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Video Compression Using DCT

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Abstract— Video is the most useful and most appealing approach to represent some information. The huge usage of digital multimedia via communications media, wireless communications, Internet, Intranet and cellular mobile leads to incurable growth of data flow through these Media. The researchers go deep in developing efficient techniques in these fields such as data compression image compression and video compression Bandwidth required for video is huge. To reduce the bandwidth requirement in transferring multimedia files is major challenge now a day. Recently, video compression techniques and their applications in many areas (educational, agriculture, medical …) cause this field to be one of the most intersect fields. This paper presents performance of Discrete Cosine Transform (DCT) based algorithm for compressing video. This review paper introduces advancement in video compression technology with perceiving quality and content of video. Block matching algorithms used for motion estimation in video compression

Keywords— video compression, Bandwidth, Discrete Cosine Transform (DCT), Block matching, motion estimation

I. INTRODUCTION

The reduction of video size by means of a video compression, "Compressed" just means that the information is packed into a smaller space. Video takes up a lot of space. Compression decreases the file size, allowing for a reasonable amount of download time or Streaming capability but also decreases the quality of the video.
There are two types of compression systems mentioned below:

1. Lossy Compression System:

Lossy compression techniques can be used in images where some of the finer details in the image can be sacrificed for the sake of saving a little more bandwidth or storage space. Rresearch in digital video compression is dominated by lossy compression, where a certain level of distortion is introduced in order to achieve the best possible compression efficiency.

2. Lossless Compression system:

Lossless Compression System which aim at minimizing the bit rate of the compressed output without any distortion of the image. The decompressed bit-stream is identical to original bit-stream.

Need of Compression:

The amount of data associated with visual information is so large that its storage would require enormous storage capacity. The figures in the Table below show the qualitative transition from simple text to full motion video data and the disk space needed to store such uncompressed data.

Table 1.1: Multimedia data types and uncompressed storage space required

Multi-media data	**Size/duration**	**Bits/pixel Bits/sample**	**Uncompressed size**
Page of text	11"x8.5"	Varying resolution	16-32 kbits
Telephone quality speech	1 sec	8 bps	64 kbit
Greyscale image	512x512	8 bpp	2 mbits
Color image	512x512	24 bpp	6.29 mbits
Full motion video	Full motion video	24 bpp	2.21 gbits

The examples above clearly illustrate the need for large storage space for digital image, audio and video data. So at the present state of technology, the only solution is to compress these multimedia data before its storage and transmission, and decompress it at the receiver for playback.

II. VIDEO COMPRESSION

The basic video compression system comprises of the video encoder at the transmitter side, which encodes the video to be transmitted in terms of bits and the video decoder at the receiver side, which reconstructs the video in its original form from the bit sequence received. The sub systems of encoder and decoder are discussed below with the detailed technology aspects from theory point of view. The steps to be followed for encoding are discussed below:

Video consist number of frames. First of all the video is converted into the sequence of frames which are nothing but like still images sequence. The intra coding method used for compression of I frame. Spatial redundancy is explained as below:

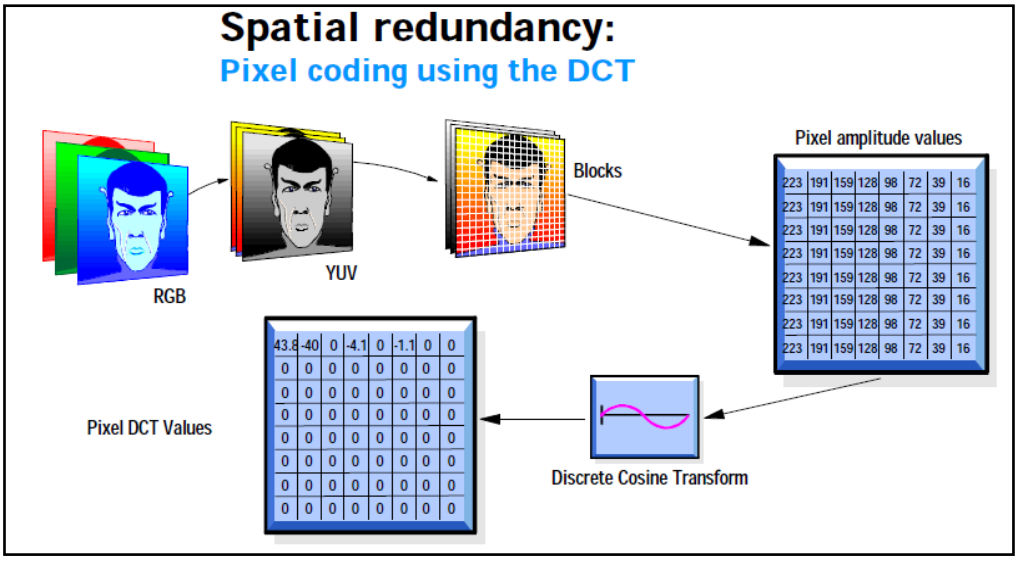

Fig 1.1 Spatial Redundancy using DCT

1. Spatial Redundancy:

The first stage is to create an I-frame; subsequent frames in a group of frames will be redirected from this frame. As the eye is insensitive to HF color changes, we convert the R,G,B signal into a luminance (how bright the picture is) and two color difference signals. We can remove more U, V information than Y. Each pixel DCT is calculated from all other pixel values, so taking 8x8 blocks reduces the processing time. The top left pixel in a block is taken as the dc datum for the block. DCT's to the right of the datum are increasingly higher horizontal spatial freqs. DCT's below are higher vertical spatial frequencies. Using an Inverse DCT we could reconstruct each pixel's value in the 8x8 block. The DCT is a lossless and reversible process.

2. Temporal Redundancy:

The consecutive frames are correlated with each other so can predict one from other and getting residue from them which will give temporal compression in the video. So according to this there are three kinds of frames in GOP: I frame P-frame and B-frame.

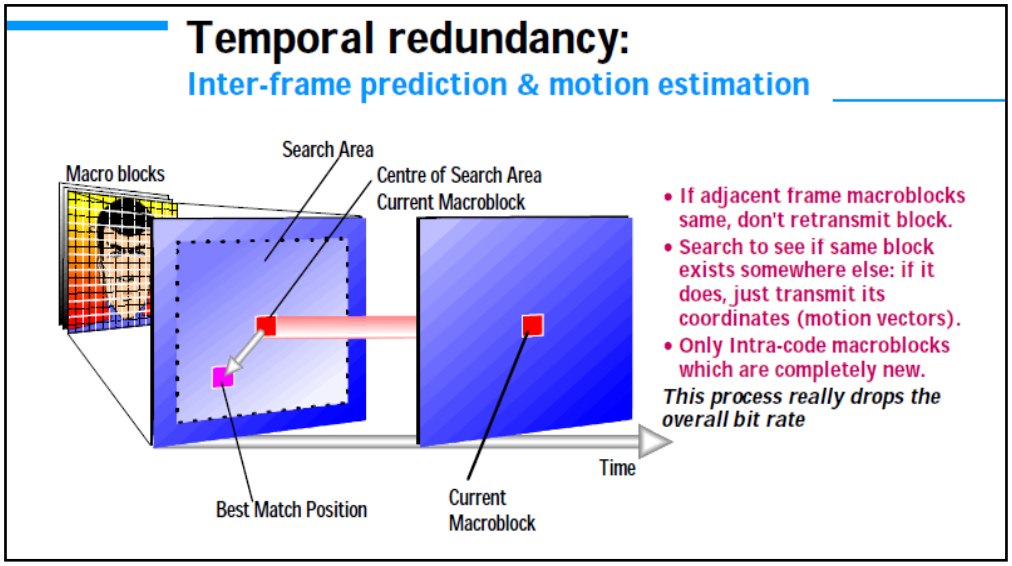

Fig.1.2 Temporal Redundancy

Block based motion compensation uses blocks from a past frame to construct a replica of the current frame. The past frame is a frame that has already been transmitted to the receiver. For each block in the current frame a matching block is found in the past frame and if its motion vector is substituted for the block during transmission. Depending on the search threshold some blocks will be transmitted in their entirety rather than substituted by motion vectors. The problem of finding the most suitable block in the past frame is known as the block matching problem.

The stages in Inter frame coding is explained in following steps:

1. Frame Segmentation:

The current frame of video to be compressed is divided into equal sized non-overlapping rectangular blocks. Ideally the frame dimensions are multiples of the block size and square blocks are most common. Block size affects the performance of compression techniques. The larger the block size, the fewer the number of blocks, and hence fewer motion vectors need to be transmitted.

Small blocks result in a greater number of motion vectors, but each matching block is more likely to closely match its target and so less correction data is required.

2. Search Threshold:

If the difference between the target block and the candidate block at the same position in the past frame is below some threshold then it is assumed that no motion has taken place and a zero vector is returned. Thus the expense of a search is avoided. Most video codec employ a threshold in order to determine if the computational effort of a search is warranted.

3. Block Matching:

Block matching is the most time consuming part of the encoding process. During block matching each target block of the current frame is compared with a past frame in order to find a matching block. When the current frame is reconstructed by the receiver this matching block is used as a substitute for the block from the current frame.

The search can be carried out on the entire past frame, but is usually restricted to a smaller search area centred on the position of the target block in the current frame. The maximum displacement is specified as the maximum number of pixels in the horizontal and vertical directions that a candidate block can be from the position of the target block in the original frame.

If the block size is *b* and the maximum displacements in the horizontal and vertical directions are *dx* and *dy* respectively, then the search area will be of size (2*dx* +*b*) (2*dy* + *b*). Excluding sub-pixel accuracy it will contain (2*dx* + 1)(2*dy*+1) distinct, but overlapping, candidate blocks. Clearly the larger the allowable displacement the greater the probability of finding a good match.

Considering every candidate block in the search area as a potential match is known as an *Exhaustive* Search, *Brute Force* Search, or *Full* Search.

4. Matching Criteria:

In order for the compressed frame to look like the original, the substitute block must be as similar as possible to the one it replaces. Thus a *matching criterion* is used to quantify the similarity between the target block and candidate blocks. If, due to a large search area, many candidate blocks are considered, then the matching criteria will be evaluated many times. If the matching criterion results in bad matches then the quality of the compression will be adversely affected.

5. Motion Vector:

Once the best substitute, or *matching block*, has been found for the target block, a motion vector is calculated. The motion vector describes the location of the matching block from the past frame with reference to the position of the target block in the current frame.

III. VIDEO DECODER

The working of the decoder is as explained below:

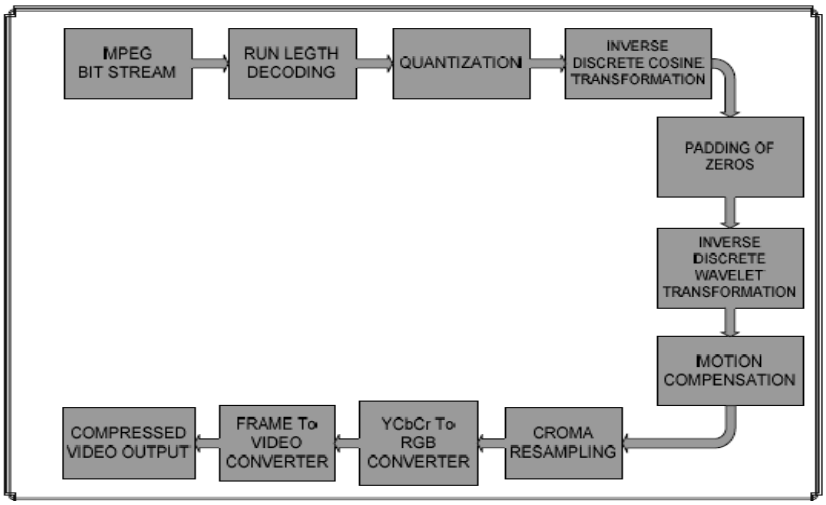

Fig. 1.3 Block diagram of Video Decoder

1. In the first step the bit stream of MPEG is decoded using run length decoder and converted to original coefficients of DCT.
2. The coefficients of DCT are quantized using quantization matrix to original DCT coefficients.
3. Then inverse DCT is taken which will give approximate component of frame.
4. Then the frames are motion compensated through motion estimation algorithm.
5. Then the chrominance component is re-sampled to original form.
6. The frames are converted back to RGB from YCbCr.
7. Finally the sequence of frames is converted to video which is final compressed video.

IV. MEASURING PARAMETER

Following parameters are subjective measure of degradation of video after the compression.

1. PSNR (peak signal-to-noise ratio):

PSNR is measured for degradation of video after the compression. PSNR is ratio between the maximum possible power of a signal and the power of corrupting noise.

$$\text{PSNR} = 10 * \log \frac{255^2}{\text{MSE}}$$

2. SSIM (Structural Similarity):

The structural similarity (SSIM) index is a method for measuring the similarity between two images.The SSIM metric is calculated on various windows of an image. The measure between two windows x and y of common size N×N is:

$$\text{SSIM}(x,y) = \frac{(2\mu_x\mu_y + c_1)(2\sigma_{xy} + c_2)}{(\mu_x^2 + \mu_y^2 + c_1)(\sigma_x^2 + \sigma_y^2 + c_2)}$$

With

- μ_x the average of x;
- μ_y the average of y;
- σ_x^2 the variance of x;
- σ_y^2 the variance of y;
- σ_{xy} the covariance of x and y;
- $c_1=(k_1 L)^2$, $c_2=(k_2 L)^2$ two variables to stabilize the division with weak denominator;

3. MSE (Mean Square Error):

The MSE represents the cumulative squared error between the compressed and the original image. The mean square error is the average of the squared errors between actual and estimated readings in a data sample.

4. CR (Compression Ratio):

The compression ratio between two videos: the original one and the compressed one coming out of video encoder, which is measured by equation as below:

$$\text{CR} = 100 * \frac{\text{Compressed\_data\_rate}}{\text{Uncompressed\_data\_rate}}$$

V. RESULTS

The comparative results of different videos are given in tabular form:

Table 1.2 Video Compression Results for Different Videos

Sr.No	Video File Name	original video Data rate	Compressed Video Data Rate	compression Ratio	PSNR	SSIM	MSE
1	Misamerica.avi	91238400	25771	147.51	34.35	0.91	86.95
2	Suzie.avi	91238400	26599	142.92	30.49	0.84	492.84
3	Mobile.avi	182476800	48949	77.66	20.78	0.67	2489.2
4	Motherdaughter.avi	182476800	25969	146.39	35.93	0.92	85.54

VI. CONCLUSION

Implemented video compression technique and obtained results for different videos. As per results video compression must be implemented in practical video codec for better improvement in communication.

REFERENCE

[1] Weinberger, M.J., et al.: 'The LOCO-I lossless image compression algorithm: principles and standardization into JPEG-LS', IEEE Trans.Image Process., 2000, 9, pp. 1309–1324

[2] 'MPEG Digital Video-Coding Standards', IEEE Signal Processing Magazine, September, 1997, pp. 82-100.

[3] Aroh Barjatya, 'Block matching algorithms for Motion estimation', DIP 6620 Spring 2004 Final Project Paper
[4] Said, A., and Pearlman, W.: 'An image multiresolution representation for lossless and lossy compression', IEEE Trans. Image Process., 1996, 5, pp. 1303–1310
[5] Feng Xiao, 'DCT-based video quality evaluation', Final Project for EE392J, Winter 2000.
[6] Video Presentation and Compression, Borko Furht and Raymond Westwater.
[7] N. Ahmed, T. Natrajan, and K. R. Rao, "Discrete cosine transform," *IEEE Trans. Comput.*, vol. C-23, no. 1, pp. 90–93, Dec. 1984.
[8] G. K. Wallace, "JPEG still picture compression standard," in Commun. ACM, vol. 34, Apr. 1991, pp. 30–44.
[9] ISO, "MPEG: generic coding of moving pictures and associated audio", Recommendation H.262, ISO/IEC, 13818-2, 1995
[10] B. G. Haskell, A. Puri, and A. N. Netravali, Digital Video: An Introduction to MPEG-2. London, U.K.: Chapman & Hall, 1997, Digital Multimedia Standards Series.
[11] D. Taubman, M. Marcellin, JPEG2000: Image Compression Fundamentals, Standards, and Practice, Kluwer Academic Publishers, 2001.
[12] Tarek Ouni, Walid Ayedi, Mohamed Abid "New low complexity DCT based video compression Method", 2009 IEEE.
[13] Dragos Ruiu, 'An Overview of MPEG-2', The 1997 Digital Video Test Symposium.

