Localized HDR Method to Enhance Quality of Images with Low Reflectance Subjects

Introduction

Textures on dark colored objects can be difficult to photograph because less light reaches the image sensor due to low reflectance. Low-reflectance subjects that are commonly photographed include pets with dark fur, black clothing and people with dark hair or dark skin tones. One such example is shown in Figure 1 below. While the background of this scene is well exposed, the facial features and fur texture of the cat in the foreground are lost. Many photography articles provide tips on how to optimize lighting and angles to properly capture texture of a dark-colored subjects. However, it would be nice to be able to capture good pictures every time, without any special lighting or positioning.

Current high dynamic range solutions process entire images at a time. As demonstrated in previous assignments, even if a high dynamic range image can be created, it cannot be properly displayed on regular displays since they have a fixed low dynamic range. In order to display these images, they need to be tone mapped which results in an image with more details but unnatural colors. In the end, further image processing is required and the final result tends to have more of an artistic effect.

In this project, I will investigate the use of a localized approach to the high dynamic range technique to improve the appearance of low reflectance objects in pictures. The goal is to produce images that reveal more details of the subject while preserving the natural color of the surround scene. Rather than applying an HDR algorithm on the whole image, I only want to alter the dynamic range of the subject to recover texture details that can be seen with the naked eye but are otherwise lost in images.

Figure 1. Picture of black cat taken with a 12MP phone camera.

Related Work

1. Beran et al. (2016) describes a color-based object detection method. In this approach, an image is converted from RGB to HSV color model to separate intrinsic color value from hue and saturation before segmentation [1].
2. Chen et al. (2005) proposes an image segmentation method which utilizes both color and texture information [2]. This method can be used to detect improvement in texture over different exposures which can help with subject identification.
3. Guthier et al. (2008) presents an optimized HDR approach in which only badly exposed regions of an image are re-exposed thus reducing the total capture time [3]. This can be applied to this project where only the area of the subject may need to be recaptured at a higher exposure time.

Approach

The first step of this project will be to create a dataset of images. The dataset will contain images from 5-10 different scenes where the texture of a dark-colored subject is lost. In each scene, the same subject will be photographed with 3-5 different exposures.

The next step is to implement the algorithm; I plan to approach this problem in two parts. The first would be to identify the subject in the scene. This will be done with image segmentation using one of the methods mentioned in the related works section above. Once the subject has been identified, the second step would be to replace that section of the image with one from a higher exposure. This effectively increases the exposure of the subject.

An additional step could be to tune the intensity of the modified subject so that the lighting matches the scene. This may be necessary if the modified exposure was too high causing the subject to look unnaturally bright in the image.

Milestones and Timeline

2/17: Create a dataset of images
2/27: Complete image segmentation algorithm
3/06: Add HDR algorithm to segmented section
3/10: Additional image processing to smooth out blending if necessary. Conduct quantitative analysis of images to measurement improvement.
3/13: Poster due
3/15: Report and code due

References

[1] L. Beran, P. Chmelar, and L. Rejfek, “Image Processing Methods Usable for Object Detection on the Chessboard,” MATEC Web of Conferences, vol. 75, p. 03004, 2016.

[2] J. Chen, T. Pappas, A. Mojsilovic, and B. Rogowitz, “Adaptive perceptual color-texture image segmentation,” IEEE Transactions on Image Processing, vol. 14, no. 10, pp. 1524–1536, 2005.

[3] B. Guthier, S. Kopf, and W. Effelsberg, “Capturing high dynamic range images with partial re-exposures,” 2008 IEEE 10th Workshop on Multimedia Signal Processing, 2008.