Implementation of Image Watermarking System

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Abstract

In this homework, we are assigned to implement a digital image watermarking system based on C.T.Hsu and J. L. Wu’s paper: “Hidden Digital Watermarks in Images”.

In this paper, we embed the watermarks with visually recognizable patterns into the images by selectively modifying the middle-frequently parts of the image in the JPEG DCT domain.
Details

In this work, two images are used for testing as follows: (one is the city view of Hong Kong contains the sky smooth region, and the other is the drawing “Mountain Landscape Saint-Remy” of painter Vincent Van Gogh with lots of high frequency DCT image blocks)

640x432, PNG format

595x467, JPEG format

Right is the watermarking image used in my program, which is a 24-bit PNG format image with 800x600 resolution. In my implementation, the watermarking image will scaled according to the host image as quarter size both in width and height. Besides, the images will be converted to binary images before embedding.

The reason why doing so in the flexibility for this homework to be applicable to cope with real life images in web publishing (for example, used in my personal homepage ☺). In the mean time, I also use the ImageMagick library (http://www.imagemagick.org) to support variety of image formats.

Test images applied with watermark is listed in the next page alone with its corresponding PSNR values, which reach the goal of visual imperceptibility.
In doing this homework, I also developed a tool for observing images in JPEG DCT domain with 8x8 image blocks. Blocks with more non-zero coefficients will be brighter compared with those have less non-zero coefficients. When double click on the DCT blocks, a popup dialog will also show you the exact DCT coefficient values.

Results

<table>
<thead>
<tr>
<th></th>
<th>DCP_1749.PNG</th>
<th>LANDSCAPE.JPG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 cropping</td>
<td><img src="image" alt="DCP_1749.png" /></td>
<td><img src="image" alt="LANDSCAPE.jpg" /></td>
</tr>
</tbody>
</table>
Conclusion

In my implementation, the adjustment of embedding watermark bits does not apply on the scale factor proposed in this paper because I think it’s hard to select a general and suitable scaling factor in that different DCT blocks with its DC value differs a lot.

So in my program, adjustment will be applied according to the DC value magnitude and non-zero values contained in each block (also consider the quantization table’s value), in order to improve the invisibility.