Different Video Compression Standards

Mrs. DiptiBhushan Save
ME Student,
SLRTCE
diptisave050384@gmail.com

Mrs. Aboli N. Moharil
Assistant Professor, EXTC Dept.
SLRTCE
deshaboli@gmail.com

Abstract— Video Compression technique has large demand in the field of video engineering due to storage and bandwidth requirements. The data quantity is very large for digital video and memory of storage devices and transmission line are not infinite. So it is practically not possible for us to store full digital video without processing. Thus, video compression standards, techniques and algorithms had been developed to reduce the data quantity. This paper will explain the different video compression standards based on various aspects.

Index Terms—*Video Compression, redundancies, MPEG-1, MPEG-2, MPEG-4, H.261, H.263, H.264*

*****

I. INTRODUCTION

Digital video compression is a process of reducing the size of video files. To achieve the good compression ratio video file needs to be encoded and decoded from one form to another form. The digital video is widely used in many applications including DVD, digital TV, and HDTVetc. These applications are more feasible because of its effective video compression algorithm as well as communication and computing technologies.Most of the video compression standards are based on the principles which can reduce the redundancy in digital video.Digital video is nothing but a sequence of picturesdisplayed. This picture is known as a frame. A frame of a digital video sequence is a 2D projection. A frame of digital video can be seen as a 2D array of pixels.Each pixel represents the color and intensity of a specific spatial location at a specific time. The Red, Green and Blue color is used to display digital picture. Each picture is represented by R, G and B components. Means the 2D array of pixels is actually three 2D array with one array of RGB components. It is seen that proper mixture of these three components in 8 bit resolution can form any color in form of digital picture.

II. THE NEED OF VIDEO COMPRESSION

The memory size required to store the digital video is very large due to its data quantity so it is not possible to store full video without processing. Therefore the different standards, techniques has been developed to reduce the data quantity of digital video with acceptable video quality. Video compression can be done by four types of redundancies those are perceptual, temporal, spatial and statistical redundancies.

1. Perceptual Redundancies

Perceptual redundancies are refer to the persistency of human eye. Human eye cannot perceive some part of digital picture, that part is selected and removed from the digital data. But it cannot affect the quality of the digital data due to human eye perception.

2. Temporal Redundancies

Video is a sequence of picture sampled at a particular rate. Two successive frames are in video are mostly similar to each other.The number of frames per second in a motion video is called as frame rate. If the frame rate of a digital video is modified to 30 frames per second then the new video is mostly similar because of the property of human eye persistency. So the temporal redundancies increases the compression gain in encoding.

3. Spatial Redundancies

As the spatial frequencies increases the sensitivity of eye is decreases. This property of human eye is known as spatial integration. This property of human eye is used to remove higher frequencies without affecting the quality. These special frequencies refer to the changes in levels in a picture.

4. Statistical Redundancies

Statistical redundancies include the binary information which have a binary codes.The transform coefficients, motion vectors and other data have to be encoded using binary codes at the last level of video compression. The simplest way to code these values is by using fixed length code i.e. 16 bit words. Instead of using 16 bit information it is better to used

less number of bits. So variable length coding is used in statistical redundancies and it also increases the compression efficiency.

III. VIDEO COMPRESSION STANDARDS

ITU-T and ISO/IEC these are the main two international organizations which decides the standards for video compressions.ISO/IEC MPEG standard includes MPEG-1, MPEG-2, MPEG-4, MPEG-4 Part 10 (AVC), MPEG-7, MPEG-21 and M-JPEG. ITU-I VCEG standard includes H.26x series, H.261, H.263, and H.264. This new generation gives the new requirements of future applications with the different video coding standard.

1. Motion JPEG

A digital video sequence can be represented as a series of JPEG pictures. This JPEG pictures are known as frames. Motion JPEG is also known as MJPEG. The advantages given by Motion JPEG pictures are that it gives flexibility for quality as well as for compression ratio. The main disadvantage of Motion JPEG is that since it uses only a series of still pictures it makes no use of video compression techniques. The result is,it gives slightly lower compression ratio for video sequences.

2. Motion JPEG 2000

It can also be used to represent a video sequence. The advantages are same as JPEG 2000, i.e., a slightly better compression ratio compared to JPEG. The major disadvantage of Motion JPEG 2000 is thatit is some somewhat complex. Since it is a still picture compression technique it doesn't take any advantages of the video sequence compression. It also gives a lower compression ration compared to real video compression techniques.

3. MPEG-1

The first public standard of the MPEG committee was the MPEG-1. MPEG-1 video compression includes techniques for efficient coding of a video sequence. This standard focuses on bit stream. It uses for storing data on CDs. In this the compression ratio is important than the picture quality.

In MPEG-1 only the new parts of the video sequence is identified and coded. This is done while transmission of video sequence. This process has reduce the bandwidth of the signal to large extent.

4. MPEG-2

MPEG-2 is the "Generic Coding of Moving Pictures and Associated Audio". The MPEG-2 standard is used for TV transmission and other applications of high data rates. It gives very high picture quality. This is a compatible extension of MPEG-1 standard means MPEG-2 decoder can decode MPEG-1 data streams. Combining of multiple audio, video and private data streams into a single multiplexed stream is specify by MPEG-2 standard. It supports wide range of broad cast, telecommunication and storage application. It enhances the better video quality at same bit rate. Using this techniques the DVD movies are compressed.

4. MPEG-4

The main feature of MPEG-4 is that it gives the support of lower bandwidth application as well as extremely high quality and unlimited bandwidth application. The one example of it is studio movies. The basic idea of this is not only related to video coding but it involves fully encoding only key frames through JPEG algorithm where minimal information is sent between every four to five frames. Compression ratio achieved by this is approximately 100:1.This standard encoder is very complex and places very heavy computational load for motion estimation whereas decoding is comparatively simple which can done using low cost decoder chips.

The basic idea is to detect motion from frame to frame in temporal directions and then use DCT to organize redundancies. The DCT is done on 8*8 block and motion prediction is done on luminance (Y) of 16*16 blocks. The DCT coefficients are end up with zero. The quantization can change for every macro block, which is 16*16 of Y and the corresponding 8*8 in both U and V. The DCT coefficients, motion vectors and quantization parameters are Huffman coded using fixed tables. The motion vectors and the DCT components are DPCM coded.

5. H.261

H.261 is a motion compression algorithm used for motion video compression task. It allows for use with communication channels that are multiples of 64 kbps (P=1, 2, 3…30). So it is called as P x 64.

H.261 coding is based on DCT (Discrete Cosine Transform). The main elements of the H.261 source coder are prediction, block transformation (spatial to frequency domain translation), quantization, and entropy coding. Whereas decoder requires prediction, motion compensation, loop filtering etc. The loop filter is applied for predicting data to reduce errors in inter frame coding. The H.261 source code operates on non-interlaced pictures occurring approximately 29.97 times per seconds. The tolerance is about ±50 ppm. In this technique pictures are coded as luminance and two color difference components (Y, C_b and C_r). It gives large improvement in video quality but requires extra processing power. When H.261 controller performs the compression, the decisions are made block-by-block basis not by picture-by-picture basis.

6. H.263

H.263 is structure wise similar to the H.261 and is backward compatible. H.263 gives superior picture quality than H.261 at bandwidth under 1000 kbps. It uses half pixel technology which gives greatly improved images. For low resolution

images also half pixel techniques gives better matches.

The features of H.263 are 3-D variable length coding of DCT coefficients, median motion vector prediction, bi-directional prediction, arithmetic entropy coding.

7. H.264

H.264 is the name used by ITU-T, while ISO/IEC has named it MPEG-4 Part 10/AVC. The current H.264/AVC compression standard is based on the picture-wise processing and waveform –based coding of video signals. It takes video compression technology to new level. This standard noticeably reduce the bit size of an I-frame and maintain a high quality of smaller box of pixels. . This is done by trying to find matching pixels among the earlier encoded pixels that border a new 4x4 pixel block to be intra-coded. By reusing pixel values that have already been encoded, the bit size can be drastically reduced. The H.264 format is broadly available in network cameras, video encoders and video management software, system designers and integrators.

IV. COMPARISON OF VIDEO COMPRESSION STANDARDS

All MPEG and H.26X standards are back compatible. The comparisons between all standards is given in table 1

V. CONCLUSION

The basic different techniques are available for video compression. We have seen here that H.264/AVC has been developed by both the ISO/IEC (MPEG) and ITU-T (VCEG) organizations. It has various improvements in terms of coding efficiency, like flexibility, robustness and application domains.

TABLE 1
COMPARISON OF VIDEO COMPRESSION STANDARDS

Standard	Applications	Bit Rate
Motion JPEG	Still image compression	Variable
MJPEG 2000	Improved still image compression	Variable
MPEG-1	Video on digital storage media (CD-ROM)	1.5Mb/s
MPEG-2	Digital Television	2-20 Mb/s
MPEG-4	Object-based coding, synthetic content,interactivity	Variable
H.261	Video conferencing over ISDN	P x 64 kb/s
H.263	Video telephony over PSTN	33.6kb/s
H.264	Improved video compression	10’s to 100’s kb/s

As per the requirements and applications, there will be always new development in video compression algorithm and hence new standard is being developed.. From the review of these various video compression standards it can be seen that there are still lots of possibilities for the improvement and development of video compression standards.

REFERENCES

[1] **S. Ponlatha and R. S. Sabeenian**, “Comparison of Video Compression Standards”, International Journal of Computer and Electrical Engineering, Vol. 5, No. 6, December 2013

[2] **RajeshwarDass Member IEEE, Lalit Singh, Sandeep Kaushik** **“**Video Compression Technique”, International Journalof Scientific& Technology ResearchVol 1, Issue 10, November 2012

[3] **Gary J. Sullivanand ThomasWiegand**, “Video Compression—From Concepts to the H.264/AVC Standard”, Proceedingsof the IEEE, VOL. 93, NO. 1, January 2005

[4] **Thomas Wiegand, Gary J. Sullivan,** “Overview of the H.264/AVC Video Coding Standard“, IEEE Transactionson Circuits and SystemsFor Video Technology, VOL. 13, NO. 7, July 2003

[5] ARPN Journal of Engineering and Applied Sciences, VOL. 10, NO. 9, May 2015