

Zooming Technique for Low Resolution Images

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Abstract. The main purpose of the image zooming is to suite a smaller or larger images to certain sized display device. To this end, image zooming methods are important to change the image size. In this paper, image zooming technique and filter design approaches are described. The experimental results confirm that the proposed approach successfully removed blocking artifact that were obtained during nearest neighbor step.

Keywords: image zooming, display device, filter design, image scale conversion.

1 Introduction

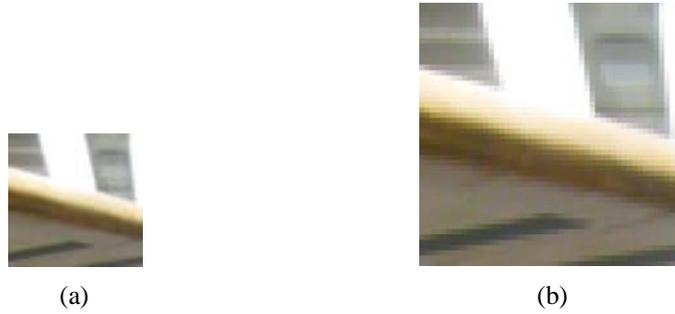
To fit a smaller image to larger display device or vice versa, image size zooming is important tool to implement image processing techniques. However, image zooming brings some unpleasant visual artifacts, thus this implementation should be conducted carefully. The image zooming can be conducted with different size upscaling [1-5]. If we assume doubling the size of the original image, we have few scenarios. For nearest neighbor method, the result images are enlarged by factor of two, and the zero-padded pixels are replaced with the same intensities. In the same manner, bilinear and bi-cubic methods are conducted.

The goal of this research is to smooth blocking artifacts and gives pleasant visual performance on the result images. This paper is organized as follows. In Section 2, basic concept of image zooming method is introduced. The filter design approach is introduced in Section 3. Simulation results and its subjective performance comparison are displayed in Section 4. The conclusions are made in Section 5.

2 Image Zooming

In image processing, image zooming is one of fundamental tools to manipulate low resolution images to high resolution ones. The zooming method is not minor process because enlarged images may contain blocking artifacts. Thus, smoothness on blocking or noisy artifacts and sharpness on edges or details should be applied. This zooming is more important to raster graphics because the details of vector graphics remain as

images are enlarged. Figure 1 shows the original small image and its enlarged images. As we can see the enlarged image contains staircase artifacts.



3 Filter Design

The filter we used is low pass filter, which is designed as with following kernel (Eq. 1), and the frequency response of \mathbf{h}_N is shown in Fig. 1.

$$\mathbf{h}_N = \frac{\begin{bmatrix} 1 & 1 & \dots & 1 \\ 1 & 1 & \dots & 1 \\ \vdots & \vdots & \ddots & \vdots \\ 1 & 1 & \dots & 1 \end{bmatrix}}{N^2} \quad (1)$$

The image zooming process is implemented as following steps. First the low resolution image is expanded with nearest neighbor method. This image may contain blocking artifacts. We need to smooth the corners of blocks enlarged pixels. To this end, we apply \mathbf{h}_N filter on nearest neighbor applied image.

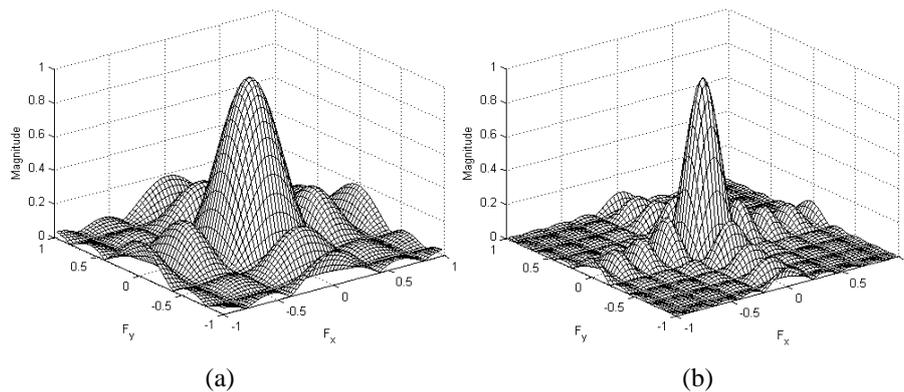


Fig. 1. Frequency response of \mathbf{h}_5 and \mathbf{h}_9 filters.

4 Experimental Results

To evaluate the performance, we conducted experiments on ten LC images. Figure 2 shows the original test images and Figs. 3-5 show their zoomed images with nearest neighbor method and filtered results.

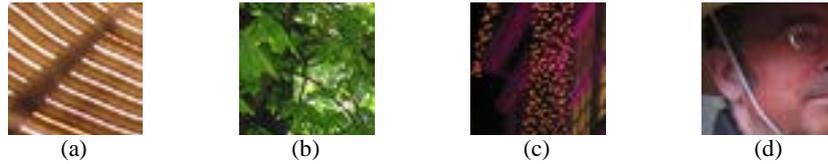


Fig. 2. Original test images: (a) image #21, (b) image #22, (c) image #27, and (d) image #30.

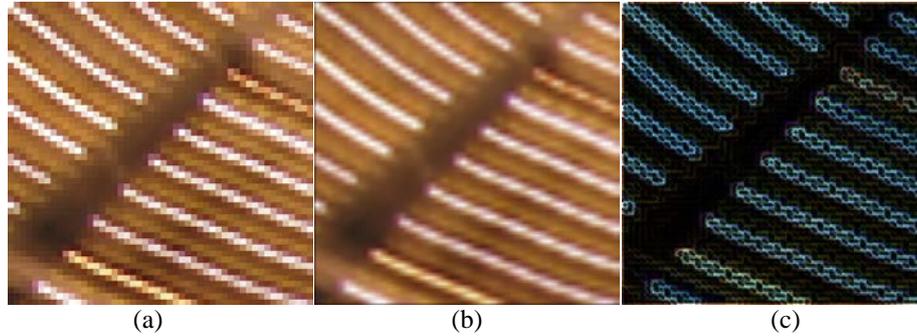


Fig. 3. Zoomed results of image #21 (zoomed by factor of 8): (a) nearest neighbor method; (b) filtered results; (c) difference between (a) and (b).

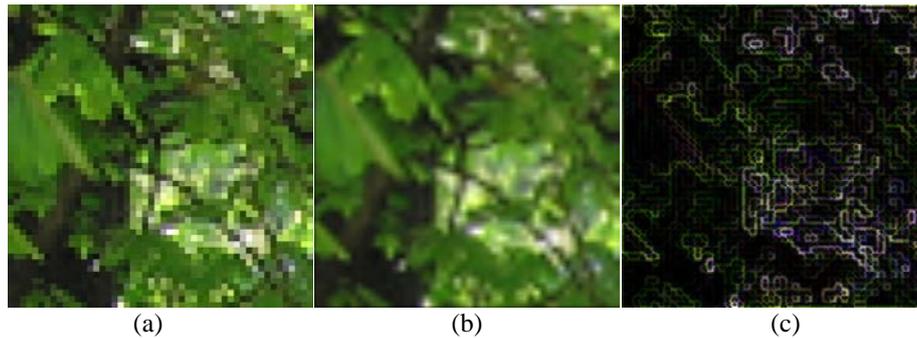


Fig. 4. Zoomed results of image #22 (zoomed by factor of 8): (a) nearest neighbor method; (b) filtered results; (c) difference between (a) and (b).

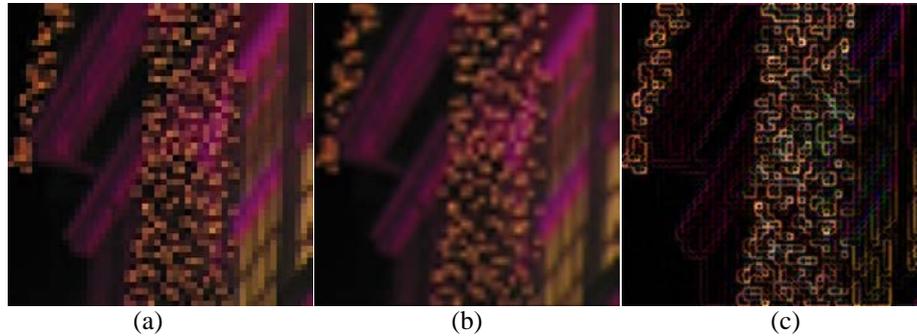


Fig. 5. Zoomed results of image #27 (zoomed by factor of 8): (a) nearest neighbor method; (b) filtered results; (c) difference between (a) and (b).

5 Conclusions

Image zooming is an important assignment which is employed in several applications. When image zooming is applied, pixels are placed into the image to enlarge the size of the image. In this paper, we applied filtering process after the nearest neighbor image zooming. The simulation results approved that the presented method eliminated unwanted visual artifact.

References

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