SKYPE VS. GOOGLE HANGOUT: LONG DISTANCE VIDEO CALL QUALITY COMPARISON

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ABSTRACT

A comparison of the long distance video call quality is presented for Skype and Google Hangout. Widely used Foreman video sequence is used for the comparison. Frames in the received video is first aligned with the best matched frames in the sent video. Then video quality is measured and compared for each best matching frame pair in the sent and received videos using different video quality matrices namely, peak-to-peak signal-to-noise ratio, structural similarity, mean sum of absolute difference and mean squared error. After that video quality of Skype and Google Hangout is compared. Finally the results are compared with a commercially available video quality comparison application, MSU Video Quality Measurement (VQM) Tool.

***Key words*:** Quality of user Experience (QoE), Skype, Google Hangout, PSNR, SSIM, MSAD, MSE

1. INTRODUCTION

Video quality measurements of a long distance video call using widely used video call over Internet applications Skype and Google Hangout is presented here. Video calls over Internet now is a basic day to day function used by majority of the Internet users. This work is a continuation of the authors' previous works on Skype long distance calls presented in [2] and [5]. Jing Zhu carried out a similar analysis for Skype on a LAN environment simulating delay characteristics of a WAN [1].

Seven parameters were used to evaluate the quality of the received video with respect to the source video namely, peak-to-peak signal-to-noise ratio (PSNR), structural similarity (SSIM), MSU blocking matrix, MSU blurring matrix, delta, mean sum of absolute differences (MSAD), and mean squared error (MSE). Details of the each parameter are given below [4, 5].

Peak-to-peak signal-to-noise ratio (PSNR) can be calculated using,

$$PSNR = 10 \cdot log_{10} \frac{MaxErr^2 \times w \times h}{\sum_{i=0,j=0}^{w,k} (X_{i,j} - Y_{i,j})^2}, \qquad (01)$$

where, *MaxErr* is maximum possible absolute value of color components difference, *w* is video width, *h* is video height, and *X* is the reference video frame, and *Y* is the source video frame. Higher PSNR values are given for high similar frames.

Structural similarity (SSIM) index is based on measuring of three components (luminance similarity, contrast similarity and structural similarity) and combining them into the result value. Higher values of SSIM provides high similarity between source and received frames.

MSU blocking metric measures subjective blocking effect in video sequence where lower values correspond to lower blocking. MSU blurring metric compares power of blurring of two images where lower values correspond to higher blurring.

Delta or the mean difference of the color components in the correspondent points of the source and received videos can be found using,

$$d(X,Y) = \frac{\sum_{i=1,j=1}^{w,h} (X_{i,j} - Y_{i,j})}{w \times h}, \qquad (02)$$

where *w* and *h* are the number of pixels in width and height of the frame, *X* and *Y* are the reference and test video frames. 0 means equal frames, positive and negative values mean deviation, lower absolute values are better.

Mean sum of absolute difference (MSAD) is the mean absolute difference of the color components in the correspondent points of image as can be found using,

$$d(X,Y) = \frac{\sum_{i=1,j=1}^{w,h} |X_{i,j} - Y_{i,j}|}{w \times h}. \qquad (03)$$

0 means equal frames, lower values are better.

Mean squared error (MSE) can be found using,

$$d(X,Y) = \frac{\sum_{i=1,j=1}^{w,h}(X_{i,j}-Y_{i,j})^2}{w \times h}. \qquad (04)$$

Lower values are better, 0 for equal frames.

Rest of the paper is organized as follows. Section 2 explains the experiment procedure and section 3 presents the experiment results with the explanation of the results. Finally conclusion of the work is presented.

2. METHODOLOGY

To measure the video quality of Skype and Google Hangout, two experiments were carried out for each, using two source videos, 1 sec and 2 sec long respectively. Foreman standard sequence was used in AVI format, 320×240 spatial resolution, and 25 fps.

SplitCam[1] virtual camera was used at the sender to feed the source video to Skype and Google Hangout and played continuously in a loop. Sender was in Taiwan and videos were recorded in Sri Lanka. At receiver video was recorded for Skype using Evaer[2] software application, and screen capturing application Camtasia[3] was used for Google Hangout as Evaer does not support recording of Google Hangouts. To accommodate initial network changes a 30 s waiting time was used before record each video for 10 s. For each application (Skype and Google Hangout) five videos were recorded and analyzed using the MSU Video Quality Measurement (VQM) Tool[4].

Best matching frames for the frames in the source video were found in the received video as explained in the [5] first and the resultant best matching frames were used to evaluate video quality against the source video. Figure 1 shows best matching frame numbers in the received video for both Skype and Google Hangout. First experiment data of the 25 frames source video was used here.

[1]http://www.splitcamera.com

[2]http://www.evaer.com/

[3]http://www.techsmith.com/camtasia.html

[4]http://compression.ru/video/quality_measure/video_measurement_tool_en.html

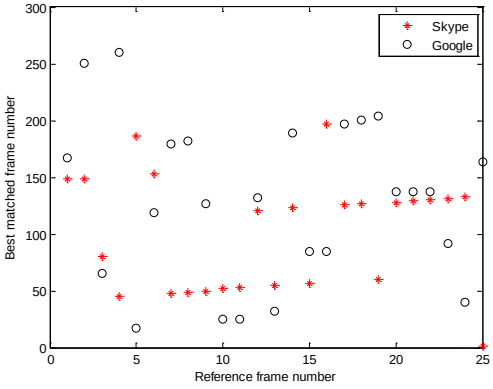


Figure 1: Best matched frame numbers

3. RESULTS AND DISCUSSION

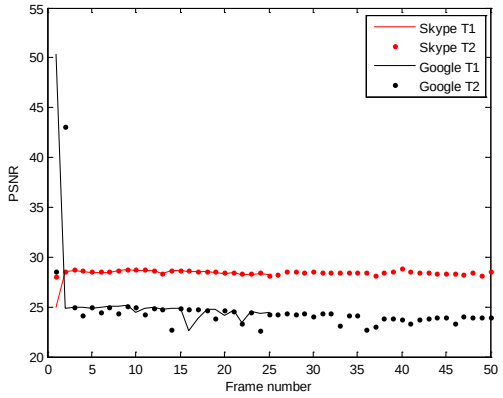
Table 1 provides a summary of the values obtained for each parameter tested for Skype and Google Hangout. First column of the Skype provides results from [2], second and third columns provide results of [5]. Each value provides the average of five experiments. Skype first column values show high deviation from the rest since the frame alignment was not used in that experiment [2]. For both Skype and Google Hangout video calls, both 25 and 50 frames source video experiments show similar values, concluding that source video length did not affect the video quality. But based on the average values, Google Hangout video call shows relatively less quality comparing to Skype video call. One reason for this may be the content added on the received video by the Google Hangout as a 'Google' logo at the top left corner and caller and receiver videos in the bottom right corner.

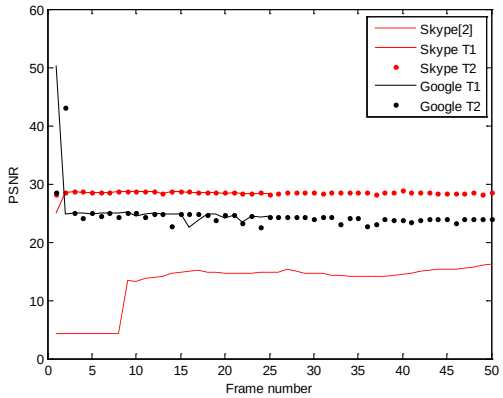
Table 1: Average experimental results

		Skype			Google	
Parameter		**[2]**	**T1**	**T2**	**T1**	**T2**
PSNR		13.52	27.93	26.74	24.82	19.14
SSIM		0.38	0.90	0.87	0.90	0.68
MSU Block. metric	S	15.08	12.64	12.47	12.64	12.47
	T	14.48	12.31	13.02	13.43	14.64
MSU Blurr. metric	S	15.08	16.32	16.28	16.32	16.28
	T	13.78	14.79	13.88	15.86	15.94
Delta		0.96	1.04	1.01	4.01	4.06
MSAD		38.26	5.37	6.57	7.80	15.86
MSE		2956.5	107.34	145.40	214.37	793.99

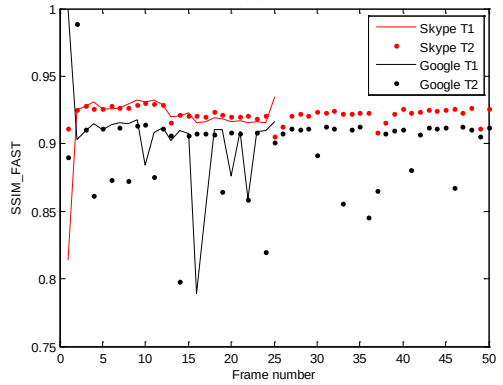
Then, for both Skype and Google Hangout calls, each parameter value received for the experiment 1 was compared graphically as shown in Figure

2. Since the values in the experiment [2] are considerably different from the rest of the experiments, Skype [5] values were included only in the PSNR graph. Overall Skype shows better quality results as per the graphs. Especially values in Skype are much steady and deviated only in a very small window.





(a)



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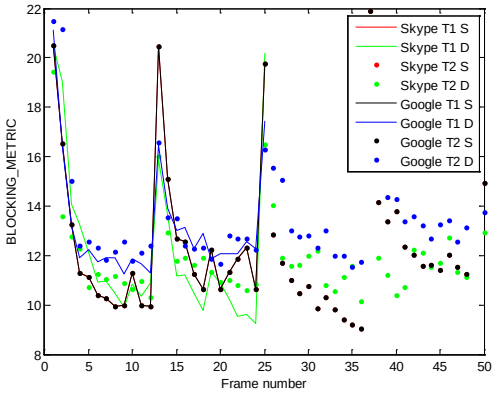

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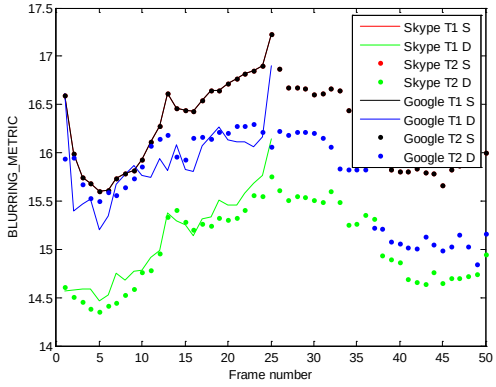
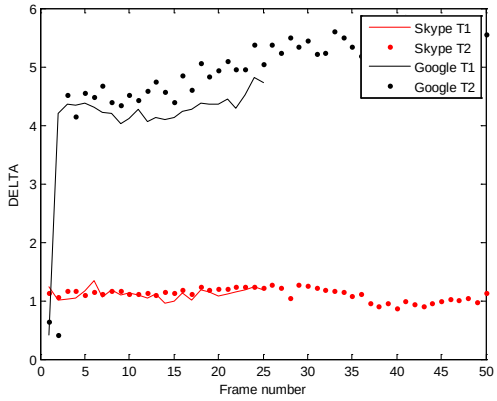
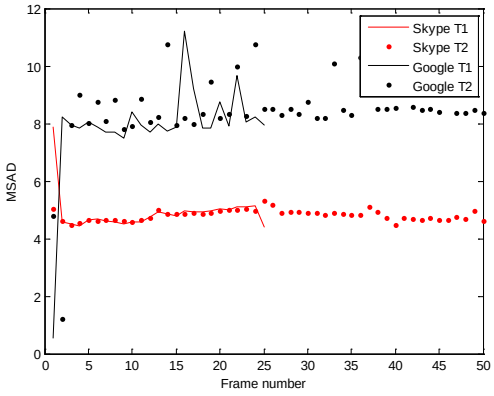


(d)



(e)



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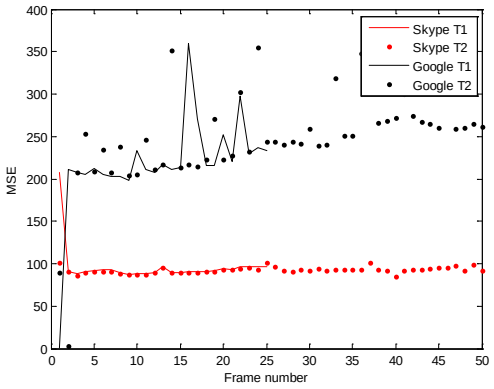

(g)

Figure 2: Performance graphs (a) PSNR (b) SSIM (fast) (c) MSU Blocking metric (d) MSU Blurring metric (e) Delta (f) MSAD (g) MSE.

An example selected source and best matched video frames for each experiment is shown in Figure 3. First row shows source frame numbers 0, 13 and 24. Second row shows best matched frames in the received video for a Skype video call, and third row shows best matched video frames for the Google Hangout video call.

(a) (b) (c)

Figure 3: Selected frames for PSNR test (top: source frame, middle: matched frames for Skype, bottom: matched frames for Google Hangout)

4. CONCLUSION

Video call quality analysis for Skype and Google Hangout is provided. Experiment was carried out between Taiwan and Sri Lanka using Foreman video sequence. First best matched frames for the source frames were found and compared for the video quality. Seven video quality parameters were measured namely, PSNR, SSIM, MSU Blocking metric, MSU Blurring metric, Delta, MSAD, and MSE. Experimental results demonstrate less fluctuating steady results for the Skype video calls, and especially all the parameters values demonstrate relatively high video quality in the Skype video call comparatively to the Google Hangout video call. Further extensive experiments are encouraged to further analyze the reasons for the differences.

5. REFERENCES

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