Video quality control by determining the frame average color

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Abstract. In modern conditions, despite variety of hardware-software complexes for creation and promotion of multimedia projects, still big problem is the optimum choice of codecs and settings of quality of operations of rendering depending on tasks of developers or a site on which there will be further a material. In most cases now «optimum parameters» of video rendering are understood as creative activity of the person which on the basis of visual survey, specific and subjective ideas of quality of «picture» of a product, has to receive balance between «quality» of the picture and final file size. In fact, now practically there are no tools in order that it is simple to compare two identical videos on quality and to make quantitative quality evaluation of the video file. Therefore, this direction of researches is important and actual. The main objective of work - to define possibility of use of average color of frame and a color difference   for quality evaluation of the video files received at different settings of rendering. Results of pilot studies of determination of average color and a color difference for frame of the video file are provided. Experimental and analytical means revealed possibilities of application of this method for quality determination the video file and findings of differences from the original. As showed research, the most high-quality codecs are H265, DivX and MPEG2. In addition, it was set that DivX showed the greatest stability on a color difference. The offered method can be applicable for a provisional estimate of quality of the received movies since average color does not consider the accuracy of some, important parameters, for example, text clearness on frame. It well copes with the general determination of video frame quality.

1. Introduction

Today it is possible to note that development of digital technologies assumed a general scale. Without them development, development and designing of difficult technical, electro technical complexes, design and testing for stability of buildings, quality control of different types of products, production of movies, processing of a sound and many other things are impossible.

They undoubtedly simplify human life, its work, lead to improvement of quality of a final product, but also generate some imbalance and confusion. Users are not always in time behind progress, but they are more often simply do not know what of the existing technologies will be suitable better for achievement of effective objectives. It is connected and with psychological aspects, and with shortage of data on technologies, properties of formats, features of these or those approaches.

In addition, you should not forget that some data types in itself are not up to the end studied. For example, work with graphics, and its processing computers were available to users practically from the very beginning of use personal, and panoramic video appeared recently and became available only after technical improvement of the equipment intended for its creation.

However, and in the technologies existing already progressive tense questions unresolved completely are observed. So today, it is very difficult to find rather easy and exact way of comparison of quality

of video, in particular their visual difference. Without it, it is very difficult to define what format better to select for storage of video, and what degree of a compression will approach better provided, that it is necessary to save the best quality.

Data definition of properties approximately, selective comparison of zones of a frame in our opinion has subjective character, dependent and from physiological opportunities of the processor of video, both from an element of chance, and from availability of the special equipment, for example, of the calibrated monitor that sometimes unattainable luxury for normal users.

The greatest interest in researchers is caused by program implementations of some improvements of video at its record, the subsequent processing as shown in work [1, 2]. Also constantly, improvement of formats, codecs and other program implementations of storage and transfer of video data demands efforts [4].

Separately there are questions of quality control among which the extremely interesting and modern approaches and methods meet. For example, version of the analysis of video of fragments by means of the neural networks trained for viewing of video based on which they can make comparative analysis.

The technology described above cannot be executed in simple, house conditions, and is not implemented everywhere yet. Therefore, we consider that has the right to offer a method and tools for comparison of image quality of the video file for the objective and situational analysis, influence of settings of rendering of video.

Essence of the offered method - to define average color of the image at accidental frame of video, then to define value and to compare their results.

This method is expected as normal users, and professionals, and can be applicable for determination of extent of change of quality of frame in a video fragment at point or global changes of setup of rendering. It will allow defining the most suitable option of settings easier.

2. Definition of problem

Primal problem is determinations of quality of video depending on the selected codec, a compression in the analysis of the image on average color. For quality, evaluation of the video image such criterion as a color difference ΔE_{ab}^* selected.

The main task at an assessment of average color is identification of settings after which irreversible color distortion on a video file frame begins. It is supposed that the type of a graphic format, its compression and the used codec can influence this parameter. In further experiments, an attempt to set influence of a graphic format and the codec on image quality in video was made.

3. Theory

As control of a color difference of the received average color from reference, original the color difference determined by a technique in equal-contrast system CIE-76 [5] and a formula taken ΔE_{ab}^*:

$$E_{ab}^* = \sqrt{(L_2^* - L_1^*)^2 + (a_2^* - a_1^*)^2 + (b_2^* - b_1^*)^2}$$

By this technique, the color difference should not exceed unit and aim at zero. As the instrument of automation of calculation the third-party calculator – Delta-E Calculator [6] used.

Receipt of video fragments was executed in the Format Factory 4.1.0 program. We selected this program as the most popular, applied in a post to processing of video for the purpose of reduction of the occupied volume of video of the file. Its settings taken by default. Conversion of the received files to a graphic format was executed in the Adobe Premiere Pro CC program, Release 2015.3 as the Format Factory 4.1.0 program cannot transform video data to graphics.

We carried out further calculations for determination of average color of a frame according to the software developed earlier [7] which works by the principle of poll of pixels in the image and determines by them average color. According to the same program executed calculation of average color of frame on the fourth second video fragment for every 10th frame, i. e. for frame: 10, 20, 30, 40, and 50.

Etalon video was received by means of the H:265 codec, with a frequency of 30 frames per second. Then this video a feather saved in the MP4, MPG, AVI, WMV formats. For each format a number of codecs are supported, their list is provided in table 1.

Table 1. List of video of formats and codecs

Video format	Codec	Frame parameters (width and height), pixel	File size
Original file (MP4)	X264	1920×1080	5 Mb 360 kb
MP4	AVC(H264); HEVC(H265); MPEG4(DivX); MPEG4(Xvid)	1920×1080	1 Mb 536 kb 977 kb 3 Mb 117 kb 3 Mb 133 kb
MPG	MPEG Video Version 2	1920×1080	8 Mb 577 kb
AVI	Uncompressed 16bpp. YUV 4:2:2 (UYVY)	1920×1080	494 Mb 304 kb
WMV	Windows Media Video 9 Screen (MSS2)	1920×1080	3 Mb 740 kb

4. Results of experiments

We conducted researches using the developed software and Format Factory 4.1.0, which started on a computer of the following configuration - Windows 10, Intel CPU Family, Model 10, Stepping 9 with MMX, SSE Integer, SSE FP, SSE2, SSE3, SSE4.1, SSE4.2, Hyper Threading, Physical processor count: 4, Logical processor count: 8, Processor speed: 3410 MHz, Built-in memory: 16338 MB, OpenGL Drawing: Enabled, Video Card Renderer: GeForce GTX 1060 6 GB/PCIe/SSE2, Video Card: NVIDIA GeForce GTX 1060 6 GB, Driver Version: 23.21.13.9135.

Graphic files of the PNG-format, which analyzed further, for average color of a frame, as a result received. Frame of the 10th, 20th, 30th, 40th and 50th of the file sample given in figure 2. Results of measurements and calculations of color difference ΔE_{ab}^{*} provided in table 2.

a)   b)

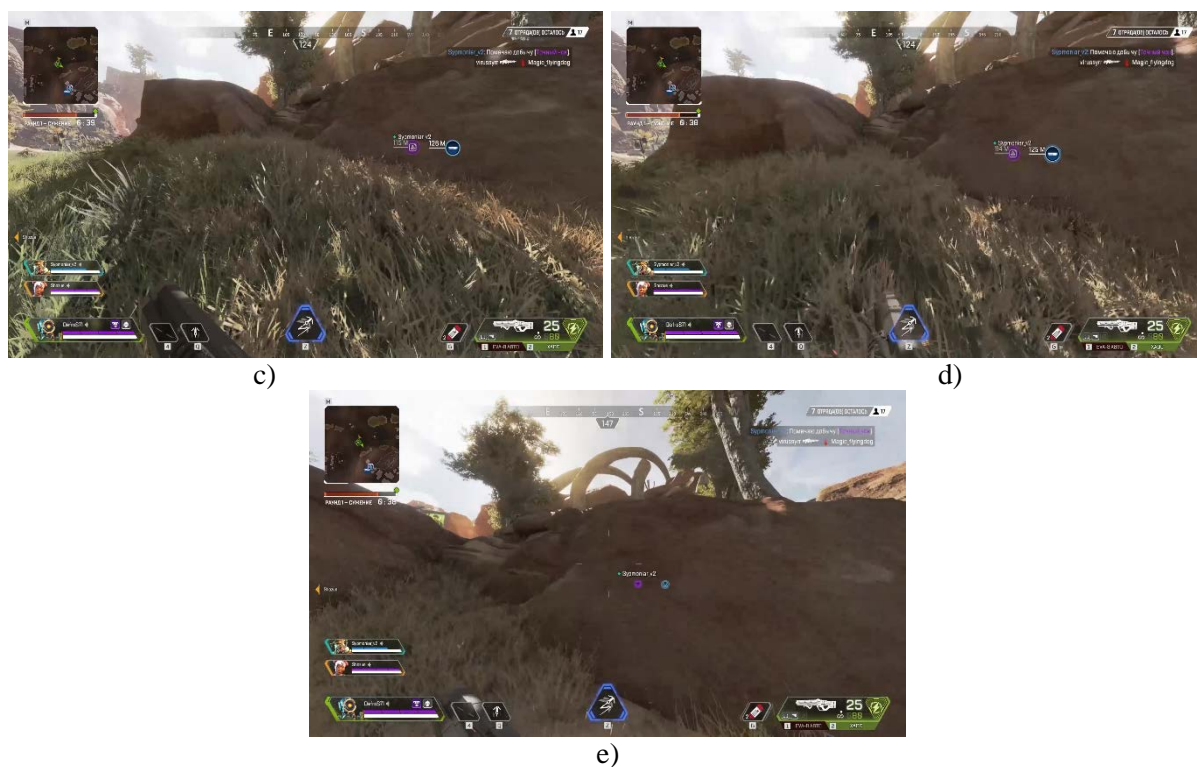c)   d)

e)
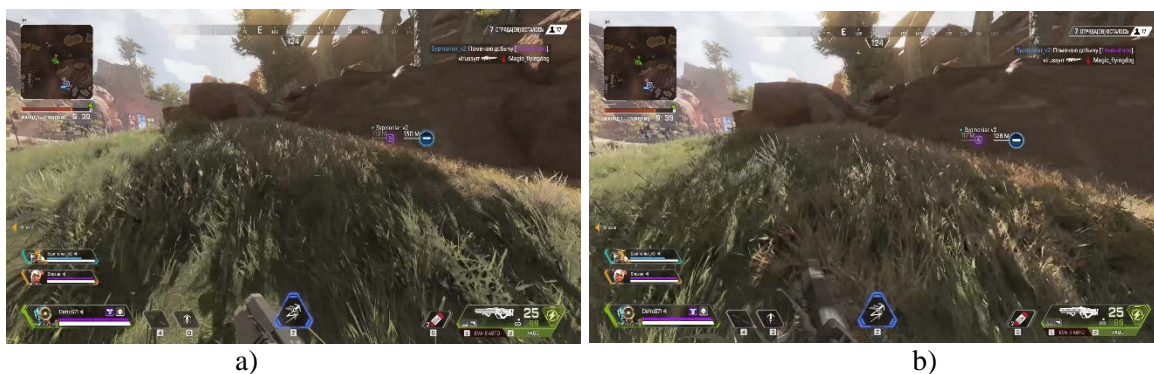
Figure 1. Samples of frame from the original video file for number of frame:
a – the 10th; b – the 20th; c – the 30th; d – the 40th; e – the 50th

Table 2. Results of determination of average color of the frame of the video file and calculated for ΔE_{ab}^{*}

Number of frames	Video format	Codec type	Indicator of average color on R.G.B channels	Value of color difference ΔE_{ab}^{*}
10	Original file (MP4)	X264	92.85.71	–
20			94.86.73	
30			95.85.73	
40			94.83.72	
50			103.92.84	
10	MP4	AVC(H264)	92.84.71	0.7976
20			95.86.74	0.7532
30			93.83.72	1.0018
40			98.87.77	1.8266
50			100.89.82	1.3476
10	MP4	HEVC(H265)	92.85.71	0
20			94.85.73	0.7957
30			94.85.73	0.4715
40			93.83.73	0.7936
50			103.92.84	0
10	MP4	MPEG4(DivX)	92.85.72	0.6115
20			93.85.73	0.7140
30			94.85.74	0.7889
40			93.83.73	0.7936
50			103.93.84	0.7863
10	MP4	MPEG4(Xvid)	92.84.72	1.3023
20			94.85.73	0.7957
30			95.85.73	0

40			94.83.71	0.6125
50			104.93.84	0.7078
10			92.85.72	0.6115
20			93.85.72	0.4198
30	MPG	MPEG Video Version 2	95.85.74	0.6108
40			94.83.73	0.6130
50			103.92.84	0
10			92.85.71	0
20			94.86.72	0.6098
30	AVI	Uncompressed 16bpp. YUV 4:2:2 (UYVY)	94.85.73	0.4715
40			95.84.72	0.7156
50			102.92.83	0.7435
10			96.90.73	2.6209
20			92.86.77	2.6470
30	WMV	Windows Media Video 9 Screen (MSS2)	93.87.77	2.3303
40			91.83.75	2.3698
50			101.94.93	4.6992

5. Discussion of results

By data, provided in tables 1 and 2 the graphic dependences presented on Figures 2 and 3. In this experimental work, we offer a new quality evaluation method of video on indicators of average color. This method allows obtaining real numeric data in the analysis of the video file as in our opinion; image quality evaluation visually is incorrect and can replaced with assessment that is more exact.

Data analysis of tables 1 and 2 (see Figure 2) revealed that the smallest file size creates the H265 codec. It possesses the best indicators on ΔE_{ab}^{*} as in its values complete coincidence ΔE_{ab}^{*} on personnel when $\Delta E_{ab}^{*} = 0$ (see Figure 3) meets more often. This condition, in our opinion, is the extremely important and defining for video file quality evaluation. Indirectly for benefit of this fact say the facts of its active implementation instead of the H264 codec and that it is one of the newest for today.

Follows from Figure 3 that values ΔE_{ab}^{*} for codecs H265, UYVY, DivX, MPG yield close results and good dynamics. H264 and Xvid codecs showed the instability and a wide spacing on values ΔE_{ab}^{*}. However, their values ΔE_{ab}^{*} are included into an admissible zone which should not exceed $\Delta E_{ab}^{*} = 2$. Besides, the H264 codec is the basic for many video hostings, such as YouTube. In addition, while there is a similar situation, it will be often applied in the field of the Internet broadcasting further.
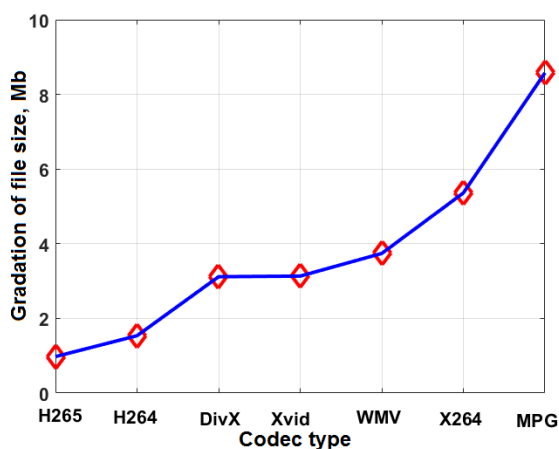

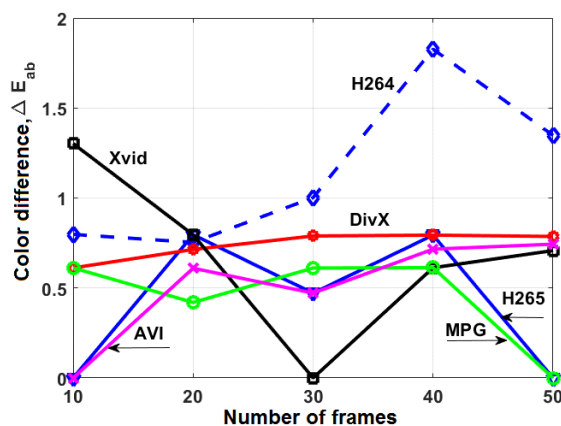**Figure 2.** Gradation of file size depending on codec type

Figure 3. Distribution color difference depending on codec type and number of frames

In this article, we did not analyze possibility of thin setup of values of codecs for final rendering of video. In our opinion, this task will be facilitated if similar exact approaches because only in such a way it is possible to see real differences in the personnel pressed at different settings are used.

We noted that codecs possess big number of settings, each of which is unique and has impact on final quality of video. Because of it, there is a lot of contributing factors and their variations, such problem can be solved only by practical consideration, by selection of best values of settings of the codec.

Moreover, it is frequent it is necessary to apply an individual approach in compression setup to different genres or simply separate movies. This is because sometimes you have to reduce the file size to the detriment of quality that in general is quite explainable. It is natural that visually to do such work it is problematic and it is impossible to vouch for a qualitative analysis. Therefore, the offered method in our opinion well is suitable for such tasks.

6. Conclusions

1. Codec Uncompressed 16bpp YUV 4:2:2 (UYVY) showed good result on values, but has inadmissibly big file size therefore is not suitable for data storage.

2. The H265 codec possesses the best indicators on and the smallest file size. Actually, it is ideal option of the codec today.

3. Codecs UYVY, DivX, MPEG2 yield close results of quality of the picture, but they possess the big file size, than H265. Therefore, they should be selected proceeding from specifically objectives.

4. The DivX codec showed the stability on quality. Four of five experiments yielded among themselves close results on.

5. The MSS2 codec showed the worst result, it exceeds a threshold of values on all studied personnel, and showed peak values from all studied codecs. However, we consider that it can be caused by incorrect behavior and default settings of the software by means of which compress in this format was made.

6. The offered method allows obtaining real numeric data in the analysis of quality of video, and can be applied to a provisional estimate of quality of the received movies since average color does not consider the accuracy of some, important parameters, for example, text clearness on personnel. However, this method well copes with the general determination of quality of personnel of video.

7. References

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