Analysis of implementation strategies for video communication on some parameters

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Abstract:

Video quality has been the concerning issue on the Internet. Over the past decades, digital video communication has become an integral part of the way we create, communicate and consume visual information. Now a day's demand for video communication has been growing rapidly and the quality of video is a measure issue. To maintain the quality of the video we use different video coding standards like MPEG-1, MPEG-2, MPEG-4, MPEG-7 and many more for video transmission. Many video compression standard techniques had been developed to compress the data and provide the good quality video. This paper gives the idea about different techniques available for video communication. In this paper we describe the features of various basic techniques available for the video compression, the implementation strategies of video compression techniques, generations of MPEG, new techniques for video communication and its main characteristics.

Keywords: MPEG-1(Motion Picture Expert Group), MPEG-2, MPEG-4 and MPEG-7, Video Communication, video compression, redundancies.

1. Introduction:

Multimedia communication is the growing attention of telecommunication and computer industry. Multimedia is a medium for interaction with information available from different sources, including video, audio, text, image, animation. Video signals are differ from image signals in several aspects. The main differences of video signals have a camera frame rate from 15- 60 frames/s, which provides the deception of smooth motion in the displayed signal. Next difference between images and video is the ability to exploit temporal redundancy as well as spatial redundancy in designing compression methods for video. Digital video is a sequence of pictures displayed overtime. Each picture of a digital video sequence is a 2D projection of the 3D world. Digital video is captured as a series of digital pictures or sampled in space and time from an analog video signal. The digital video or a picture can be seen as a 2D array of pixels frame. Every pixel value represents the color and intensity of a specific spatial location at a specific time. The Red-Green- Blue (RGB) color space is typically used to capture and display digital pictures. Each pixel is thus

represented by one R(Red), G(Green), and B(Blue) components.. A resolution of 8 bits per component is usually sufficient for typical consumer applications.

2. The Need for Compression:

The digital video has compelling redundancies and eliminating or reducing those redundancies results in compression. Video compression can be lossy or loss less. Loss less video compression reproduces identical video after de-compression. We primarily consider lossy compression that yields perceptually equivalent, but not identical video compared to the uncompressed source. Figure.1 shows data compression by using some compression algorithms.

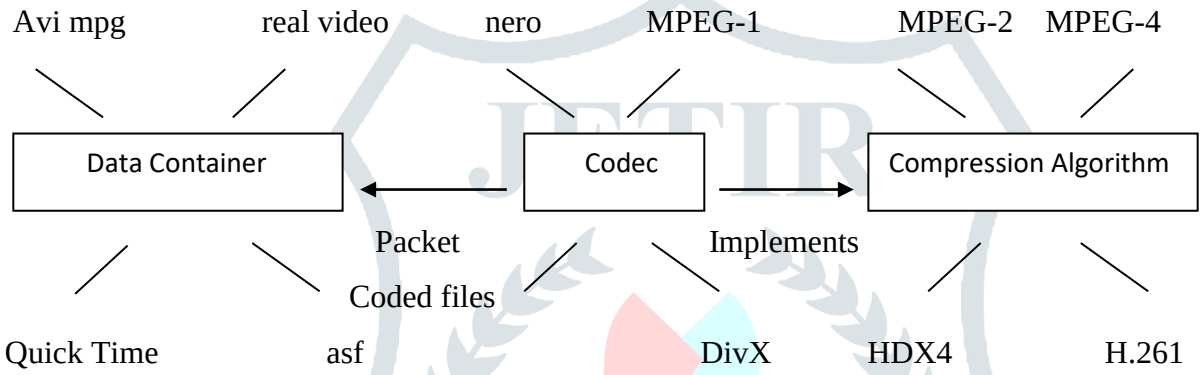

Figure1: Relation between codec, data containers and compression algorithms

Video compression has four types of redundancies: i) perceptual, ii) temporal, iii) spatial, and iv) statistical redundancies.

i. Perceptual Redundancies

Perceptual redundancies refer to the details of a picture that a human eye cannot perceive. Any data that a human eye cannot perceive can be shed without affecting the quality of a picture. The human visual system affects how both spatial and temporal details in a video sequence are perceived.

ii. Temporal Redundancies

This redundancy exists between successive pictures or objects. The persistence property can be take advantage of to select a frame rate for video display just enough to ensure a perception of continuous motion in a video sequence. Since a video is essentially a sequence of pictures sampled at a discrete frame rate, two successive frames in a video sequence look largely similar.

iii. Spatial Redundancies

Spatial Redundancy is redundancy within a single picture or objects. Spatial frequencies refer to the changes in levels in a picture. The sensitivity of the eye drops as spatial frequencies increase; i.e., as the spatial frequencies increase, the ability of the eye to discriminate between the changing levels decreases. The human visual perception thus allows the advanatge of spatial, temporal, and perceptual redundancies.

iv. Statistical Redundancies

The transform coefficients, motion vectors, and other data have to be encoded using binary codes in the last stage of video compression. The simplest way to code these values is by using fixed length codes; e.g., 16 bit words. However, these values do not have a uniform distribution and using fixed length codes is wasteful. Average code length can be reduced by assigning shorter code words to values with higher probability. Variable length coding is used to exploit these statistical redundancies and increase compression efficiency further.

3. Video Communication Standards

Video Compression is a method for reducing the data used to encode digital video data. The benefits of compression are smaller storage requirements and lower transmission bandwidth requirements. There have been five major initiatives in video coding that have led to a range of video standards.

- Video coding for ISDN(Integrated Services Digital Network) video teleconferencing, which has led to the ITU video coding standard called H.261 is also the baseline video for most multimedia conferencing systems.
- Video coding for low bit rate video telephony over POTS(Plain Old Telephone Service) networks with as little as 10 Kbps allocated to video and as little as 5.3 Kbps allocated to voice coding, which led to the ITU video coding standard called H.263.
- To stores movie data on CD-ROM with a speed of 1.2Mbps for Video coding and 256 Kbps allocated to audio coding, which led to the initial ISO MPEG-1 standard.
- To store video on DVD (Digital Video Disk) with 2-400 Mbps allocated to video and audio coding, which led to the ISO MPEG-2 video coding standard. The ITU has given this standard the number H.262. It's used for video coding for broadband ISDN, broadcast.
- Video coding for object based coding at rates as low as 8Kbps and high as 1Mbps or higher, which led to the ISO MPEG-4 video coding standard. Key aspects of this standard include independent coding of objects in a picture, the ability to combine graphics, animated objects and natural objects in the scene, and finally the ability to transmit scenes in higher dimensionality formats (e.g., 3D).

Video Communication Standards:

Year	Standard	Publisher	Popular Implementations	Bit Rate
1984	H.120	ITU-T		
1988	H.261	ITU-T	Videoconferencing, video Telephony	P X 64 Kbps
1993	MPEG-1	ISO,IEC	Video-CD	1.5Mbps
1995	H.262/MPEG-2	ISO, IEC, ITU-T	DVD video, Bluray, Digital Television, SVCD	2-20Mbps
1996	H.263	ITU-T	Videoconferencing, Video Telephony, Video on Mobile Phones(3GP)	33.6-?Kbps
1999	MPEG-4	ISO,IEC	Video on Internet	2-4Mbps SDTV 6-10 Mbps HDTV
2003	H.264/MPEG-4 AVC	Sony, Panasonic, Samsung, ISO, IEC, ITU-T	Blu-ray, HD DVD, Digital Video Broadcasting, iPod Video, Apple TV, Video Conferencing	10-100Kbps
2009	VC-2	SMPTE	Video on Internet, HDTV Broadcast, UHDTV	1Gbps
2013	H.265	ISO, IEC, ITU-T		
2001	MPEG-7	ISO/IEC	Digital library, multimedia directory services, Broadcast media selection: radio channel, TV channel, security services: traffic control.	

4. MPEG Standards:

Our expectations are that a Multimedia standard is to provide support for a large number of applications. MPEG is the standard in video codec, and it is the most common video format for video communication. MPEG format, including MPEG video, MPEG audio and MPEG (video and audio synchronization) of three parts, MP3 (MPEG-3) audio files is an application of the MPEG audio and video include MPEG-1, MPEG-

2, MPEG4 and MPEG-7(audio and visual) and many more. The most known are MPEG-1, MPEG-2, MPEG-4 and MPEG-7 which are also formally known as ISO/IEC-11172, ISO/IEC-13818, ISO/IEC- 14496 and ISO/IEC-15938

- MPEG-1: This Standard is for the storage, retrieval of moving pictures and audio on storage media.
- MPEG-2: It's used for digital television; it's timely response for the satellite broadcasting and cable television.
- MPEG-4: Codes content as objects and enables those objects to be manipulated individually or collectively on an multimedia scene.
- MPEG-1, 2, and 4 make content available. MPEG-7 lets you to find the content what you need.

i. MPEG-1 video coding standard:

The initial multimedia standard for coding, compression, and transmission of audio, video, and data streams in a synchronized and mixed Packets is MPEG-1. By using MPEG-1 algorithm, a 120-minute film can be compressed to about the size of 1.2 GB and file format is mpg and dat files. The Uncompressed digital video requires a very high transmission bandwidth, and the VHS VCR-grade equivalent raw digital video requires around 30 Mbps transmission bandwidth, with compression still necessary to reduce the bit-rate to suit most applications.

The degree of compression is achieved by exploiting the spatial and temporal redundancy present in a video signal. The target of the MPEG-1 was storage of multimedia content on a standard CDROM, which supported data transfer rates of 1.4 Mbps and a total storage capability of about 600 MB. MPEG-1 is formally called ISO/IEC 11172. Better solution for this problem was developed in MPEG-2

ii. MPEG-2 video coding standard:

The MPEG-2 algorithm is used for creation the DVD and also in some of the HDTV (high definition television) and high demand video editing, processing of the application. Using MPEG-2 compression algorithm could produce a 120-minute film (the original video files) in the size of about 4GB to 8GB, of course, image quality indicators are MPEG-1 cannot be compared. The compressed file format made by the algorithm is usually the vob file. The original objective of MPEG-2 was to code interlaced BT601 video at a bit rate that would serve a large number of consumer applications. The MPEG-2 handles interlace efficiently which is missing in MPEG-1. Since the picture resolution of BT601 is about four times that of the SIF of MPEG-1, the bit-rate chosen for MPEG-2 optimization were 4, and 9 Mbps. However, MPEG-2 allows much higher bitrates. Both spatial and temporal redundancy reduction are needed for the high compression requirements of MPEG-2. In the scanned video there is a very less difference between MPEG-1 and MPEG-

2 compression capabilities. However, interlace presents complications in removing both types of redundancy.

iii. MPEG-4 Video coding Standards

MPEG-4 is a compression scheme which can be a 120 minute film is compressed to about 300 MB. The many encoding formats such as ASF, DivX, Xvid, mp4 are used by MPEG.

- DivX : its a video encoding technology can be said produced for DVD, which works with a certain type of MPEG-4 file, and was used to rip DVDs in the pre HD era.
- Xvid:its an open source version of Div X, popular among movie pirates.

MPEG-4 uses elements from three fields: digital television, interactive graphics and the World Wide Web with focus of not only providing higher compression but also an increased level of interactivity with the audio-visual content. The MPEG-4 standard, or formally ISO 14496 was started in 1993, and core of the standard was completed by 1998. Since then there have been a number of extensions and additions to the standard.

Overall, MPEG-4 addresses the following main requirements:

- Content Based Access
- Universal Accessibility
- Higher Compression

In some of the applications it may be require video objects to be simultaneously available in several spatial or temporal resolutions. Temporal scalability is used for partitioning of the video objects in layers, where as the base layer provides the basic temporal rate, and the enhancement layers, when combined with the base layer, provide higher temporal rates. Spatial scalability involves generating two spatial resolution video layers from a single source such that the lower layer can provide the lower spatial resolution, and the higher spatial resolution, it can be get by combining the enhancement layer with the interpolated lower resolution base layer. The MPEG-4 supports rectangular and arbitrary shaped objects in temporal and spatial scalability.

iv. MPEG-7 Video coding Standards

All previous MPEG standards have mainly described coded representation of audio-visual information. The MPEG 7 is also called the Multimedia content description interface. MPEG-7, on the other hand, focuses on the standardization of a common interface for describing multimedia materials (representing information about the content, but not the content itself—"the bits about the bits"). The commonalties between previous MPEG standards and MPEG-7 rely on the fact that previous standards can use MPEG-7 descriptions to improve their facilities of content description. MPEG-7, is also named as "Multimedia Content Description Inter-face," is the standard that describes multimedia content so users can easily search, browse, and retrieve

that content more efficiently and effectively than they could use text-based search engines. The MPEG 7 standard is used for describing the features of multimedia content.

- It is to be used in indexing, searching and browsing of multimedia content
- Strictly saying, MPEG-7 is not a data compression scheme.
- MPEG-7 is mainly a software implementation.
- MPEG-7 is not targeted at specific application. It aims to be as generic as possible for future extension.

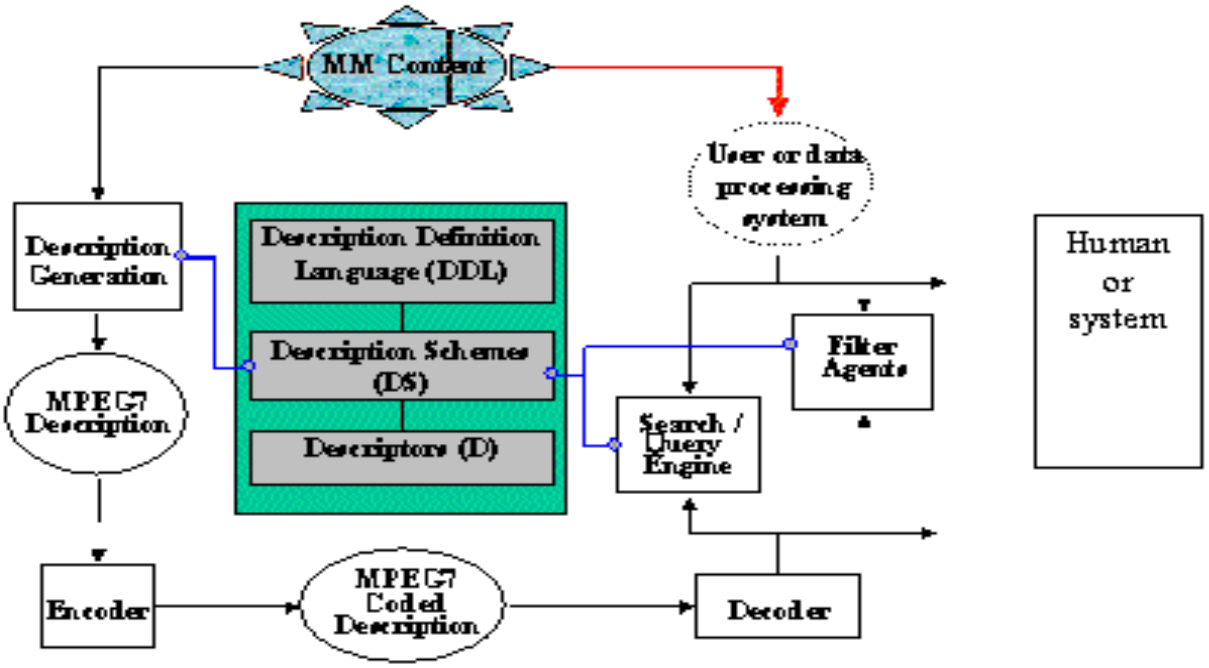

Fig. 1

5. Comparison of MPEG-1, MPEG-2 and MPEG-4 video Standards:

Features/ Technology	MPEG-1	MPEG-2	MPEG-4
1. Video Structure i. Sequence type ii. Picture structure	 Progressive Frame	 Interlace, progressive Top/Bot field, Frame	 Interlace, progressive Top/Bot field, Frame
2. Core Compression i. Picture types ii. Motion comp. Block size	 I,P,B pictures 16X16	 I,P,B pictures 16X16(16X8 field)	 I,P,B rect/arb. Vops 16X16,8X8(overlape

iii. Transform and block size iv. Quantizer type	DCT,8X8 Linear	DCT,8X8 Linear and non linear	d) DCT,8X8 Linear and non linear
3. Interlace compression i. Frame and field pictures ii. motion comp. Frame/field iii. coding frame/field	 Frame picture No No	 Frame, field picture No No	 Frame, field picture Yes Yes
4. object based video i. Arbitrary object shape ii. Shape coding	 No No	 No No	 Vop Binary, grey scale alpha
5. Scalable Video i. SNR Scalability ii. Spatial scalability iii. Temporal sclability	 No No No	 Picture Picture Picture	 (Via spatial) Picture, vop Picture, vop
6. Stero/3D/multiview Stereo/multiview suppot	 No	 Yes	 Yes

6. Conclusion

In this paper we concluded the basic techniques available for video communication. We compare different MPEG standards. This paper covers the Comparative study of MPEG standards on some implementation parameters.MPEG-1 video, MPEG-2video, MPEG-4 video and MPEG-7 are the medium to be used in video transmission. MPEG-7 is about the future of media in the 21st century. MPEG-7 provides a comprehensive and flexible framework for describing the content of multimedia. As per the requirements there will be always new development in video compression techniques. By doing review of various video communication techniques there is still lots of possibilities to improve the video communication on wireless network.

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