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Hexagonal Search Based Compression Noise Estimation And Reduction In Video

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***Abstract*—Due to the advancement of digital devices more and more images and videos were captured using smart phones and digital devices.These images and videos were compressed at lower bit rates.Since,the available bandwidth is limited in nature. The compressed images and videos were affected with compression noise,in-order to remove such compression noise a content dependent noise reduction technique is being used here.The Video compression has become an unavoidable feature now a days. Proposed block matching motion estimation in video compression technique such as DCT (Discrete Cosine transform) is used to achieve optimal compression of individual frames and hexagon-based diamond search (HEXBDS) algorithm used for motion estimation.The proposed algorithm is efficient and robust.The proposed algorithm that reducing the bandwidth used by Motion Picture Expert Group (MPEG) algorithm. The objective of this paper is to propose a new algorithm which focuses on combing the hexagon-based search, which is faster than diamond search algorithm. Experiments are performed and obtained high accuracy of hexagon search based method.**

***Index Terms*—Compression Ratios,DCT (Discrete Cosine transform),Hexagon-based diamond search (HEXBDS),Motion Picture Expert Group (MPEG),peak signal-to-noise ratio(PSNR),perceived image quality (PIQ)**

I. INTRODUCTION

Due to limited channel bandwidth and high requirements of real time video system,In visual communication and multimedia applications efficient video coding becomes vital process for many and requires a very high compression ratio. To achieve this objective, the large amount of temporal correlation or temporal redundancy,should found out and reduced.To reduce the temporal redundancy between successive frames of a video one of the effective and popular method is called Motion Estimation (ME).

Block matching motion estimation is used in many motion compensated video coding technique.That aims at exploit the strong temporal redundancy between successive frames.The ME is quite computational intensive and can consume up to 80% of the computational power of the encoder.If the full search (FS) is used,then all possible candidate blocks will be in a single search window.Hence, fast search algorithms are highly covetable to significantly speedy process without affecting distortion seriously.Quantizing transform coefficients are the main reason behind compression noises this type of noise is dependent on the distribution of coefficients. so in order to remove the compression noise we need to have a content-aware method[1].Many Motion Estimation variants were developed,Among them which are three-step search (TSS), new three-step search (NTSS) [2], four-step search (4SS) [3][6], and diamond search (DS) [5] algorithms are commonly used.In TSS,FSS and NTSS algorithms,different sized square shape patterns for searching were employed.While,a diamond-shaped search pattern is used in the DS algorithm, which is a faster processing and posses similar distortion as compared with NTSS and FSS.The Diamond search algorithm is found to be more better than four step search (FSS)algorithm and block based gradient descent search, in terms of mean square error performance and number of search points required[4].That's why diamond search pattern may yield much more speed improvement over some other square-shaped search pattern methods.Other pattern shape better than diamond search algorithm, we propose a hexagon-based search algorithm that can used to achieve substantial speed improvement than the Diamond Search algorithm with similar distortion.

II. ALGORITHMS FOR BLOCK MATCHING

Generally, Block Matching Algorithm(BMA) is used for estimating motion on the block by block basis[7].Typically,Block matching algorithm, each video frame is divided into MxN pixels of non-overlapping blocks.The present block is compared with a corresponding block in the previous frame in a given search area of size M+2pxN+2p. where p is the maximum allowed displacement.The displacement between these two blocks is referred to as the motion vector.The role of Block Based Motion Estimation is proposed [2][10]. Here videos are converted into picture blocks of size 8x8 or 16x16.Each block treats as an object.Then motion vector and found out,helps to locate the most similar block in a prior picture. Motion estimation searches a neighbouring area in a given reference frame for matching area. The best match, is one with minimum energy difference for the current block and the matching area.

The equation for Mean squared error is given by,

$$\text{MSE} = \frac{1}{N^2}\sum_{t=0}^{N-1}\sum_{t=0}^{N-1}(C_ij - R_ij)^2 \qquad (1)$$

$Where$ C$_i j$ is the current block sample and $R_i j$ is reference area sample.

III. ALGORITHMS FOR MOTION ESTIMATION

The design goal of Motion estimation Algorithm is to estimate the current frame as accurately as possible by using previously existing frames or future frames and hence to maintain an acceptable computational complexity. Current frame is motion compensated and subtracts the model from the frame and hence to produce a motion compensated residual frame. Important Motion Estimation algorithms follow different strategies used for selecting search points.

A. FSS(Four Step Search) Algorithm

The FSS algorithm uses a center biased property. There are 9 points located on the center of 5x5 window of 15x15 search space. Then an additional 5 or 3 points were considered to position the minimum Block Match point. If minimum Block Match point founded at center.FSS algorithm Stated below.

Firstly, there are 9 points located on the center of 5x5 window of 15x15 search space. Block Match point is found out among the 9 points. If the minimum Block Match point is found at the center of search window, go to last step; otherwise go to next step.Now, the search pattern will depend on the location of the previous minimum Block Match point.If the minimum Block Match point is at the corner then additional 5 checking points were used.If the minimum Block Match point is at the middle of horizontal or vertical edge then additional 3 checking points were used.

If the minimum Block Match point is found out at the center of the search window,then search pattern strategy will be same as before, but if min. Block Match point foundout at the center of the search window then,the search window is now reduced to a 3 x 3 and 8 checking points is now considered surrounding min.BDM point. And again min. Block Match point is found.

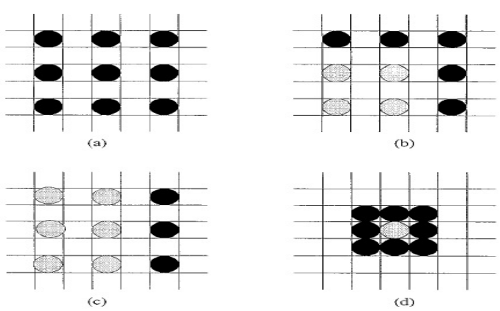

Fig. 1. FSS search patterns

B. DS (Diamond Search) Algorithm

Diamond Search Algorithm [8]provides a compact structure used for exploits the center biased characteristic of motion vector distribution for basic property in real time videos. For finding all possible directions, Diamond Search algorithm exploits a diamond shape that tries to behaves like an ideal circle shaped coverage considering all for investigating motion estimation. The Diamond Search algorithm is explained as follows [8]:

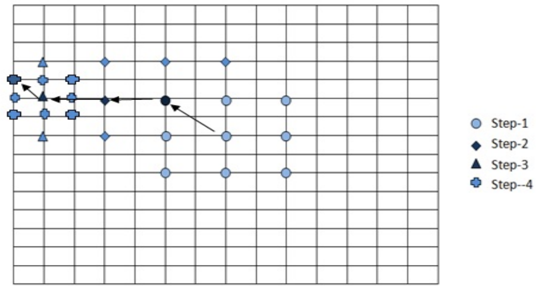

Fig. 2. The path used in 4SSF

The nine checking points of LDSP(Large Diamond Search Pattern) are tested and the search pattern is centered at the origin of the search window.The minimum cost function(MCF) point calculated and is being located at the centre. The MCF point foundout from the previous search step and is being re positioned at the centre point to form a new Large Diamond Search Pattern. If the new MCF point obtained is located at the centre space.Transform the search pattern from Large Diamond Search Pattern(LDSP) to small diamond search pattern (SDSP). The MCF point found out and final solution for the Motion Vector which points out as the best matching block algorithm.

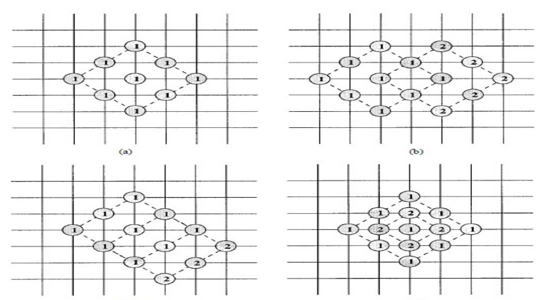

Fig. 3. Diamond Search Patterns

C. HEXS(Hexagonal Search) Algorithm

Hexagonal Search (HEXS) Algorithm In ideal case, to achieve the fastest search speed a circle shaped search pattern with a uniform distribution of minimum number of search points is desirable. The Hexagon based search pattern (HEXSP) [9] may be the approximate solution for this. It is demonstrated in the fig.3.

In an image compression standard,by using block matching algorithm the image is to divide into small blocks.For converting each block pixel value into frequency domain we use Discrete Cosine Transform(DCT).Basically quantization that converts each real DCT coefficient to an integer by scaling and discarding the digits after the decimal point.The compression process is to encode the DCT coefficients utilizing as few bits as possible. After quantization, the DCT coefficients are zeros.Hexagon-based search applied to block motion estimation in video coding searh area, not only the performance but also computational complexity of fast.Finally get the compressed video.

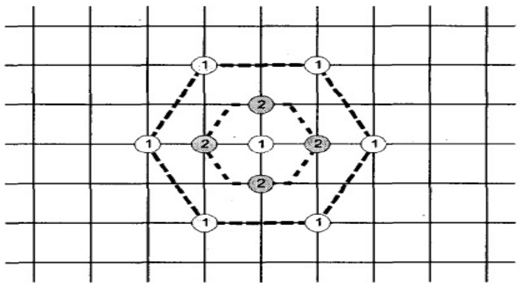

Fig. 4. Large Hexagonal Pattern 2-Inner Hexagonal Pattern

IV. SIMULATION RESULTS

For analysing this paper,only the first 30 frames of the available from the test video sequences is considered for simulated.The number of frame to be simulated in the source code is specified by the user.In terms of average number of search points required to obtain Motion estimation we obtain that performance of HDS algorithm against the selected fast Block matching algorithm is better.Also,the average PSNR (Peak Signal to Noise Ratio) per block per frame for HEXS Algorithm gives a better value.

Although the number of frame to be simulated in the source code is specified by the user, only the first 30 frames of the available test video sequences is considered to be simulated and analyzed in this paper. The performance of HDS algorithm against the selected fast BMAs in terms of average number of search points required to obtain MV per block per frame while the average PSNR per block per frame for HDS algorithm gives a better value.HDS algorithm constantly better than FSS,and DS algorithms in terms of search points and PSNR also required in determining the Motion Estimation.

Fig. 5. Video input converted into frames

The search patterns of previously used block matching algorithms are symmetrical in all four vertical and horizontal directions, which do not correspond with the directional characteristics of the Motion Estimation.Hence , search pattern of

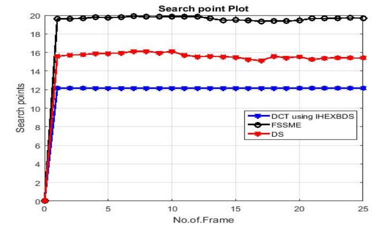

Fig. 6. Search point plot

a new kind is needs to find the motion estimation with more quick and which direct in the proper direction.

Based on the horizontal center biased technique for Motion distribution and directional Motion distribution proposed above, the horizontal cross search pattern and diamond search(DS) patterns, as shown in Fig. 4. proposed in the new Block matching algorithms, which is termed the diamond search (DS) algorithm.

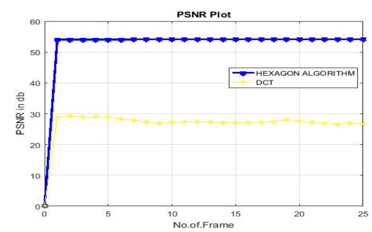

Fig. 7. PSNR Plot

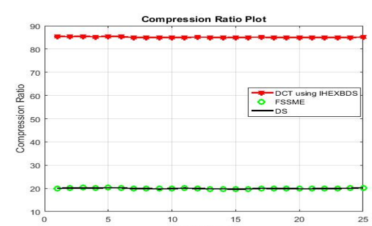

Fig. 8. compression Ratio Plot

V. CONCLUSION

In this techno leading world every electronic device has much more applications that use for images and videos.Present scenario,every communication that needed to be have images and videos to make it complete representation, communication cannot be imaginable without images and videos. Due to the limitation in bandwidth needed for transmission and limited memory make video compression a serious issue to be consider in the communication field.

A novel fast algorithm using hexagon based search pattern in block motion estimation proposed in this paper. The diamond based search and other fast search methods while maintaining similar distortion performance that significantly speedup gain over.The proposed HEXBS system that consistently provides a faster search performance than other block matching techniques including DS regardless of no motion, small medium , large-motion techniques.The hexagon based search technique used to find any motion estimation in motion field with fewer search points as compared to the DS algorithm.In the larger the motion estimation, the more significantly used to the speedup gain for the new method should be.The simulation results have verified the statement and convincingly demonstrated the dominance of the proposed HEXBS as compared to fast methods in terms of smallest number of search points used.

REFERENCES

[1] Xinfeng Zhang,Xianming Liu, ”Low Rank Decomposition Based Restoration of Compressed Images via Adaptive Noise Estimation”,IEEE Transactions on Image processing, Vol. 25, No. 9, september 2016.

[2] R. Li, B. Zeng, and M. L. Liou, ”A new three-step search algorithm for block motion estimation,” IEEE Transactions on Circuits Systems for Video Technology, vol. 4, pp. 438-442, Aug. 1994.

[3] L. M. Po and W. C. Ma, ”A novel four-step search algorithm for fast block motion estimation,” IEEE Transactions on Circuits Systems for Video Technology, vol. 6, pp. 313-317, June 1996.

[4] Shan Zhu, Kai-Kuang Ma, ”A new diamond search algorithm for fast block-matching motion estimation,” IEEE Transactions on Image Processing, vol. 9, no. 2, pp. 287-290, Feb. 2000.

[5] Jo Yew Tham, Surendra Ranganath, Maitreya Ranganath, and Ashraf Ali Kassim, ”A novel unrestricted center-biased diamond search algorithm for block motion estimation,” IEEE Transactions on Circuits Systems for Video Technology, vol. 8, no. 4, pp. 369-377, Aug. 1998.

[6] L. M. Po and W. C. Ma, A novel four-step search algorithm for fast block motion estimation, IEEE Trans. Circuits Syst. Video Technol.,vol. 6, pp 313-317, June 1996.

[7] L.-M. Po and W.-C. Ma, A novel four-step search algorithm for fast block motion estimation, Circuits and Systems for Video Technology, IEEE Transactions on, vol. 6, no. 3, pp. 313-317, 1996.

[8] S. Zhu and K. K. Ma, A new diamond search algorithm for fast block-matching motion estimation, IEEE Trans. Image Processing, vol. 9, pp. 287-290, February 2000.

[9] Ce Zhu, Xiao Lin, and Lap-Pui Chau, Hexagon-Based Search Pattern for Fast Block Motion Estimation, IEEE Transactions on Circuits and Systems for Video Technology, Vol. 12, No. 5, pp. 349-355, May 2002.

[10] Aroh Barjatya, Block-Matching Algorithms For Motion Estimation, DIP 6620 Spring 2004 Final Project Paper.