Multivariate Analytics On User Personality Features To Enhance The Qoe In Video Streaming.

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Abstract: Video Streaming is a technology which allows the user to view a video online without being downloaded on a host machine. Many researches have been currently done to increase the quality of experience of the user. Dynamic Adaptive Bitrate streaming is the recent technology in video streaming which increases the quality of experience of the user by dynamically adjusting the video content based on the network condition. This adjustment in the content of the video viewed is not done based on the user perception and preferences. This paper presents a novel idea in improving the quality of experience of the user viewing the streaming videos by studying the preferences to different multimedia parameters color, contrast, brightness, saturation, sharpen, gamma, motion blur, Gaussian filter, frame resizing and audio equalizer. In this work user preferences to various multimedia parameters based on their personality types were examined and it reveals that there exist a correlation between user personalities and color, hue, contrast, saturation, motion blur and color threshold filter parameters. The findings suggest that user quality of experience can be enhanced by streaming the video based on their personalities with appropriate color, saturation, hue, color threshold, contrast settings in the video that is streamed.

Index Terms: color, contrast, hue, personality, saturation, streaming, video

1. INTRODUCTION

The Digital era is an amalgamation of video, audio, animation and video games. [1]The most widely and influential service in the internet is video. [2]According to cisco, of all the multimedia components creating network traffic, video traffic will hold a share of 82 percent in the near future. By the year 2022 live internet video will account for 17 percent of internet video traffic. The requirements for video streaming services is heterogeneous because it involves various content, sources, interest, devices and network limitations. [3]Normally Video streaming is built around manage and unmanaged networks. The QoS of video Streaming services is built around a dedicated network architecture provided by the managed networks. The quality of streamed video is of high because it has a backing of optimal network architecture. The Over the Top video services are provided by unmanaged networks. Currently Live Streaming and Video on Demand is prominently provided by video streaming services. [4]Recently Adaptive bitrate streaming techniques are used for live and on demand video streaming which involves more number of users at a particular time. [5]Client viewing using adaptive bitrate technique will involve in a process through which the selection of profile and schedule of the next chunk to download. As Adaptive bit streaming is used by many different video streaming services, more research on efficient content delivery to the user has been done. The quality of experience of the user while viewing a video through adaptive bitrate streaming has been a major concern.

This paper makes a multivariate analytics on different multimedia parameters which are a principle component of a video. This paper tries to figure out relationship between personalities of a user and the different multimedia components. The idea behind this analytics is, if video content is delivered based on user personality the quality of experience of the user will have an excellent feedback. Since Multimedia is a multi-tactile subject there is a need to understand the existence of a relationship between the personality of the user and different parameters involved in the video. To the best of our knowledge research on studying the relationship between personality and multimedia parameters are very scarce.

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2 REVIEW OF LITERATURE

This investigation mainly focuses on video content and user personality, many literatures in this perspective has been reviewed. [6]Cognitive style and personality, its impact on multimedia perception has been studied. [7], [8] Personality and its alliance with the performance of the students as well as contemplation on association between video lecture and student's perspective has been reported. A single video on a particular title is created based on developer's perception, and does not take into account the look and feel of the user. [9]When user experience multimedia almost all senses get involved to sound, video, text and images. [10]When video content is transferred across network, it adapts itself based on the available bandwidth. [11]Streaming of video is based on HTTP (Hyper Text Transfer Protocol) adaptive streaming technologies. [12],[13]Assessing the transferred video content based on Quality of Experience (QoE) is more vital than assessing it with Quality of Service (QoS). [14]Personalized Systems based on emotions and personality will aid researchers and practitioners develop and evaluate user-centric personalization systems which incorporate the factors that have a tremendous impact on learning curve, decision-making, emotions and personality. [15] Carl G. Jung after an extensive research on mental system and psychology concluded that each person has their own psychological type. The Jung theory was adapted by Myer and Briggs and they formulated MBTI (Myers Briggs Type Indicator). [16], [17] According to MBTI, personality of each person will be in any one of the sixteen types. These sixteen types can be narrowed down to four main categories each consisting of two

opposite preferences. The inborn qualities of a person determine the response of a person to a particular situation. The four main categories include Extroversion (E) vs. Introversion (I), Sensing (S) vs. Intuition (N), Thinking (T) vs. Feeling (F), and Judgment (J) vs. Perception (P). [18], [19]. The concept of relating personality to multimedia goes hand in hand in research perspective.

3 METHODOLOGY

The main objective of this research is to personalize video segment which is used in adaptive bitrate streaming based on the user interest and liking. This study was conducted and carried out to fulfill the laid down objectives. (A) To explore the relationship between the personality types and different multimedia parameters by carrying out multivariate analytics on them. (B) To personalize the video content available in video streaming services.

TABLE 1

RESULTS OF HOTELLING'S T^2 TEST FOR FINDING RELATIONSHIP BETWEEN PERSONALITY TYPE AND AUDIO EQUALIZER BANDS AND CROP

S.No	Personality Type	Multimedia Parameter	Value	Sig.
1	(E,I)	Audio Equalizer Bands	.010	.899
2	(S,I)	Audio Equalizer Bands	.024	.281
3	(T,F)	Audio Equalizer Bands	.029	.146
4	(J.P)	Audio Equalizer Bands	. 023	.322
5	(E,I)	Crop	.007	.485
6	(S,I)	Crop	.006	.588
7	(T,F)	Crop	.008	.417
8	(J,P)	Crop	.015	.102

This experiment was conducted with 512 participants out of whom 294 were male and 218 female. Their age was in the range from 16 to 31. Participants were unaware of the QoE experiments and the participant's knowledge about the study was less. The participants were well versed in computer and were given training on personality test, VLC (VideoLAN) Player handling. The participants were provided with user application form and a declaration, which they read before starting the experiment. The participants filled the personality test questionnaire online and arrived at their personality types. After completing the personality test, participants were shown the Avatar Movie clip. This movie was selected because the user can easily differentiate the multimedia components audio, video and color. The movie segment was from timeline 1hr: 50min: 40sec to 2hr: 12min: 22sec (22 Minutes).

4 EXPERIMENTAL SETUP

All the participants were given a consistent interface, pentium dual core at 2.70 GHz with 2 GB RAM, monitor was acer-193 hov with contrast and brightness of the monitor set at 56 and 85. The mode of the monitor was in movie, the setting of the monitor was 32-bit, Screen resolution was 1366 by 768 pixels and the size of the monitor was advanced-normal size(96 dpi). Zebronics Headphone with frequency 250 Hz was provided. The participants first answered question based on the preferences pertaining to different image properties filters, contrast (0-2), brightness (0-2), hue (0-360), saturation (0-3), gamma (0-10), sharpen (0-2). Next the participants answered question to different video editing and filtering properties such as crop, aspect ratio, motion blur, deinterlace mode, magnify wrapper filter, scaling mode, gaussian blur factor, motion detect filter, color threshold filter using VideoLAN. The user preferences to different audio equalizer settings were also analyzed(60 Hz, 170 Hz, 310 Hz , 600 Hz , 1 KHz, 3 KHz, 6 KHz,12 KHz, 14 KHz,16 KHz, preamp equalizer). This research focused mainly on deriving relationship between user personality and image properties filter, video editing properties, audio equalizers. A level of significance for this analysis was taken as $p \neq 0:05$. Hotelling's T^2 test was adopted to investigate the existence of any relationship between personality type and audio equalizer bands and crop. While two sample t-Test or Independent t-Test was adopted to compare personality types with different video filters. Chi-Square (χ^2) Test was used to identify whether there is any association between the attribute Introvert , Extrovert and the attributes such as color, aspect ratio, deinterlace mode, magnify wrapper, scaling mode, quality of motion detect video filter and quality of video by color threshold video filter. Similarly we applied this test for personality pairs (Sensing, Intuitive), (Thinking, Feeling) and (Judging, Perceiving).

5 MULTIVARIATE ANALYTIC OUTCOMES.

Hotelling's T^2 test was applied to identify whether the personality types differ in the selection of different audio band's frequency and crop. The findings reveal that ($p > 0.05$) for audio frequency band and crop, the mean vectors of frequencies of audio bands, crop and personality types are homogeneous. The personality types are not differing in the selection of different audio bands and crop. (Table-1) The Independent t-Test reveal that ($p < 0.05$) for hue ($p = 0.034$) for introvert and extrovert personalities, ($p < 0.05$) for Motion Blur ($p = 0.049$) for sensing and intuitive personalities, ($p < 0.05$) for Contrast ($p = 0.040$) for Thinking and Feeling personalities, ($p < 0.05$) for Saturation ($p = 0.049$) for judging and perceiving personalities. Thus, there is a significant difference between the personality types in the means of all parameters such as hue, motion blur, contrast, and saturation. The results reveals that introvert and extrovert personalities exhibit heterogeneous preferences for hue, sensing and intuitive personalities show heterogeneous preferences for motion blur whereas thinking and feeling display heterogeneous preferences for contrast, judging and perceiving have heterogeneous preferences for saturation.(Table-2). The Chi-square test reveals that, ($p < 0.05$) for introvert and extrovert personalities with color ($p = 0.007$), ($p < 0.05$) for thinking and feeling personalities with color threshold video filter ($p = 0.028$). Based on the findings we explore that there is association between personality pair (introvert, extrovert) with color and personality pair (thinking, feeling) with color threshold video filter.(Table-3). Table-4 list out the multimedia parameters to which the personalities correlated.

TABLE 2

TWO SAMPLE T - TEST OR INDEPENDENT T – TEST FOR EXPLORING RELATIONSHIP BETWEEN PERSONALITY TYPES AND DIFFERENT VIDEO FILTERS

Filters	Introvert and Extrovert		
	t	df	Sig. (2-tailed)
Contrast	0.219	510	.826
Brightness	-0.414	510	.679
Saturation	0.149	510	.882
Gamma	-0.257	510	.797
Hue	**-2.129**	**509**	**.034**
Sharpen	1.423	510	.155
Preamp equalizer	-1.180	509	.238
Motion blur	0.641	510	.522
Gaussian blur	0.480	510	.632
Filters	**Sensing and Intuitive**		
Contrast	0.763	510	.446
Brightness	0.640	510	.523
Saturation	0.566	510	.572
Gamma	1.715	510	.087
Hue	-1.170	509	.243
Sharpen	-0.237	510	.813
Preamp equalizer	0.360	509	.719
Motion blur	**1.970**	**510**	**.049**
Gaussian blur	-1.272	510	.204
Filters	**Thinking and Feeling**		
Contrast	**-2.063**	**510**	**.040**
Brightness	-0.770	510	.442
Saturation	0.217	510	.829
Gamma	-0.472	510	.637
Hue	0.545	509	.586
Sharpen	-0.609	510	.543
Preamp equalizer	0.290	509	.772
Motion blur	-0.586	510	.558
Gaussian blur	0.842	510	.400
Filters	**Judging and Perceiving**		
Contrast	-1.034	510	.302
Brightness	0.150	510	.881
Saturation	**1.954**	**510**	**.049**
Gamma	1.103	510	.271
Hue	1.196	509	.232
Sharpen	0.715	510	.475
Preamp equalizer	-1.398	509	.163
Motion blur	-1.392	510	.165
Gaussian blur	-0.415	510	.678

TABLE 3

CHI-SQUARE TEST FOR FINDING RELATIONSHIP BETWEEN PERSONALITIES, COLOR THRESHOLD FILTER, COLOR

Personality	Attribute	Value	df	Asymp. Sig. (2-sided)
(E,I)	Color Threshold Video Filter	6.962	4	.138
(S,I)	Color Threshold Video Filter	1.601	4	.809
(T, F)	**Color Threshold Video Filter**	**10.864**	**4**	**.028**
(J, P)	Color Threshold Video Filter	2.429	4	.657
(E,I)	**Color**	**19.279**	**7**	**.007**
(S, I)	Color	4.813	7	.683
(T, F)	Color	11.561	7	.116
(J, P)	Color	4.349	7	.739

6. MATHEMATICAL MODEL FOR BUILDING PERSONALITY BASED VIDEO SEGMENT.

TABLE 4

PERSONALITY AND ITS CORRELATION WITH MULTIMEDIA PARAMETERS

S.No	Personality	Multimedia Parameter Correlated
1	Introvert, Extrovert (E,I)	Hue
2	Sensing and Intuitive (S,I)	Motion Blur
3	Thinking and Feeling (T,F)	Contrast
4	Judging and Perceiving(J,P)	Saturation
5	Thinking and Feeling (T,F)	Color Threshold Filter
6	Extrovert and Introvert (E,I)	Color

A mathematical model for these findings has been formed at a pixel level, taking into consideration the preferences by the personality.

$$g(x,y) = PC[f(x,y)] \quad (1)$$

$$h(x,y) = PH[g(x,y)] \quad (2)$$

$$i(x,y) = PCO[h(x,y)] \quad (3)$$

$$j(x,y) = PSA[i(x,y)] \quad (4)$$

$$k(x,y) = PCTF[j(x,y)] \quad (5)$$

Where PC-Personality based Color, PH-Personality based Hue PSA-Personality based Saturation, PCTF-Personality based Color Threshold value, f(x,y) is the original pixel value and g(x,y), h(x,y),i(x,y), j(x,y), k(x,y) are personality preference values.

$$PC[f(x,y)] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R_{(x,y)} \\ G_{(x,y)} \\ B_{(x,y)} \end{bmatrix} \quad (6)$$

$$OR$$

$$PC[f(x,y)] = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R_{(x,y)} \\ G_{(x,y)} \\ B_{(x,y)} \end{bmatrix}$$

$$where \quad 0 < B_{(x,y)} <= 255$$

$$PC[f(x,y)] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} R_{(x,y)} \\ G_{(x,y)} \\ B_{(x,y)} \end{bmatrix} \quad (7)$$

$$OR$$

$$PC[f(x,y)] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R_{(x,y)} \\ G_{(x,y)} \\ B_{(x,y)} \end{bmatrix}$$

$$where \quad 0 < R_{(x,y)} <= 255$$

For example, the PC function can be implemented when the pixel (x, y) fall in the following condition. Similarly for other constraints, matrix can be constructed based on the findings.

Condition-1:

If($0<R_{(x,y)}<=255$) and ($0<G_{(x,y)}<=255$) and ($B_{(x,y)}=0$), then color at (x,y)=shades of yellow, for a user with Feeling personality dislikes yellow, it can be replaced using (6).

Condition-2:

If $R_{(x,y)}=0$ and($0<G_{(x,y)}<=255$) and ($0<B_{(x,y)}<=255$), then color at (x,y)=shades of cyan, For the following personalities ENFJ,ENFP,ESFP,ESTP,ISTJ,INFP,INTJ,ISTP,INTP shades

of cyan can be replaced using(7). Similarly PH[g(x,y)], PCO[h(x,y], PSA[i(x,y)], PCTF[j(x,y)] is set based on the personality preferences.

7. VIDEO STREAMING BASED ON PERSONALITY

Streaming of video from a server to client involves the following process. First the video is captured, encoded in different formats and transcoded into different size and rates, for the video to fit in different playback devices ranging from laptop, personal computer, television, mobile and tablets. The idea behind video streaming based on personality is the transcoding phase can be done in context with the user personality, because the findings reveals that there exist a relation between the multimedia components involved in the making of a video and personality. A novel method of transcoding can be implemented based on the user personality and it can be called as trans-personality. (Fig 1).

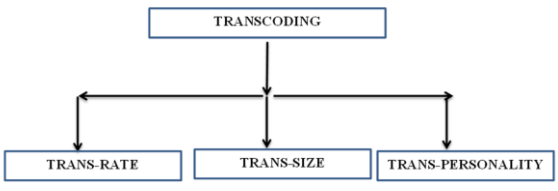

***Fig. 1**. Transcoding is done based on size, rate and proposed model TRANS-PERSONALITY*

8 CONCLUSION

The Video segment which is in the resource of video streaming services can be custom made based on the personality of the user. The interpretations of the results suggest that the incorporation of these research outcomes in any video streaming services may improve the quality of experience of the user. The findings reveal that color has a fine correlation with different personality traits. A complete analysis on color choices of the user disclose that user with feeling personality does not prefer yellow shades of colors, the ENFJ, ENFP, ESFP, ESTP, ISTJ, INFP, INTJ, ISTP, INTP personalities can be filtered with cyan shades. The EITJ, ESTJ, ESTP, ENTP, ISTP, INTP personalities can be filtered with white shades. The magenta color shades can be filtered for ESTJ personality. The ISTP, INTP, ENTP can be filtered for shades of green Color. For contrast the introvert preference was between 0.7 and 1.2 and the extrovert preference was between 0.9 and 1.2. The hue and saturation can be set based on the personality type and the RGB values. The motion blur and color threshold filter shows relationship between personalities through which the size of the video segment can be reduced not comprising with the quality of experience of the user. The brightness, sharpen, gamma, gaussian filter, frame resizing, aspect ratio, deinterlace mode, magnify wrapper, scaling mode, quality of motion detect video filter and audio equalizer do not have any relationship with the personalities, so it is optimal to adjust the multimedia settings at the client end. An algorithm has been implemented using python tool which personalize the video content based on the user personality. The future enhancement that can be done based on this study is, deep learning in the user behavior patterns while viewing the streamed video can be studied and video content can be fully personalized.

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