HEVC VIDEO COMPRESSION FRAMEWORK

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Abstract: This paper is focused on the conceptual modelling of the HEVC coding using Graph Theory approach. This paper also proposes an algorithm to estimates the rate and distortion presence in frame sequence by applying RD-Theory and the concept of Lagrangian coefficient measurement using bitrate Vs time analysis.

INTRODUCTION

With the huge increment of constant top notch video substance, there emerges a need of performing sufficient pressure without influencing the visual substance of a video over low transfer speed organizations. Because of the heavier idea of video substance, performing highend pressure essentially influences the perceptual nature of a video. Hence, the appeal of watching web based recordings online open up the extent of video coding; accordingly it has become a promising zone of exploration. The ordinary H.264/AVC is a joint exertion of ITU-T and MPEG bunches went before by H.263 video coding standard in the time of 2003[1-5].

Later on, H.264/AVC acquired the consideration regarding become versatile in the business standard. The broad plan examination demonstrates that H.264 is exceptionally utilitarian on accomplishing half pressure proficiency when contrasted with its inheritance renditions. It is likewise professed to offer critical help to the great video expansions in low piece rate channels of various versatile gadgets. Albeit the current situation in the field of video pressure has seen a wide scope of potential applications which executes H.264/AVC video coding convention. Regardless of having every one of these meanings the variety in implanted plan of certain cell phones presents difficulties in handling H.264/AVC effectively. It further prompts significant expense of calculation. The unique conduct of versatile organizations likewise causes overhead in force limitation cell phones while handling H.264. Henceforth, there exist a significant tradeoff between very good quality pressure and force utilization, additionally plan complexities related with hand-held gadgets. Keeping every one of these realities into the brain our proposed study planned to upgrade the exhibition of customary HEVC by coordinating it with a Graph based technique for productive video compression[6-10].

PROBLEM FORMULATION

Due to the diversity in design methodologies of hand-held devices and various futuristic video compression applications, a major trade-off exists between the cost of computation and efficient high-end compression. However, the complex implementation processes involved in different multimedia processing units of mobile devices compatible with H.264/AVC poses very high cost of computation though it achieves high-performance compression. Therefore it subsequently initiates a major research problem of conceptualizing a less complex design enabled H.264/AVC to achieve high-performance video compression while making least computational overhead. Compare to previous protocols, the H.264/AVC encoding process involves least complex implementation while considering removal of spatial, temporal and statistical redundancies from a signal to make it more compact and efficient. It performs quantization on macro blocks of 16x16 with respect to special frequency components/coefficients from spatial domain analysis aspects and further performs a considerable amount of compression with effective numerical stability. Still the encoding pipelined process is claimed to generate computation overhead on smart phones. The next segment will formulate the objective of the proposed study which helps conceptualizing the novel concept of video compression.

PROPOSED CONCEPTUAL MODEL

The conceptual modelling of the proposed system is considered for the purpose of performing high-end compression on multimedia files while retaining the utmost visual quality of the decoded object sequence at the receiver end. The conceptualization of the proposed system is subjected to perform high-end compression on HD videos with the aim of retaining highest visual perception at the receiver end. It also involves a technique called elastic frame profiling method which is derived on the basis of objectifying the numerical coefficients underlying functionalities from the first frame (reference) till the end of test frame using Graph Theory approach. The following Figure 4.1 exhibits the proposed schema of graph based compression integrated with the functionalities of HEVC, Motion Compensation and Lagrangian coefficients measurements. The study extensively performed the HEVC encoding on the top of the encoding process where few of the operational specifications from H.264/AVC are considered in this context.

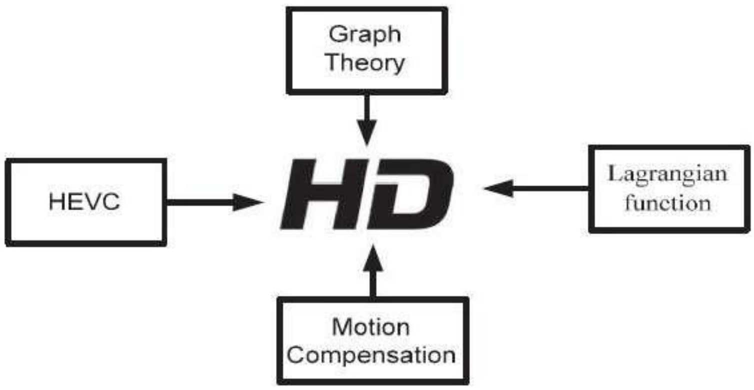

Figure 1 : Conceptual Modelling of Graph-based HEVC Compression

A deep insight into the video compression model introduced by the study of Pooja et al. [11] reveals the fact that it uses 16 x 16 block orientations to perform H.264 video coding on heavier multimedia files. On the other hand the study of Anudeep G. et al. [12] enhanced the performance efficiency of conventional uniform block size technique and extended its scope of applicability by considering variable block size method. The proposed study explicitly adopted these two concepts involved into the prior studies and thereby extended the optimality of RD-theoretical trade-off in terms of block size and conventional 16 x 16 orientation integrated with HEVC. These blocks are often termed as macro blocks and these are also further divided into sub-blocks for the ease of computation and encoding. Segmentation of a macro block initiates encoding over homogeneous regions with low frame rates. It also performs coding on few sets of blocks to reduce the computation overhead and complexities. The proposed study incorporates inter-frame prediction coding for each pixel blocks present in each frame and reference frames. The investigational analysis generates useful information about the effective prediction, thereby the extracted information is sent to the HEVC decoder for the retention of high quality video frames at the receiver end. The concept also applied the principle of Lagrangian coefficient measurement which is formulated as follows:

$$\alpha = \beta + \gamma . \theta \qquad (1)$$

β denotes the sum of squared differences in between the coefficients of actual macro block and reconstructed macro blocks. On the other hand γ signifies the scalar multiplier and θ denotes the required bit rates to transfer the estimated/transformed coefficients, motion vectors followed by motion compensation and residuals once the encoding process is done. The study further modifies the initiation operations of AVC scheme and its inherent components to achieve superior performance efficiency in between the elastic mobility entities and transitional motion vectors. The following Table-1 highlights the notation used in the proposed algorithm of graph-based video compression.

Table 1: Highlights the notation used in the proposed algorithm of graph-based video compression.

Serial No.	Annotation	Description
1.	M_b	Micro block
2.	*Ref(F)*	Reference frame
3.	*TMV*	Transitional Motion Vector
4.	*R*	Rate
5.	*Dist*	Distortion
6.	V_{matrix}	Matrix to hold value
7.	O_{CF}	Optimum Compressed File
8.	E	Edges
9.	V	Varices
10.	I	Image
11.	U	Translation Motion Vector With least tree size

The proposed algorithm description is depicted below.

Algorithm One: Proposed Graph-based Video Compression using HEVC
Input: Mb, Ref (F), TMV, r, Dist
Output: OCF
START
1. Initiate a Tree based structure of E,V
2. For (unique(Mb←32x32)
3. InitRef(F) -->Greyscale I
4. U ←Compute min (TMV| γ)
5. End of For
6. Estimate r, Dist for U
7. Apply Lagrangian coefficient measurement for all TMV & compute α
$\alpha = \beta + \gamma.\theta$
8. IF(arg(α) <TMV)
9. Estimate elastic motion compensation for u.
10. ELSE
11. For (all_frames)
12. Vmatrix←unique(frame_block)
13. END
14. Update Vmatrix
15. Compute PSNR, r, Dist
END

The above algorithm further simulated in a numerical computing platform on a 32 bit machine. However, the algorithm implementation has been carried out by means of standard Foremen dataset which is available in the web. The implementation process of the proposed graph-based compression protocol shows that it converts the RGB input video frames into greyscale to simplify the level of commutation. It further applies a linked investigational analysis subjected to identify the non-overlapping unique macro blocks. The proposed system also considers estimating the translation motion vectors with least size of the connectivity tree.

Further the algorithm also estimates the rate and distortion presence in frame sequence by applying RD-Theory. The concept of Lagrangian coefficient measurement (eq. 1) makes the computation of TMV and α easier. Finally it checks the argument value of α , if it is found to be lesser than TMV then the process performs elastic motion compensation else it checks for the non-repetitive frame block sequences and update the matrix accordingly. The matrix is a data structure considered to hold the output value. Finally the proposed algorithm applies a quantization procedure on the block entities and the motion attributes to effectively measure the motion compensation from the frame registration process. It also evaluates tracking down motion objects to enhance the predictive analysis which required predicting future reference blocks along with motion compensation during encoding process.

RESULTS AND DISCUSSION

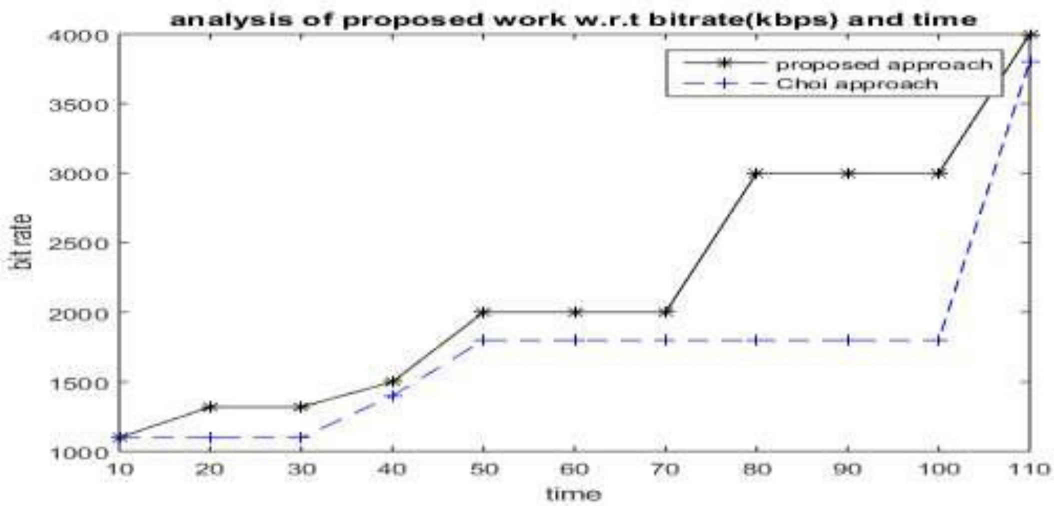

Figure 2: Performance Evaluation of the proposed method w.r.t bitrate

Figure 2 shows that the proposed graph based compression attains performance efficiency with respect to bit rate and time as compared to the Choi approach. In the STAGE-II, the experimental results are also compared with the conventional H.264/AVC and Choi approach in the following Figure 3.

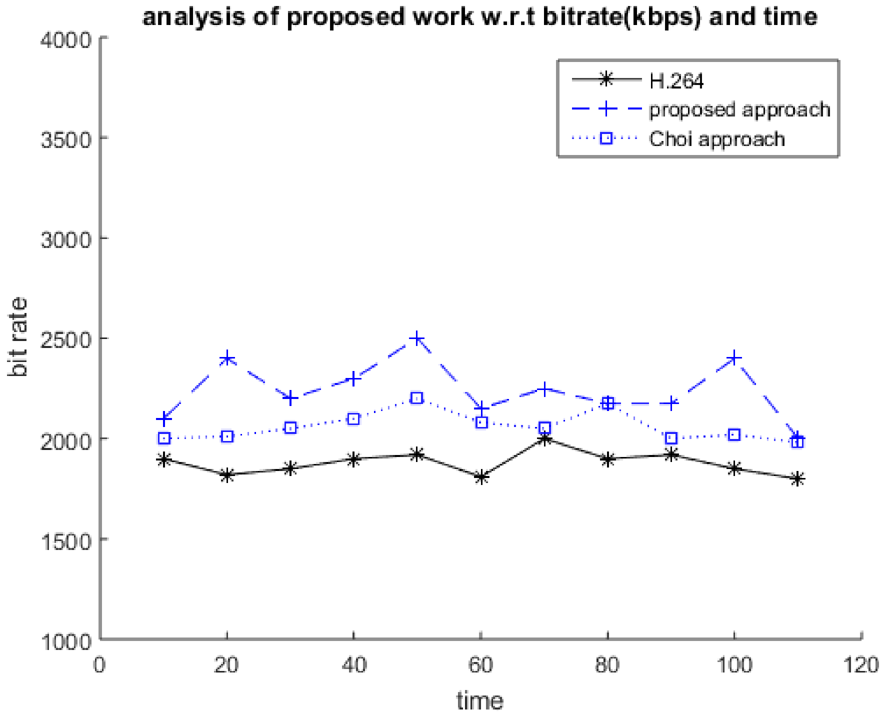

Figure 4: Performance Evaluation of the proposed method w.r.t bit rate

The experimental analysis also considers performance parameter like PSNR which is evaluated with respect to different bit rate. In STAGE-I the system performs evaluating PSNR with respect to 10Hz.

CONCLUSION

The proposed study introduces a novel video compression algorithm on the top of conventional H.264 algorithm to achieve efficient compression efficiency along with reducing the cost of computation. The system evaluates the encoding process based on HEVC standard where Graph Based RD-Theory plays a crucial role to enhance the prediction of motion compensation. The study considers PSNR and bitrates as performance parameters. Moreover, the outcome of the study shows that it excels the performance of H.264 as well as conventional HEVC and ensure a better scope of implementation in futuristic video compression algorithms.

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