

Activity 6

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Objective:

to restore faded photographs using three white balancing algorithms: Contrast Stretching, White Patch Algorithm, and Gray World Algorithm.

A colored digital image is made up of three channels (red, green, and blue) that are overlain within each pixel at varying levels. Here, the image was loaded and the three channels were separated. As shown, each color channel has its own grayscale with varying brightness levels depending on how 'red', 'blue', or 'green' the image is at a pixel.

```
number = 4;  
im = imread(['IMG',num2str(number),'.jpg']);  
R = im(:,:,1);  
G = im(:,:,2);  
B = im(:,:,3);
```

Fig 1a: Original Image



Fig 1b: Grayscale of red channel



Fig 1c: Grayscale of green channel



Fig 1c: Grayscale of blue channel



Contrast Stretching Method

Here, every channel was contrast stretched. In contrast stretching, the range of intensity values was stretched through normalization in order to enhance the contrast. Figure 2 shows that the objects are more distinguishable.

```
Rmin = min(R(:)); Rmax = max(R(:));  
Gmin = min(G(:)); Gmax = max(G(:));  
Bmin = min(B(:)); Bmax = max(B(:));  
  
Rstretch = (R-Rmin).*(255./(Rmax-Rmin));  
Gstretch = (G-Gmin).*(255./(Gmax-Gmin));  
Bstretch = (B-Bmin).*(255./(Bmax-Bmin));  
  
imrestore = im;  
imrestore(:,:,1) = Rstretch;  
imrestore(:,:,2) = Gstretch;  
imrestore(:,:,3) = Bstretch;  
  
figure(1); imshow(im);  
figure(2); imshow(imrestore);  
imwrite(imrestore, [num2str(number), 'CS.jpg']);
```

Fig 2a: Original Image



Fig 2b: Image produced by contrast sketching



Gray world method

Here, we assume that the average color is gray. Hence, in the algorithm, the averages of red, green, and blue were taken and divided with their respective color channel. As shown, the image produced by the algorithm has too much brightness. This maybe due to several clipped pixels along the image. Also, problem arises when the image does not have a good color distribution and when the colors do not really average to gray.

```
Rmean = mean(R(:));
Gmean = mean(G(:));
Bmean = mean(B(:));

Rwb = R.*(255./Rmean);
Gwb = G.*(255./Gmean);
Bwb = B.*(255./Bmean);

imrestore(:,:,1) = Rwb;
imrestore(:,:,2) = Gwb;
imrestore(:,:,3) = Bwb;

figure(3); imshow(imrestore);
imwrite(imrestore, [num2str(number), 'grayworld.jpg']);
```

Fig 3a: Original Image



Fig 3b: Image produced by gray world



White Patch Method

Here, we first determined what the camera output is for a white object. In this image, the white region cropped is the white tshirt. The algorithm of this method is almost the same as the gray world method, except that the white balancing constants were taken by getting the averages of the color channels of the white patch. As shown from the image, this algorithm has a good correction (e.g. the color of the sky becomes more blue).

```
imcrp = (imcrop(im,[300 1020 40 20])); %IMG4
Rcrp = imcrp(:,:,1);
Gcrp = imcrp(:,:,2);
Bcrp = imcrp(:,:,3);

Rw = mean(Rcrp(:));
Gw = mean(Gcrp(:));
Bw = mean(Bcrp(:));

Rwb = R.*(255./Rw);
Gwb = G.*(255./Gw);
Bwb = B.*(255./Bw);

imrestore(:,:,1) = Rwb;
imrestore(:,:,2) = Gwb;
imrestore(:,:,3) = Bwb;

figure(4); imshow(imcrp);
imwrite(imcrp, [num2str(number),'cropped.jpg']);
figure(5); imshow(imrestore);
imwrite(imrestore, [num2str(number),'WP.jpg']);
```

Fig 4a: Original Image



Fig 4b: Image produced by white patch



Comparison of enhanced images

Fig 5a: Original Image



Fig 5b: Image produced by contrast stretching



Fig 5c: Image produced by gray world



Fig 5d: Image produced by white patch



Comparison of enhanced images

Fig 6a: Original Image



Fig 6b: Image produced by
contrast stretching



Fig 6c: Image produced by
gray world



Fig 6d: Image produced by
white patch



Comparison of enhanced images

Fig 7a: Original Image



Fig 7b: Image produced by
contrast stretching



Fig 7c: Image produced by
gray world



Fig 7d: Image produced by
white patch



Summary of observations and analysis

Contrast stretching:

- Image contrast is enhanced for Figure 5 and 6 by stretching the range of normalization.
- In Figure 7, the hue became bluish, which indicates that the image is unbalanced.

Gray World:

- Image produced has too much brightness for all Figures. This may be due to (1) several clipped pixels along the images, (2) the images do not have a good color distribution and (3) the colors of the images do not really average to gray.

White Patch:

- The images were enhanced. For example, in Figure 5d, the color of the sky is blue. In Figure 6d, the barong is white. In Figure 7d, the ambience is bright because I assume that the photo was taken under direct sunlight.
- I think the algorithm can still be improved because the images are a bit bluish. Though, this maybe due to the white patch I selected may not exactly the camera's output for a white object.

Self-evaluation: 12/10