A New Approach to Naturalness for Still Images－Depending On TV Genre
TV화질에 있어서 자연스러움의 새로운 접근－TV장르*

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Abstract

‘Naturalness’ is the important “ness” which is a key factor in image quality assessment. ‘Naturalness’ is a representative factor depending on the context of the image which arouses different emotions. The Image Quality Circle was split into two steps. The first step is predicting the visual perceptual attribute which are lightness, colourfulness, hue and contrast. The next step is SSE which is dependent to image contents. In this study the image contents are grouped in genres. The images were rendered using four different colour attributes which are lightness, contrast, colourfulness and hue. Using a scale, the score of image quality and SSE was asked to each participant for all rendered images. A seven-point category scale of increasing amount of “ness” is used as a quantitative adjectives sequence. The image quality model was built by combining the SSEs for each scene. The SSEs, where vividness is common, are considered as independent variables to predict the image quality score. Then the vividness model was built using colour attributes as variables to predict the vividness of each scene (genre). Vividness is an important factor of naturalness which the meaning is different for all scenes that links the naturalness and image quality. The vividness meaning was different for each scene (genre). Therefore, the colour attributes that express the vividness would depend on the image content.

Keywords : Vividness, Image Quality, TV genre, Emotion

요 약

‘Naturalness’의 경우 화질 평가에 있어서 중요한 요인으로 여겨진다. ‘Naturalness’는 다른 감성이 부여되는 이미지의 컨텐츠에 의존하는 중요한 요인이다. The Image Quality Circle은 한 단계에 해당하는 ‘ness' 단계를 두 가지로 나누었다. 두 단계 중 하나는 lightness, colourfulness, hue and contrast와 같은 지각 속성을 예측하는 단계이다. 다음 단계는 이미지의 컨텐츠에 따른 SSE를 찾는 단계이다. 이 연구에서 이미지들은 TV장르로 분류해 놓았다. 각각의 이미지들은 lightness, colourfulness, hue and contrast를 단계별로 변형시켰다. 각 변형된 이미지의 화질 점수와 SSE의 점수를 실험 참가자들에게 물었다. 정성적 항목에 7 점 단계의 정량적 평가를 실시하였다. 각 장르에 따른 세 가지 SSE를 변수로 이용하여 화질 평가 모델을 수립하였다. 생생함 (vividness)은

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모든 장르에 공통으로 존재하는 SSE이고 나머지 SSE들은 모두 모델에서 독립변수로 취급하였다. 그 후 색 속성을 이용하여 각 장르에 따른 생생함을 예측하는 모델을 수립하였다. 생생함은 각 장르에 따라 의미가 다르며 화질 평가와 자연스러움(Naturalness)를 연결하는 중요한 요인이다. 각 장르마다 생생함이 다른 의미로 여겨지기 때문에 각 장르에 생생함을 최적으로 표현하는 색 속성 또한 장르마다 다를 것이다.

주제어 : 생생함, 화질 평가, TV 장르, 감성 (감정)

1. Introduction

Many reports have been focusing on image quality in display technology. In judging image quality for display (TV, mobile phone, monitor, etc.), customers opinion has been considered as an important factor. In other words, the judgment by the users are more important than the objective specs of the TV. In this paper, we obtain the tool for judging image quality based on the customer opinion using scene specific emotion.

Engeldrum (2000) has defined the "nesses" as the customer perceptions which are the perceptual attributes that form the basis of quality preference or judgement by the customer. Perceptual attribute is a characteristic of an image that we sense which is called "nesses". In shorthand terms, perceptual attributes are considered as colourfulness, hue, lightness etc. The image quality score cannot be computed directly from the perceptual attributes. Image dependency of image quality is emphasised by the phase "preferences do not occur in a vacuum, they are always formed relative to a context"(Mellers & Cooks, 1996).

An important "ness" is the 'Naturalness' which indicates that it is a key factor in image quality assessment. 'Naturalness' is a typical factor depending on the context of the image. Therefore, since each scene arouses different emotions 'Naturalness' is different for each scene. A psychologist as Zajonc(1980) has emphasising the importance of emotion which is the first response after the information process in making their decision. Work of studies on psychological dimension affecting the judgment for image was introduced by Kim et al.(2008). The psychological dimension was divided into 3 categories – SSE (the scene-specific emotion), Sensation, and Pleasant-Unpleasantness. Image quality depending on the scene was obtained by using an adjective scale experiment. The results show different reactions in the three psychological dimensions for all scenes by different control levels (e.g. contrast, brightness, hue (tint), saturation (colour), colour temperature and gamma) for the TV.

Those SSE were used as a factor in 'The Image Quality Circle'(Engeldrum, 2000) in this study. The "nesses" procedure in the Image Quality Circle was split into two steps. The first step is predicting the visual perceptual attribute which are lightness, colourfulness, hue and contrast. The next step is SSE which is dependent to image contents. In this study the image contents are grouped in genres.

Image quality cannot be derived by the colour attribute directly. However, adjectives can be derived by colour attributes.

2. Experimental Setup

Subjective image quality evaluation was performed in a test room using a 40-inch LCD-TV (TV Logic). Twenty female and male, total of forty, with normal vision participated the experiment. The participants evaluated the TV still pictures from a distance of 2.5m which is standard distance of 5h (h:height of the display). The room was illuminated with 400-600lx fluorescent lighting, which is a typical viewing condition at home in Korea. A large screen with grey colour was installed behind the TV, in order to minimize any

possible fatigue over the eyes, as well as to give adequate contrast between the screen and the background.

Table 1. SSE for each genre.

TV	SSE		
News	Vividness (생생한)	Pleasant (쾌적한)	Simple (심플한)
Documentary	Vividness (생생한)	Strong (힘찬)	Abundant (plentiful) (풍부한)
Sports	Vividness (생생한)	Refreshing (시원스러운)	Dynamic (active) (역동적)
Love affairs	Vividness (생생한)	Intense (strong) (강렬한)	Sensuous (감각적)
War	Vividness (생생한)	Daring (bolding) (대담한)	Tense (긴장되는)

Figure 1 is shows the representing images of each genre which were selected by previous studies of Kim. Additionally, two images were added to each genre (scene) making three images each and 15 images in total. The images were rendered using four different attributes which are lightness, contrast, colourfulness and hue. Figure 2 shows the rendered images for sport scene. Each attribute was rendered in five levels where level 3 is the original image. Level 1 is the lightest, less colourful and with smallest contrast image which is called the default level image. The hue is rendered towards the red to yellow, yellow to green, green to blue and blue to red as the level increases and the opposite direction as the level decreases. The images were shown randomly with a grey uniform screen in between the images to avoid after-image effect.

Three different SSE (Scene-Specific Emotion), which shows unique emotions effected by scenes, was chosen for each genre. Among the three SSEs for each genre, 'vividness' was the common emotion word for all five

genres. Although the word 'vividness' is the same, the meaning is slightly different for all five genres. 'Vividness' in this study is an adjective meaning lively, life like, fresh and full of life. 'Vividness' is an important factor in judging image quality. However, how 'vividness' appears depends on the image contents itself. In other words, 'vividness' is image dependent. The other two SSE are the top two adjectives in Kims study. Table 1 lists the SSEs for each genre. Note that the SSEs in Table 1 are the translated words of Korean expressions used in the actual psychophysical experiment.

News (NS)   Sports (SP)

Documentary (DQ)   Love affairs (LV)

War (WR)

Figure 1. Representing image of each genre.

Figure 2. Rendered images for sports scene.

investigate the relativity.

Figure 3. 'Vividness' scores plotted against the 'intense' (diamond) and 'sensuous' (square) score of 'Love affair' genre.

Using a scale, the score of image quality and SSE was asked to each participant for all rendered images. A seven-point category scale of increasing amount of perceptual attributes is used as a quantitative adjectives sequence without the far end of the nine-point category scale suggested by Bartleson(1984). Another difference is that the centre point of the scale is fixed for the default image of Level 3. Additionally, the score of contrast was asked in due to the complexity of calculating the contrast value for complex images.(Choi et. al., 2008) The other colour attributes (lightness, colourfulness, and hue) are calculated by the CIECAM02(CIE, 2004) and the values are normalised with the default level having the centre value of 4.

Figure 3 shows one of the plots which the 'vividness' scores is plotted against the 'intense' and 'sensuous' score of love affair genre. The relativity was judged by the R^2 value of the fitted line that runs through the origin. R^2 value approaches 1 with higher relativity to each other. The R^2 for each fitted line in Figure 3 are 0.129 (Intense) and 0.477 (Sensuous) which show low relativity with 'vividness'. The relativity of the SSEs for all five genres is derived as above and listed in Table 2.

3. Results

3.1. SSE for Image Quality Modelling

Although the SSEs are the most answered adjectives by the survey, it may illustrate similar meanings. In other words, vividness amy have the same meaning as refreshing for sports genre. In order to avoid repetition among SSE, the relativity were examined. The SSE score for each genre were plotting against each other to
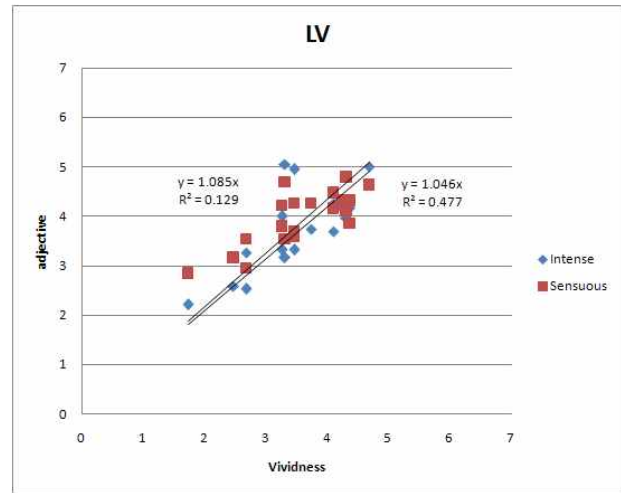
Table 2. The relativity of the SSEs for all five genres.

LV	Vividness	≠	Intense(strong)	≠	Sensuous
DQ	Vividness	=	Strong	=	Abundant(plentiful)
SP	Vividness	=	Refreshing	=	Dynamic(active)
WR	Vividness	≠	Daring (Bolding)	≠	Tense
NS	Vividness	=	Pleasant	≠	Simple

Table 3. Image quality model for each genre.

	1	2	3
LV	1.23V-0.35a(intense)+0.16b(sensuous)=IQ	1.07V-0.47a+0.46b=IQ	1.02V-0.23a+0.17b=IQ
DQ	0.99V=IQ	0.99V=IQ	1.01V=IQ
SP	1.01V=IQ	0.99V=IQ	0.97V=IQ
WR	0.9V+0.32a(daring)-0.27b(tense)=IQ	1.64V+0.07a-0.79b=IQ	0.72V+0.27a-0.06b=IQ
NS	0.4V+0.6a(simple)=IQ	0.45V+0.55a=IQ	0.38V+0.64a=IQ

The weighting factors of the model are the optimized coefficient of the data fitting the experiment data and model data. also the value of the weighting factors indicate the correlation to the image quality score. All three SSEs ('vividness', 'intense' and 'sensuous') for love affair are independent to each other. In other words, all three SSE are important in deriving high image quality. For documentary, 'vividness', 'strong' and 'abundant' showed high correlation to each other. 'Vividness', 'refreshing' and 'dynamic' were similar emotions for sports genre. The SSEs for 'war' were all dependent to each other. 'Vividness' and 'pleasant' was the same meaning to each other and independent to 'simple' for news genre.

3.2. Vividness for Image Quality

The model was built by combining the SSE for each scene. The SSEs are considered as independent variables to predict the image quality score. The model was constructed with a simple linear relationship between the variables and image quality score. The weighting factors were determined by minimising the difference of the predicted image quality score and answered image quality score.
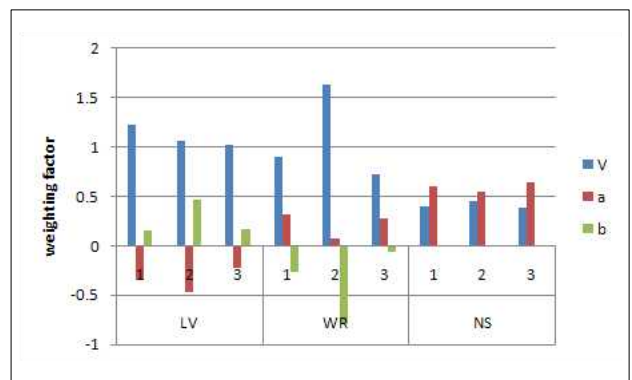

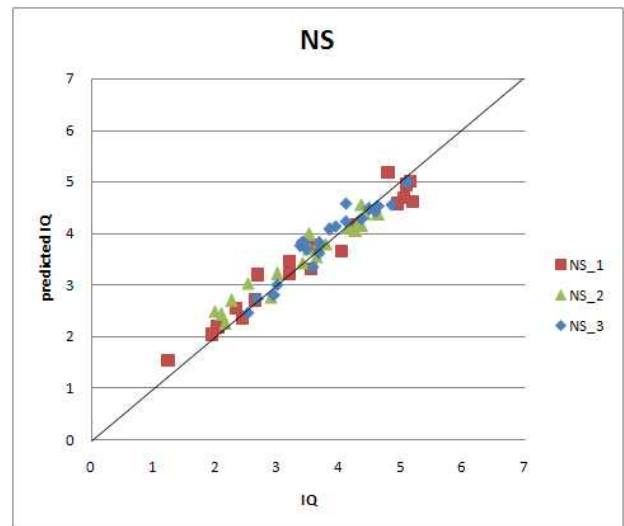Figure 4. Graph for weights of each SSE in the model.

Figure 5-1. The image quality score answered by the experiment (x-axis) plotted against the image quality scores predicted by the models (y-axis) in Table 3 for News.
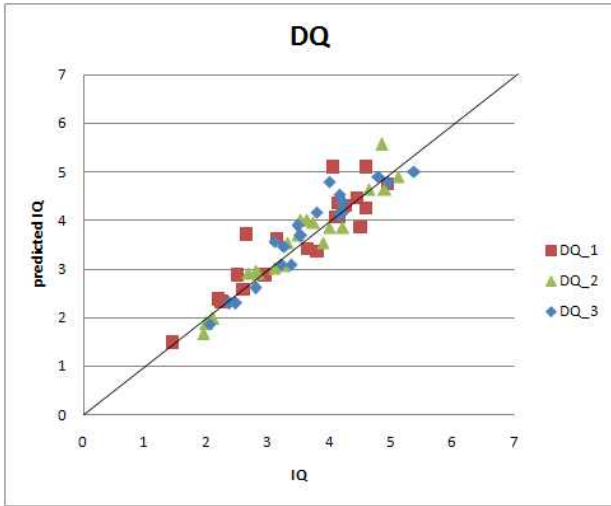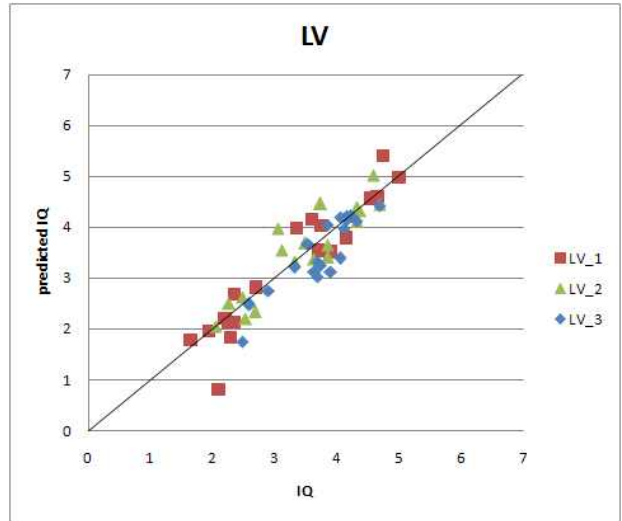
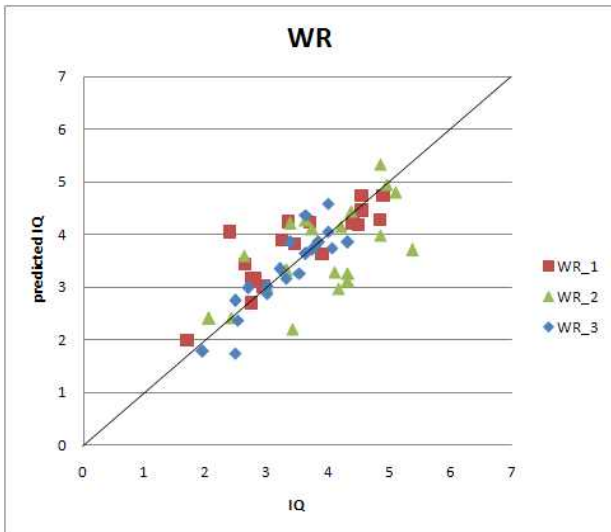Figure 5-2. For Documentary

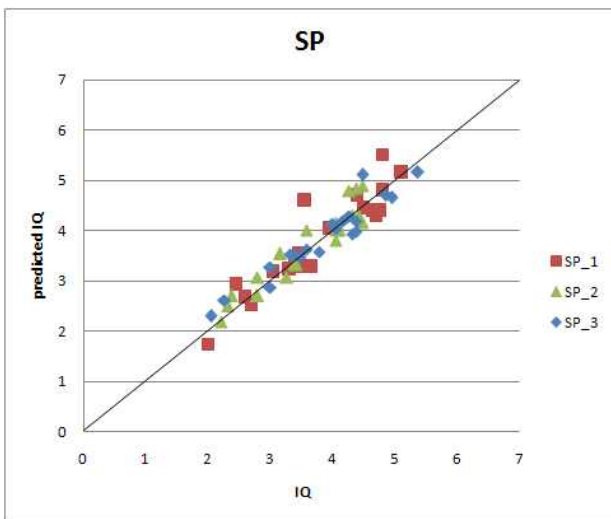Figure 5-5. For Love affairs

Figure 5-3. For War

Figure 5-4. For Sports

The weight for 'vividness' is the largest for all genres except news. 'Vividness' and the other emotion words can be considered as a sub-term of naturalness which depends and describes the image contents. Therefore, 'vividness' is an important factor of naturalness which the meaning is different for all scenes that links the naturalness and image quality.

Figure 5 shows the graphs between the predicted and answered image quality score. The results for all three images are plotted on each graph with different symbols. The image quality score answered by the experiment are plotted against the image quality scores predicted by the models using the SSEs as variables.

Except for the war scene, the image quality is highly related to the SSEs.

3.3. Colour Attributes for Vividness

The 'vividness' meaning was different for each scene (genre). Therefore, the colour attributes that express the vividness would depend on the image content. The colour attribute of each rendered image were predicted by CIECAM02. Lightness, colourfulness, and hue angle are the average values of each pixel. However, the predicted value of contrast for each image was asked to the participants. The model to predict the 'vividness' is a linear equation with the colour attributes as the
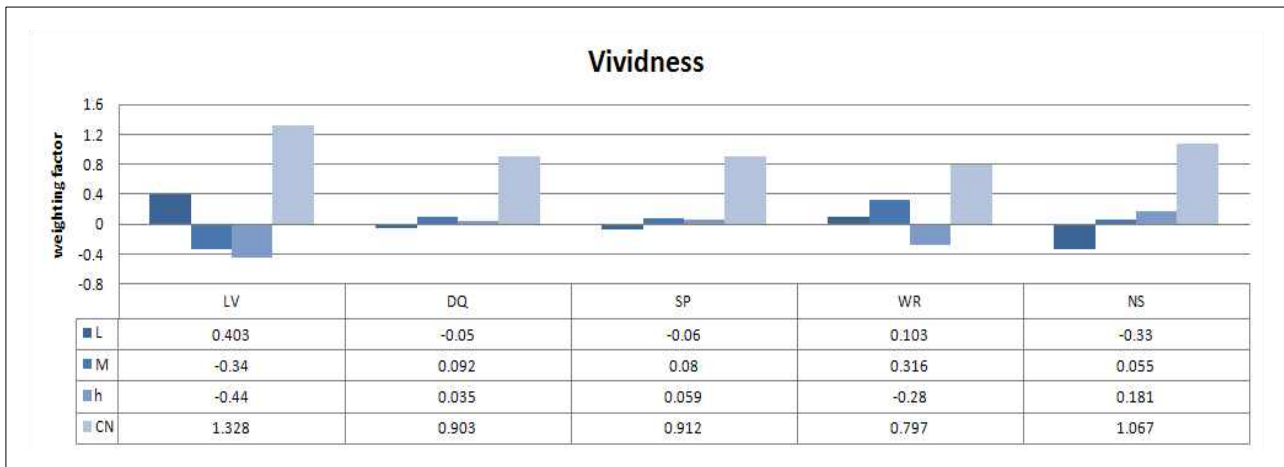
Figure 6. Weights of colour attributes for different genre.

independent variables. Figure 6 is the graph of the weights for each colour attributes of the 'vividness' model. The weighting factors are obtained by the same method as the image quality model above.

The colourfulness is an important factor for love affair and war enhancing the vividness after the contrast. For documentaries and sports contrast is the only important factor predicting the 'vividness'. The lightness and contrast is important factors in vividness for love affair and news. Although results for only predicting the 'vividness' are shown in this paper other SSE were obtained by the same method. The main colour attribute to emphasis the vividness is different for all different genres.

4. Conclusion

It is widely known that naturalness is an important factor in assessment of image quality. Naturalness depends on different genre and can be expressed by SSE (scene-specific-emotion). In this study, the 'vividness' was the common SSE for all five genres (news, sports, documentary, love affair, war). Two models were built to predict the image quality depending on different genres using psychophysical experiment results. The first model is the image quality model which uses the 'vividness' as a common variable. The weight of the 'vividness' in the

model depends on genres. The second model is the 'vividness' model to predict the 'vividness' using colour attributes as variables.

References

Kim, H.Y, Weo, J.W., Cho, S.H., Lee, J.M., Lee, N.K., & Shin, S.K. (2008). Effect of Color-Space Variation of TV Still Pictures on Psychological Dimensions for Image Quality Evaluation, *CGIV,* Terressa.

Mellers, B. J. & Cook, A. D. J. (1996). The role of task and context in preference measurement, *Psychol Sci.* 7(76).

Bartleson, C. J. (1984). *Optical Radiation Measurements, Vol. 5 Visual Measurement,* Academic Press, Orlando.

Engeldrum, P.G. (2000). *Psychometric scaling: a toolkit for imaging, systems development,* Imcotek Press, Winchester.

Choi, S.Y., Luo, M. R., Pointer, M. R., & Cui G. (2008). Subjective Rules on the Perception and Modeling of Image Contrast, *CIC proceeding,* Portland.

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist, 35,* 151-175.