overcome the problem of H.264 standard.

II. LITERATURE SURVEY

VARIOUS TECHNIQUES OF OF LOSSY VIDEO COMPRESSION

1. A GPU based real time video compression for video conferencing [1]

ENCODING ALGORITHM

1: Start
2: Input RGB frame
3: Convert to YCoCg
4: Down sample Co and Cg by N
5: Decompose Y with the Contourlet Transform
6: Quantize CT coefficients / Keep the M% most significant CT coefficients
7: Round all components' elements to the nearest integer
8: IF the frame is an internal frame
9: Calculate the frame as the difference between the frame and the previous keyframe
10: Run-length encoding of Co, Cg and the lowpass CT component of Y
11: END IF
12: Run-length encoding of the directional subbands of Y
13: DEFLATE all components seperately
14: IF frame is NOT the last frame
15: GOTO Start
16: END IF
17: Finish

In this algorithm, real-time video encoding based on the contourlet transform and optimized for video conferencing ability avoids the need for reencoding at the source or maintaining multiple copies of cached video content in streaming video service networks. Furthermore, depending on the method used for manipulating the contourlet coefficients of the directional subbands of the luminance channel, the algorithm has the inherent ability to suppress the noise induced by low-quality sensors. This is achieved through the manipulation of the structural characteristics of the video through the rejection of insignificant coefficients.

In the cases where higher compression is needed, the visual quality degradation is much more eye-friendly than with other well established video compression methods. The proposed method does not suffer from artificial block artifacts but introduces fuzziness and blurring, providing smoother images. Another advantageous characteristic of the presented algorithm is that it can exploit general purpose GPU computing techniques in order to provide enhance computational efficiency, by migrating its most computationally intensive parts on the GPU. The experimental evaluation of the presented algorithm provided promising results. Future work could include an improvement on the handling of the chrominance channels in order to reduce the difference in the PSNR values between the full video sequence and its luminance channel.

2. Hybrid Hierarchical Search Motion Estimation For Video Compression [2]

ALGORITHM

Step 1: Level-1 is the lowest level and consists of the original frame at its full resolution. This level is subsampled by a factor of 2 in vertical and horizontal
Directions to produce Level-2.

Step 2: This step involves sub-sampling Level-2 in the same way to produce Level-3 (highest level).The subsampling subsampling process ends, by getting Level-1,Level-2 and Level-3.

Step 3: In this step, the search starts from the highest level (Level-3) using 4 X 4 block sizes, where a FS algorithm will be performed to get the initial coarse motion vector and the best match position will be passed to the lower level (Level-2).

Step 4: This step involves searching Level-2 by using the new proposed cross-diamond search pattern (using 8 X 8 block sizes) to get a new motion vector, and the best match position will be passed to Level-1 (Lowest level).

Step 5: In this step, the New Three-Step-Search algorithm is used on Level-1 utilizing 16 X 16 block sizes.Hence the final motion vector is obtained and that will be added to the previous image to get the next predicted image frame.Motion estimation algorithms intend to construct the current frame as accurately as possible while keeping the computational complexity acceptable.

In quantization algorithm we used the same quantization applications and surveillance cameras. The incorporation of the DEFLATE algorithm to the method, along with the various quantization steps and the proposed contourlet coefficient truncation scheme provided increased compression efficiency compared to the older version, while introducing minimal visual quality degradation. The scalable video compression scheme that the algorithm provides is ideal for video conferencing content. It achieves high quality encoding and increased compression efficiency for static.

Full Search Algorithm is the most efficient for Motion Estimation.But its highly expensive. Hierarchical Fast Search motion estimation is in order to reduce the Full Search complexity. Therefore, a new Hierarchal Search technique is developed that achieves a performance much better than the existing hierarchical techniques with reduction in complexity.

3. TRANSFORM-CODED PEL-RECURSIVE VIDEO COMPRESSION [3]

For block-based hybrid video coders that use block transforms to encode the prediction errors our algorithm is performed on a block by block basis.first derive the equations necessary to perform the reconstruction of pixels within the current block at the decoder. Assume that pixels in blocks are ordered into vectors. Let x be the N2 x 1 vector that contains the values of pixels from the current N x N block with the ordering so that x(j), j = 1, . . . , i − 1, is spatially causal to x(i), 1 ≤ i ≤ N2. Likewise let ˆx be the N2 x 1 vector of decoded pixels from the current block, and y the N2 x 1 vector of pixels from the motion-aligned previous frame block. Rewriting Eq. in terms of vectors and matrix operation,

$$p = A\hat{x} + By$$

Here, matrices A and B contain the prediction weights αi,j and βk,l. Notice that matrix A is strictly lower triangular, as the neighborhood Γm,n defined in Eq. is spatially causal. If we denote the decoded residual as ˆr, combining Eqs. results in,
Assuming that we are using block transforms and quantization, decoded residual can be written as:

Where H is the inverse of the applied block transform, and ˆc contains the de-quantized transform coefficients received by the decoder. Letting I be the identity matrix, we can derive the equation for ˆx as,

ˆx = Aˆx + By +Hˆc,
ˆx = (I − A)
−1 **By** + (**I − A**)
−1**Hˆc**

Observe that the matrix (**I − A**) is guaranteed to be invertible, since **A** is strictly lower triangular. In order to see what the encoder needs to accomplish it is convenient to consider the reconstruction of a hybrid video coder given the same reference block. This can be written as, ˆ**x***h* = **y** +**Hˆc***h*

where ˆ**x***h* is the hybrid codec's reconstruction and ˆ**c***h* is its dequantized transform coefficients. Comparing Eqs. it is clear that the proposed codec encodes with the transform, **T***pr* = (**I − A**) −1**H** that encoding with this new transform enables the decoder to use **H** for a given block, i.e., the same simple inverse transform that the hybrid codec uses, and then perform pel-recursive decoding within that block. We term **T***pr* the *pel-recursion enabling transform*. In general **T***pr* is non-orthogonal even for an orthogonal **H**. The encoder's task can hence be summarized as finding the optimal quantized coefficients for **T***pr*.INTRA prediction and derive an equivalent non-orthogonal transform for simple predictors and an associated algorithm for the **T***pr*.

This technique does not sacrifice decoder complexity and designs a decoder that transform decodes residuals of a block using simple transforms (DCT/DST in HEVC). It then predictively reconstructs the block's pixels using pel-recursion and the decoded residuals. We showed that on the encoder side the proposed method can be seen as a pelrecursion enabling transform, *Tpr*, which the encoder uses to design transform coefficients. A straightforward, parallelizable implementation of this work obtains improvements over the HEVC baseline.

4. An Improved Macro block classification algorithm in video compression[4]

The frame is classified into 16x16 macroblock size and if the size is greater than 16, the matrix is again divided into the next smaller dimensions. It makes the classifier adaptive. The entire classification is divided into four classes from 1-4 which specifies the background, text, picture and the other portions that cannot be determined. These are determined by using mean and standard deviation and the magnitude estimation of each pixel is performed. Mean is the average value of the array and standard deviation is the square root of the average value. Magnitude estimation is done by considering the mean value of each pixel which is multiplied with a 5x3 matrix and the sum of absolute value of the resulting matrix is taken.

- Class 1- picture
- Class 2 - text
- Class 3 - Background
- Class 4 - Foreground

if sigma < 10
Class = 3 (background)
else if (Dx>25 && Dy>25 && alpha>300) II (Dx>50 && Dy>50)
Class = 2(text)
else if (sigma>25 && (alpha<200)
Class = l(picture)
else Class=4 (Foreground)

where, sigma- standard deviation, Dx and Dy are the magnitudes. A tolerance value is set for the testing of background, text and image. Tolerance for background is 0.1 *255, and that for image and text is 50 and 80 respectively. These values are used for the comparison as opposed to using the transform H. It is important to note and determination of the features. Four adjacent neighbors are considered for this purpose. If the value of the neighbors are less than or equal to the respective tolerance values of image, text and background they can be classified accordingly. i.e., with the context information of the four neighbors the block can be classified as either text or picture.

In this technique, Enhanced macroblock classification method is used for classifying the frame into four different classes so that it is easy to identify the foreground and background, which helps to efficiently segment the content using top hat and bottom hat filter. The reconstructed compressed image after motion compensation is of high quality, since motion compensation is performed based on the intensity of the pixels in the frame. Higher compression can be obtained along with a high quality is the major advantage. The result is verified for several videos and different compression ratios obtained depending on the length and quality of the video.

5. Edges based Intra-prediction in HEVC Standard [5]

According to the standard features and process, the first important step in intra-frame prediction process is the quadtree block decomposition which is in action with respect to a predefined threshold and the amount of details in differentarea of and image. While in this paper, fist a fixed block sizes of from 32x32 to 4x4 has been used and then canny edge detection algorithm is used for variable block size partition at each instance of intra-frame prediction to be able to evaluate the flexibility of HEVC intra-frame prediction with 35 modes in total and 33 different angular modes and further perform a comparison between H.264 and H.265 standards. Here, for algorithm Equal block partition , after that variable block size is used. For variable block size canny edge detection method is used because it detects edge with low error rate, which means that the detection should accurately catch as many edges shown in the image as possible. Among all edge detection method this method gives best result. For variable block size partition here canny edge detection method is used. For this type of partition picture is first splited in to equal size of picture block of CU sizes of either 64x64 or 32x32 or 16x16 which is depend on picture size. After that canny edge algorithm is applied on each picture blocks, if any edges are present in to block that block is again splited in to four equal size of block. This process is done until block size up to smallest PU size 4x4.

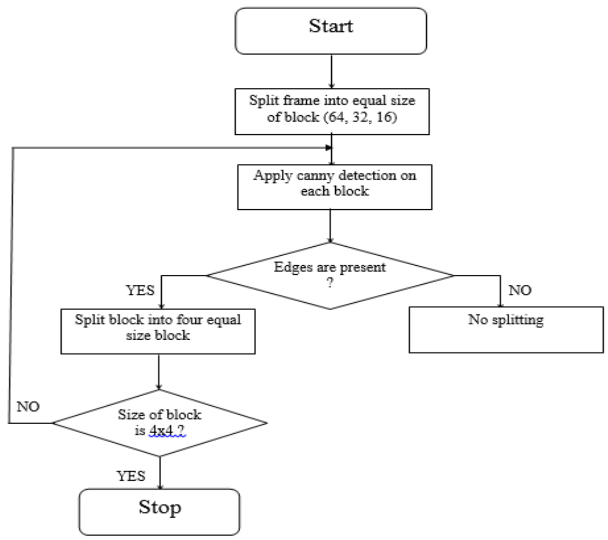

Fig.1 ALGORITHM [5]

In this technique, intra - prediction algorithm is implemented for Fixed sizes block and variable size block, for variable block size canny edge detection is used. Two type of video sequences are tested: CIF and QCIF. For both video sequences it is clear that among all fixed block sizes Intra 4x4 gives best result for Y- PSNR. As block size increases PSNR decreases. Proposed canny edge variable block size algorithm gives better result for Y- PSNR compared to all fixed size block.Y- PSNR is compared with previous video coding standard H.264/SVC for 4x4 block size. HEVC 4x4 fixed size block give better result than H.264/SCV 4x4 Block.Also result for Y-PSNR for all video sequences.

III. CONCLUSION

In this paper five different lossy techniques are used for compression of video for various requirements and application.There is used different video compression standard.Among this five techniques last technique is best technique because in this edges based intra prediction in latest standard HEVC which overcome the problem of all technique and increase PSNR value and give higher compression ratio(CR).

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