PERFORMANCE ANALYSIS OF INTERPOLATIONS METHOD FOR MOBILE IMAGE SHARING COMPRESSION

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To my beloved father and mother.

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ABSTRACT

This research focuses on the development of new lossy image compression algorithm based on interpolations specifically for mobile pre-transmission image sharing. By using combinations of image interpolations, the algorithm will compress the original image file into a significantly smaller size while maintaining the image quality and resolution of the transmitted image. During the preliminary test, numbers of interpolations have been tested such as bilinear, box, nearest neighbour, bicubic and Lanczos. Based on the best performance in terms of small memory output and high Peak signal-to-noise ratio (PSNR), the combination of bilinear and Lanczos is selected. Thus, the compression algorithm is named as Bilinear-Lanczos (BL) where the input image will be downscaled using bilinear interpolation then will be upscaled back using Lanczos interpolation. Compared to other pre-transmission compression for mobile image sharing, BL reshapes back the compressed image into the original size to enhance the quality of the transmitted image. The comparison between BL and Whatsapp, WeChat, Telegram, BeeTalk, Viber and KakaoTalk mobile app compression shown that BL outperforms all of the conventional image sharing apps in terms of image quality, file size and resolution of the compressed image. Based on the results, it shows that BL has the potential to be embedded in mobile social apps where the compressed image is smaller in order to maintain the real time performance of the image sharing and the shared image is more detail and high quality compared to current available sosial apps that support image sharing.

ABSTRAK

Kajian ini tertumpu pada penghasilan algorithm pemampatan berkehilangan yang baru berdasarkan pada interpolasi untuk perkongsian gambar di mobile semasa pre-penghantaran. Algorithm berdasarkan gabungan interpolasi, akan memampatkan saiz gambar asal kepada saiz lebih kecil dan mengekalkan kualiti gambar dan resolusi gambar yang telah dihantar. Pada permulaan uji kaji, interpolasi yang di uji adalah seperti 'bilinear','box','nearest neighbour','bicubic' dan 'lanczos'. Berdasarkan penyampaian yang baik pada saiz memori keluaran yang kecil dan tinggi nisbah puncak-signal-kepada-hingar(PSNR), gabungan 'bilinear' dan 'lanczos' dipilih. Oleh itu, algorithm pemampatan dinamakan 'Bilinear_Lanczos'(BL) di mana gambar input akan di turun skala menggunakan interpolasi 'bilinear' kemudian dinaikkan skala semula menggunakan interpolasi 'Lanczos'. Berbanding pre-penghantaran pemampatan perkongsian gambar di mobile, BL membentuk semula gambar yang dimampatkan kepada saiz asal gambar untuk mempertingkatkan kualiti gambar yang telah dihantar. Perbandingan BL dan Whatsapp, WeChat, Viber, Telegram, KakaoTalk dan Beetalk pemampatan aplikasi mobile menunjukkan BL mempunyai prestasi yang baik berbanding aplikasi perkongsian gambar yang lain dari segi kualiti, saiz fail dan resolusi gambar yang dimampatkan. Berdasarkan keputusan yang diperoleh, BL mempunyai peluang untuk digunakan dalam aplikasi sosial media di mobile di mana gambar yang dimampatkan lebih kecil untuk mengekalkan masa nyata prestasi gambar yang dikongsi dan gambar yang dikongsi adalah lebih terperinci dan mempunyai kualiti yang tinggi berbanding aplikasi media sosial yang digunakan untuk perkongsian gambar sekarang.

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BL	-	Bilinear interpolation and lanczos interpolations
JPEG	-	Joint Photographic Expert Group
DCT	-	Discrete Cosine Transform
PSNR	-	Peak-signal-to-noise ratio
ICBI	-	Iteractive Culvature Based Interpolation
FYP	-	Final Year Project

CHAPTER I

INTRODUCTION

1.1 Introduction

Mobile sharing image compression has become a topic to be discussed due to the increasing number of practical social applications of the algorithm. Image scaling or it is generally known as image interpolation methods are implemented in a variety of mobile computer and technology. The problem with the algorithm that has already implemented and used nowadays is quite simple to be described; a digital image is needed to be represented on a large bitmap from the original data sampled on a smaller grid, and this image should look like it had been acquired with a sensor having a resolution of the upscale image or, at least, present a 'natural' texture.

There are some interpolations that are commonly applied to solve the problem in large image likes nearest neighbour, bilinear, or bicubic interpolation. The nearest neighbour is the most basic and it requires the least processing time of all the interpolation algorithm because it only considers on pixel. It's just like copying the existing value. In the bilinear interpolation, it determines the gray value of the weighted average of the 4(2x2) closest pixels of the specific input coordinate and assign the value to the output coordinate. Bilinear interpolation is much smoother looking images than the nearest neighbour. Bicubic interpolation goes one step beyond bilinear interpolation by considering the closest 16 pixels(4x4).[10,11] Bicubic produces sharper images than the previous two methods. But, the problem is the algorithms do not fulfil requirements at the output. The output of images that are processed by the algorithms are affected by visual artifacts like pixelization, jagged contours, over-smoothing, and etc.[10, 11]

The popular image compression method is the Joint Photographic Expert Group (JPEG) standard. JPEG has a good compression performance, low computational and memory complexity. These criteria make it an attractive method for natural image compression. From Figure 1.0, it shows the basic block diagram for the JPEG encoder. JPEG is an algorithm that uses the Discrete Cosine Transform (DCT) on an image block of size 8x8 pixels. JPEG operates on small blocks. Cause of the fact, JPEG is motivated by both computer or memory consideration. A quality measures determine the quantization steps for each of the 64 DCT coefficient. The quantized coefficients of each block are then zigzag-scanned into one vector that goes through the run-length coding of the zero sequence, thereby clustering long insignificant low energy coefficient into short and compact descriptors. Then, the run-length sequence is fed to an entropy coder that can be a Huffman coding algorithm with either a known dictionary or a dictionary extracted from the specific statistics of the possible image.[8,9,12]

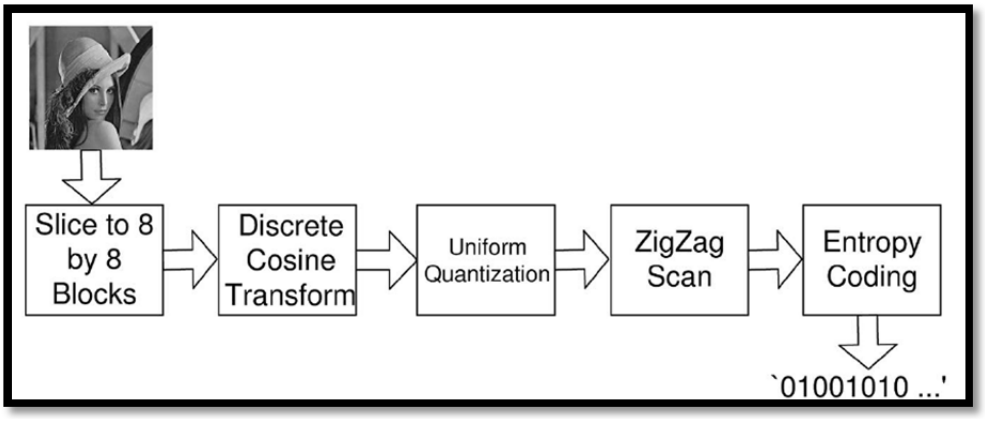

Figure 1.0: JPEG encoder block diagram

Nowadays, virtual meeting using mobile apps has become the most popular way to socialize through all over the world. With the advancement of image sharing function in the mobile social apps like Whatspp, WeChat and etc, the virtual meeting seems almost the same as the actual face to face meeting. However, because of the internet speed limitation, the image file is usually compressed to a smaller file size before the image is transmitted to the apps server. This process is important to ensure that the real-time experience between the users of the social apps. Due to the pre-transmission image compression, the quality of the receive image is quite degraded than the original image sent by the originators especially in terms of resolutions and image quality.

These circumstances are used as the motivation for the existing of this research for ‘Performance Analysis of Interpolations Method For Mobile Image Sharing Compression’. This research focuses on the interpolations based on image compressions that will compress the original image file to a significantly smaller size while maintaining the image quality and resolution of the received image. Based on the image compression characteristics, the interpolation method that has high quality of the shared image (as high as the original image) without shattering the transmission time due to its small size of the images after compression is suitable to be utilized in social apps image sharing. The algorithm to be created is illustrated in the Figure 1.1.

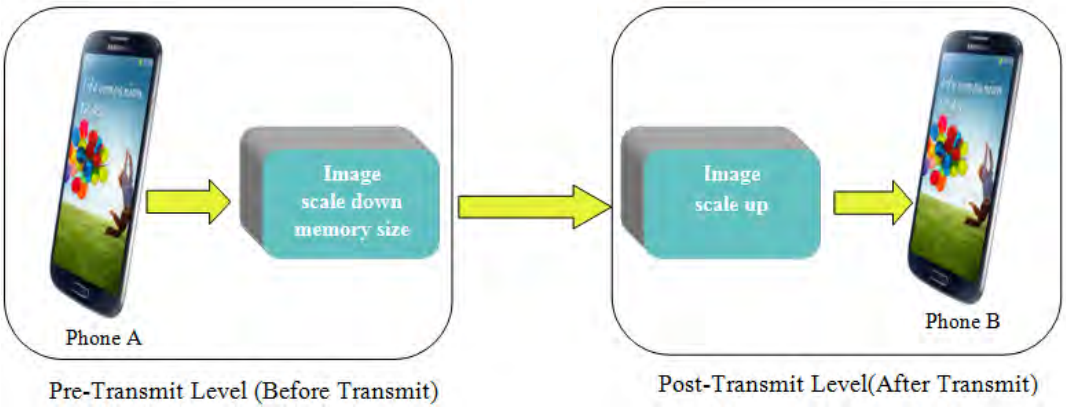

Figure 1.1: The mobile image sharing compression

From the figure above, it shows the big file image is transmitted from Phone A (transmitter,Tx) to Phone B(Receiver,Rx). The created algorithm will apply downscale method (algorithm 1) to compress the file size of the original image. Then, at Phone B (receiver,Rx) the upscale method (algorithm 2) is applied on the receive images before the image is received. The upscale image will turn the resolution of the image to the original resolution. The combination of algorithm 1 and algorithm 2 is the interpolation methods for mobile image sharing, compression which is suitable for mobile image sharing to ensure the real-time experience between users of the social apps.

1.2 Problem Statement

The problems that cause the idea of this project are:

i. The quality of the receive image is quite degraded than the original image sent by the originators especially in terms of resolutions and image quality.
ii. Large file size for the transmitted images of receiver's phone.
iii. Visual artifacts like jagged contour, over-smoothing on the output of the algorithms like bilinear and bicubic interpolation.

1.3 Aim And Objectives Of The Research Work

For this project, there are some aim and objectives that want to achieve which are:

i. To develop a mobile image sharing compression method based on image interpolations(scaling).
ii. To maintain image quality and resolution of the compressed image.
iii. To compress the original image file to a significantly smaller size

1.4 Scope Of Project

Some tasks to be taken to make sure that the research goes smoothly. There are:

i. Develop a mobile image sharing compression method based on interpolations.
ii. Collect data from the applications in the mobile phone which allow the image file sharing
iii. Analyze the collected data based on:
    a. The quality of the image based on the peak-signal-to-noise ratio(PSNR) of the compressed image
    b. The resolution size of the compressed image
    c. The file size of the image

CHAPTER II

LITERATURE REVIEW

2.1 Image Compression Algorithm

The applications of social apps on mobile phone grows rapidly and it always has improvement day by day. Developers will find an appropriate ways to make their application in a convenient way for the user like Whatsapp, WeChat, Telegram and etc. Information to be shared in social apps is in the of multimedia, which not only consists of text, numeric data and audio, but also images and video. But, there are some requirements for the data to be received at the receiver's phone; the receiver needs to receive the image in the high quality. Besides, the compression of file size is important to make sure that the real-time experience between the user of social apps. Therefore, there are a few algorithms that have been provided and suggested to be used in mobile image sharing compression.

From Alfred M. Bruckstein, 2003,[8] JPEG which is the lossy image compression has a good compression technique and low computational. But, for the low bit rate, JPEG cause disturbing artifact to the images. It is known that at low bit rates a down-sampled image when JPEG compressed visually beats the high resolution image compressed via JPEG to be represented by the same number of bits. [8]Then, it shows how to do down-sampling to a low-resolution and use JPEG at the low-resolution as well. At the output, it shows that there is an improvement on the overall peak-signal-to-noise (PSNR) performance of the compression process. Plus, the auto-correlation provides a good estimation to establish the down-sampling factor that achieves optimal performance.[8]

Figure 2.0: The original image (on the left), JPEG compressed-decompressed image(middle), and down-sampled-JPEG compressed-decompressed and up sampled image(right). The down-sampling factor is 0.5. The compressed 256x256 for " Lena' image in both causes used of 0.25bpp inducing MSEs of 219.5 and 193.12, respectively. The compressed 512x512 " Barbara" image in both cases used 0.21bpp inducing MSEs 256.04 and 248.42 respectively.[8]

The other paper that introduced the algorithms for image compression is from Andrea Giachetti,2007. The authors said about the image upscaling that: