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VIDEO QUALITY MODEL OF COMPRESSION, RESOLUTION AND ADAPTATION BASED ON SPACE-TIME REGULARITIES

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ABSTRACT -

A high degree of temporal redundancy characterizes video signals in general due to the strong correlation between succeeding frames. Actually, the current video compression methods do not fully utilize this redundancy. In this paper, we introduce a novel video compression method that tends to actively exploit the relevant temporal redundancy in the video frames to enhance compression effectiveness with a low processing burden. It entails converting the video frames from 3D to 2D, which enables the exploration of the video's temporal redundancy using 2D transforms and avoids the computationally taxing motion compensation step. The video's high spatial correlation is a result of this alteration of its spatial temporal correlation. In fact, this approach eventually unifies each collection of images into a single image with strong spatial association. As a result, the decorrelation of the images created by the DCT results in effective energy compaction and a high video compression ratio. Numerous experimental studies were carried out to demonstrate the method's effectiveness, particularly when using slow-motion footage and high bit rates. The suggested approach appears to be well suited for embedded video compression systems and video surveillance applications.

KEY WORDS: Huffman Coding, Discrete Cosine Transform (DCT), Frames, Spatio-Temporal, Video, and Encryption/Decryption Times.

INTRODUCTION

The main objective of video coding is to reduce the quantity of video data needed for storage or transmission without sacrificing visual quality. The quality, disc space, and bandwidth requirements of the application determine the desired video performance. high video compression for portable digital video applications. To provide more effective compression, these encoders take advantage of interframe correlation. With the goal of further optimizing perceptual streaming video compression, the combined space-time resolution adaptation methods.

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"Overview of the high efficiency video coding (HEVC) standard" was proposed by G. J. Sullivan, J. Ohm, W.-J. Han, and T. Wiegand **[1]**. The newest video coding standards, High Efficiency Video Coding (HEVC), are currently being developed and are discussed in this paper. The fundamental objective of the project to standardize HEVC is to provide much better compression performance compared to current standards—in the range of 50% bit-rate reduction for equivalent perceptual video quality. The technical properties and features of the HEVC standard are described in general in this article. C. Bovik, H. R. Sheikh, E. P. Simoncelli, Z. Wang, and others **[2]** "Image quality assessment: from error visibility to structural similarity" has been proposed. By comparing distorted images to reference images, objective approaches for evaluating picture quality have historically attempted to quantify the visibility of defects (differences) between them. characteristics of the visual system in humans. We present a different complementary paradigm for quality assessment based on the deterioration of structural information, presuming that human visual perception is highly adapted for obtaining structural information from a scene .A. Mackin, D. R. Bull, F. Zhang, and proposed **[3]** "A frame rate dependent video quality metric based on spatiotemporal pooling and temporal wavelet decomposition", An objective quality metric (FRQM) is presented in this study to describe the connection between frame rate fluctuations and perceptual video quality. Through temporal wavelet decomposition, sub band combining, and spatiotemporal pooling, the suggested method calculates the relative quality of a low frame rate video compared to its higher frame rate counterpart. On the publicly accessible BVI-HFR video database, which covers a varied variety of scenes and frame rates up to 120fps, FRQM was tested alongside six commonly used quality metrics (two of which directly tie frame rate variation to perceptual quality). "Toward a realistic perceptual video quality metric" was proposed by Z. Li, A. Aaron, I. Katsavounidis, A. Moorthy, and M. Manohara **[4]**. The implementation, optimization, and testing of various visual processing algorithms and systems, as well as their design, are all heavily influenced by visual quality evaluation in this work. In order to forecast picture quality based on human perception, we provide a systematic, thorough, and current assessment of perceptual visual quality measures (PVQMs) in this study.

PROPOSED METHOD

To achieve the best rate-quality performance during video encoding. The QRO module processes the video frames of the full resolution video as the first phase, determining the suitability for both spatial and temporal adaptation based on the video's content and the input quantization value (QP).

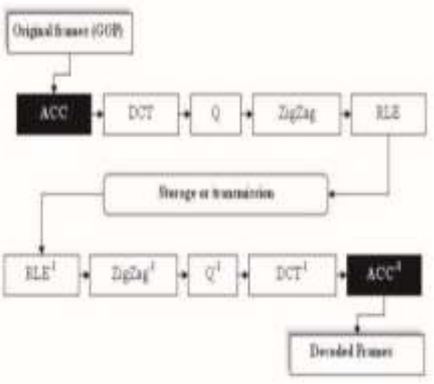


Figure.1: Proposed Block Diagram

There are two choices: one for geographical adaptation and the other for temporal adaptation. The modules that perform spatial and temporal down sampling are then controlled by these choices. Flag bits are used in the bitstream to indicate the adaption. Therefore, the resolution-optimized video serves as the host encoder's input. The flag bits are taken out of the bitstream at the decoder, where the host decoder then decodes resolution-resampled video frames. Finally, the original resolution is temporally and spatially up sampled for video frames.

Accordion Based Representation

In order to take advantage of this next supposition, we first do a temporal decomposition of the 3D video signal. Figure 3 illustrates the temporal and spatial decomposition of a single 8X8X8 video cube. Temporal frames are those obtained after the temporal decomposition. These latter are created by combining pixels from video cubes with the same column rank. We change the direction of event frames in the Accordion Representation to boost correlation. As seen in the figure above. The pixels with the same coordinates in various frames of the video cube tend to be spatially adjacent when represented as an accordion.

This representation converts the 3D original video source's high spatial correlation's temporal correlation into a high spatial correlation in the 2D representation ("IACC"). The purpose of rotating the event temporal frames horizontally is to better utilise the unique correlation of the video cube frame extremities. The distances between the pixels that are correlated in the source are likewise minimized by accordion representation in this way.

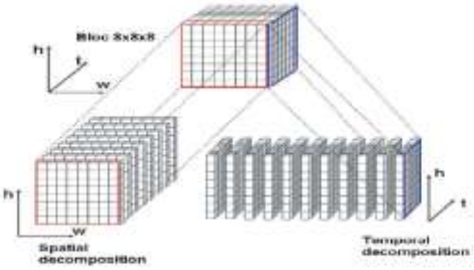


Figure: 3.2 Spatio-Temporal Decomposition

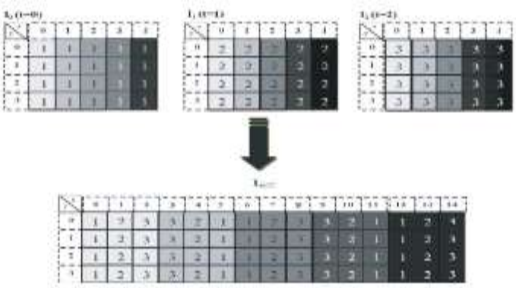


Figure: 3.3AccordionRepresentation

DCT BASED CODING METHODS

Transform coding, which was created more than 20 years ago, has shown to be a very efficient video coding technique, particularly in the spatial domain. It now serves as the cornerstone for practically all video coding standards. The DCT, a format that is extremely similar to JPEG, is used by the majority of transform-based intraframe video coders. The name M-JPEG for the video format might be interpreted as standing for motion. N blocks are first separated from the input frame. Each block receives a unitary space-frequency transform, which results in a N X N block of transform (spectral) coefficients

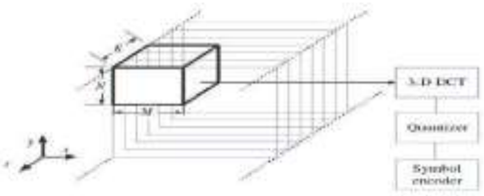
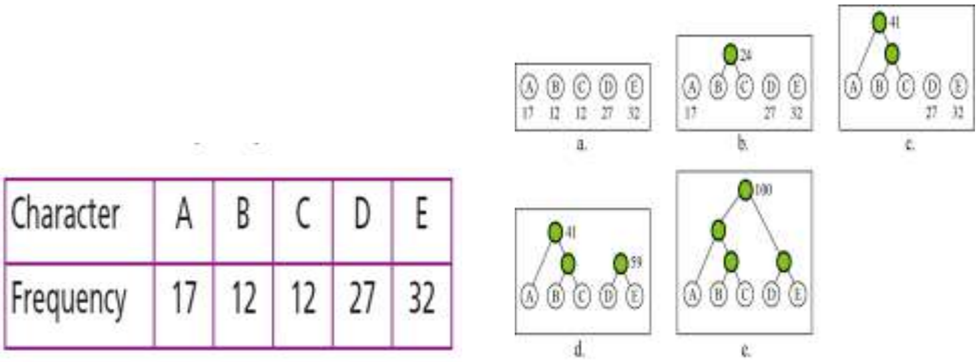


Figure: 3.4 DCT Applying

A real valued transform that is closely similar to the DFT is the DCT. In particular, a rapid computing approach results from the expression of a N N DCT of x (n1, n2) in terms of the DFT of its even-symmetric extension. There are no artificial discontinuities produced at the block boundaries due to the even-symmetric extension procedure. Additionally, real arithmetic is all that is needed to calculate the DCT. The DCT is well-known and frequently used for data compression because of the aforementioned characteristics.

HUFFMAN CODING

Symbols that appear more frequently are given shorter codes, while symbols that occur less frequently are given longer codes. Consider a text file with simply five characters, for instance (A, B, C, D, E). We first assign a weight to each character depending on how frequently it is used before we can assign bit patterns to each character. Assume for the purposes of this example that the character frequency is as indicated in the table. Starting at the root and following the branches that lead to a character will reveal the character's code. The bit value of each branch on the path, taken sequentially, makes up the code itself.



Character	A	B	C	D	E
Frequency	17	12	12	27	32

Figure: 3.5 Huffman coding

The DCT is utilized in the temporal domain in the suggested approach. ACCfiJPEG still has certain artefacts left over from 3D DCT-based compression techniques [9][10]. In fact, the translation from the spatial to the frequency domain is possible when the DCT is applied to IACC. After the quantification process, we will remove the "IACC" frame's high spatial frequencies, which really display the source's high temporal frequencies for the 3D signal. Therefore, a strong quantification will not impair the visual quality but will instead affect the video's flow.

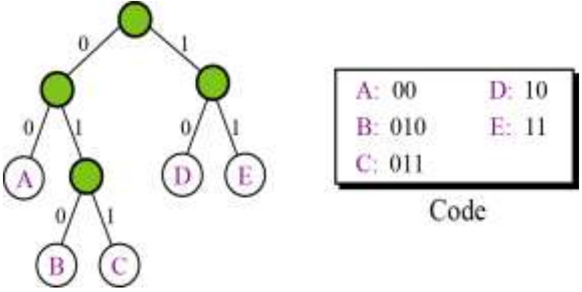


Figure: 3.6 Final Tree Diagram & Code

It is possible to interpret a pixel's value shift from one frame to the next as a high frequency in the temporal domain. The signal is smoothed after some of the coefficients have been quantized (set to zero). As a result, some quick changes over time are a little distorted, which explains the different character of the ACCJPEG PSNR. A useful feature like noise removal will be provided by this. In fact, the very high temporal frequency.

RESULT

In fact, this approach eventually unifies each collection of images into a single image with strong spatial association. As a result, the decorrelation of the images created by the DCT results in effective energy compaction and a high video compression ratio.

Browse input:

Figure: 5.1 Browse input

Output validation values:

Figure: 5.2 output validation & values

It entails converting the video frames from 3D to 2D, which enables exploration of the video's temporal redundancy using 2D transformations computationally taxing motion correction phase. The video's high spatial correlation is a result of this alteration of its spatial temporal correlation. In fact, this approach eventually unifies each collection of images into a single image with strong spatial association. As a result, the decor relation of the DCT-generated images results in effective energy compaction and a high video compression ratio.

5.3 Comparison Between Existing System And Proposed Method

S.NO	PARAMETERS	EXISTING SYSTEM	PROPOSED METHOD
1.	Encrypted time	200.68 ms	220.83 ms
2.	Decrypted time	2.468 µs	5.5369 µs
3.	Mean Square Error (MSE)	5.472	0.2425
4.	Peak signal-to-noise ratio (PSNR)	39.256 dB	78.468 dB

5.4 Graphical Representation

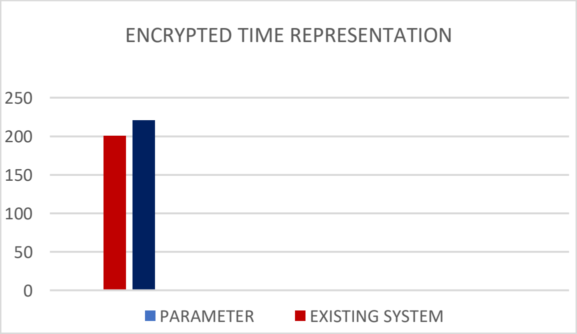


Figure: 5.5 Encrypted time

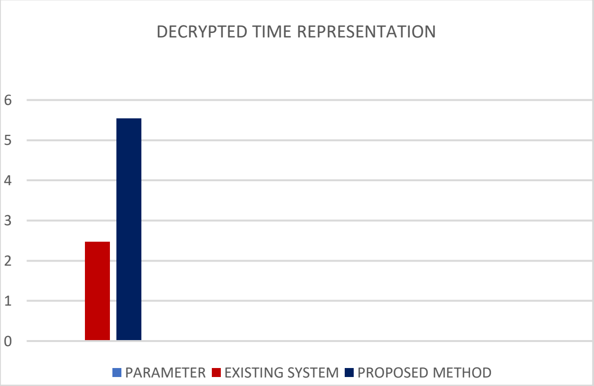


Figure: 5.6 Decrypted Time

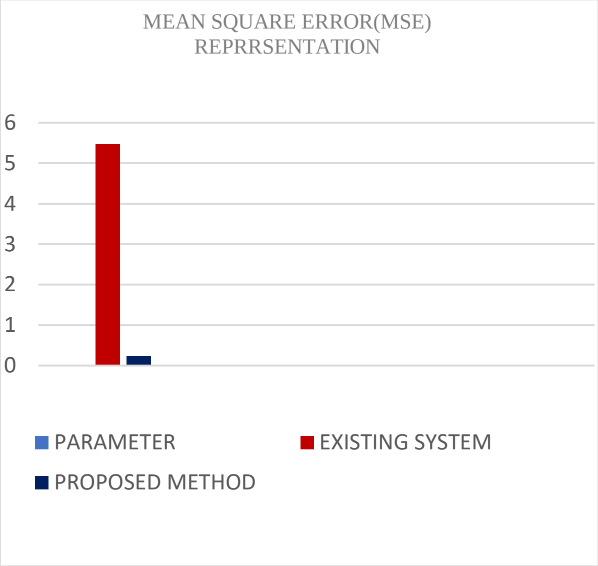


Figure: 5.7 MSE Values

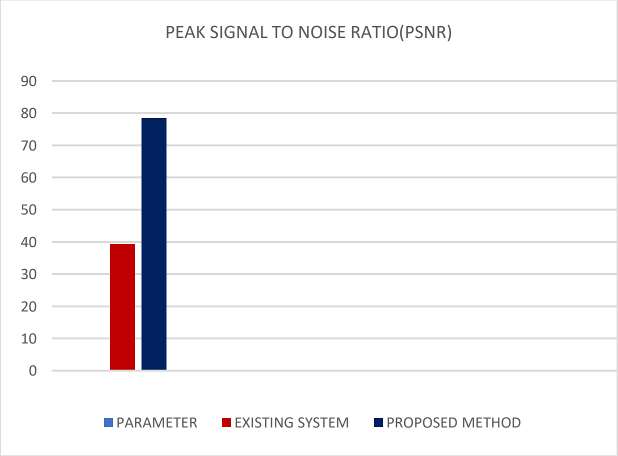


Figure: 5.8 PSNR Values

6 CONCLUSION

We put out a brand-new video quality model termed that can take into consideration the perceived impacts of space-time distortions such the simultaneous application of compression and spatial and/or temporal subsampling. This effort is based on recent research on the space-time statistics of natural movies, where we demonstrated the existence of space-time directional regularities that are exposed by comparing frames that are out of sync with one another, then divisively normalizing the results. We came up with a method to pinpoint the best space-time regular routes in a perfect film. We came up with features that quantify the degree to which spatial and/or temporal subsampling and compression violate these space-time directional regularities.

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