A Fast Image Resampling Method

Wen-Pinn Fang[1] and Chun-Hung Lai[2]

[1]*Department of Computer Science and Information Engineer, Yuanpei University of Medical Technology, HsinChu, Taiwan, R.O.C.*
[2]*Department of Computer Science and Information Engineer, Yuan Ze University, Chung-Li, Taiwan , R.O.C.*

Summary
This paper proposed a fast resampling method for digital image. Recently, using mobile device is very popular. It is very important to make the images suitable for every different mobile device. There are many methods to change the size of image. The most important methods are image resampling and image retargeting. This paper proposed a fast resampling method. The method is suitable for mobile device which the computational power is lower than desktop or notebook.

Key words:
Image resizing, resampling, fast decoding

1. Introduction

Recently, there are many mobile device invited. People use the mobile devices to watch and transmit images every day. However, the resolution and size are different. In real application, it is necessary to change the size of images in real time. To balance computational cost and image quality is very important. There are many approaches to resize an image. Some brief description of the image resizing method will be introduced in next section. This paper proposed a fast resampling method. Without complex analysis. It is suitable for critical power consideration system. The image quality is also acceptable especially for texture style images.

The rest of this paper is organized as follows: Relative knowledge is described in the section 2; the proposed method is demonstrated in Section 3; an example is presented in Section 4; the conclusions are given in Section 5.

2. Relative Research

Before describing the proposed method, it is necessary to understand the application and relative knowledge of image resizing. The relative topics include image retargeting and image resampling. They are explained as below:

2.1 Image Retargeting

In the decade, many researchers discuss the method of video and image resizing. The methods include image cropping style [1][2][3][4], seam carving [5][6][7][8][9], wrapping [10][11] and hybrid approaches [10][11],[12]. The cropping method reserved the most important region directly. Avidn and Shamir [5] proposed a method to find out the seams first, remove the unimportant region, reserved significant regions. Many researchers extended the study. For example, Mansfeld, etc al [3], Rubinstein and Shamir [7], Grundmann, etc. al [8] proposed some suggestions to improve the quality and eliminated errors. On the other hand Wan [11] and Li [12] discuss the deformation effect after an image has been retargeted. Rubinstein [13] combined cropping and zooming method to achieve resizing. Sun, etc al [14] proposed cyclic seam caving algorithm for the same purpose. Dong, *etc. al* [15] discussed the relationship between reservation region and whole result. Pritch [16] study the deformation and cropping relationship by shift-map method, the paper get better image quality. Ding [17] designed specific filter and get better image quality after the image has been resized. In Fig. 1, an image resizing example is shown.

2.2 Image scaling

In computer graphics, image scaling is the process of resizing a digital image. Scaling is a non-trivial process that involves a trade-off between efficiency, smoothness and sharpness. There are many approaches to modify the size of an image. The algorithms which adopted in commercial software includes: Nearest, Box, Triangle, Quadradic, Catron, Gaussian, Sinc, Mitchell, Lanczos2, Lanczos3 and GDIHalfTone. In nearest method, replace the colors with a set of the same colors. Box method replaces the pixel value by the mean of pixels. Triangle and Quadradic methods set the pixels by polynomial interpolation. Halftone method diffuses errors to the later pixels. In these methods, a lot of computations are necessary.

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3. Propose Method

This paper proposed a fast method to resize an image. A symbol table is show as table 1.

Table 1: Symbols table

symbol	*meaning*
O	Original image
D	Destination image
W	Width of original image
H	Height of original image
w	Width of Destination image
h	Height of destination image
(*i*,*j*)	Location of image
index	A set of non-overlapped numbers
list	A set of color

The algorithm is shown as below:

Fast Resampling
Input: original image O, which size is W by H, destination width w
Output: destination image D, which size is w by H

```
Let index=0
flag=false;
let Linked-List list is empty
index=a set of random number which smaller than W
For i=1 to H
    For j=1 to W
       If j≠index then enqueue O(j,i) into list
    End For
    For j=1 to w
       D(j,i)=dequeue
    End For

End for
                ----------end of Algorithm
```

4. Experimental Results

Some experimental results are shown as Fig.1. (a1) and (a2) are the original images which the size are 512-by-512. The resizing images are shown as Fig.1 (a2)(a3) and (b2)(b3). The qualities are acceptable by vision. The authors also test more than 600 images. Compute the average PSNR between the image which resize by the proposed method and by the commercial software.

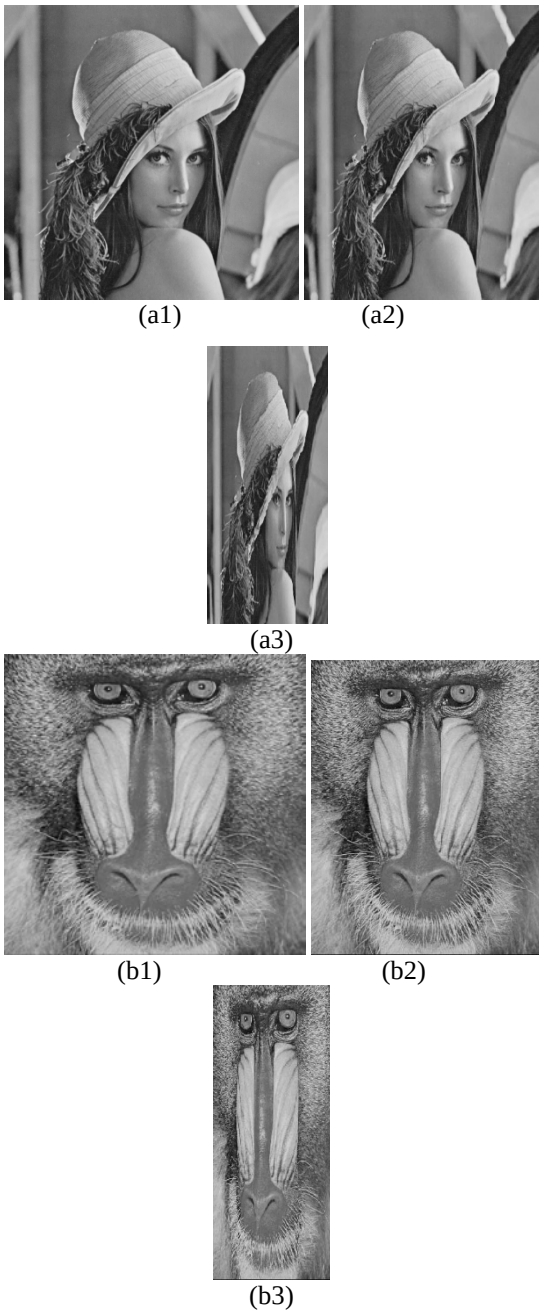

Fig. 1 Experimental results. (a1) and (b1) are the original images, (a2)(a3) and (b2)(b3)are the resampling results.

5. Conclusion and Discussion

There are two topics: image quality and computational complexity. As shown in table 2 and table 3. The effect of proposed method is near to the methods which adopted by commercial software.

Table 2: Compare with exist methods (smooth style image)

Method	*PSNR*		
	412×512	312×512	312×512
Nearest	25.2637	25.5687	25.6688
Box	25.2591	25.5557	25.6328
Triangle	25.2311	25.5313	25.6302
Quadradic	25.2260	25.5257	25.6250
Catron	25.2311	25.5313	25.6289
Cubic	25.2256	25.5247	25.6253
Gaussian	25.2273	25.5182	25.6168
Sinc	25.1839	25.4517	25.5500
Mitchell	25.1786	25.4635	25.5526
Lanczos2	25.2274	25.5244	25.6209
Lanczos3	25.2297	25.5199	25.6176
GDIHalfTone	25.2435	25.5399	25.6306

Table 3: Compare with exist methods (texture style image)

Method	*PSNR*		
	412×512	312×512	212×512
Nearest	29.8756	28.8511	28.4902
Box	29.8960	28.8761	28.5034
Triangle	29.8654	28.8581	28.5180
Quadradic	29.2744	28.6627	28.4040
Catrom	29.8549	28.8529	28.5181
Cubic	29.2658	28.6662	28.4165
Gaussian	29.0204	28.5695	28.3365
Sinc	28.7139	28.3971	28.1830
Mitchell	29.0192	28.4835	28.2645
Lanczos2	29.2498	28.6418	28.3793
Lanczos3	29.0544	28.5748	28.3472
GDIHalfTone	29.6090	28.6866	28.3612

In complexity analysis, the complexity of the proposed method is O(n). The complexity of the interpolation style method are $O(n^2)$. Although some methods are O(n), they need Lagrange Interpolation or mean computation. The proposed method only use a link-listed. It is suitable for embedding system especially real time application.

In the future, it is very important to balance the image quality, computational cost and content meaning. Artificial intelligence approach maybe is the solution.

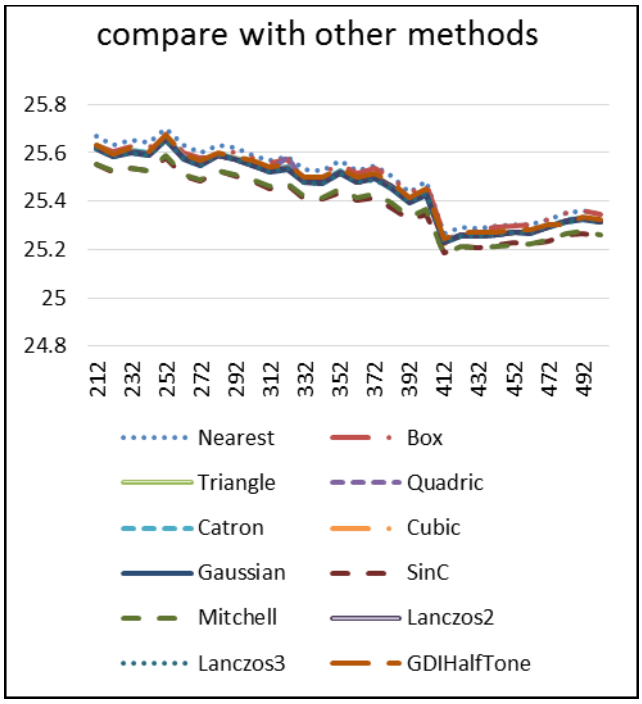

Fig. 2 The different between exist method and the proposed method (smooth style image)

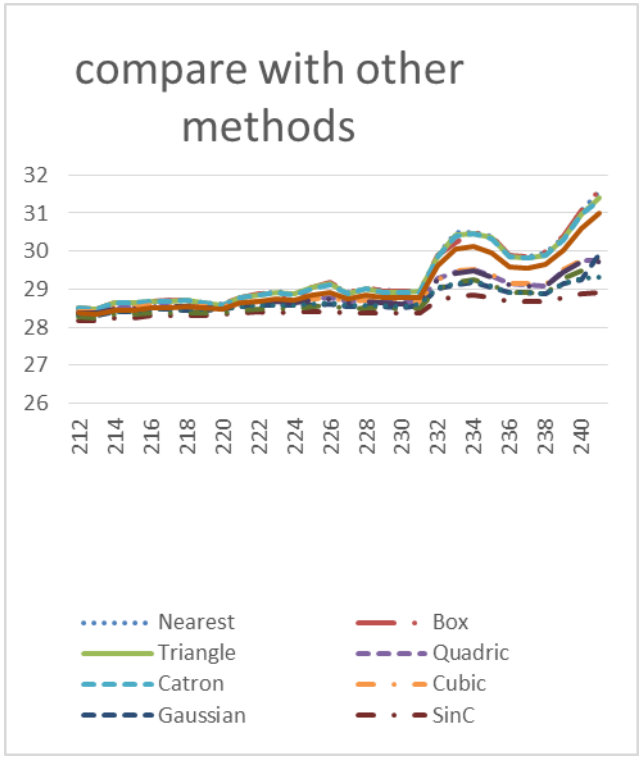

Fig. 3 The different between exist method and the proposed method (texture style image)

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Wen-Pinn Fang received his BS degree in Mechanical Engineering in 1994 from National Sun Yat-sen University and his MS degree in Mechanical Engineering in 1998 from National Chiao Tung University, where he also got his PhD degree in Computer Science in 2006. His recent research interests include image sharing, pattern recognition, image processing and e-learning.

Chun-Hung Lai received his BS degree in Computer Science and Informartion Engineering in 2014 from Yuanpei University. He is a Master's student in YuanZe University now. His recent research interests include pattern recognitiom and image processing.