Project No. LLIV-343 "Use of multimedia and interactive television to improve effectiveness of education and training (Interactive TV)"

WP2 Task 1
FINAL REPORT ON EXPERIMENTAL RESEARCH

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Introduction

Since digital video technology has been replacing analog technology; SDTV coexists with HDTV; 2DTV coexists with 3DTV or Stereoscopic TV; a variety of technical standards (video display and signal formats, analog and digital video interfaces, video compression ratio levels and wired and wireless transmission technology) have increased. A great number of choices of video encoding and transmission technology technical specifications with different video content quality are possible. Technical improvements and development of new technology not always matches with the high level of observer's subjective assessment of video quality.

Nowadays we have many digital television standards (DVB-T/S/C/H, IPTV) that use wired and wireless transmission technologies and protocols (IP, RTP, RSTP, DASH, HTTP, HTLML5), several encoding/decoding standards (MPEG-2, H.264/AVC, H.265/HEVEC), as well as different displays (LCD, LED) varying in size (16:9, 720p, 1080i/p), technology and interface (SDI, ASI, CVBS, YPbPr, HDMI) standards. There are a lot of configuration options for encoding, multiple choices of encapsulation and transmission, etc. All of above mentioned influences technical quality of video displayed and also objective and subjective assessment of video quality made by a viewer. New and improved video encoding and transmission technology (e.g. HEVEC/H.265, HTTP/HTML5, WebM, Theora, VP8) is clearly required to adapt and improve existing objective video quality measurement algorithms (e.g. MSE, PSNR, SSIM, VQM) and verification of algorithms with redesigned subjective video quality measurements (e.g. PC, ACR, DCR, DSIS).

With the rapid development of DTV methods and tools, preconditions are being made for the creation and implementation of new services. New services can be spread using various technologies, such as Web and DVB. However, the qualitative parameters of services for individual technologies are different. As it is known, the qualitative parameters for digital TV are regulated by the ITU and ETSI recommendations. However, rapid development of different technologies integration leads to creation of common criterions for quality of service and metrics for their evaluation. It is known that the qualitative parameters for audio/video content consist of two components – objective and subjective. DTV operators are faced with a difficult task– how to match the requirements of broadcast parameters to ensure the required QoE- Quality of Experience to the end user optimizing transmission parameters related to QoS- Quality of Service.

The main aim of this study (publication, report and poster) is to evaluate impact of the video content and technical specifications on the observer's subjective and objective assessment of video quality through the measurements in experimental setup and statistical analysis of results. Video quality subjective and objective measurements were performed using a variety of video interfaces and selected specific video content with wide range of technical specification. In additional to create an integral and statistically confident subjective criterion representing QoE, which depends on any set of objective parameters related with different technologies and representing QoS.

WP2 Task 1

Tasks:

1. Perform joint research and develop methodology and appropriate tools for objective digital television path quality estimation, security and audio-visual materials development:
1.1. Creation of subjective and objective digital television technology quality factors and their estimation;
1.2. Development and validation of integral quality estimation criteria;
1.3. Development of methodology and tools for objective quality estimation;
1.4. Perform statistical reliable experimental research;

Results:

1. Publication. R. Pauliks, I.Slaidins "Impact of Video Content and Technical Specifications on Subjective Quality Assessement", Electronics and Electrical Engineering, No 6 (122), KAUNAS, KTU, 2012.

2. Report. R. Pauliks "Impact on Video Content and Technical Specifications on Subjective Quality Assessment", 4st International Workshop on Multimedia Experience, Yarra Valley, Australia, 2012, 5-7 July

3. Poster. R. Pauliks, K. Belahs, V. Gauja, K. Tretjaks "Image and Sound Transmission Laboratory, IST-LAB for Broadcast/Multicast Television Compression/Transmission Systems Subjective and Objective Video Quality Measurement", IEEE Signal Processing Society "2012 IEEE International Conference on Image Processing" (ICIP), Orlando, Florida, USA, 2012

4. Report. R.Pauliks, K.Belahs, K.Tretjaks, "Subjective Video Quality Assessment Methods", Space Research Review, Vol. 2, 2013, p. 25-33

5. Publication. R. Pauliks, I. Slaidins, "Quality Evaluation Of Synthetic Video In Simultaneous Double Stimulus Environment", Proceedings of the 2013 IEEE International Conference on Image Information Processing (ICIIP-2013), India 2013, p. 170-175.

6. Publication. R.Rollande „The use of structural modelling methods for analysis of personalized study planning" and participation in conference IEEE Technically Co-Sponsored Science and Information (SAI) Conference 2014, in London Heathrow, United Kingdom, 2014 26-29 August

7. Publication. Saulius Japertas, Aurelijus Budnikas and Gedeiminas Činčikas, "Identification Technology of Mobile Phone Devices using RFF"

8. Publication. Tautvydas Bakšys, Gediminas Činčikas, "Early warning system using DVB"

9. Publication. Vytautas Jakutis, Eligijus Sakalauskas "Interactive TV", Telekomunikacijos ir elektronika, 2014

10. Publication. Vytautas Deksnys, Eligijus Sakalauskas, Gediminas Činčikas, "New Integral Quality of TV Service Criterion Construction Based on Quality of Experience Statistical Estimation"

Conclusion

This paper, report and posters presents the results and analysis of the series of specially designed experiments performed with the aim to study the impact of video content and technical specifications on objective and subjective quality assessment. The focus was on revealing the relation between technical specifications of video scenes and interfaces on subjective quality assessment made by observers influenced by appearance of different types of common artifacts in digital videos (blocking, blurring, flickering, etc.) and transmission parameters (bitrate, delay, jitter, packet loss, etc.).

The research results and analysis of the series of specially designed experiments performed with the aim to study the impact of video content and technical specifications on subjective quality assessment. The focus was on revealing the relation between technical specifications of video scenes and interfaces on subjective quality assessment made by observers influenced by appearance of different types of common artifacts in digital videos (blocking, blurring, flickering, etc.). For a very vibrant synthetic video scenes, with high values of TA and SA (especially with high TA values) it was experimentally observed that there is no significant difference in subjective quality assessment score either using standard definition analog YIQ (576p composite video) or high definition analog or digital YUV (1080i YPbPr, YCbCr), as in both cases well observable impairments are caused.

Differences in subjective video quality assessment scores for different video scenes within the same test conditions could be explained with differences in spatial activity (SA) and temporal activity (TA) parameters. In SDS tests there were observed strong dependence between subjective video quality assessment scores and lgTA value with correlation coefficient -0.85. Similar, but no so strong dependence was observed between TA of video scene and MOS in SS1 and SS2 tests (correlation coefficient -0.4 – 0.5). At the same time there was not observed significant relation between quality scores and SA of video scene.

Based on the testing we can conclude that, if it is necessary to choose broadcasting and streaming video content between the 1080i or 720p video encoding and as the main constraints are limited network and storage resources, then it is definitely better to choose 720p encoding. It allows saving in average 10-15% of the total storage and the total amount of data exchange not decreasing quality scores (r=0.89 720p versus 1080i).

The video quality comparison brings to the conclusion that there is a very close correlation between one screen and two screen methods (r=0.78 for 5 grade scale), while allowing respondents to choose between methods, 75% of respondents prefer to simultaneously two screens method. SDS method is more suitable if necessary to measure relatively small and difficult to perceive video quality impairment changes.

Statistical model for TV perception integral quality criterion estimation is created relating objective TV parameters with subjective TV translation perception. Proposed statistical model is based on introduced new metrics and two grades (Yes/No) perception of video quality estimation and hence is dedicated for the ordinary and non-skilled audience of observers or more

precisely for end users. This model could be valuable for DTV operators seeking to optimize their service delivery. Using the data obtained by proposed methodology, DTV operators can better understand the quality requirements and even can evaluate graded quality criterions. For example, on the basis of obtained data three grades for quality estimation can be defined, i.e. top level grade 5, when ordinary observers can't detect audio/video corruption, grade 4, when no more than half observers detect corruption and grade 3 when more than half but not all observers detect corruption. We can conclude that in this way experts should define the grades 2 and 1. The experimental investigation of created integral quality criterion was performed for three DTV parameters: bitrate, packet loses and packets delay. A confidence interval as a statistical measure of criterion's Q estimation accuracy is found. For the experiment presented above with 25 observers, the width of confidence interval is about 12% of value Q.

Image and sound transmission technology laboratory (IST-Lab) for video quality testing has been developed, e.g. video coding and video transmission quality parameters and video quality testing methods and metrics have been tested.