

SCANNED DOCUMENT COMPRESSION USING HIGH EFFICIENCY VIDEO CODING (HEVC) STANDARD

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ABSTRACT

Compression of the scanned image documents becomes more difficult since it consists of constant nature picture, or it is binaries earlier than compression. It might cause the quality of the image to object outline and quality. In order to solve this issues in this research work presents a novel document compression or data compression is designed and implemented for scanned documents .This implementation follows the procedure of HEVC video compression method standard to compress the scanned documents and follows a pattern matching algorithm to predicts the results of the compression .The efficiency of the proposed HEVC document compression methods is applied to high-quality particular and multipage document compressor. The proposed HEVC document compression make use of the quad tree based structure method to maintain macro blocks of size 64×64 , 32×32 , and 16×16 pixels. The quality of the compressed scanned documents results of the proposed HEVC methods is measured by using angular prediction and planar coding thus improve the quality of the scanned documents .The results of the proposed HEVC data compression and existing H264 data compression results are measured in terms of the parameters namely Peak Signal to noise ratio(PSNR),Normalized correlation coefficient (NCC) and Image Fidelity ,time comparison results .It experimented that the proposed HEVC methods have higher PSNR,NCC ,IF and less time comparison than the earlier data compression H264 methods.

Keywords : Data compression, HEVC standard, Binarization , Quad Tree Based Coding, performance comparison ,peak signal to noise ratio (PSNR) ,Normalized correlation coefficient (NCC),information fidelity (IF) .

1. INTRODUCTION

In imaging knowledge, Image processing is a form of signal processing intended for specified image, such as get something on film or videocassette frame; the results of the image processing methods may be image or representation of the set of description of the image. Most of the image

processing methods consider the image as two dimensional manner thus apply general image processing methods to perform these processes.

Image processing usually refers to digital image processing method to perform the above mentioned tasks. In an informative image processing method it must be probable to be appropriate detailed image processing operation to particular regions. Consequently individual measurement of an image capacity is procedure towards restrain movement shape at the same time as another measurement capacity is practiced to get better color performance.

Image compression [1-4] is disturbed through reduce the amount of bits essential to characterize as an image. Several number of the image compression which relates to real time applications are telecast TV, remote sensing via satellite, military communication ,telecommunication , teleconferencing, transformation of the image into some form of the notion for the educational ,governmental activities and medical images for magnetic resonance imaging , dependency image, climate maps, and so on.

In order to perform this process existing work uses a H.264/AVC Figure 1 document compression method by applying the document compression method in the different direction manner. Several number of the different block sizes are taken into document compression in four directions that each one of the direction in the document compression method consists of several number of modes of operation and use of four neighboring block pixels size for final prediction . In this standard is only applicable to small number of image block size and supports only four direction to predict data compression this is not efficient method for all real time applications this problem is solved by using the Advanced video coding (AVC) method for scanned documents data compression is applied to H.264.

Advanced Video Coding is a manuscript available through the international standards bodies ITU-T (International Telecommunication Union) and ISO/IEC (International

Organization for Standardizations / International Electro technical Commission). It generally specifies a design in favour of compressed video and a technique designed for decoding this format to construct a displayable video series. The pattern document is does not essentially indicate how to decide digital video encoder and it becomes more complex in practice.

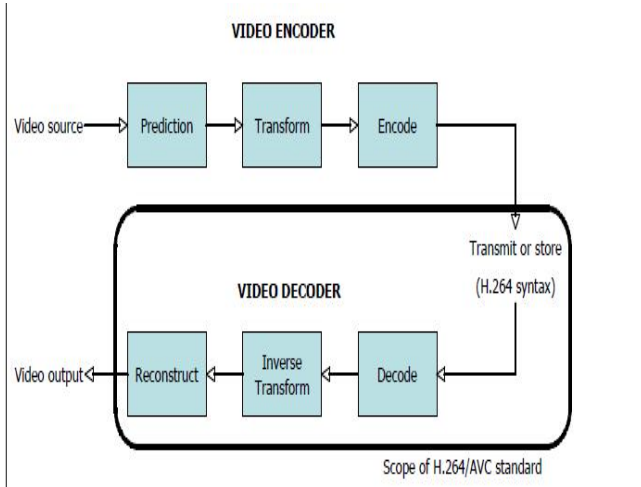


Figure 1 : The H.264 Video Coding and Decoding Process

Digital media maintain designed for document transmission and storage space substantiate the necessitate for well-organized coding algorithms have been discussed and implemented in well-organized manner [5-8]. Conventional paper media is being substitute through digital versions, with the improvement of keep away from the huge storage space and conservation needs related through the document versions, whilst building the documents without difficulty for a big number of users. The major purpose of the current work is to capably constrict scanned compound documents. Such documents are frequently initiate through examination of book that includes mutually text and pictorial contents.

2. BACKGROUND STUDY

In [9], the condition of the majority of video coding standards together with MPEG-2 Visual, H.263 and H.264/AVC present merely the bit-stream grammar and the decipher development in regulate in the direction of allow interoperability. The encoding process is taken into the consideration for during development process to reduce the complexity of the compression. Though, the outfitted manage of the basis encoder is a key difficulty in video compression. For the principle, encoding of a videocassette

resource, additional coding factors such as large-scale block form, shift vectors, and transform coefficient intensity have been strong-minded. The preferred values conclude the rate-distortion effectiveness of the created bitstream of a specified encoder.

In [10], ever-increasing significance of digital medium hold up designed for document communication and storage space justify the necessitate designed for well-organized coding algorithms used for this type of information has been examined. Conventional paper media is being substitute through digital versions, with the improvement of keep away from the huge storage space and conservation needs related through the document versions, whilst building the documents without difficulty for a big number of users. Unlike synthetic created documents cannot be straightforwardly segmented into foreground and background objects; as a result, manuscript encoders have a propensity to have poor results.

A new intra-prediction mode [11] designed for the H.264/AVC standard. In every one pixel inside a block is calculate through a weighted sum of its neighbours with Markov linear model. Then the weights are obtained all the way through a least-squares approximation beginning restructure data in the neighboring blocks, consequently with the intention of negative overhead is essential to communicate the weights to the decoder.

In[12] enlarge the job as well as be appropriate context-adaptive linear prediction all the way through the make use of LSP intra prediction. Ever since the linear prediction coefficients absolutely surround the neighbouring texture characteristics, the intra prediction mode preserve be adaptively familiar according to the local context. negative additional overhead is necessary for signalling the coefficients along with the decoder basically repeat the equivalent deriving process.

In[13], H.264/AVC is the mainly recent intercontinental video coding standard by ITU-T (International Telecommunication Union) and ISO/IEC (International Organization for Standardization / International Electro technical Commission). The MPEG-2 video coding standard through maintain of interlaced video coding, was make possible technology intended for digital television systems WWW. Though, a growing amount of services and increasing recognition of elevated designation TV are

generate superior requirements designed for higher coding effectiveness.

In [14] future algorithm, use a multi scaling partition of the specified picture up to a prearranged level or up to that level by the side of which no additional division is needed. At every one level, the map furthermore the consequent probabilities are compute by means of the gray value in sequence controlled in with the purpose of image level along with in the image level advanced to that level. A most excellent fine-tuning of the algorithm is at a standstill to be done. But, the nearly everyone relatively interesting measurement of the future techniques is excessive fastness during image encoding. It preserve be look in the lead as individual of the greatest solution to the difficulty of huge computational cost for obtaining fractal code of images.

In [15], propose an enhanced pre- in addition to post-processing algorithm to facilitate sharpens the document previous to compression by remove the describe halo effect along with softens it again, subsequent to reconstruction, by means of a Gaussian filter. concerning compression, we propose a 3-layer MRC codec designed for composite documents with the purpose of uses the H.264/AVC operational in INTRA mode (AVC-I) to encode Foreground along with Background layers as well as JBIG2 towards encode the binary Mask. Even although fundamental scheme used now has been accessible in one of our previous works.

In [16], Intra prediction as well as transform participate significant roles in exploring spatial correlation. By using flexible way guess along with block range partition followed through DCT transform, the state-of-the-art video coding calculate H.264/AVC accomplish towering coding efficiency during intra frame coding. In this, the directional prediction, reconstruct border pixels are use to extrapolate a prediction block all along every prediction direction.

In [17], the multidimensional multiscale parser (MMP) algorithm, a newly proposed an entire lossy compression technique has been effectively useful towards descriptions as glowing as former types of data, as video and ECG signals have been residential. Dictionary is updated by means of extended additionally contracted version of concatenations of earlier encoded blocks. This tends that MMP build its individual dictionary although the input data be individual encoded, by using segments of the input itself, which lend its entire flavor.

3. PROPOSED METHODOLOGY

In this paper presents a novel data compression method for data where each page or documented is compressed into some form of the data to reduce the complexity of the documents, it reduces the storage capacity of the pages of documents. In earlier work uses video encoding based H.264/AVC standard method to compress the document in the pages. In this method the documents are converted into blocks and grouped as frames, and then these frames are predicted by using the prediction. It produces best data compression results for converted frames since the existing data compression standard method are easily applicable to the video compression method in well organized manner. The major issue of the presented video coding based data compression method requires a Larger gains to perform the encoding process in the data compression stage, it reduces the compression results and more time complexity to perform data compression.

In order to perform this process into the larger gains in the data compression process ,in this work presents a novel document compression method which uses a HEVC standard based quad tree data compression methods .In this works the documents are splitted into many pages and grouped them similar pages into frames. The select anyone of the grouped frames into the, video coding HEVC standard method. These frames are decomposed into the blocks with different images sizes 64×64 , 32×32 , and 16×16 pixels for quad tree based pattern matching to match the similar frames and it is compressed using video standard HEVC method.

This work each one of the selected document from pages is considered as tree and the splitted block size from the pages is considered as leaf node in the quad tree based video coding structure. In this work the compressed document results are predicted or measured based on the two pattern matching methods such as Angular prediction and planar coding. These selected predicted methods improves the quality of the document compression method thus reduces the size of the documents without reducing the quality of the documents and without missing the text that are presented in the documents .The performance comparison results of the existing and proposed HEVC data compression method have measured using the parameters like PSNR, NCC,IF and time after compression is performed. PSNR can be measured with the number of bits of the scanned documents.

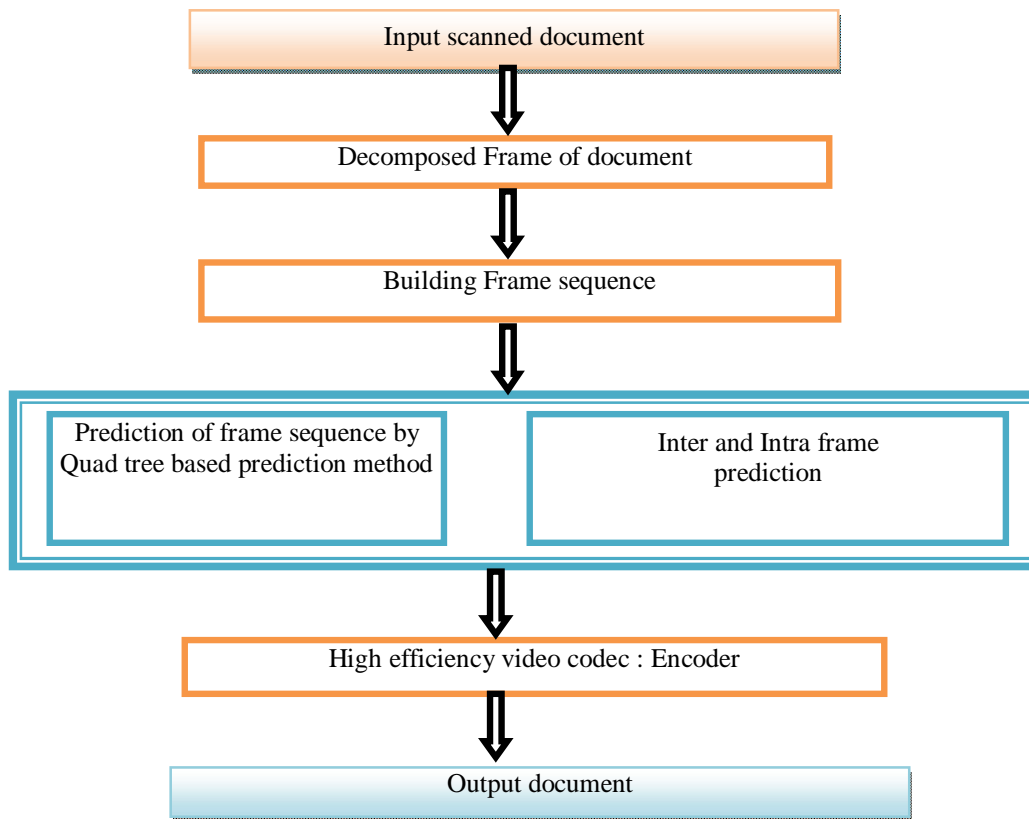


Figure 2 : Proposed methodology architecture

In existing work uses a block matching based estimation method for document compression, where in this work each document is splitted into various blocks.

H.264/AVC

In black based matching method the splitted documents are grouped as frames and it is fed into video compression H.264 method to perform data compression .It consists of several number of macro blocks of the following size such as 16×16 , 16×8 , 8×16 , 8×8 , 4×8 , 8×4 , and 4×4 pixels. Then it performs a block based matching method for each one of block size pixels similar pixels size are matched and fed into compression method the position of the frames are similarly matched based on the correlation function result for each one of the frames in the converted document image .

H.264 Motion Estimation Algorithm

The general unit of this video compression standard method is 16×16 macro block. In this schema each one of the selected macro block is divided into several number of the encoding frame such as 16×8 , 8×16 , and 8×8 blocks.

Similarly the 8×8 macro blocks is also further splitted into 8×4 , 4×8 and 4×4 blocks. The following two major steps are taken into consideration to make final decision in encoding mode during data compression.

Step 1: Most excellent motion vectors (MV) of every probable mode are considered. The corresponding criterion is characteristically desired based on the sum of the absolute difference (SAD).

Step 2: The rate-distortion evaluation results of the each one of the mode in the selected block is tested, less rate distortion result is selected as the best mode for data compression. But in this work the various block size are not supported during data compression process. In order to overcome these problems and improve the document compression result, in this work presents a HEVC document compression method which improves the document compression results.

Quad Tree Based Prediction Representation

The efficiency of the proposed document compression method results is improved by utilizing different macro

block pixels structures. It supported upto 64 * 64 sizes of pixel values that transform the data blocks into frames and calculates the spatial correlation with the purpose of high declaration. A usually high spatial resolutions value becomes more efficient to specify the larger block sizes. In this method large block sizes are represented in the form of the quad tree structure. HEVC proposal limit the make use of huge macro blocks to inter-picture coding modes, and through simply individual of the motion vector. In this work smaller block sizes are not taken for document compression to reduce the encoding complexity .The very smaller micro blocks are grouped into larger macro blocks of 64 x 64 sizes with less rate–distortion optimized (RDO) fashion.

Proposed QT-Based Motion Estimator Algorithm

Step 1: Quad tree structure decomposes the document image into following sizes $2^N \times 2^N$ down to blocks of size $2^{n_0} \times 2^{n_0}$, $2^n \times 2^n$ into $2^{n_0} \times 2^{n_0}$

Step 2: this decomposed block is further splitted into quad tree structure in square manner and pick randomly one block bit from this splitting results is represented as $(N - n_0 + 1)$ –level hierarchy ($0 \leq n_0 \leq N$)

Step 3: Build an inverted index tree for document block through the consideration of the tree and the leaf nodes separately for each document blocks. The tree node for selected block is represented as is $2^N \times 2^N$

Step 4: After the tree node is selected then the child node for the quad tree is also added and it is represented as $2^{N-1} \times 2^{N-1}$

Step 5: In this tree structure the nodes values of the tree is represented as bit values such as 0 and 1, where the leaf nodes is represented as “0” and the siblings nodes of the leaf node is represented as the bit stream value of “1.”

Step 6: Let b_{i_1} //Block i with level 1

Step 7: $b_{i_1-1,4+i+j} b_{i_2}$ the children where $j \in [0,1,2,3]$ where T be the completed tree with ordered pairs of nodes(l,i).

Inter and Intra frame Prediction

HEVC

The aim of this work is to improve the quality of the document compression method , the proposed method has

two prediction methods such as angular prediction and planar coding. The details are given below.

Angular Prediction

A block which has the similar characteristics and size are selected based on the calculation of the angular value in nine different directions. In this different directions the block size of the similar frames are extended and predicted in efficient manner. This procedure can be done by the selection of the block sizes in uninformed direction through representing the prediction angle. In this work the predicted block is represented in 2-D array prediction Block and is created for various different block of sizes $N \times N$ pixels as follows.

Step 1: Angle of prediction indication: The angle of prediction is point towards through the dislocation of the previous row of the calculation chunk comparative to the indication row (the restructure row beyond the calculation chunk). This displacement is particular through integer pixel accurateness, and it will designate through variable $disp_{ref}$.

Step 2: Calculating Relative displacement designed for each row: For every one of j th row in the calculation block the dislocation qualified to indication row is considered as follows:

$$disp(j) = disp_{ref} \cdot \left(\frac{j + 1}{N} \right)$$

where $j = 0 \dots N - 1$

Step 3: Calculate projected position: For the selected i th pixel in the block of the prediction row j is represented as pred Block(i, j).This value is dependent on higher position row . In this, if the ridge position has partial accuracy, then the calculation is created by means of linear interruption through 1/8 pixel accuracy. It is also, the prediction signal is generated through lifting the individual location pixel.

Planar Coding

It also use a another prediction method to enable the reconstruction process in well organized manner for different block sizes . The planar method make available maximal stability of the image level surface at the macro block boundaries and is capable to pursue regular transform of the pixel values through indication of planar gradient intended for every macro block implied in this mode.

Encoding of macro block in Planar mode

Step 1: Indication of bottom right example of macro block in a bit stream.

Step 2: Determine right most value for selected bottom samples from the document block size through calculation of the interpolation among the bottom-right corner example and the closest reference example.

Step 3: Compute the assessment of the nth example in the bottom row of samples by using ,

$$P_n = ((S - n) \cdot P_r + n \cdot P_c + S/2)/S$$

Where $n = (1, S)$ determination characterize the width and height of a square block of samples. P_r =closest reference example, $P_c = \text{bottom - right corner sample}$

Step 4: Compute Middle example values $P(x,y)$ through via bilinear interpolation.

$$P(x, y) = P(x, 0) + P(0, y) + P_r + P_c$$

It is obtained by the weighting the sum of the above mentioned two reference samples values ,the reconstructed value of the block is directly specified as (denoted as $P(x, 0)$), and to the left (denoted as $P(0, y)$), jointly through the linearly interpolated example standards in the rightmost column and on the bottom row of the chunk.

Step 5: Decrease curve of the planar plane. This is capable of separating the planar-coded neighbourhood addicted to portion wise linear section and restructure them by means of linear interpolation.

4. EXPERIMENTAL RESULTS

In this experimentation work is carried out to MATLAB simulation environment with the set of the different documentation pages is taken for data compression using the standard document compression method such as H.264 and Quad -Tree based Compression. In order to measure the performance accuracy of the above mentioned data compression methods ,we adopt a conventional image compression metrics such as peak signal to noise ratio(PSNR), Image Fidelity(IF), and Normalized correlation coefficient(NCC) as a distortion metric. Conventional PSNR have been used to evaluate the quality of the data compression methods before and after the compression of the image or text, documents etc. If the

value of the compressed data is achieves higher PSNR value it says that the data compression result of the propose HEVC works well without loss of the data or image information. Similarly the image fidelity of the proposed work also high it says that qualities of the input data are not reduced.

In this experimentation work measure the performance evaluation of the proposed HEVC based quad tree image compression method and the existing H.264 data compression methods in terms of the PSNR,MSE,NCC and image fidelity (IF) .It demonstrate that the performance comparison results of the proposed HEVC method have higher PSNR values, NCC and IF for selected data since it performs the data compression method based on the referred data compression results and intra ,inter frame detection is performed separately to improve data compression results .To reduce the complexity of the work proposed methods uses a quad tree based compression ,during compression process each data in the documents are splitted as quad tree manner, higher order wise the tree splitted again and again this reduces complexity and exactly identifies the data in efficient manner thus improves the performance of the proposed HEVC data compression results when compression to existing data compression method.

4.1 Peak Signal-To-Noise Ratio (PSNR)

The purpose of the PSNR is used to measure the performance comparison of the data compression methods in terms of the quality for compressed data image Z sized $M \times N$ is

$$PSNR = 10 \log_{10} \frac{255^2}{MSE}$$

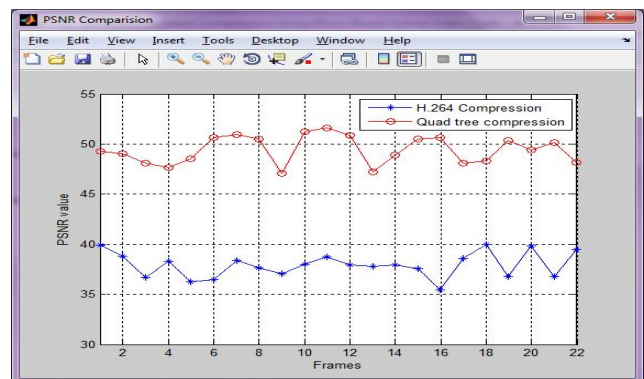


Figure 3 : PSNR Comparison Graph for H.264 and Quad -Tree Based Compression

In the above Figure 3 shows the performance evaluation results of the proposed HEVC quad tree based data compression method results and existing H.264 data compression methods. The PSNR value is higher for Quad –tree based compression when compare with the existing H.264 .It says that better document quality is achieved when using Quad tree based compression against H.264. Larger gains with minimal distortion of the document can be resulted.

4.2 Mean Square error (MSE)

In PSNR, Means square error is defined as the measurements of error value results for compressed data and it specified as follows ,

$$MSE = \frac{\sum_{x=0}^{M-1} \sum_{y=0}^{N-1} (A(x, y) - Z(x, y))^2}{MN}$$

Where m x n be the original data I and its compressed data approximation is specified as K.

4.3 Image Fidelity

The strength of the compressed data results is measured in terms of the image fidelity (IF) is evaluated by combining two major quality metrics such as IF_m and IF_f into a quality score,

$$IF = \lambda \cdot IF_m + (1 - \lambda)IF_f$$

IF_m – Correlation measurement , IF_f -Similarity Where $0 < \lambda < 1$ is a parameter used for fine-tuning the comparative significance of the two components.

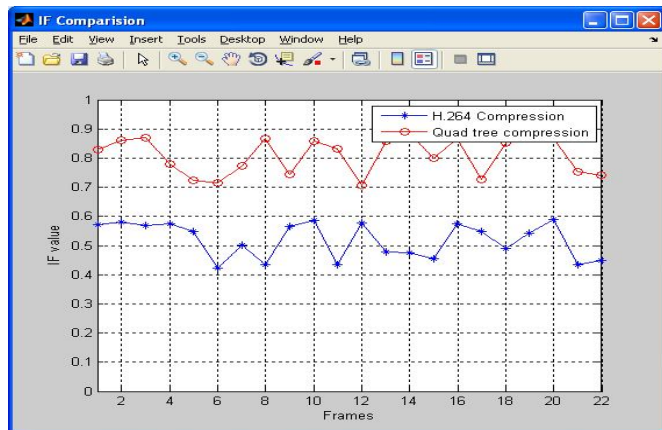


Figure 4 : IF Comparison Graph for H.264 and Quad –Tree Based Compression

In the above Figure 4 shows the performance evaluation image fidelity results of the proposed HEVC quad tree based data compression method results and existing H.264 data compression methods. The Image fidelity (IF) results for proposed quad tree based data compression results is high when compare to existing H.264 .It says that better document quality is achieved when using Quad tree based compression against H.264. Larger gains with minimal distortion of the document can be resulted.

4.4 Normalised correlation coefficient

The performance evaluation results for compressed and scanned document can be measured by considering the following condition If the scene viewed time will be high it compressed data result also high . In order to improve the data compression results the original data image are manually adjusted into some of the dynamic range , the real strength values are stretched to fill up a well-built interval. This can be completed via using the fundamental template matching equation

$$r_{Lp} = 1 - \frac{1}{d_{max}} \left(\frac{1}{N} \sum_i |A(i) - B(i)|^p \right)^{1/p}$$

where A, and B are two matching patterns and d_{max} is the utmost probable distance among them. This is accurately what NCC correlation does when call up by way of category = "Lp" and standardize = FALSE.

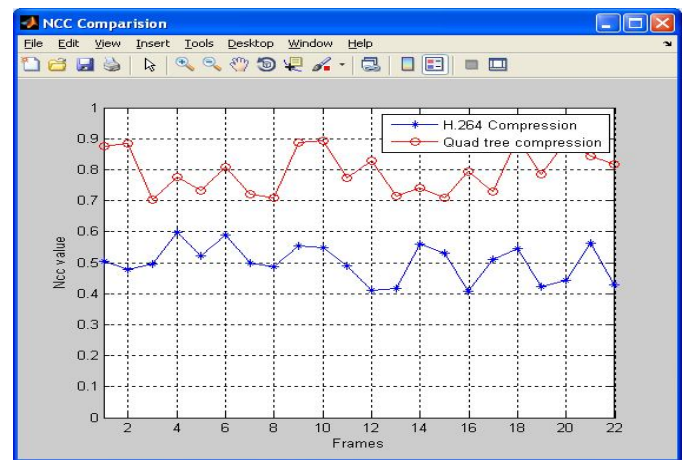


Figure 5 : NCC Comparison Graph for H.264 and Quad –Tree Based Compression

In the above Figure 5 shows the performance evaluation NCC results of the proposed HEVC quad tree based data compression method results and existing H.264 data

compression methods. The NCC are high for proposed quad tree based data compression results, when compared to existing H.264. It says that better document quality is achieved when using Quad tree based compression against H.264. Larger gains with minimal distortion of the document can be resulted. The above graphs show the PSNR, IF, NCC value and values are tabulated in Table 1.

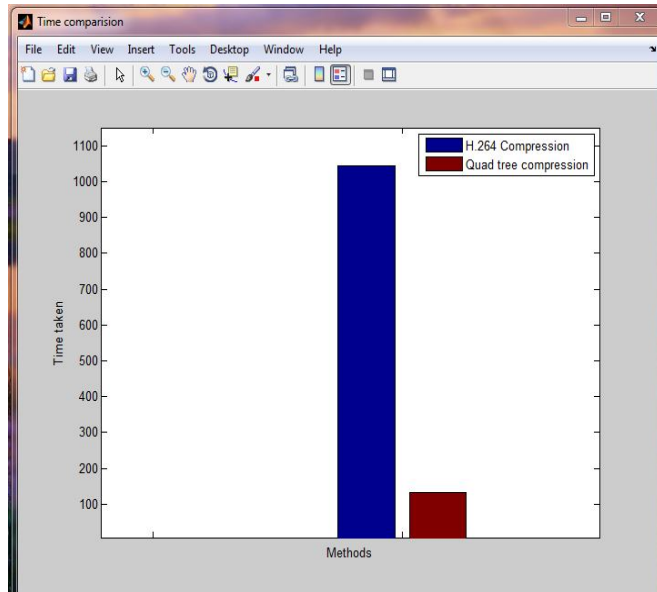


Figure 6 : Time comparison of AVC and HEVC

In the above Figure 6 shows the performance evaluation time comparison results of the proposed HEVC quad tree based data compression method results and existing H.264 data compression methods. The time comparison results of the proposed system taken less 152.57 ms when compared to, when compared to existing H.264 data compression methods have taken 1089 ms. It says that better document quality is achieved when using Quad tree based compression against H.264.

5. CONCLUSION AND FUTURE WORK

In this research develop an novel data compression methods based on the video coding HEVC standard is implemented in MATLAB simulation environment. To reduce the complexity of work initially the documents are splitted into several number of the pages and these pages are grouped into the video frames. The selected documents pages in the frames are fed into the data compression standard HEVC method. After that the selected document can be decomposed into several numbers of the blocks. Then pattern matching is performed for selected data frames

based on quad tree-based coding structure. It splits the presents data blocks into the following size 64×64 , 32×32 , and 16×16 pixels. Each one of the document is considered as tree and the splitted blocks for documents is considered as leaf. Pattern matching is done by using two prediction methods such as Angular prediction and planar coding. Thus improves the quality of the data compression method. In this presents work we apply HEVC data compression method to documents, further this work should be extended this similar work to compress colored compound manuscripts. It is improved to devise a particular encoder designed for compressing together the text and the image blocks in the multifaceted manuscript well relatively than by means of divide encoders.

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