OBRT : Lossless Video Compression Using DCT and DWT Techniques

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***Abstract*—Video compression technique is now mature as is proven by the large number of applications that make use of DWT and DCT technology. This paper gives the idea about for video compression technique but not very much good for the real time video compression techniques either have a demerit of loosely techniques like DCT and DWT but here we are going to present a noble technique in which we will use object position change finding algorithm to get our video process in real time and having lossless decompressions. Compression is done in real time, such a way while maintaining the benefits of keeping all of the information of the source and also the benefits of compression during the production process[1]. "Lossless" means that the output from the decompressor is bit-for-bit identical with the original input to the compressor. The decompressed video stream should be completely identical to original. In addition to providing improved coding efficiency in real time the technique provides the ability to selectively encode, decode, and manipulate individual objects in a video stream. The technique used results in video coding that a high compression ratio can be obtained without any loss in data in real time.**

***Keywords*— Discrete Cosine Transform (DCT),Discrete Wavelet Transform (DWT).**

I. INTRODUCTION

Rapid growth of multimedia and Internet, compression techniques have become the thrust area in the fields of computers. Popularity of multimedia has led to integration of various types of computer data. Multimedia combines many data types like text, graphics, still images, animation, audio and video data.

Some of the advantages of these approaches include a more natural and accurate rendition of the moving object motion and efficient utilization of the available bit rate by focusing on the moving objects. In addition to these, compression advantages, if suitably constructed, the object repetition based coding techniques can also support content-based functionalities such as the ability to selectively code, decode, and manipulate specific objects in a video stream.

In this paper we present an object repetition based video coding approach that retains the relative advantages of both the hybrid based and block-based coders while minimizing the drawbacks of both.

A) Video Compression:

Video compression technology encompasses a wide range of research areas such as communications, information theory, image processing, computer vision, psychophysics, etc. Compression techniques come in two general flavors: lossless and lossy. As the name states, when lossless data is decompressed, the resulting image is identical to the original. Lossy compression algorithms result in loss of data and the decompressed image is not exactly the same as the original.

Fig1:Compression techniques

1)Lossless Compression : In lossless compression[2,4] scheme, the reconstructed image, after compression, is numerically identical to the original image.It is used in many applications such as ZIP file format & in UNIX tool gzip.It is important when the original & the decompressed data be identical. Some image file formats like PNG or GIF use only lossless compression. Most lossless compression programs do two things in sequence: the first step generates a statistical model for the input data, and the second step uses this model to map input data to bit sequences in such a way that "probable" (e.g. frequently encountered) data will produce shorter output than "improbable" data.

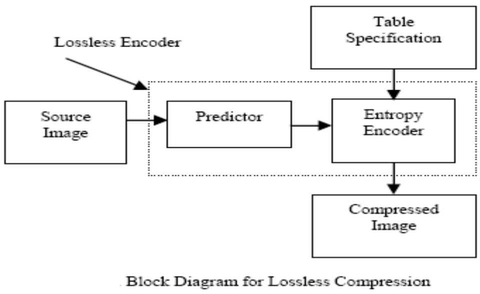

Fig2 : Lossless compression

*2)Lossy Compression :*Lossy compression technique[13,9] provides higher compression ratio than lossless compression. In this method, the compression ratio is high; the decompressed image is not exactly identical to the original image, but close to it. Different types of lossy compression techniques are widely used, characterized by the quality of the reconstructed images and its adequacy for application. A lossy compression scheme, may examine the color data for a range of pixels, and identify subtle variations in pixel color values that are so minute that the human eye/brain is unable to distinguish the difference between them .

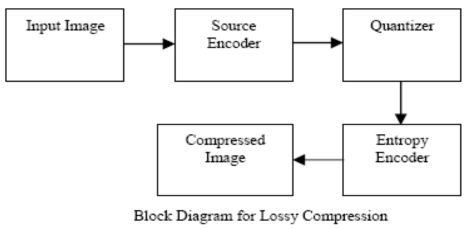

Fig3: Lossy compression

II. Background and Related work

A)Techniques of loseless video compression

In loseless video compression several encoding techniques have been used for decompression namely

- Run length encoding
- Entropy encoding
- Huffman encoding
- Arithmetic coding
- LZW coding

1)Run Length Encoding:
RLE is used in lossless data compression.RLE is a simple form of data compression in which data is in the form of runs.Runs is sequences in which the same data value occurs in many consecutive data elements are stored as a single data value and count, rather than as the original run. RLE may also be used to refer to an early graphics file format. It does not work well at all on continuous-tone images such as photographs, although JPEG uses it quite effectively on the coefficients that remain after transforming and quantizing image blocks.

2)Entropy encoding:
An entropy encoding is a coding scheme that involves assigning codes to symbols so as to match code lengths with the probabilities of the symbols. Typically, entropy encoders are used to compress data by replacing symbols represented by equal-length codes with symbols represented by codes proportional to the negative logarithm of the probability. Therefore, the most common symbols use the shortest codes.

3)Huffman coding:
The Huffmans algorithm is generating minimum redundancy codes compared to other algorithms. The Huffman coding has effectively used in text, image, video compression, and conferencing system such as, JPEG, MPEG-2, MPEG-4, and H.263 etc.. The Huffman coding technique collects unique symbols from the source image and calculates its probability value for each symbol and sorts the symbols based on its probability value. Further, from the lowest probability value symbol to the highest probability value symbol, two symbols combined at a time to form a binary tree. Moreover allocates zero to the left node and one to the right node starting from the root of the tree. To obtain Huffman code for a particular symbol, all zero and one collected from the root to that particular node in the same order.

4)Arithmetic Encoding: AC is the most powerful technique for statiscal lossless encoding that has attracted much attention in the recent years. It provides more flexibility and better efficiency than the celebrated Huffman coding does. The aim of AC is to define a method that provides code words with an ideal length. Like for every other entropy coder, it is required to know the probability for the appearance of the individual symbols. AC is the most efficient method to code symbols according to the probability of their occurrence. The average code length is very close to the possible minimum given by information theory. The AC assigns an interval to each symbol whose size reflects the probability for the appearance of this symbol. The code word of a symbol is an arbitrary rational number belonging to the corresponding interval.

5) LZW Coding:
LZW algorithm is working based on the occurrence multiplicity of character sequences in the string to be encoded. Its principle consists in substituting patterns with an index code, by progressively building a dictionary. The dictionary is initialized with the 256 values of the ASCII table. The file to be compressed is split into strings of bytes (thus monochrome images –coded on 1 bit – this compression is not very effective),each of these strings is compared with the dictionary and is added, if not found there. In encoding process the algorithm goes over the stream of information, coding it; if a string is never smaller than the longest word in the dictionary then it s transmitted. In decoding process, the algorithm rebuilds the dictionary in the opposite direction; it thus does not need to be stored.

B. Videocompression formats

Several formats have been used for compression techniques for videocompression [10]such as JPEG ,MPEG , H.264

1)JPEG

The JPEG standard, ISO/IEC 10918, is the single most widespread picture compression format of today. It offers the flexibility to either select high picture quality with fairly high compression ratio or to get a very high compression ratio at the expense of a reasonable lower picture quality. Systems, such a cameras and viewers, can be made inexpensive due to the low complexity of the technique.

The blockiness appears when the compression ratio is pushed too high. In normal use, a JPEG compressed picture shows no visual difference to the original uncompressed picture.

JPEG image compression contains a series of advanced techniques. The main one that does the real image compression is the Discrete Cosine Transform (DCT) followed by a quantization that removes the redundant information (the “invisible” parts).

2)MPE G-1

The first public standard of the MPEG committee was the MPEG-1, ISO/IEC 11172, which first parts were released in 1993. MPEG-1 video compression is based upon the same technique that is used in JPEG. In addition to that it also includes techniques for efficient coding of a video sequence.

3)MPE G-2

The MPEG-2 project focused on extending the compression technique of MPEG-1 to cover larger pictures and higher quality at the expense of a higher bandwidth usage.

MPEG-2, ISO/IEC 13818, also provides more advanced techniques to enhance the video quality at the same bit-rate. The expense is the need for far more complex equipment.

As a note, DVD movies are compressed using the techniques of MPEG-2.

3)MPE G-3

The next version of the MPEG standard, MPEG-3 was designed to handle HDTV, however, it was discovered that the MPEG-2 standard could be slightly modified and then achieve the same results as the planned MPEG-3 standard. Consequently, the work on MPEG-3 was discontinued.

4)MPE G-4

The next generation of MPEG, MPEG-4, is based upon the same technique as MPEG-1 and MPEG-2. Once again, the new standard focused on new applications.

The most important new features of MPEG-4, ISO/IEC 14496, concerning video compression are the support of even lower bandwidth consuming applications, e.g. mobile devices like cell phones, and on the other hand applications with extremely high quality and almost unlimited bandwidth. In general the MPEG-4 standard is a lot wider than the previous standards. It also allows for any frame rate, while MPEG-2 was locked to 25 frames per second in PAL and 30 frames per second in NTSC.

When “MPEG-4,” is mentioned in surveillance applications today it is usually MPEG-4 part 2 that is referred to. This is the “classic” MPEG-4 video streaming standard, a.k.a. MPEG-4 Visual. Some network video streaming systems specify support for “MPEG-4 short header,” which is an H.263video stream encapsulated with MPEG-4 video stream headers. MPEG-4 short header does not take advantage of any of the additional tools specified in the MPEG-4 standard, which gives a lower quality level than both MPEG-2 and MPEG-4 at a given bit-rate.

5)H.264

H.264 is the latest generation standard for video encoding. This initiative has many goals. It should provide good video quality at substantially lower bit rates than previous standards and with better error robustness – or better video quality at an unchanged but rate. The standard is further designed to give lower latency as well as better quality for higher latency. In addition, all these improvements compared to previous standards were to come without increasing the complexity of design so much that it would be impractical or expensive to build applications and systems.

An additional goal was to provide enough flexibility to allow the standard to be applied to a wide variety of applications: for both low and high bit rates, for low and high resolution video, and with high and low demands on latency. Indeed, a number of applications with different requirements have been identified for H.264:

> Entertainment video including broadcast, satellite, cable, DVD, etc (1-10 Mbps, high latency)

> Telecom services (<1Mbps, low latency)

> Streaming services (low bit-rate, high latency)

> And others

As a note, DVD players for high-definition DVD formats such as HD-DVD and Blu-ray support movies encoded with H.264.

6)MPE G-7

MPEG-7 is a different kind of standard as it is a multimedia content description standard, and does not deal with the actual encoding of moving pictures and audio. With MPEG-7, the content of the video (or any other multimedia) is described and associated with the content itself, for example to allow fast and efficient searching in the material.

MPEG-7 uses XML to store metadata, and it can be attached to a time code in order to tag particular events in a stream. Although MPEG-7 is independent of the actual encoding technique of the multimedia, the representation that is defined within MPEG-4, i.e. the representation of audio-visual data in terms of objects, is very well suited to the MPEG-7 standard.MPEG-7 is relevant for video surveillance since it could be used for example to tag the contents and events of video streams for more intelligent processing in video management software or video analytics applications.

7)MPEG-21

MPEG-21 is a standard that defines means of sharing digital rights, permissions, and restrictions for digital content. MPEG-21 is an XML-based standard, and is developed to counter illegitimate distribution of digital content. MPEG-21 is not particularly relevant for video surveillance situations.

III.Methods of video compression

Basically two methods are currently used in video compression namely

- Discrete cosine transform (DCT)
- Discrete Wavelet Transform (DWT)

A) DCT

Discrete cosine transform (DCT)[6] is a general orthogonal transform for digital image processing and signal processing, with such advantages, as high compression ratio, small bit error rate, good information integration ability and good synthetic effect of calculation complexity.

The DCT process is applied on blocks of 8 * 8 or 16 * 16 pixels, which will convert into series of coefficients, which define spectral composition of the block. The Transformer transforms the input data into a format to reduce interpixel redundancies in the input image. Transform coding techniques use a reversible, linear mathematical transform to map the pixel values onto a set of coefficients, which are then quantized and encoded. The key factor behind the success of transform-based coding schemes is that many of the resulting coefficients for most natural images have small magnitudes and can be quantized without causing significant distortion in the decoded image.DCT Attempts to decorrelate the image data after decorrelation each transform coefficient can be encoded without dropping off compression efficiency.

Fig4: Discretecosine Transform

Discrete Cosine Transform is the basis for many image and video compression algorithms[5], especially the still image compression standard JPEG in lossy mode and the video compression standards MPEG-1, MPEG-2, and MPEG-4.

1)Merits

- It has been implemented in single integrated circuit;
- It has the ability to pack most information in fewest coefficients
- It minimizes the block like appearance called blocking artefact
- The results when between sub-images become visible

2)Demerits:

- It provides less compression ratios & blocking artifacts.
- It cannot allow good localization both in spatial& frequency domain.
- It should not haveTransformation of the whole image◎ introduces inherent scaling.
- It cannot have Betteridentification of which data is relevant to human perception◎ higher compression ratio.

B) DWT

The DWT represents an image as a sum of wavelet functions, known as wavelets, with different location and scale. The DWT[7] represents the image data into a set of high pass (detail) and low pass (approximate) coefficients. The image is first divided into blocks of 32×32. Each block is then passed through the two filters: the first level decomposition is performed to decompose the input data into an approximation and detail coefficients. After obtaining the transformed matrix, the detail and approximate coefficients are separated as LL,HL, LH, and HH coefficients. All the coefficients are discarded except the LL coefficients that are transformed into the second level. The coefficients are then passed through a constant scaling factor to achieve the desired compression ratio.

1)Merits

- It provides higher compression ratios & avoids blocking artifacts.
- Allows good localization both in spatial& frequency domain.
- Transformation of the whole image- introduces inherent scaling.
- Better identification of which data is relevant to human perception- higher compression ratio.

2)Demerits

- The cost of computing DWT as compare to DCT may be higher.

- The use of larger DWT basis functions or wavelet filters produces blurring and ringing noise near edge regions in images or video frames
- Longer compression time
- Lower quality than JPEG at low compression rates
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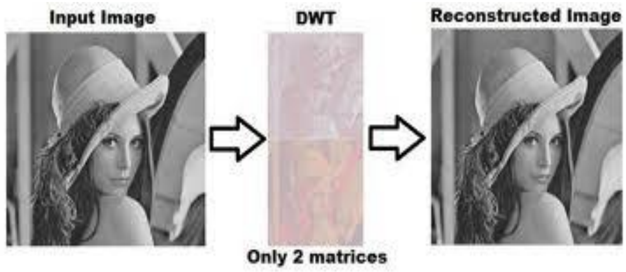


Fig5: Discrete Wavelet Transform

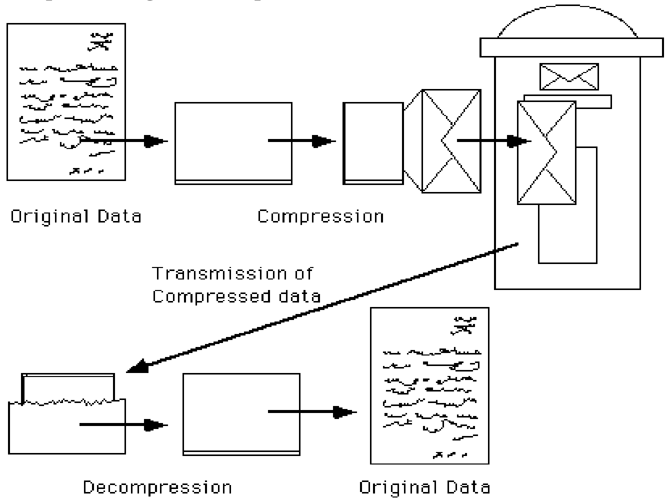
IV PROPOSED WORK

Video compression technique is now mature as is proven by the large number of applications that make use of DWT and DCT technology. This paper gives the idea about for video compression technique but not very much good for the real time video compression techniques either have a demerit of loosely techniques like DCT and DWT but here we are going to present a noble technique in which we will use object position change finding algorithm to get our video process in real time and having lossless decompressions. Some of the advantages of these approaches include a more natural and accurate rendition of the moving object motion and efficient utilization of the available bit rate by focusing on the moving objects. In addition to these, compression advantages, if suitably constructed, the object repetition based coding techniques can also support content-based functionalities such as the ability to selectively code, decode, and manipulate specific objects in a video stream.

Fig6: Video compression

1)ORVC.

Video coding in most video applications is to reduce the amount of video data for storing or transmission purposes without affecting the visual quality. The desired video performances depend on applications requirements, in terms of quality, disks capacity and bandwidth. Object repetition based video compression techniques achieve efficient compression by separating coherently moving objects from stationary background and compactly representing their shape, motion, and the content



V CONCLUSION

In this paper we present an object repetition based video coding approach that retains the relative advantages of both the hybrid based and block-based coders while minimizing the drawbacks of both. It p resent a complete system for object-based video compression with a method for 2-D content-based triangular mesh design, two connectivity preserving affine motion parameterization schemes, two methods for temporal mesh propagation, polygon-based adaptive model failure detection/coding scheme, and bitrate control strategies.

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