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EVALUATION OF FUNCTIONAL CHARACTERISTICS OF MODERN SOFTWARE FOR AUDIO AND VIDEO DATA FLOWS PROCESSING

The paper analyzes functional capabilities of modern software products for audio and video data flows processing. Main advantages and disadvantages of each of them are determined. Recommendations on feasibility of the given products application for solving a certain set of tasks are presented.

Kew words: *audio and video data flows, compression, coding, decoding, image motion compensation, macroblocks.*

Goal of the research

Goal of the research described in the paper is the analysis of main functional characteristics of modern software for audio and video information flows processing as well as comparative study of main advantages and disadvantages of the products.

Problem statement

Audio and video information processing is one of the most progressing trends in the field of information technologies. There exists a certain set of software that implements algorithms of informational data flows processing. Some of them are oriented towards the limited space of problem solution while others make it possible to use larger spectrum of capabilities for solving the stated problems requiring, however, higher material costs and powerful computational resources.

It should be mentioned that there does not exist software for performing the entire spectrum of the possible tasks of audio and video information processing. Consequently, a problem of choosing a specific software product to solve a concrete task appears quite frequently [1].

Analysis of the modern software for audio and video information flows processing

In the process of studying the problem it makes no sense to evaluate functional capabilities of each of the existing software tools for working with multimedia information as a great variety of them is available. Besides, a majority of them is, to a certain extent, modification of the previous developments. Therefore, while considering this problem it is very important to form a representative sampling from the list of the existing software.

As a result of the work that was performed, the following examples of the software products for processing audio and video data flows have been chosen.

Sony Vegas is a digital system of nonlinear video and audio editing that offers an unlimited number of audio and video tracks, each of them having its own pair of tracks (A / B). This system supports multichannel input-output in the full duplex mode (26 physical outputs can be used for outputting the signal with independent mixing bus at each of them), synchronization using MIDI Time Code and MIDI Clock, 24 / 32-bit sound with discretization frequency of 192 KHz. For real-time signal processing four-band parametric equalizer and a compressor could be installed in the gap of each track as well as 3 references could be used at the connection module of the Direct format [2]. Instruments used in *'Vegas Pro'* enable real-time editing and processing of DV, AVCHD, HDV, SD/HD-SDI and XDCAM™ formats, precise audio correction, volume sound creation and two-layer DVD. There is also a possibility to create standard DVD with complex video, subtitles, multilanguage menu and commentaries. In addition, the program supports such function as two- processor and two-monitor operation.

Among the advantages of *Sony Vegas* we should also mention a convenient and flexible interface. As to disadvantages, we observe a complete absence of modules that plug-in third-party producers, slow computation as compared to other editors, absence of literature and high price of the commercial version.

Corel Digital Studio package supports project publication using e-mail, photo and video sites as well as social networks. Besides, it supports working results publication on mobile devices. The package includes the following set of utilities: *PaintShop Photo Express* – a program for photo editing; *VideoStudio Express* – simple video editor; *DVD Factory* – a utility for recording DVD-discs; *WinDVD* – a well-known player of digital video. For fast access to the package tools a special gadget could be used. It is quickly activated together with Windows. It looks like a small window with references to all utilities of *Digital Studio 2010* that is permanently on the desktop.

Corel Digital Studio is distinguished by the integrity of all components and a simple interface with minimum functions.

Among the drawbacks it is important to mention a relatively low speed of this software operation and limited video editing functions for such a massive software product that includes only converting and trimming capability.

Camtasia Studio package offers a user everything that is necessary for convenient recording on the computer of what is going on in the screen, voice commentaries and video flow from web-camera providing the creation of visual video text-books, presentations and advertising shows for delivering via the Internet or on the compact discs.

Finished material can be recorded on the compact disc, published in the Internet, saved in a corporate network Intranet and due to the support of Flash format and formats for recording on compact discs,video materials created using *Camtasia Studio* package could be made accessible for any user.

Besides, buildup for *PowerPoint* package, applied to *Camtasia Studio,* allows to record information in *PowerPoint* presentation for users to see the omitted material in its initial form or simply the material they got interested in. By one mouse click it is possible to record all sounds, image from a web camera, animation and image motion. After that a user can edit or exchange video material in any of the popular video formats so that each viewer could see the prepared material.

Among the negative factors high product price should be mentioned, which makes this program feasible to be used only for professional work. Also *Camtasia Studio* is not an optimized software package for video playing, i.e. reproduction quality leaves much to be desired as compared with specialized software tools.

ImTOO Video Editor connects, trims, and separates different types of video files The program supports 3GPP and 3GPP2, AVI, such files as Macromedia Flash, QuickTime, MPEG4, RAW h264, Windows Media and MPEG files. The utility is simple for installation and use. On starting, the application window with three buttons is opened. Depending on the task to be performed, one of them is pressed: *Join, Split, Cut*.

When two or more video files are merged, it is necessary to choose files (or a folder where they are located), initial format, compression method, the number of shots per second, bit rate and a folder for saving the results. Then the *Join* button must be pressed.

When the task of a video file splitting is to be performed, after specifying the source and a folder for initial files, it is necessary to set the process parameters. The file may be divided manually specifying the estimates on the time scale or automatically – into segments, parts of equal size or parts equal in time.

File cutting is a more simple process – it is necessary to choose a source, a folder for results and then to specify the boundaries of cutting into time-lines.

Advantages: before any operation pre-view of the file in a built-in player is available; when files of different types are merged, the format of results could be specified; on completing the process a utility will switch off the computer automatically, switch it to the doze mode, waiting mode or will simply finish its operation.

It should be also noted, that in spite of all its advantages, *ImTOO Video Editor* is only a utility for merging, splitting or cutting of video files and it is not sufficient for ensuring high-quality professional video editing.

Sony Sound Forge is an audio editor comprising a set of utilities intended for working with sound. This program enables effective processing of sound compositions, superimposing a lot of effects, accurate and fast recording, data coding and audio files conversion into different formats [3].

It is one of the most popular and really useful programs intended for audio processing at the professional level. Its application enables such audio signal processing that makes it unrecognizable or editing of the poorly recorded part of a musical instrument. *Sony Sound Forge* successfully combines practically the whole set of modern sound effects and powerful sound editing means for their further use, powerful editing functions, the capability to build in and to connect any modules that support the Direct technology, user-friendly interface. *Sound Forge* has long been a branch standard used by professionals for editing, audio materials recording and multimedia information content creation.

Advantages: user-friendly interface, qualitative graphic representation of the wave form in the process of editing and playing, supporting discretization frequency of 192 KHz and capacity of up to 32 bit, export and import of files of different formats, more than 35 processing algorithms, capability of handling a majority of functions from MIDI controllers, SMPTE- and MTC-synchronization with other programs or periphery, an unlimited number of canceling operations.

Disadvantages: inconvenient real-time signal processing, algorithms of working with a hard disc is not always effective, absence of adequate means for CD recording, absence of built-in noise-absorbing facilities and batch processing of files.

VirtualDub program makes it possible to perform a lot of different tasks from various fields.

Typical tasks that are successfully solved using *VirtualDub* include: video files re-coding from one format into another, application of filters (cleaning from noise), jitter stabilization, changing the size), etc.; cutting / glueing files without recoding, replacement or adding sound tracks; video capture from analog sources; per-shot viewing, analysis of the image quality, saving of separate shots into a file (screenshots); batch processing of a variety of files.

Essential advantages: VirtualDub occupies only 1 – 2 megabytes on the disk; it does not require installaton; free distribution. The latter circumstance has led to *VirtualDub* having a number of modificatios (*VirtualDubMod*, *VirtualDub-MPEG2* etc.) distinguished by additional capabilities [4].

As drawbacks a limited list of functional capabilities for working with video files and absence of impressive effects for video processing could be mentioned.

Ffdshow – a media decoder that is usually used for fast high-precision conversion of video flow into MPEG-4 ASP (i.e. encoded using Div, Xvid або FFmpeg MPEG-4) and AVC (H.264) formats, also supports a lot of other video and audio formats. It is a free software issued under GPL lisence. It opeates under Windows as *DirectShow* filter

Ffdshow includes subtitles support that is switched on, the possibility to choose a set of codecs to be used, making snapshots from the screen, keyboard control, brightness and image stretching control, a set of image processing filters, the possibility to connect video processing plug-ins and *DScaler* filters. It also provides the possibility to use integrated audio filters, an equalizer, a mixer, *Dolby* decoder, *DSP* plug-ins of *Winamp* etc. A number of postprocessing elements are taken from MPlayer and *AviSynth* filters.

Ffdshow uses *libavcodec* library and some other open-source packages of video formats such as MPEG-4 (including ones encoded using Xvid, 3ivx, all Div versions), H.263 and VP6, H.264/AVC, WMV and a lot of others. *Ffdshow* also decodes an audio flow into MP3, AAC, Dolby AC3, WMA and Vorbis formats and a variety of others.

Postprocessing filters of *Ffdshow* are used in *VirtualDub* and *AviSynth* video editors by means of VFW adjustment. *Ffdshow* can also be used in these editors for coding of the common video flow from MPEG-4, compatible with Xvid, Div and x264 codecs, without sacrificing quality, and a number of other formats supported by *libavcodec* basic library.

At the given moment the support of the following video formats has been realized: H.264/AVC, XVid, Div 4/5/6, MPEG 4, Div3, MP41, MP42, MP43, H.263, FLV1,Theora, VP3, VP5, VP6, VP6F, MPEG1, MPEG2, WMV1, WMV2, WMV3, VC-1, WMVP, MSS1/2, H.261, Hiffyuv, MJPEG, SVQ1, SVQ3, QTRLE, 8BPS, QRPZA, FFV1, DV, CamStudio, CorePNG, LOCO, MSZH, Techsmith, ZLib, ZMBV, AutoDesk RLE, Cinepack, Indeo, MS Video 1, MS Video RLE, QPEG, Real Video and a number of others.

Among drawbacks the absence of multiflow support should be mentioned. And really, at present two processors cannot be used. Although the work is going on, much time will pass until multiprocessor version is released. At the given moment there exists only partial multiflow operation – in resize filter, in MPEG4/MPEG2/MPEG1 codecs (via libavcodec), Xvi and x264.

There is one more factor that should be taken into account - F*fdshow* does not comprise splitters that, among other things, provide splitting the containers of the MKV, OGM and MP4 type into video, sound and subtitles.

MAGIX Movie Edit Pro 14 PLUS 7.5.2.1 is a professional non-linear video editor that comprises tools for analog and digital video extraction from any source (camera, TV, VHS, Internet) and virtual player functions. The program includes large library of video and sound effects and the capability of subtitles creation.

Main features: programmable timer for recording TV programs, non-linear editing and video restoration in the real-time mode, correction of colour, focuse and image stabilizer (removal of tremor), restoration of audio (cleaning from noise and sound optimization), high-quality preview with scaling ability, 70 video-, photo- and color effects, 170 3D effects, 45 professional effects for sound duplication, cutting of video, creation and usage of self-effects, subtitles creation, recording on VCD, SVCD, DVD, mini DVD (support of recording on several disks).

One more feature should be mentioned: when new project is created, previous viewing of each new film is saved in the bottom panel so that a user can work with several films simultenuously. If *Import File* button is pressed, the program asks whether it should attach a new clip to the highlighted project or create a new project. But, unfortunately, *Import File* function does not make it possible to view all the imported files.

POP FLV Jukebox is a software that enables converting video files and DVD video into FLV format designed for broadcasting video in the Internet. *POP FLV Jukebox* supports a majority of video formats including AVI, MPEG, WMV, ASF, MOV, QT, DAT (VCD), MP4, VOB (DVD), 3GP and RM/RMVB. Besides, the program has wide capabilities that enable full adjustment of the converted video. Using *POP FLV Jukebox* video files or DVD can be splitted into separate clips in FLV format setting the beginning and the end of the clips. The program has user-friendly interface, it is simple in use and can perform packet converting of files [5].

Canopus EDIUS Pro enables real-time work of video editors, mixing of different HD / SD formats incding HD, HDV, DV, MPEG-2, lossless and non-compressed video. Using qualitative transcoding technology, *EDIUS Pro* converts video in HD and SDresolution applying different relationships of sides and frequency of shots. *EDIUS Pro* also provides reoresentation and output into DV (displaying) of all effects, transitions and titles as well as exporting projects into any format including DVD-Video. New capabilities such as multicum function support, editing of several parts within one project, improved trimming tool and the possibility to work with the most important shots while doing color correction make *EDIUS Pro* a flexible solution for nonlinear editing.

Canopus EDIUS Pro is fast-acting but unsuitible for editing a documentary as well as for editing films and video fragments that are planned to be used in the Internet, computer games and different multimedia educational courses.

Pinnacle Studio combines simple and intuitive interface with professional capabilities such as slowing and acceleration, creation of one's own musical accompaniment, more than 100 transitions including 3D effects, Hollywood FX, color correction, brightness and contrast control. This software makes it possible to work with available Firewire controller, web camera or capture card

performing export video, its editing and adding special effects. As to video capturing, there exists one indisputable advantage. Soft from *Pinnacle Systems* is most often sold together with capture boards, i.e. a user is provided with a hardware-software complex for working with video. Therefore, if you have a capture board from *Pinnacle*, you will be able to capture video from any sources. The number of HD video cameras is growing and it should be noted that *Pinnacle studio* supports high-definition video, but usually not at the given moment – HD operation module must be activated at extra cost (about $40). The necessary tools are always at hand, just where you expect them to be, which makes film creation process much faster. Unfortunately, only four tracks are at a user's disposal, no more tracks could be added. They are placed extremely illogically. E.g., the track for titles superposition is under the video track, which is inconvenient for perception. Beginners are fond of this program, particularly due to a large number of different effects and transitions. However, you should remember that at a price of $100 you get a 'naked" program with inactivated effects, i.e. all those "bells and whistles" you will have to buy separately. Studio from the box could do practically nothing. Additional expenses will be required for using sound in MP3 format, for working with any files of MPEG format, for effects and transitions etc. It is worth noting that all those "trifles" are included in the price of any other video-editing programs.

Wondershare Video Converter Platinum is a video converter that transforms different video files into the majority of popular formats so that a user could play video on different players such as iPod, iPhone, Apple TV, Zune, PSP, Pocket PC, Creative Zen, PS3, Xbox 360, Archos and others. It is also HD video converter and AVCHD video converter that convert HD відео and AVCHD video into m2ts, mts into avi, ts into mp4 without sacrificing quality. *Wondershare Video Converter Platinum* consists from two interdependent programs – *DVD Ripper Platinum* and *Video Converter Platinum*.

Main capabilities: conversion into the variety of video formats including MP4, MOV, 3GP, AVI, WMV, MKV, RM, MPEG-1, MPEG-2, FLV, ASF; conversion of HD video and AVCHD video (m2ts, mts, ts, tp, trp etc) into such formats as avi, mp4, flv; conversion of video into SWF, DV (digital video format), AU, AIFF, FLAC; possibility to extract an audio track from video files of M4A, WMA, WAV, MP3, AAC and AC3 formats; it allows to trim video, to add different effects, to edit water marks and add subtitles. Two windows of the previous viewing allow you to control all the processes; integrated tool for file transfer between a computer and iPod/PSP; automatic updating with new versions. *Wondershare Video Converter Platinum* has tools for synchronization of video collection from Sony PSP and iPod Video.

Drawbacks: absence of multichannel support and relatively high price for the offered spectrum of capabilities.

Solving the problem of data processing in Mpeg 4 part 10 (H.264) format

H.264 is a standard (a formalized set of algorithms) of video data compression adopted by International standardization organization (ISO). It is also known as MPEG-4 part 10 and AVC (Advanced Video Coding).

As compared to MPEG2 (DVD-Video) and MPEG4 ASP (Div, Xvi), H.264 compression is much more effective, which ensures better image quality and smaller file volume. H.264, adopted as a standard for compression of high-definition video (HD, HDTV), distributed on the new-generation carriers Blu-ray and HD DVD, is used in mobile devices, supported in Apple QuickTime, distributed in the systems of digital telecasting, video conference communication and video surveillance systems[6]. H.264 is a hybrid standard of block coding of video data with motion compensation. Compensation is based on the usage of vectors of shot areas displement for predicting image changes. As high degree of correlation between two sequenced frames is characteristic of video images, there exists a possibility to use this for coding displacement vectors of different image parts rather than image as a whole. In this case a predicted difference between current frame and its areas, that are present in other frames in the position shifted from the initial one, is coded. This is called "an intermediate prediction" technique [7].

Standard H.264 assumes image fragmentation into macroblocks with the size of 16x16 pixel each. Macroblocks are combined into groups (one or several). In this way an image can be coded as one or several groups. Application of macroblocks grouping enables usage of different error correction methods, different types of macroblocks coding as well as such tools as separate coding of half-frames.

In color video images coding of the brightness component is performed separately from the color component. Taking peculiarities of human vision into account, discretization of color signal relative to luminance signal is used [8].

This standard is implemented using the above-described *Ffdshow*.

Conclusions

The spectrum of tasks that can be solved with modern software for working with audio- and video materials will satisfy both a professional in a certain field and a beginner. As to a separately taken products, none of them can be considered to be perfect according to the following criteria: price, functional capabilities, speed of operation, expenses for computer resources and quality of the achieved result.

For performing tasks that involve only editing of multimedia information one should use only free utilities that make it possible to save time and do not require powerful computational resources. Under these conditions such software tools as *ImTOO Video Editor* and *VirtualDub* would be helpful, but, however, you should not expect that they will solve more complicated problems. For conversion it is better to use specialized software products that support a large number of formats and offer the possibility of their fast conversion such as *Ffdshow* having a number of advantages over other software tools for solving the given set of problems. It should be noted, however, that *POP FLV Jukebox* has proved to be suitable in this field. For professional editing there exists a large number of software products, each of them having its own advantages and such drawbacks as long time to be spent on information processing (*Corel Digital Studio*), relatively low image quality (*Camtasia Studio*) and many other factors. While choosing such software, attention should be paid to convenience of work, price (it does not always correspond to the quality as in the case with *Pinnacle Studio*) and to the spectrum of functional capabilities of each product: if it is really sufficient for achieving a qualitative result. An important factor in professional audio and video creation is also software economic efficiency in relation to computer resources, which influences the time spent on performing operations.

Proceeding from the analysis of software for audio and video information processing, the following conclusion can be made: in order to achieve higher speed and quality of video information processing with minimal expenses it is feasible to use a set of several software tools.

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