COMPARATIVE RESEARCH ON VIDEO FORMATS AND APPLICATION IN PROCESSING OF VIDEO DATA FOR THE PROJECT OF HISTORICAL GIS OF 1000 YEARS THANGLONG – HANOI

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ABSTRACTS

The main issues in processing multimedia data for applications is trade-off between quality and data volume. This presentation report on a comparative research on different video formats and propose the choice of appropriate formats for video data depend on the implementation environment. We also report the stages of manipulation of multimedia data for the project of historical GIS of 1000 years Thanglong –Hanoi in order to present historical and architectural values of famous sights in Hanoi.

1. INTRODUCTION

1.1 Characteristics of video and digital video data

The term *"video"* commonly refers to several storage formats for moving pictures. Video can be recorded and transmitted in various physical media: analog video on tapes, digital video on tapes, on optical discs or computer files. Containing a huge volume of information, bring the vivacity and attractiveness to applications, video data are used in many sectors of daily human life.

In comparison with analog video, digital video processing operations including noise reduction, restoration, super resolution and video sampling structure conversion and compression are more easier.

The main video systems are

- PAL / SECAM: Frame rates of 25 frames per second
- NTSC (National Television Standard Committee): Frame rates of 29,97 frames per second
- HDTV (High Definition TV): digital TV of high quality, frame rates up to 50 frames per second.

1.2 Issues in video data processing

Two main issues in manipulation of digital video data are the huge data volume and the difficulty of intervention in real time.

To figure how big volume the video data has, we calculate by example, which size it has one video segment of one hour playing ? In NTSC standard with frame size of 720 x 480, frame rates of 30 frames per second (exactly at rate 29,97 frames per second) and using 24 bit color, the original uncompressed video file has the volume of: 3600 x 30 x 720 x 480 x 3 byte = 111,974,400,000 byte = 104.28 GB. We can see that uncompressed video data require an incredible amount of memory for storage and capacities of current storage devices are too small for video data.

Below we revise different video formats and compression methods in order to choose the appropriate procedure for processing video data depend on its usages.

2. VIDEO STANDARDS

2.1 AVI Format

AVI format is very popular because it is designed for use on Windows platform. AVI format is very flexible, many video compression algorithms developed up to now are applicable to video data of AVI format to create video products the most appropriate to each usage.

Video for Windows

- Intel Indeo 5.x is used for video distribution on the Internet. It is suitable to computers with MMX micro processor or Pentium II processor or higher. This compression method has following features: option for quick compression, flexible control of keyframes, regulation of hue, good playback effect and produce output video files of reduced size.

This compression method includes parameters to regulate in order to produce video files appropriate for different speeds of data communication, from modem connection of 56Kbps to LAN connection of 100 Mbps. This video compression method is designed for working together with the Intel audio compression method.

- **Microsoft RLE:** this compression method is appropriate to compress the clips that use large areas of solid colors, such as cartoon animation having a small number of colors. This compression method using compression code of 8 bit length with very effective loss-less compression algorithm RLE (Run-Length Encoding) giving video output of high quality.

- Microsoft Video1: Microsoft Video1 is one loss compression method using color space compression. Compression code include several control parameters to modify the number of colors in frames (8 bit color or 24 bit color), video quality, number of keyframes, ... This compression method allows to create video files suitable to implement on the low speed network for distance e-learning applications

- Cinepak code by Radius: is used to compress video data of 24 bit color on the CD-ROM or on the Web for quick downloading. This compression method has higher compression ratio and higher decompression speed in playback than the compression method Microsoft video 1. We can regulate the parameters to control the final quality of images.

After processing, the video files can be used on the network with low speed as 30Kbps. The compression method Cinepak produces video data of high decompression speed for playback but the compression stage is time consuming. This compression method is appropriate to use in the final step for producing the ready –to – use video segments.

Below is the table of comparison of compression methods for the AVI format. All format use the same frame size of 476 x 360, the frame rates of 30 per second and the IMA ADPCM compression for 22 kHz stereo audio channel.

Table 1: comparison of compression methods for the AVI format

Parameters compression method	Data communication speed	file size	Quality
Original video (1'.05)	**4.98 Mb/s**	**324.8MB**	**Very good**
Intel Indeo 5.10	156.75kb/s 91 kb/s	10.54 MB 5.82 MB*	Good
Microsoft Video1	133.22 kb/s 30.67kb/s	8.47 MB 1.97 MB*	Good
Microsoft RLE	104 kb/s 28 kb/s	6.67 MB 1.78 MB*	Good enough
Cinepak code by Radius	171.3 kb/s	10.9 MB	Good

Note: * *after regulating of parameters in the compression algorithm such as number of colors, desired quality, v.v..*

2.2 MOV format

Quicktime formats are build from audio and picture compression algorithms for the Macintosh platforms [1,4,10]. Video editing software usually uses compression code of the Quicktime standards for the Macintosh platforms. The video editing devices usually use proprietary compression method of producers.

Video standard Quicktime

- Cinepak is used to compress the video data of 24 bit color. This compression code is suitable for CD-ROM and video on the Web. The compression method Cinepak has high compression ratio and high speed of decompression for playback. Cinepak uses asymmetric compression algorithm and produces video files of small size but compression is time consuming. This compression method is appropriate to use in the final step for producing the ready –to – use video segments

- Sorenson Video is used to compress the video data of 24 bit color for use on the CD-ROM or on the Web for quick downloading. Sorenson Video compression method is similar to the Cinepak method but it is the new compression method designed for producing video data of high quality. This compression method produces video with better images, smaller

size of file than compression method Cinepak. Therefore, it is usually not used in editing stages but to produce ready-to-use video files for including in applications.

- Animation is used for clips that use large areas of solid colors, such as cartoon animation. Compression method Animation bases on the technology of Apple and the RLE compression algorithm. The compression algorithm has quality setting parameter to determine the degree to which the compression is lossy;100% quality is lossless.

Below is the table of comparison of compression methods for the MOV format. All format use the same frame size of 476 x 360, the frame rates of 30 per second and the standard IMA compression 4:1 for 22 kHz stereo audio channel.

Table 2: comparison of compression methods for the MOV format

Parameters Compression method	Data communication speed	file volume	quality
Original (1'.05)	**4.98 Mb/s**	**324.8MB**	**Very good**
Animation	272.33KB/s	17.3 MB	Good enough
Cinepak	272.33KB/s	4.7 MB	Good enough
Sorenson Video	37.08KB/s	2.4 MB	Good enough

2.3 MPEG standards

Video compression standard MPEGs is developed by the Moving Picture Experts Group (MPEG). These video compression standards are widely used in current video products. MPEG is also the most used in the area of digital television, HDTV, video CD, video DVD, video conferencing, video on the Internet and many other applications. Three video formats of MPEG standard, MPEG-1, MPEG-2, MPEG-4 have became world wide standards.

- MPEG-1 standard is released in 1991 with the following features: it is optimized for the NTSC video data of the resolution of 352x240 dpi, the frame rate of 30 frames per second and the resolution of 352 x 288 dpi, the frame rate of 25 frames per second. If the resolution is not set suitably some error can be occurred. MPEG-1 works the best with the data communication speed of 1,5Mbps. MPEG-1 used only in progressive scan mode. It can not use in interlaced scan mode such as the television broadcast. MPEG-1 is used as standard format for CD video products. As to audio compression, MP3 standard is used in MPEG-1.

MPEG 1 is appropriate for applications on LAN, for video distribution (Video CD), Video Library.

- **MPEG-2** standard has been release in November 1994. MPEG-2 uses YUV color encoding system with the down sampling ratio of 4:2:2. The MPEG-2 standard has the goal of enhancement the quality of video for better then the MPEG-1 standard, hence it requires the higher speed of data communication, from 5 to 20 Mbps.

MPEG-2 is not appropriate for low speed network. It is used for video on demand (VOD) or cable television (CATV).

- **MPEG-4** is an ISO/IEC standard. MPEG-4 standard has been release in October 1998 and became one international standard in January 1999. At the end of year 1999 the version 2 of MPEG-4 standard has been release. This format is flexible, the resolution is regulable and do not requires high speed of data communication.

MPEG-4 is suitable for implementing e-learning applications on the Internet and video conferencing, tele meeting.

Table 3: comparison of MPEG standards

	MPEG1	MPEG2	MPEG4
Quality	TV Quality Video	Very good Theater Quality Video	From average to very good as MPEG-2 Web Streaming Video
Compression algorithm	DCT, Motion Compensation	DCT, Motion Compensation	Object-based Compression
Typical Screen Size	352 x 240 dpi	720 x 480 dpi	Any
Data communication speed	1,2 Mbps	5~20 Mbps	Low speed ~ 64Kbps
Audio	MP1	+AAC, multi channel	+ TwinVQ
Type of application	Low resolution Video CD, used on computers of low performance.	High resolution, high quality for digital television, HDTV, CATV, DVD	- video distribution on LAN, wireless network or the Internet - Video conferencing H263. - digital television

2.4 Recommendations

For video data using on the network with low speed or on the Internet, the following video compression methods are appropriate:

- For AVI format: the compression codes Intel Indeo 5.10, Microsoft Video1 and Microsoft RLE.
- For MOV format: the compression codes Cinepak and Sorenson Video.
- For MPEG format: the compression codes MPEG4, H261 and H263.

Using these compression methods we can store files of high quality video for 10 hours playback on one normal CD.

On the network with high speed connection and on CD, DVD for local computer we can use MPEG1, MPEG2 and MPEG4 standards.

For the purpose of storage original video as sources of data it is better to use the video formats of low compression ratio such as DVNTSC, DVPAL, AVI, MOV.

3. PROCESSING THE IMAGES AND VIDEO DATA FOR HISTORICAL SITES OF HANOI

The Project of Historical GIS of 1000 Years Thanglong –Hanoi aims to present historical value of Hanoi to public. In the first phase the data collection of 150 historical sites of Hanoi has been completed.

The data include pictures and video files.

3.1 Processing files of image

The pictures is taken by digital still camera SONY DSC-P93A of resolution of 5.1 MG pixel and saved under picture file format TIFF. TIFF format using the lossless compression algorithm LZW (Lempel -Zif &Welch) gives high resolution, high quality pictures of 24 bit color or more. Moreover, TIFF format supports Alpha channel and multi-layer, is easy to enhance the quality and to create special effects.

The preprocessing step aims to create the original source data for the late use in other applications. It is required to preserve high fidelity of original data.

The Adobe PhotoShop is used to cut the frame layout, to regulate the brightness and the contrast. Each original picture of size 2592 x 1944 pixels and 24 bit color is saved in TIFF format to file of 6MB. For use in application, the pictures are converted to JPEG format with the size reduced to 2MB.

3.1 Processing files of video

For the video data, the sites are filmed using digital camera SONY DCR VX 2000 using NTSC format and the frame size of video is set at 720 x 480dpi. The video segments of 2-10 minutes length are saved on video cassette tapes Mini DV. Because the video data is collected by nonprofessional, some retouched are needed.

In the preprocessing step, we input video data to computer through IEEE 1394 port of video capture board device DC2000 of Pinnacal. The input video using DVNTSC standard, frame size 720 x 480 dpi. In the original format, the video data give high quality images but has very big volume. For the 150 sites, the total length of video is 20 hours and the volume is 300 GB approximately.

The Adobe Primiere 6.5 is used to preprocess video sequences through the following steps

- Remove the redundant or bad quality frames;
- Filter noise using Gaussian Blur or Median filter;
- Regulate the brightness, the contrast and the frame rate;
- Add the video transition for scenes;
- Remove the audio channel and replace by the narration or music.

After preprocessing the video sequences are saved in DV NTSC format on the tape through IEEE 1384 port of the device.

For the distribution by DVD discs to playback on computers or DVD devices, we use the standard MPEG 2 with extension M2V. The volume of data is reduced considerably to 2GB for one hour of playback.

To use on the Web, the output format should be MPEG4.

4. CONCLUSIONS

Before become ready to use, multimedia data passes through the processing procedure composing from several steps. The choice of appropriate format and the most suitable compression algorithms to reduce the volume but at the same time preserving the quality required for each category of application is very important. This comparative research has handled different formats of video data and compression algorithms in order to propose the suitable procedure for collecting, processing, archiving and using the video data for distribution on the web and on the CD, DVD discs.

Apply the processing procedure for video data in the Project of Historical GIS of 1000 Years Thanglong–Hanoi, through reducing the file sizes the speed of loading of images and video have been improved significantly. The performance of the web site presenting historical values of Hanoi has been improved.

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