Digital Photography with Flash - No Flash Image Pairs

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***Abstract*—We present a variety of applications that analyze and combine the strengths of such flash/no-flash image pairs. Our applications include denoising and detail transfer (to merge the ambient qualities of the no-flash image with the high-frequency flash detail), white-balancing (to change the color tone of the ambient image), continuous flash (to interactively adjust flash intensity), and red-eye removal (to repair artifacts in the flash image). We demonstrate how these applications can synthesize new images that are of higher quality than either of the originals**

***Keywords*—Bilateral Filter, Noise removal, sharpening, white balancing, red-eye removal.**

I. Introduction

An important goal of photography is to capture and reproduce the visual richness of a real environment. Lighting is an integral aspect of this visual richness and often sets the mood or atmosphere in the photograph.
When capturing the natural ambient illumination in such low light environments, photographers face a dilemma. One option is to set a long exposure time so that the camera can collect enough light to produce a visible image. However, camera shake or scene motion during such long exposures will result in motion blur.Another option is to open the aperture to let in more light. However, this approach reduces depth of field and is limited by the size of the lens.
Today, digital photography makes it fast, easy, and economical to take a pair of images of low-light environments: one with flash to capture detail and one without flash to capture ambient illumination.In this paper, we present a variety of techniques that analyze and combine features from the images in such a flash/no-flash pair. :

A. Denoising and Detail Transfer

The ambient image denoising technique builds on a bilateral filter. But the basic bilateral filter tends to either over-blur (lose detail) or under-blur (fail to denoise) the image in some regions. The flash image contains a much better estimate of the true high-frequency information than the ambient image. Based on this observation, we modify the basic bilateral filter into a joint bilateral filter. The values of variance for the filters are automatically computed by our algorithm depending on the image.
We then detect flash shadows and specularities in the flash image and then use that mask to improve our result from the joint bilateral filter.
Also to pass over more details from the flash image to the ambient image, we obtain the details from the flash image using a basic bilateral filter on the flash image and then dividing the original by the filtered image to get the detailed layer, furthermore to enhance the details we add the laplacian of the flash image too.

Flash and No-Flash Image

Detail Transfer; Our Result

B. White Balancing

Sometimes the viewer wants to see the image under a more illuminant setting, for that we perform white balancing. We can think of the flash as adding a point light source of known color to the scene. The difference image between luminance of flash and ambient images corresponds to the illumination due to the flash only, which is proportional to the surface albedo at each pixel p. Our approach is applied per channel to get a suitable threshold for the new illumination. Using the luminance difference we find a mask of the ambient

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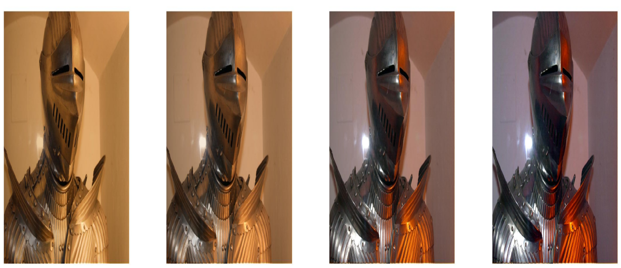
image proportion to the difference image and ignore the low confidence pixels. The final threshold is achieved by taking the mean of the remaining pixels.

No-Flash , Flash Image

White Balanced Image

C. Continuous Flash Adjustment

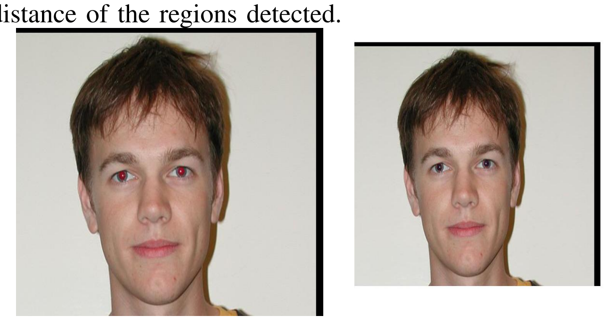
When taking a flash image, the intensity of the flash can sometimes be too bright, saturating a nearby object, or it can be too dim, leaving mid-distance objects under-exposed. With a flash and non-flash image pair, we can let the user adjust the flash intensity after the picture has been taken simply by interpolation/extrapolation of the flash and ambient images in the YCbCr color space.



alpha set at 0.5,0.8,1.2,1.5

D. Red eye Detection and removal

Our red-eye removal algorithm considers the change in pupil color between the ambient image (where it is usually very dark) and the flash image (where it may be red). We convert the image pair into YCbCr space to decorrelate luminance from chrominance and compute a relative redness measure.
We then use a threshold to get regions above a particular redness value based on mean and variance. After this we put spatial constraints to detect a pair of eyes based on shape and distance of the regions detected.



Flash image and corrected image

Flash image and corrected image

II. References

-Digital Photography with Flash and No-Flash Image Pairs-Microsoft Research(2004)