DEVELOPING A HIGH DEFINITION VIDEO QUALITY OF EXPERIENCE MODEL BASED ON INFLUENTIAL PARAMETERS

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Abstract

Multimedia applications are quickly becoming a basic necessity for both business and personal situations. They are being used on daily basis, for a big part of the population, it's becoming the main source of entertainment and communication. Internet based Television and IPTV are now being preferred over standard Television due to the added functionality that it provides. Users not only expect good quality they also require it to be available continuously without fail. The research reported in this thesis is focused on the "Development of a high definition video Quality of Experience (QoE) model based on influential parameters". We have proposed a model for predicting QoE for high definition videos. We sought and justified appropriate parameters for inclusion into our prediction model. Our analysis has helped us in identifying parameter quantization as the most influential parameter from content domain. Whereas the parameters such as packet loss, packet reorder and jitter were found to be equally influential on QoE from the network domain. We also were able to show that parameter buffer size was the most influential parameter from the customer premises processing domain. We also showed that by integrating these parameters from the three domains of content, network and customer premises processing has enabled us to predict QoE with greater accuracy. The model enables the service provider to predict QoE and act before user perception goes beyond a predetermined threshold level. By including all the most influential parameters from all three domains we have ensured that we were accounting for a complete end to end effect of a user's perception. We were also able to identify the optimal configuration for good quality. In addition, we determined configurations that reduced the output quality to unacceptable levels that should be avoided. We were also able to find out a mathematical relationships between these parameters.

We have discussed the current state-of-the-art knowledge for QoE in the three identified domains and then proceeded to identify the shortcomings of models and methods found in the current literature. We made use of Taguchi robust designs for reducing the run time of experiments. This also helped us in analyzing many different configurations but only conducting experiments on a subset of these configurations. For three experiments the Taguchi DoE technique helped us reduce the number of test combinations from 81 to only 9 combinations. For the fourth experiment we were able to reduce the

number of combinations from 256 to only 18 combinations. We were able to reduce known boredom and memory effects by careful design of our experiments. Moreover, we were able to analyze the results using an appropriate signal to noise ratio (SNR) analysis method. This method helped us identify the most influential parameters for QoE in the three identified domains and it also assisted in the identification of optimal configurations. The method utilize quality loss model for identifying optimum configurations. By this method we found the SNR for each configuration and those individual parameter configurations were selected which ensured the highest SNR values. This helped identify the optimum configurations from each domain. In addition, we used the House of Quality (HoQ) method to validate the results of our SNR analysis. We were able to show that for individual domain the HoQ method was able to verify the results of our SNR analysis. HoQ only failed when we tried to use it to verify the end to end video quality degradation. We identified that the reason for HoQ method's failure in generating acceptable results was the use of weights to identify the most influential parameters in situation were all parameters under investigation where already found to be influential. These heavy weight parameters canceled the effect of each other and the parameters became statistically insignificant.

We proposed a QoE prediction model by using the most influential parameters identified from each domain. Our results show that these influential parameters were the major reasons for degradation in quality. Hence, using such parameters can help in better prediction of video quality degradation.

We made use of ordinal logistic regression for developing the prediction model. We proposed a complete model which was able to predict quality upto an 88% accuracy. Later, we developed a reduced version of the model for low computing solutions which was able to predict quality with 84.5% accuracy.

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