Original Research Paper

Volume - 7 | Issue - 6 | June - 2017 | ISSN - 2249-555X | IF : 4.894 | IC Value : 79.96

Engineering

IMAGE OPTIMIZATION: REDUCES THE DELAY IN WEB PAGE LOADING USING SUCCESSIVE BLOCKS INTERFRAME CODING

Escalin Tresa L — Research Scholar, Electronics and Telecommunication Engg & Sathyabama University, Chennai, India

Dr Sundararajan M — Dean Electronics Sciences & Bharath University, Chennai, India

ABSTRACT The ideal load time for websites is less than 2 seconds. If the loading time is less than 1 second, many sites can be loaded at the same time. A fast site has a good user experience (UX) and a satisfied UX leads to higher conversations. Slow sites have a poor user experience. Every image affects the load time of the website, so compressing the image will leads to a better performance with less loading time and good user experience. Image compression plays a significant role in transmission on TCP / IP applications while loading / transmitting web pages. In this article, we propose an image compression technique called Successive Blocks Interframe Coding (SBIC) with the base of local redundancy reduction using MPEG-4 standard. The images in the web page gets reduced without quality / size loss and hence load time gets reduced with high compression ratio. The load time of web pages was analyzed using the tool Telerik Fiddler Web Debugger v4.6.20171.9220 and https://tools.pingdom.com.

KEYWORDS : Successive Interframe, Image Compression, Block Sequencing

INTRODUCTION

In 2006, Amazon reported that they will speed up their website for every 100 milliseconds to increase a revenue of 1%. Google reported that the page speed should be considered in the search results ranking to improve the performance of website. Optimizing the page speed could be a hedonic process, kind of running on a treadmill. These benchmarks were based on studies that shows 47% of people expect web pages to load in less than 2 seconds and 57% of visitors abandoned the pages that takes greater than 3 seconds to load. Hence image size is an important component of a site's speed. This article explains the ways to optimize the images to improve load times. Websites such as News, Encyclopedia, Geo, Journal, Books, Electronics Commerce, Photo Sharing etc. uses high graphics since the nature of sites is relay on images [1][2][3]. So, high image compression and transmission will help the users to stay on the website effectively. Table I shows the loading time vs. metrics of the website.

TABLE I
WEBSITE LOADING TIME VS. METRICS

Sl.No	Loading Time (Sec)	Metrics
1	< 1	perfect
2	1-3	above average
3	3-7	average
4	> 7	very poor

This article describes the proposed image compression using Successive Blocks Interframe Coding (SBIC) on the web pages and explains how it reduces the loading time.

WEB PAGE LOADING TIME ANALYSIS

In this section, we have chosen few world class standard websites for analyzing the web elements and the load time. All the chosen websites were taken from the location San Jose, California, USA. All the web pages as shown in Fig 1, 2, 3, 4, 5 were tested and the bottlenecks were analyzed and shown in table II, III, IV, V, VI.

Test image 1- Domain Name: https://www.amazon.com/

Fig 1: Clip of (https://www.amazon.com) on Mar 30, 2017 at 19:10

TABLE II
RESULT OF TEST IMAGE 1 FOR LOAD TIME & PAGE SIZE

Sl.No	Performance grade	Load time	Faster than	Page size	Requests	Tested from
1	71	1.79 s	75 % of tested sites	4.7 MB	136	San Jose on Mar 30 at 19:10

Test image 2
DomainName: http://www.nationalgeographic.com/

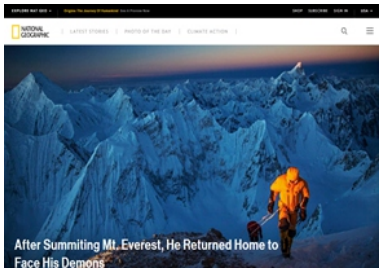

Fig 2: Clip of (https://www.nationalgeographic.com) on Mar 30, 2017 at 20:14

TABLE III
RESULT OF TEST IMAGE 2 FOR LOAD TIME & PAGE SIZE

Sl. No	Performance grade	Load time	Faster than	Page size	Requests	Tested from
1	59	3.91 s	42 % of tested sites	3.7 MB	123	San Jose on Mar 30 at 20:14

Test image 3- Domain Name: http:// www.flipkart.com

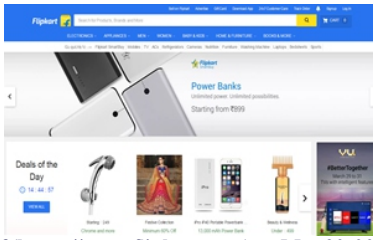

Fig 3: Clip of (https://www.flipkart.com) on Mar 30, 2017at 19:52

TABLE IV
RESULT OF TEST IMAGE 3 FOR LOAD TIME & PAGE SIZE

Sl. No	Performance grade	Load time	Faster than	Page size	Requests	Tested from
1	90	60.00 s	3 % of tested sites	1.1 MB	98	San Jose on Mar 30 at 19:52

Test image 4- Domain Name: http:// www. snapdeal.com

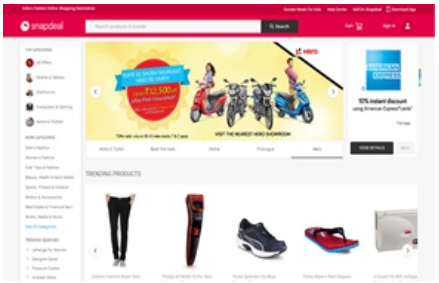

Fig 4: Clip of (https://www.snapdeal.com) on Mar 30, 2017 at 21:22

TABLE V
RESULT OF TEST IMAGE 4 FOR LOAD TIME & PAGE SIZE

Sl. No	Performance grade	Load time	Faster than	Page size	Requests	Tested from
1	A 95	02.26 s	66 % of tested sites	1.6 MB	92	San Jose on Mar 30 at 19:52

Test image 5- Domain Name: http:// www. discovery.com

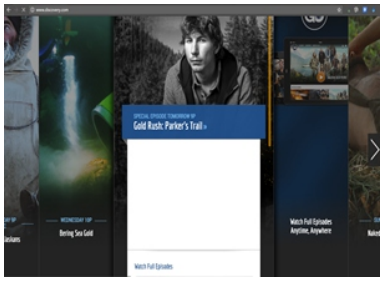

Fig 5: Clip of (https://www.discovery.com) on Mar 30, 2017 at 21:35

TABLE VI
RESULT OF TEST IMAGE 5 FOR LOAD TIME & PAGE SIZE

Sl. No	Performance grade	Load time	Faster than	Page size	Requests	Tested from
1	73	02.50 s	62 % of tested sites	4.5 MB	153	San Jose on Mar 30 at 21:35

Fig 6 and 7 shows the graphical representation of the domain with page size and load time respectively.

Fig 6: Domain vs. Page size

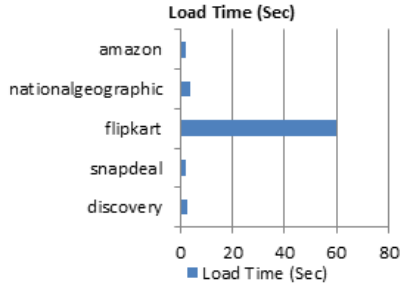

Fig 7: Domain vs. Load Time

IMAGES RATIO ON WEB PAGES

This section shows the image ratio in percentage on the loaded web page. The percentage of image shows the importance over the business sites and other sites. So, image compression plays here an important role in web pages. Table VII shows the analysis report of web elements percentage from the total website.

TABLE VII
WEB ELEMENTS PERCENTAGE FROM THE TOTAL WEBSITE

	Content Type					
Domain	Image	Script	HTML	CSS	Others	Plain text
Amazon	72.40%	9.00%	1.40%	2.60%	14.50%	0.00%
Snapdeal	60.70%	16.00%	4.70%	4.30%	14.20%	0.10%
National geographic	71.40%	22.40%	0.60%	1.70%	3.90%	0.00%
Discovery	45.70%	23.70%	1.20%	5.50%	23.90%	0.00%
Flipkart	45.80%	35.60%	11.60%	5.00%	1.80%	0.20%

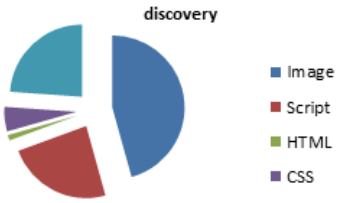

Fig 8: Domain 'discovery' vs. Web Elements

Fig 9: Domain 'amazon' vs. Web Elements

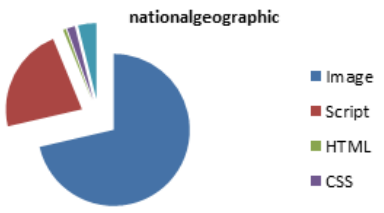

Fig 10: Domain 'nationalgeographic' vs. Web Elements

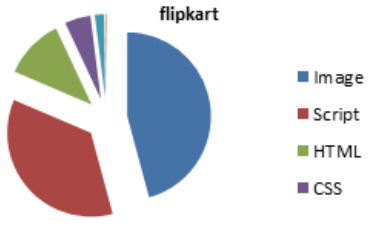

Fig 11: Domain 'flipkart' vs. Web Elements

Fig 12: Domain 'snapdeal' vs. Web Elements

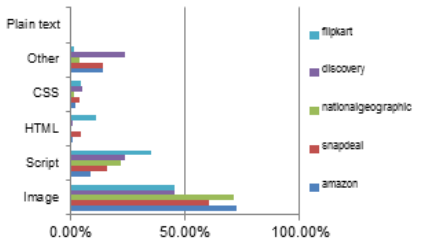

Fig 13: Overall web element's analysis

Fig 8, 9, 10, 11, 12, 13 clearly shows that the percentage and importance of image is high. Since the image takes highest percentage, the transmission over TCP/IP will take highest bandwidth. The proposed SBIC helps to reduce the image transmission percentage over the internet and has a high compression and decompression rate.

SUCCESSIVE BLOCKS INTERFRAME CODING (SBIC)

Unlike other compression methods SBIC works on the closest relationship of an image; meaningful image will have successive pixels/blocks relationship. The proposed SBIC takes advantage of this successive relationship to perform compression which is more than any other existing formats like JPEG, JPEG 2000.

No search algorithm is performed in the proposed SBIC to find the relation between image blocks. If the block matching process is used in SBIC, will get better results but time complexity will be more ie O(n2). To get a good performance, SBIC follows Successive pixels/blocks relationship and is shown in Fig 14 and the image with successive relationship is shown in Fig 15. The logic is simple ie by visually analyzing the image, we can trace the closest relation between the successive blocks [4][5]. This successive relationship helps SBIC to compress the image highly than the normal since the correlation of the successive blocks measures over 30% to 70%.

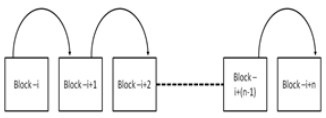

Fig 14: Successive Blocks

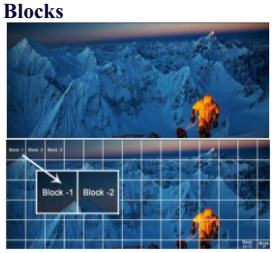

Fig 15: Example

By visually analyzing the Block 1 and Block 2, the closest relationship between them can be identified. This successive inter-relation is termed using Equation 1. Similarly, the closest successive inter-relation for Block 2 and Block 3, Block 3 and Block 4…. Block n-1 and Block n could be identified throughout the image [6][7].

$$\text{Similarity}(\text{image\_block}_i) = \begin{cases} \text{block}_i, & i\sim = (i+1) \\ \text{block}_{i+1}, & \sim 30\% - 70\% \end{cases} \quad (1)$$

SBIC uses MPEG coding for compressing the images and the general block diagram for the proposed SBIC is shown in Fig. 16

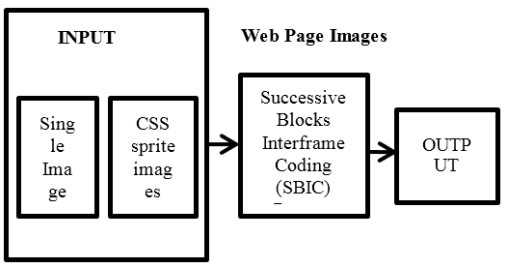

Fig 16: SBIC block diagram

- **Successive Blocks & MPEG Encoding**

Successive block may contain the same still or moving objects. Motion estimation checkout the movement of objects in an image sequence to find the vectors which represents the estimated motion. Motion compensation uses the ability of object motion to bring about the compression. Motion estimation and compensation are the suitable techniques to eliminate the temporal redundancy because of high correlation between the successive blocks. To compress the images, redundancy between the neighboring frames can be abused where a frame is selected as reference frame and successive frames are predicted from reference frames using Motion estimation technique. This technique evaluates previous and future frames to determine blocks that have no changes and the motion vectors were saved in the place of blocks and this process is called as Interframe coding.

In an image the entire blocks (Block 1, 2,. n) were converted into frames and all the MPEG frame sequences were encoded by MPEG-4 H.264 compression technique. The redundant blocks were eliminated when the fixed size blocks were transformed into frames. Motion estimation and Motion compensation were executed in the current and reference frame. After eliminating the redundant information, remaining information is compressed using frame difference. This process repeats until all the frames get compressed [8].

RESULT & DISCUSSION

To reduce data redundancy in multispectral imagery we proposed SBIC which was based on the successive blocks closest relationship or local redundancy for multispectral image compression. The relationship between the successive blocks of an image can be defined with respect to successive blocks relation, spectral-feature and spatial-feature characteristics in a block. This section analyses and discusses the results of the image compression performed by the proposed SBIC on a set of test images. Images from various domains as in Fig 17 were compressed using the proposed SBIC and the comparison results of both original and compressed images are shown in Fig 18.

The proposed SBIC is suitable for any kind of images and are not limited to these test images. The experimental result shows a feasible quality improvement with high compression ratio when compared with JPEG (Joint Photographic Expert Group).

Fig 17: Test images from various domain's for SBIC

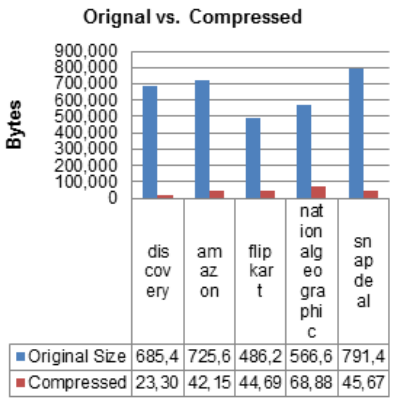

Fig 18. Comparison of Original vs. Proposed (Size)

CONCLUSION

Various compression techniques have been developed in the past two decades to address major challenges faced by digital imaging. The compression methods are generally classified into Lossy and Lossless compression [9]. Lossy compression can achieve a high compression ratio since it allows some acceptable degradation. But it cannot completely recover the original data. However, Lossless compression doesn't have degradation. It can completely recover the original data after compression. The proposed lossless SBIC is the challenging method such that it compresses the image more than the other compression methods such as JPEG, JPEG 2000. To simplify the computations of SBIC, block transform coding exploits correlation of the pixels within several small blocks that divides the original image. The successive relationship among the blocks in an image, data appears in the form of redundancy. As a result, each block is transformed, quantized and coded separately. The proposed SBIC generally uses 8*8 pixel blocks. 256*256 pixel blocks can be used to obtain a better, effective and fastest result and also the block size is customizable. As a result, SBIC compresses the web page images better than the other existing compression methods and makes the websites to load faster since the image transmission is reduced overall.

References:

[1] C. Je and H.-M. Park. Optimized Hierarchical Block Matching for Fast and Accurate Image Registration. Signal Processing: Image Communication, Volume 28, Issue 7, pp. 779-791, August, 2013.

[2] Li, Renxiang; Zeng, Bing; Liou, Ming (August 1994). "A New Three-Step Search Algorithm for Block Motion Estimation". IEEE Trans. Circuits and Systems for Video Technology. 4 (4): 438–442.

[3] Lu, Jianhua; Liou, Ming (April 1997). "A Simple and Efficient Search Algorithm for Block-Matching Motion Estimation". IEEE Trans. Circuits and Systems for Video Technology. 7 (2): 429–433.

[4] Zhu, Shan; Ma, Kai-Kuang (February 2000). "A New Diamond Search Algorithm for Fast Block-Matching Motion Estimation". EEE Trans. Image Processing. 9 (12): 287–290.

[5] Nie, Yao; Ma, Kai-Kuang (December 2002). "Adaptive Rood Pattern Search for Fast Block-Matching Motion Estimation". IEEE Trans. Image Processing. 11 (12): 1442–1448.

[6] Escalin Tresa L, Dr Sundararajan M, "Image Compression technique using Successive Blocks Interframe Coding", Journal of Theoretical and Applied Information Technology, Vol 95, No 8, April 2017.

[7] Escalin Tresa L, Dr Sundararajan M, "Image Compression for Digital Image Archive using Successive Blocks Interframe Coding", International Journal of Pharmacy and Technology, Vol 9, Issue no 1, Page 29061, April 2017.

[8] Po, Lai-Man; Ma, Wing-Chung (June 1996). "A Novel Four-Step Search Algorithm for Fast Block Motion Estimation". IEEE Trans. Circuits and Systems for Video Technology. 6 (3): 313–317.

[9] Marcelo J Weinberger, Gadiel. Seroussi, and Guillermo Sapiro, "The LOCO-I lossless image compression algorithm: Principles and standardization into JPEGLS" IEEE Transaction Image Processing, volume 9, no. 8, pp. 1309-1324, August 2000.