DIP PROJECT PROPOSAL

Digital Photography with flash and no flash image pairs
Project ID: 8

Link to the project repo : Link

Team : DIPped in chutney

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Main Goals

We perform a variety of applications that analyze and combine the strengths of 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)
- **Red-eye removal** (to repair artifacts in the flash image).

Problem Definition

Flash photography was invented to remove the problem faced by the photographers while clicking pictures in low light conditions. By adding artificial light to nearby objects in the scene, cameras with flash can use shorter exposure times, smaller apertures, and less sensor gain and still capture enough light to produce relatively sharp, noise-free images, however the use of flash can also have a negative impact on the lighting characteristics of the environment. Objects near the camera are disproportionately brightened. In addition, the flash may introduce unwanted artifacts such as red eye, harsh shadows, and specularities, none of which are part of the natural scene.

We perform a variety of techniques that analyze and combine features from the images in such a flash/no flash pair:

- **Ambient image denoising** : The bilateral filter either under blurs or over blurs the image. The flash image contains more information about the true high frequency detail as compared to the ambient image. So we will use that to create a joint bilateral filter. We will then further detect flash shadows from the flash image and use that mask to improve upon the result from the joint bilateral filter.
- **Flash-to-ambient detail transfer** : We transfer high-frequency detail from the flash image to the denoised ambient image, since this detail may not exist in the original ambient image. We get the detailed layer by dividing the original flash image with the basic bilateral filtered image. We add the laplacian filtered flash image to the enhance the detail layer.
- **White balancing** : The difference between the luminance of the flash image and the ambient image is the illumination due to the flash only, which is proportional to the surface albedo at each pixel. Our approach is applied pe channel to get the suitable threshold for the new illumination. Using the luminance difference we

find a mask of the ambient image proportion to the difference image. We ignore the low confidence pixels. The final threshold is calculated by taking the mean of the resultant pixels.

- **Continuous flash intensity adjustment** : This can be done by extrapolation/interpolation of flash and ambient images in the YCbCr color space.
- **Red-eye correction** : We perform red-eye detection by considering how the color of the pupil changes between the ambient and flash images. We then calculate redness by converting the image pair into YCbCr space to decorrelate luminance form chrominance. We use a threshold to get the regions above a particular redness value. After that we use certain spatial constraints to detect the pair of eyes.

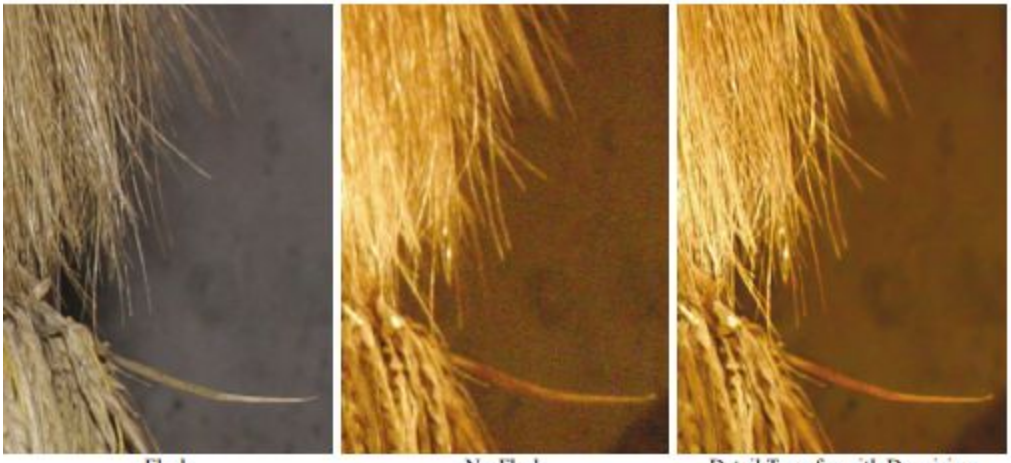
Results of the Project

- **Ambient image denoising** : After performing ambient image denoising we would obtain a denoised sharper ambient image.

(a) No-Flash Flash

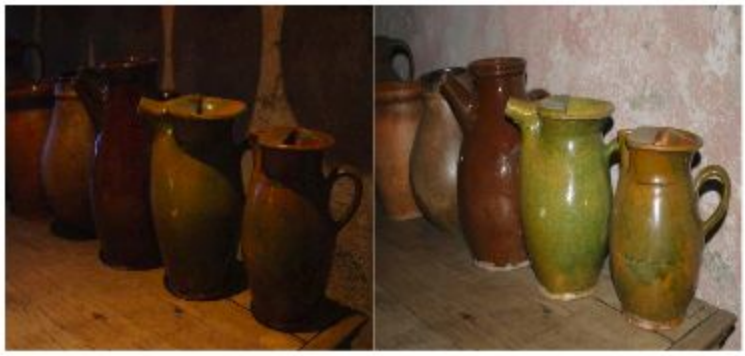
(c) Denoised via Joint Bilateral Filter

- **Flash-to-ambient detail transfer** : As a result of flash to ambient detail transfer we get a more detailed ambient image. Details which were missing from the ambient image due to low lighting conditions



Flash No-Flash Detail Transfer with Denoising

- **White Balancing** : We would obtain a whiter illuminant image while preserving the “feel” of the ambient image.



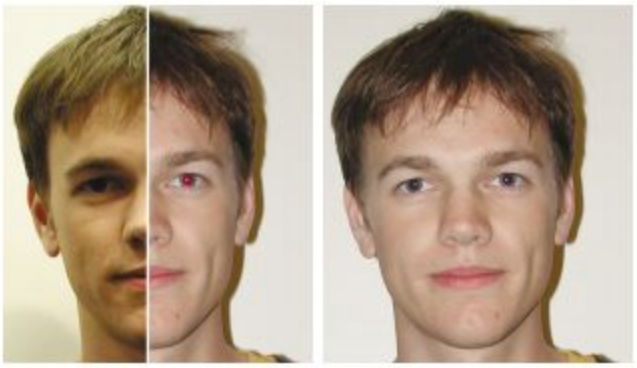
No-Flash , Flash Image

White Balanced Image

- **Continuous flash intensity adjustment** : We would obtain a continuous interpolation control between the image pair so that we can interactively adjust the flash intensity of the images.

Figure 10: An example of continuous flash adjustment. We can extrapolate beyond the original flash/no-flash pair.

- **Red-eye Removal** : We would remove the red colored artifact that appeared on the pupils due to the flash



Project Timeline and Work Division

(This is how we plan on dividing our timeline)

Day	**Task Assigned**
29th September - 6th October	Ambient Image Denoising (Pranay)
6th October - 13th October	Detail Transfer to ambient image (Pranay)
13th October - 20th October	White Balancing (Swapnil)
20th October - 27th October	Continuous flash Intensity adjustment (Swapnil)
27th October - 3rd November	Red Eye Removal (Pranay)
3rd November - 10th November	Report (Pranay) and presentation (Swapnil)