Image Deblurring Techniques
TJHSST Senior Research Project Proposal
Computer Systems Lab 2009-2010

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October 27, 2009

1 Purpose and Scope

Motion blur in images is a common problem for professionals in various fields. When the image is deblurred, the usefulness of the image increases. Parts of the image that were difficult to identify can be rendered to effective clarity. This project will explore and implement image deblurring techniques. By implementing these techniques, users can efficiently remove blur from an image.

2 Background

Regarding many image processing techniques, transforming the image from a spatial domain to a frequency domain is very helpful. In the area of image deblurring, a Fourier Transform is useful in creating the frequency domain image. The Discrete Fourier Transform only describes the frequencies contained in the spatial domain of the image, as opposed to a Continuous Fourier Transform which will describe a continuous range of frequencies. After applying the Fourier Transform, a blur kernel can be applied to the frequency domain image, and after applying an inverse transformation, a blurred image will be obtained. The same process can be done to remove blur from an image. Instead of applying the blur kernel to the frequency domain image, it can simply be removed, and then transformed back to spatial domain to produce the deblurred image.

Attempting to traditionally deblur an image will result in unwanted noise and ringing artifacts. However, a finite number of Fourier basis functions are able reconstruct the image without much data loss. In determining the blur kernel, iterating between updating the blur kernel and the estimated latent image will ultimately allow the two to converge and produce an acceptable deblurred image.

3 Procedure and Methodology

Code for my project will be done primarily written in the C programming language. I will also need to use imagemagick to convert various images into the pgm format, which I can use to directly read color values. Testing will revolve around applying forward and inverse Fourier Transforms to test the functionality of the image transforms. Ultimately, after applying blur kernels to the frequency domain image, I will be able to visually verify the effect of the deblurring program.

In applying image deblurring techniques, I will be primarily focusing on eliminating ringing artifacts from a transformed image. A secondary focus will involve determining the blur kernel that is applied to the frequency domain image.

4 Expected Results

Images serve various purposes in many different fields, and the clarity of an image is almost universally preferred. Thus, a program to effectively remove blur in images would be useful in any subject area. Such functionality would allow photographers and image editors to be able to remove blur and increase clarity of images. Casual image enhancement would allow photographers to take more presentable pictures with less blur. Deblurring photographs taken by roadside cameras would allow law enforcement to clearly read license plate numbers.