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LIMITATIONS IN PROCESSING AND REPRODUCTION OF VIDEO AND AUDIO [1]

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Abstract: *The report addresses problems encountered during the processing and reproduction of video and audio content of various computer systems. The processing of multimedia content involves the addition of graphical information. The studies made so far on the possible cause of the effects on reproduction are presented. The players and playouts that are used are specified.*

The diagram of standard video file processing, the processing of multimedia content by adding graphic information, sequence diagram for processing and modification of video conten and state diagram are presented.

The studies conducted so far on the possible cause of the impact on reproduction are presented.

Keywords: *DirectShow, players, playouts, GraphStudio, Media Player, character generator.*

JEL Codes: *I20, C88*

INTRODUCTION

One of the most commonly used multimedia applications are the players, with the help of which audio and video content is played. We can divide them into standard and specialized ones.

Standard players usually have play, pause, forward and backward scrolling, and stop buttons. Also they often have a progress bar to monitor the current position relative to the length of the entire file.

Specialized players are part of or they themselves are playout systems. These are software systems used in the reproduction and broadcasting of multimedia content of television and radio productions. The specialized players upgrade the standard ones with some of the following functionalities: storing of data for the broadcast media files; analysis of data flows; adding automatic and manual graphical and audio effects.

The report addresses problems encountered during the processing and playback of video and audio content on different computer systems. Multimedia content processing involves adding graphical information.

SUMMARY

A large number of Windows systems are built using the DirectShow interface. This interface allows the realization of standard and specialized players by connecting different COM objects (filters). It is possible to create your own filters that make non-standard functionality (for example, adding an effect to video or audio).

The universality of DirectShow is partly due to its modular approach. Audio and video are treated as data streams, and software modules can control and interact with these streams when they move from the input device (camcorders, webcams, DVD drives, TV tuner cards, cards for analog video capture, capture card) to the output device (sound card, video monitor, file).

Software modules are called filters and represent COM objects registered in the Windows system (it is possible to create own objects). The connected modules form a graph. Each has input and/or output pins that are used to connect to the other filters in the graph.

There are three main types of filters:

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- Source filters – read the multimedia data from the sources; these filters have only output pins;
- Transforming filters – transform the data provided by the output of other filters (for example: resize video frames, volume, split or mix data from two streams); have input and output pins;
- Rendering filters – reproduce the multimedia data (for example, on the monitor screen, with the speakers of the device, record the data to a file); have only input pins.

One stage (step) of the processing may include one or two filters, respectively, when both data streams (video and audio) are processed simultaneously or separately.

The main stages of video processing are:

- Reading of the source data – in most cases we have only one data source and one filter, respectively, but if we mix data from one or more sources we have the appropriate number of filters;
- Separation of audio and video – used almost always because all other data processing is performed only on audio or video data; this type of filter is not necessary when the filters for the reading of the source data submit unmixed data streams, i.e. they are separated in the source filter;
- Decode the stream – not used only when we have raw data, i.e. there is no encoding or compression of input data;
- Modify flow – changes the flow data; in most cases are not used.

GraphStudioNext is a graphical editor of DirectShow with open source. It allows the construction and testing of own graphs from the filters available in the Windows system. Execution of the graphs can be obtained data on the size of the streams, their processing speed and all their parameters (color depth, audio channels).

Important functionality of GraphStudioNext is the ability to visualize and monitor the DirectShow graphs registered in the system, but created in other applications.

The main point in the realization of this type of systems is to find the balance between the requirements and the load on the computer system and on the other hand functionality and flexibility of the application.

System logic model

Diagram of standard video file processing

The standard processing of a video file can be divided into three stages (see diagram Fig. 1):

- Read video content – can be divided into two sub-stages: reading the file and splitting the video and audio;
- Decoding frames – the decoding of video and audio is performed in parallel;
- Rendering of frames – similar to decoding is done in parallel in the output video and audio devices.

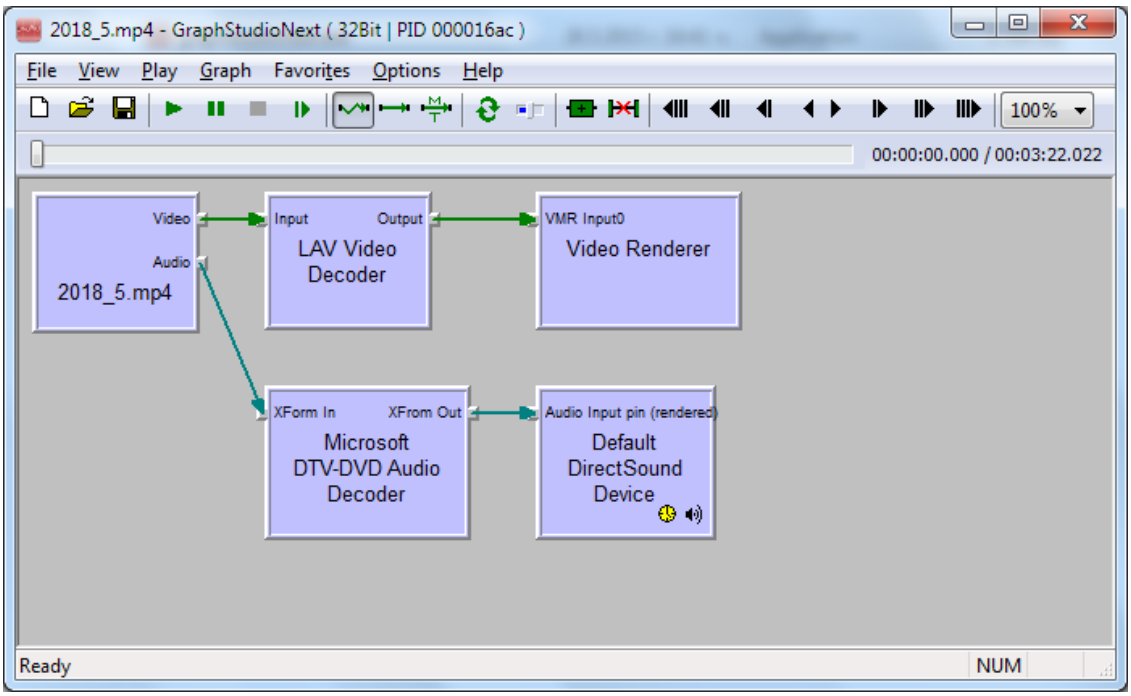

Fig. 1. Diagram of standard video file processing

Activity diagram

The activity diagram presents the work processes and their stages.

The diagram in Fig. 2, shows the processing stages of every single video frame in the DirectShow graphs in the DSPlayer and UNIPlayer applications. The diagram clearly shows that the processing includes five stages (steps): reading data, splitting video and audio, decoding,

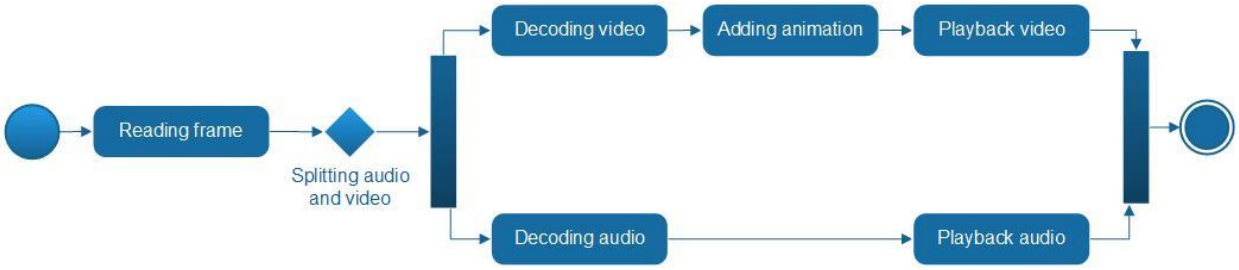

Fig. 2. Activity diagram when processing a video frame

processing data (in this case adding animation), playback. The last stage is missing from DSPlayer because it is not intended to modify the data. From the diagram, you can see that video and audio processing is done in parallel, and the two streams are synchronized after the playback, with the audio leading.

State diagram

The state diagram describes the statuses in which the system can be located. In some cases, the chart describes all possible states, and in others, it is a reasonable abstraction.

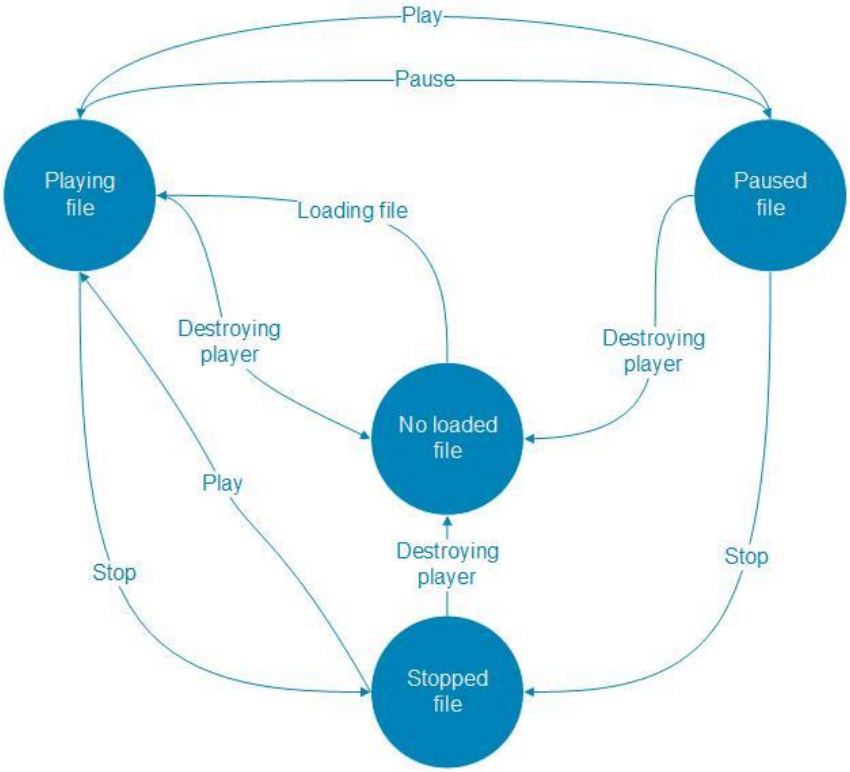

Fig. 3. Player state diagram

The diagram (see fig. 3) sets the statuses in which the DSPlayer and UNIPlayer applications may be located. For the first application, the diagram describes all states of the system. For the second application, it is an abstraction, and the conditions in which the control animation filter may be located are not included in the chart because possible combinations of states and transitions become too many.

The player initially does not have a loaded file. After loading a valid file goes into the state of its execution. When you hold the current frame by passing the Pause command, only the last frame begins to play. From this state, you can come out by using the Play command (continue playback) or by using the Stop command (to stop playback). It is also permissible to stop playback when we have a file running (again using a Stop command). The execution of the file may start again (if it is currently stopped) by using the Play command. The player can be destroyed at any time (regardless of the state in which it is located), and if a file is loaded, it is released.

Three applications were developed for the research: DSPlayer, GDIAnimation and UNIPlayer.

DSPlayer enables playback of video files (Fig. 4). There is an option to open a file selection window using the Browse button. Playing the video file starts with the Play button. Hold the execution of the current frame through the Pause button. Stop playback with the Stop button.

GDIAnimation visualizes simplified Animation (Fig. 5). The current animation state is displayed in the panel. The Active checkbox indicates whether the animation is active, i.e. there is movement or not. The Speed bar can change the speed of movement. The minimum value is 1, the maximum 10, and the default is 5. Through Direction is set to the direction of movement of the animation – left to right or right to left.

UNIPlayer allows the addition of animation to video playback (Fig. 6).

Fig. 4. *DSPlayer* application screen

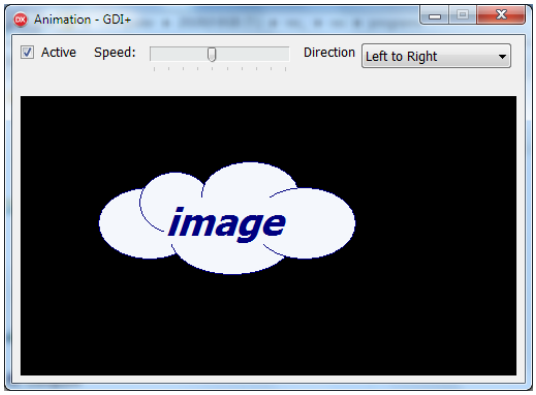

Fig. 5. *GDIAnimation* application screen

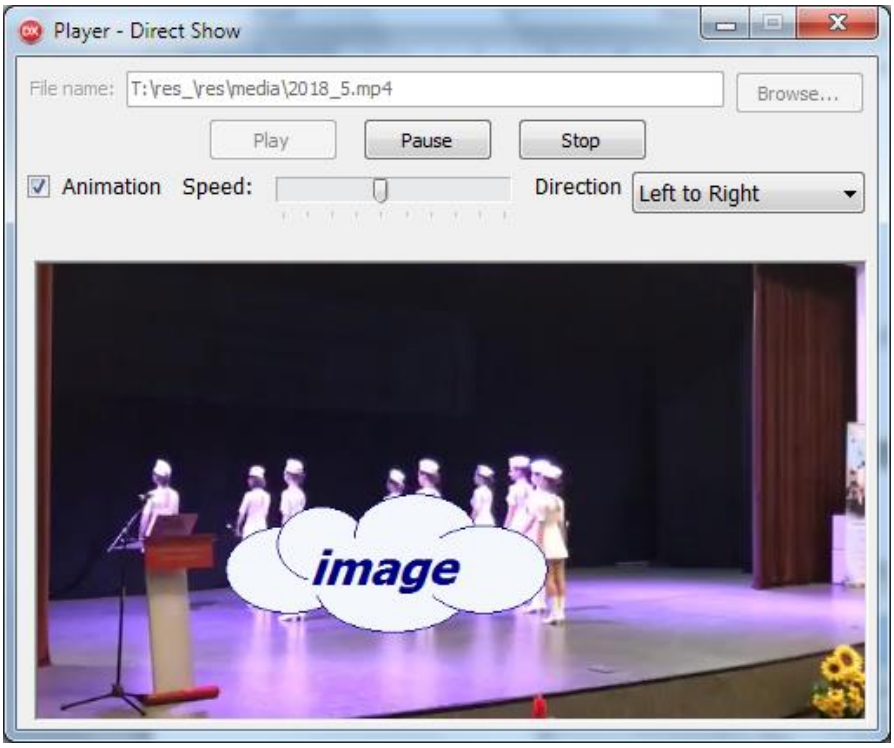

Fig. 6. *UNIPlayer* application screen

Application testing

The developed applications were tested on three different computer systems (CS), with 64 bit operating system:

- CS1 – laptop with processor Intel Core 2 Duo E8500, two cores 3.16 GHz; 4.00 GB RAM; graphic card Intel Q45/Q43 Express Chipset;
- CS2 – laptop with processor Intel Core i5-4200M, two cores 2.5 GHz; 8.00 GB RAM; graphic card NVIDIA GeForce GT 740M with 2.00 GB RAM, 980 MHz;
- CS3 – desktop computer with processor Intel Xeon E5-1650, two cores 3.20 GHz; 8.00 GB RAM; graphic card NVIDIA GeForce GTX 1050 with 2.00 GB RAM, 1 GHz.

Results

When testing the applications on the three computer systems, the following negative effects were observed:

- Audio and video mismatch – this is the first effect observed in an audio and/ or video processing problem;

- Drop of frames – visually it can look like blurring the picture, tearing it apart, sometimes the image is rendered mostly red/ green/ blue;
- Image boil – most often obtained by incorrect decoding of video with interlace; in this case, this effect is obtained as a consequence of the previous one, when every odd/ even frame is omitted.

During the tests, the amplification of the indicated effects when operating on a laptop battery was logically established.

Table. 1 and Table. 2 shows which effects in which configuration and to what extent they are observed. The last effect can be observed in any situation where we have a frame leak. It can be clearly seen that with the latest computer system these problems are missing or at least not noticed.

Table 1. Audio and video mismatch in different computer systems

	DSPlayer	UNIPlayer
CS1	It is noticeable when more instances of the application are started or when operating on a battery.	It is also noticeable when working on electricity.
CS2		It is noticeable when operating on battery or starting 2 or more instances.
CS3		

Table 2. Drop of frames in different computer systems

	DSPlayer	GDIAnimation	UNIPlayer
CS1	It is noticeable when operating on battery or starting 2 or more instances.	It is noticeable when 5 or more instances are started.	It is also noticeable when working on electricity.
CS2			It is noticeable when operating on battery or starting 2 or more instances.
CS3			

CONCLUSIONS

The processing and reproduction of video and audio content on low-end systems result in the following negative effects:

- Audio and video mismatch;
- Drop frame;
- Image boil.

To avoid these effects, switching to a high-end coomputer system and a video controller are practiced. More processor cores, more system RAM and newer generation integrated video controller.

REFERENCES

Paulsen, K. Moving Media Storage Technologies: Applications & Workflows for Video and Media Server Platforms. Focal Press, 2011

https://en.wikipedia.org/wiki/Media_player_software

https://en.wikipedia.org/wiki/Playout

http://vwlowen.co.uk/directshow/page01.htm