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Introducing Effects in an Image: A MATLAB Approach

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Table of Contents

List of Figures…….. ……5

Abstract…….7

Introduction…….8

1. **Types of Images……...9**
2. **Filter Designing……..12**
3. **Difference between day and night images…….....14**
4. **Random Experiments on image.....17**
5. **Factors Influencing an image……...21**
6. **Effects of Night on an Image…….....32**
7. **Dawn and Evening effects.....36**

Conclusion…….....39

Bibliography…….40

List of Figures

1. Chapter -1

Fig 1.1 : INTENSITY IMAGE
Fig 1.2 : BINARY IMAGE
Fig 1.3 : INDEXED IMAGE
Fig 1.4 : RGB IMAGE

2. Chapter -2

Fig 2.1: 3-D PLOT OF GAUSSIAN LOW PASS FILTER
Fig 2.2 : ORIGINAL IMAGE
Fig 2.3 : FILTERED IMAGE

3. Chapter -3

Fig 3.1: DAY IMAGE-1
Fig 3.2: NIGHT IMAGE-1
Fig 3.3: DIFFERENCE BETWEEN 4.1 AND 4.2
Fig 3.4 : DAY IMAGE -2
Fig 3.5 : AFTER SUNSET IMAGE-2
Fig 3.6 : DIFFERENCE BETWEEN 4.4 AND 4.5

4. Chapter -4

Fig 4.1: DAY IMAGE
Fig 4.2: INTENSITY HISTOGRAM OF Fig 5.1
Fig 4.3: NIGHT IMAGE
Fig 4.4: INTENSITY HISTOGRAM OF Fig 5.3
Fig 4.5: RESULT OF EDGE DETECTION ON Fig 5.1
Fig 4.6: TEXTURE ANALYSIS OF Fig 5.1

5. Chapter-5

Fig 5.1: HUE SCALE
Fig 5.2: YELLOW SHIFT
Fig 5.3: GREEN SHIFT
Fig 5.4: BLUE SHIFT
Fig 5.5: RED SHIFT
Fig 5.6: IMAGE WITH DIFFERENT SATURATION LEVELS
Fig 5.7: ORIGINAL DAY IMAGE
Fig 5.8: BRIGHTENESS OF Fig 5.7 DECREASED BY 20 PERCENT
Fig 5.9: BRIGHTENESS OF Fig 5.7 DECREASED BY 40 PERCENT
Fig 5.10: BRIGHTENESS OF Fig 5.7 DECREASED BY 50 PERCENT
Fig 5.11: BRIGHTENESS OF Fig 5.7 DECREASED BY 60 PERCENT
Fig 5.12: BRIGHTENESS OF Fig 5.7 DECREASED BY 70 PERCENT
Fig 5.13: BRIGHTENESS OF Fig 5.7 DECREASED BY 80 PERCENT
Fig 5.14: BRIGHTENESS OF Fig 5.7 DECREASED BY 90 PERCENT
Fig 5.15: BRIGHTENESS OF Fig 5.7 DECREASED BY 100 PERCENT
Fig 5.16: RELATIONSHIP OF PIXEL VALUES TO DISPLAY

6. Chapter -6

Fig 6.1: DAY IMAGE-1
Fig 6.2: FULL MOON LIGHT IMAGE OF Fig 6.1
Fig 6.3: DAY IMAGE -2
Fig 6.4: FULL MOON LIGHT IMAGE OF Fig 6.3
Fig 6.5: DAY IMAGE -3
Fig 6.6: FULL MOON LIGHT IMAGE OF Fig 6.5

7.Chapter -7

Fig 7.1: DAY IMAGE 1
Fig 7.2: EVENING IMAGE FOR Fig. 7.1
Fig 7.3: DAY IMAGE 2
Fig 7.4: DAWN IMAGE FOR Fig 7.3

Abstract

The standard technique for making images viewed at daytime lighting levels look like images of night scenes is to use a low overall contrast, low overall brightness, desaturation, and to give the image a “blue shift". Moonlit night scenes have a tinge of blue. Earlier work to model this perceptual effect has been statistical in nature; often based on unreliable measurements of blueness in paintings of moonlit night scenes.In Digital Image Processing we implement all these factors to derive the desired results.

INTRODUCTION

A digital image is composed of *pixels* which can be thought of as small dots on the screen. A digital image is an instruction of how to color each pixel. In the general case we say that an image is of size *m*-by-*n* if it is composed of *m* pixels in the vertical direction and *n* pixels in the horizontal direction. Image formats supported by Matlab are BMP, HDF, JPEG, PCX, TIFF, XWB In this project report we present various types of images that are being used in Digital Image Processing. Some light has been thrown on the difference between day and night images by utilizing their intensity histograms. We have also discussed various attributes of an image. Finally we present the details of augmenting the day image with loss of details associated with night vision.

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CHAPTER – 1

TYPES OF IMAGES

1. Intensity image (gray scale image)

This is the equivalent to a "gray scale image" and this is the image we will mostly work with in this course. It represents an image as a matrix where every element has a value corresponding to how bright/dark the pixel at the corresponding position should be colored. There are two ways to represent the number that represents the brightness of the pixel.

Fig:1.1:Intensity image

2. Binary image

This image format also stores an image as a matrix but can only color a pixel black or white (and nothing in between). It assigns a 0 for black and a 1 for white.

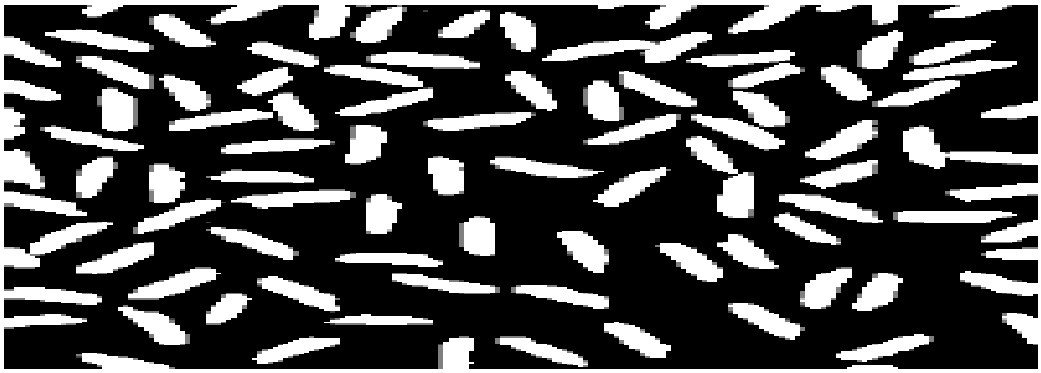

Fig 1.2: Binary image

3. Indexed image

This is a practical way of representing color images. An indexed image stores an image as two matrices. The first matrix has the same size as the image and one number for each pixel. The second matrix is called the *color map* and its size may be different from the image. The numbers in the first matrix is an instruction of what number to use in the color map matrix.

Fig 1.3:Indexed image

4. RGB image

This is another format for color images. It represents an image with three matrices of sizes matching the image format. Each matrix corresponds to one of the colors red, green or blue and gives an instruction of how much of each of these colors a certain pixel should use.

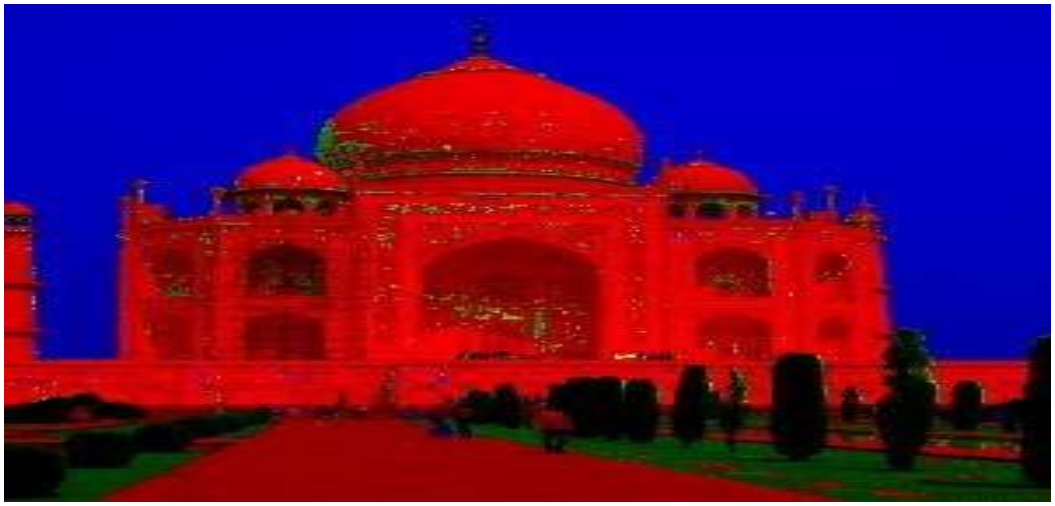

Fig 1.4: RGB image

CHAPTER -2

FILTER DESIGNING

We designed a Gaussian low pass filter and observed its effects on an image

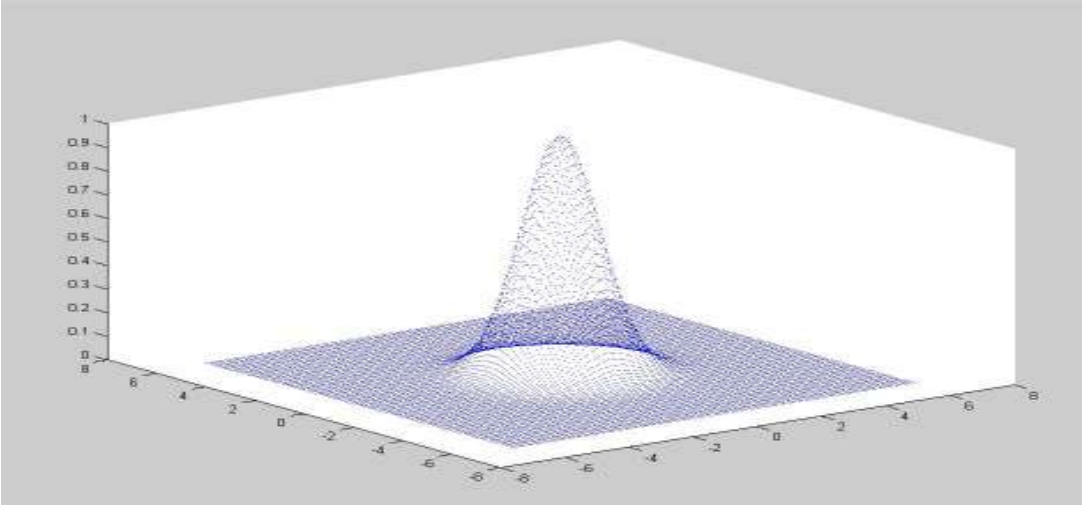

Fig 2.1 : 3-D Plot of Gaussian low-pass Filter

FILTER CODE

```
clc;
clear all;
c = input ('enter cut off frequency');
for u = -2*pi : .1 : 2*pi
    for v = -2*pi : .1 : 2*pi
        d = (u^2+v^2)^.5;
        a = exp(-(d^2)/2*c^2);
        plot3(u,v,a)
        hold on;
    end
end
```

ORIGINAL IMAGE

Fig 2.2

FILTERED IMAGE

Fig 2.3

CHAPTER-3

DIFFERENCE BETWEEN A DAY AND A NIGHT IMAGE

Fig3.1 : Day Image

Fig3.2 : Night Image

Fig3.3 : Difference between the above images

ANOTHER EXAMPLE

Fig 3.4 : Day Image

Fig 3.5 : After Sunset Image

Fig 3.6 : Difference between the above Images

CHAPTER - 4

RANDOM EXPERIMENTS ON AN IMAGE

1. **Intensity Histogram**
2. **Edge detection**
3. **Texture**

1. Intensity Histogram

We tried to find out the difference between the day and a night image by analyzing the intensity histograms of different images.Here is one example :

Fig. 4.1: Day Image

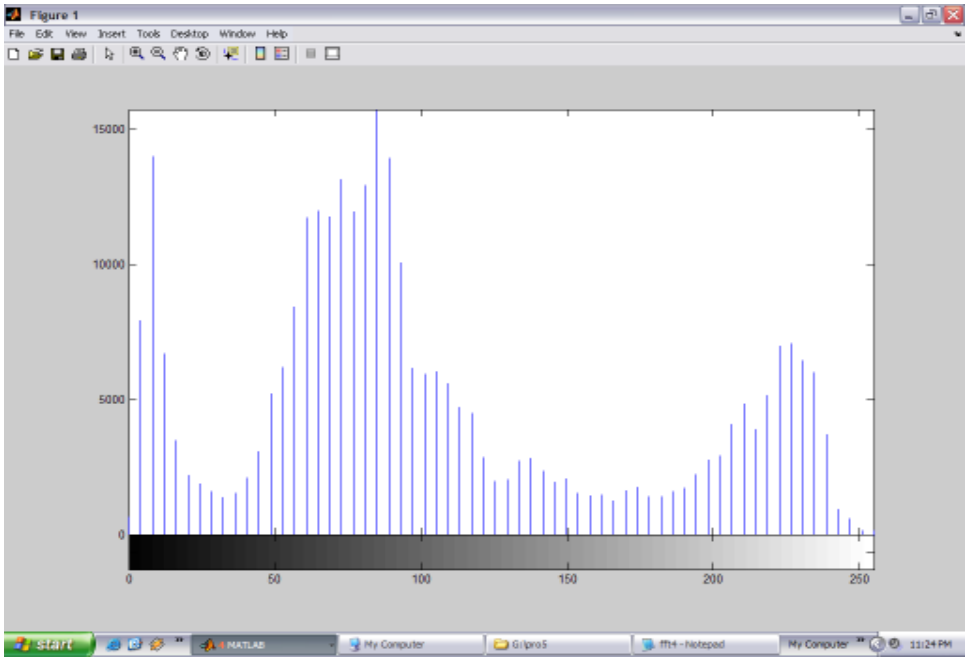

Fig 4.2 : Intensity Histogram of Fig 4.1

Fig 4.3 : After Sunset Image

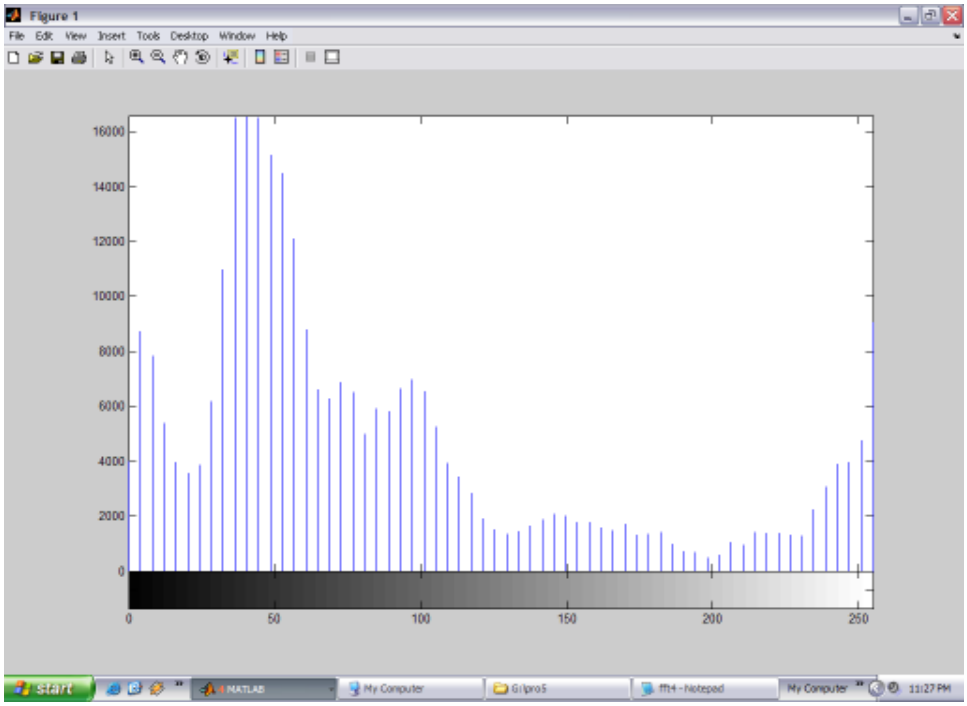

Fig 4.4 : Intensity Histogram of Fig 4.3

2. Edge Detection

In an image an edge is a curve that follows a path of rapid change in image intensity.Edges are often associated with boundaries of objects. Edge function looks for places where intensities change rapidly

Fig 4.5 : Result of edge detection on fig 4.1

3. Texture

Text analysis attempts to quantify intuitive qualities described by terms such as rough , smooth , silky or bumpy as a function of spatial variation in pixel intensities. Texture analysis can be helpful when objects in an image are more characterized by texture than by intensity.

3.1 Texture Functions

1. ***rangefilt***: : calculates local range of an image
2. ***stdfilt*** **:** calculates local standard deviation of an image
3. **entropyfilt** **:** calculates local entropy of grayscale image

Fig 4.6 : Result of texture analysis on fig 4.1

CHAPTER – 5

FACTORS INFLUENCING AN IMAGE

1. **Hue**
2. **Saturation**
3. **Brightness**
4. **Contrast**

1. HUE

Hue is one of the three main attributes of perceived color, in addition to lightness and chroma (or colorfulness). Hue is also one of the three dimensions in some color spaces along with saturation, and brightness (also known as lightness or value). Hue is that aspect of a color described with names such as "red", "yellow", etc.

Usually, colors with the same hue are distinguished with adjectives referring to their lightness and/or chroma, such as with "light blue", "pastel blue", "vivid blue". Notable exceptions include brown, which is a dark orange and pink, a light red with reduced chroma.

In painting color theory, a hue refers to a pure color—one without tint or shade (added white or black pigment, respectively).A hue is an element of the color wheel.

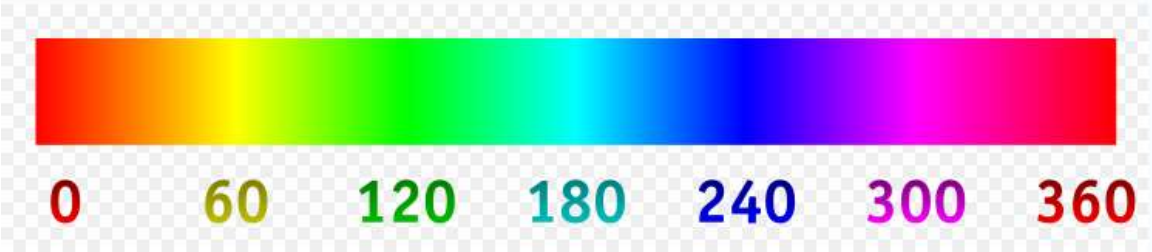

Fig 5.1 : Hue scale

Images with different hues on hue scale

Fig 5.2: Yellow shift

Fig 5.3:Green shift

Fig5.4:Blue shift

Fig 5.5 Red shift

2. Saturation

Saturation is the measure of colour intensity in an image. The less saturated the image, the more washed-out it appears until finally, when saturation is at zero, the image becomes a monochrome or grayscale image.

Generally, when dealing with images, the range of colour saturation which is normally expressed as a number in the range zero to one, maybe adjusted from a gray scale to just the amount of colour present in the original image. It is possible however to force colour saturation of images to values greater than one which tends to "beef up" the colour of an image. In figure one below, you can see the same image with a colour saturation of zero, one and two .

Fig 5.6 Images with different saturation levels

Of course, if an image is monochrome to begin with it's not possible to magically increase colour saturation and turn it into a colour image. The effect shown in the figure above was obtained by using the Colour Matrix class. This enables you to change the characteristics of an image as it is drawn. The matrix is set up to "shear" the colour space using the following set of values. Note that each colour component has an

effective luminance which contributes to the overall brightness of the pixel. The effective luminance value for red is 0.3086. Green has an effective luminance of 0.6094 and the value for blue is 0.082. The reciprocal of the saturation value is multiplied by the effective luminance of the colour component to produce a value by which each colour component of each pixel is multiplied during the matrix operation

3. Brightness

Brightness is also a very crucial factor that effects overall view of an image. Here we have presented a day image and in subsequent images the brightness level has been reduced upto certain percentage.

Fig.5.7 Original day image

Fig 5.8 : Brightness decreased by 20 percent

Fig 5.9 : Brightness decreased by 40 percent

Figure 5.10 : Brightness decreased by 50 percent

Figure 5.11 : Brightness decreased by 60 percent

Figure 5.12 : Brightness decreased by 70 percent

Figure 5.13 : Brightness decreased by 80 percent

Figure 5.14 : Brightness decreased by 90 percent

Figure 5.15 : Brightness decreased by 100 percent

4. Contrast

The variation in the intensity of an image formed by an optical system as black and white bar. Image contrast is defined as (a-b/a+b) where a and b are the illuminance in the images of bright and dark bar respectively

4.1 *Contrast adjustment*

An image lacks contrast when there are no sharp differences between black and white. Brightness refers to the overall lightness or darkness of an image.

To change the contrast or brightness of an image we perform contrast stretching. In this process, pixel values below a specified value are displayed as black, pixel values above a specified value are displayed as white, and pixel values in between these two values are displayed as shades of gray. The result is a linear mapping of a subset of pixel values to the entire range of grays, from black to white, producing an image of higher contrast.

The following figure shows this mapping. Note that the lower limit and upper limit mark the boundaries of the window, displayed graphically as the red-tinted window

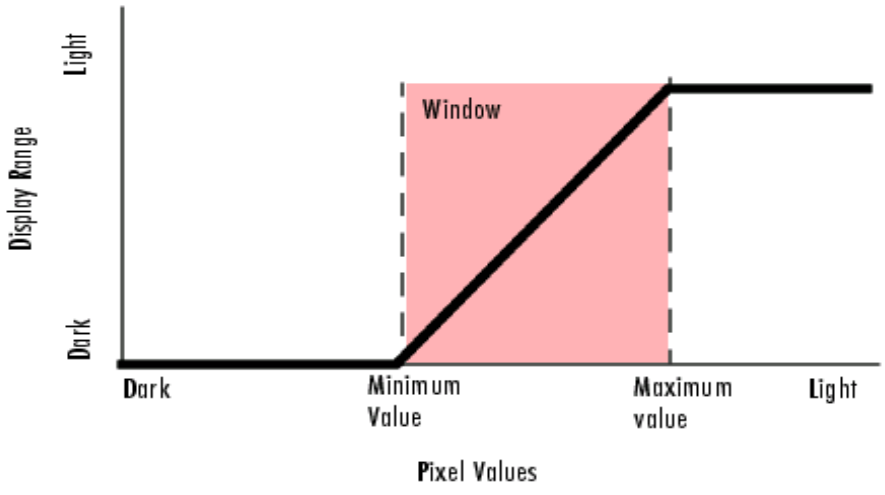

Fig 5.16 : Relationship of pixel values to display

4.2 ***Contrast Stretching***

As mentioned earlier also, contrast stretching (often called normalization) is a simple image enhancement technique that attempts to improve the contrast in an image by `stretching' the range of intensity values it contains to span a desired range of values, e.g. the full range of pixel values that the image type concerned allows. Low contrast images can be due to the poor illumination, lack of dynamic range in the imaging sensor, or due to the wrong setting of the lens. The idea behind the contrast stretching is to increase the dynamic range of intensity level in the processed image

Note: Here we would like to mention that in this project we had to reduce the contrast and brightness of the image rather than enhancing them. However we utilized "**contrast stretching**" technique only but in a opposite manner. In other words we reduced the range of pixel values rather than increasing it, which gave us the desired result.

CHAPTER -6

EFFECTS OF NIGHT ON AN IMAGE

Here we present some of the examples of final results which we got in the completion of our project "**NIGHT EFFECTS IN AN IMAGE**"

8.1 Implementation

Input image was assumed to be RGB image .If it is a high dynamic range image, it should be scaled to the [0,1] range. Then the image was converted to HSV colormap. Further the range of pixel values was reduced to [0.2 0.6] and the overall brightness of the image was reduced by almost 70 percent. The resulting low contrast and low brightness image is then given a blue shift. Now this bluish image is low pass filtered using Gaussian Kernel G_{kernel} where the standard deviation SD_1 is chosen to remove the fine details that would not be visible at night.

$$I_{blur} = G_{kernel} * I$$

The original image is also convolved with second Gaussian Kernel $G_{kernel2}$,with standard deviation $SD_2 = 1.6\ SD_1$ after which we take the difference of the two blurred images.

$$I_{blur2} = G_{kernel2} * I$$

$$I_{diff} = I_{blur} - I_{blur2}$$

I_{diff} is the bandpass component .The final night image was obtained by utilizing the following equation..

$$I_{NIGHT} = I_{blur2} + I_{diff}^{0.8}$$

Fig 6.1:Day Image 1

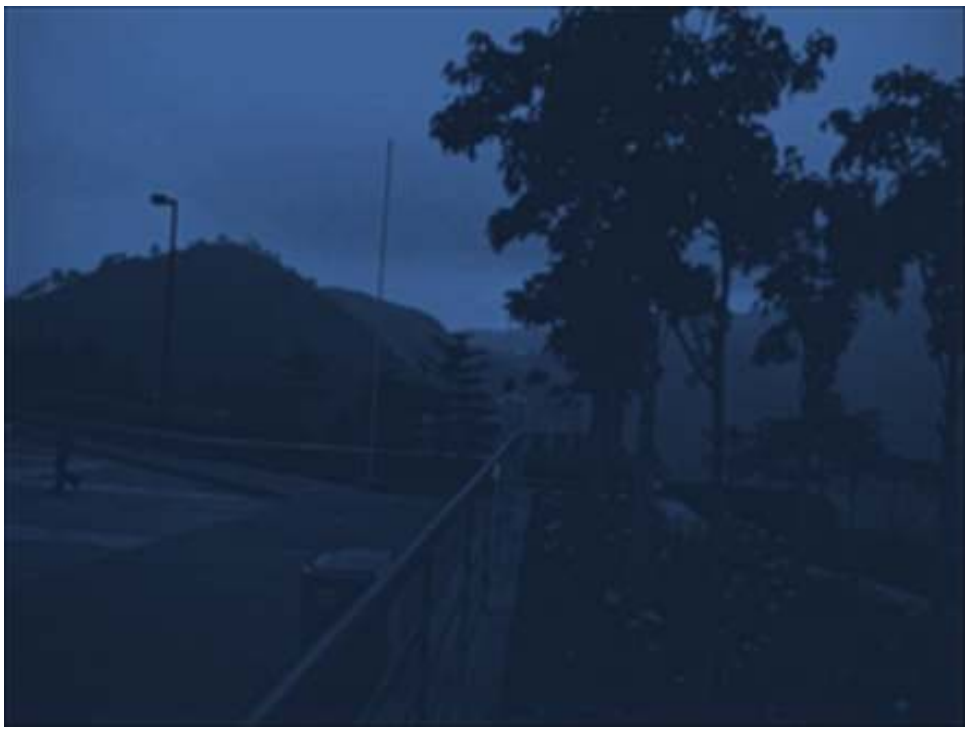

Fig 6.2: Night Image 1

Fig 6.3: Day Image 2

Fig 6.4:Night Image 2

Fig 6.5: Day Image 3

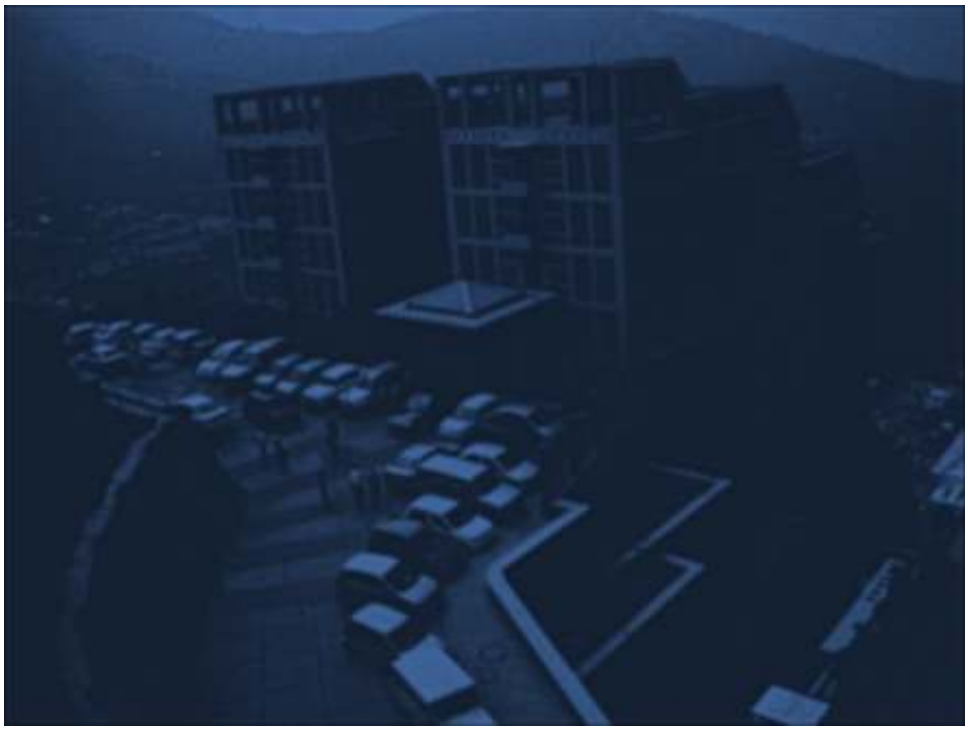

Fig 6.6 :Night Image 3

CHAPTER -7

DAWN AND EVENING EFFECTS

An evening image differs from night image in that the evening image has a bit of red shift along with brightness and contrast reduced by a small percentage. Where as a dawn image has even less level of brightness and contrast and contains no colour shift.

Fig 7.1: Day Image 1

Fig 7.2: Evening image for Fig. 7.1

Fig 7.3: Day image 2

Fig 7.4: Dawn image for Fig7.3

Conclusion

After the completion of the project we came to the conclusion that an image comprises of various determining factors which influence the overall view of he image. Variation in any one factor results major deviation from the original image.Some of the factors which we analysed during this project includes hue, saturation, brightness and contrast. However there are still a vast number of aspects which are yet uncovered. The results which we achieved for the day and night images could be further improved and researched by studying additional factors like white noise.

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