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A PATH FOR HORIZING YOUR INNOVATIVE WORK

QUALITY METRICES IN IMAGE ENHANCEMENT TECHNIQUES

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Abstract: Image enhancement, modifying the value of picture elements, is a classical method for improving the visual perception. Therefore, the processed image is more suitable than the original image for some applications. The most well-known method is the histogram equalization. In the histogram equalization the effect of brightness saturation will be appeared in some quasi-homogeneous region. Linear contrast stretching the new wide histogram dynamic range can be assigned directly from the original histogram dynamic range. By enhancing each modals of histogram independently the obtained image will give better visual perceptibility than the global enhancement. The standard deviation of each modal will be calculated and summed for providing the proportional of stretching range. In this paper Gamma correction, contrast stretching and Histogram Equalizations techniques have been implemented in this project. To compare all these techniques some quality measures have been applied like SNR (signal-to-noise ratio), PSNR (Peak signal-to-noise ratio), CoC (coefficient of correlation) etc.

Keywords: Quality Metrices, SNR, PSNR, CoC, Image Enhancement

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1. INTRODUCTION

Image enhancement improves the quality of images. Revealing details, removing blurring and noise and increasing contrast are examples of enhancement operations. The original image might have areas of very low and very high intensity, which mask details. An adaptive enhancement algorithm reveals these details and adjust their operation based on the image information being processed. In this case the contrast, mean intensity and amount of blur removal could be adjusted based on the pixel intensity statistics in various areas of the image. Image enhancement techniques are used by planetary scientists to enhance images of Mars, Venus and other planets. Image enhancement techniques is used by doctors to manipulate CAT scans and MRI images. Image processing is an excellent topic for classroom application of science research techniques. Image enhancement is used to improve the quality of an image so that users can better interpret it. Removing blurring and noise, increasing contrast of the image are the examples of image enhancement operations.

Images can be manipulated by using the following image processing functions:

- brightness
- gamma correction
- despeckle
- blur
- sharpen
- soften
- edge enhance
- gamma correction
- contrast

2. Common Problems with images

1.Noise

2.Blur

3.Low Contrast

2.1 Noise

Noise is divided into two parts:

2.1.1 Independent noise: This can often be described by an additive noise model, where recorded image f(i,j) is the sum of the true image s(i,j) and the noise n(i,j).The noise n(i,j) is often zero-mean and described by its variance. The impact of the noise is often described by the signal to noise ratio (SNR), which is given by:

$$SNR = 10\log_{10}\left(\frac{\sigma_g^2}{\sigma_s^2}\right)$$

Where σ_g^2 = variance of Noise-free reference image and σ_s^2 = variance of enhanced image. Larger the SNR values good image quality.

2.1.2 Data-dependent noise: This type of noise is used to model noise with a multiplicative, or non-linear ,model and these models are mathematically more complicated.

2.2 Blur Blur is a smoothed version of an image. De-blurring is equivalent to enhancing high frequency components of the image. High Pass filters are used to get the high frequency components and added back to the original image

3. QUALITY METRICS

Some quality measures have been developed as follows:

a) The Signal-to-noise ratio(SNR) :

$$SNR = 10\log_{10}\left(\frac{\sigma_g^2}{\sigma_s^2}\right)$$

Where σ_g^2 = variance of Noise-free reference image and σ_s^2 = variance of enhanced image. Larger the SNR values good image quality.

b) The Coefficient of correlation (CoC) :

$$CoC = \frac{\sum\left(g - \overline{g}\right)\left(\hat{g} - \overline{\hat{g}}\right)}{\sqrt{\sum\left(g - \overline{g}\right)^2 \sum\left(\hat{g} - \overline{\hat{g}}\right)^2}}$$

c) Peak-Signal-to-noise ratio (PSNR) :

$$PSNR = 10\log_{10}\left(\frac{255 * 255}{\sigma_s^2}\right)$$

Where σ_s^2 = variance of enhanced image.

4 . RESULTS AND DISCUSSIONS

The term image enhancement is mean as the improvement of an image appearance by increasing dominance of some features or by decreasing ambiguity between different regions of the image.

There are four steps in applying image enhancement process:

a) The first step is image capturing.

b) Second step is to save image used image extensions.

c) The third step is to select picture with three different types which is normal image, bright image and dark image.

d) The last step is applying the three proposed techniques to the selected images.

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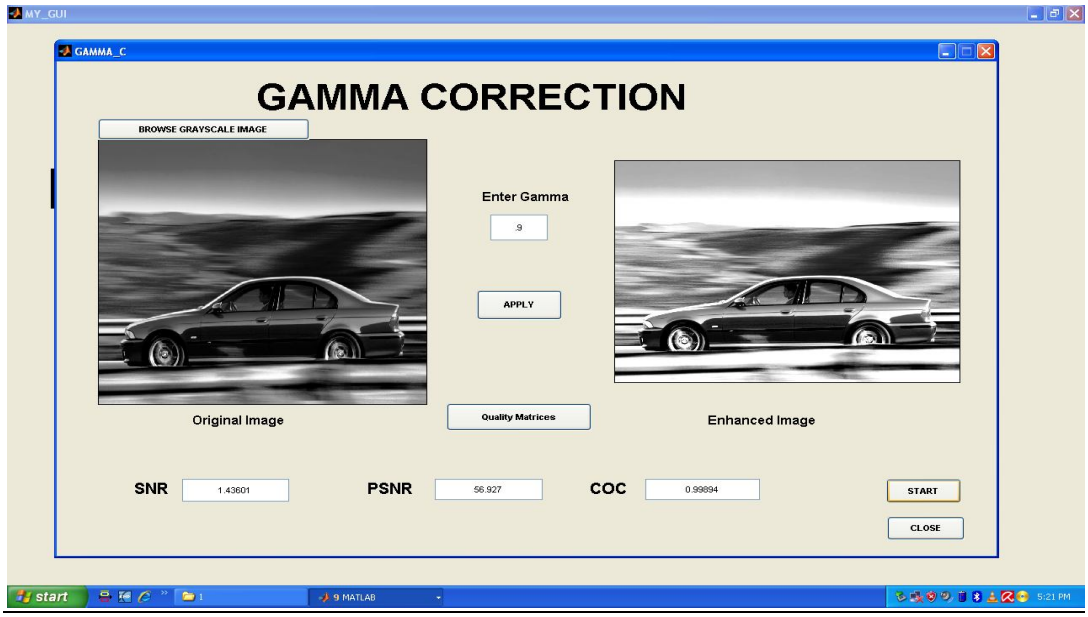

Figure 1: Gamma correction Technique

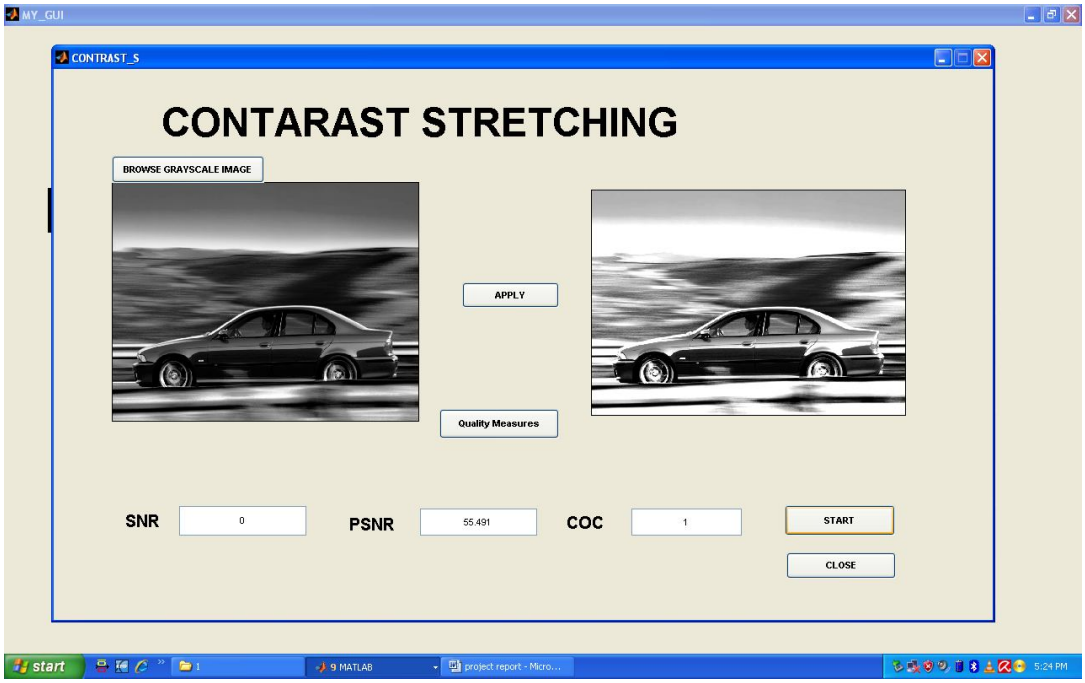

Figure 2: Contrast Stretching Technique

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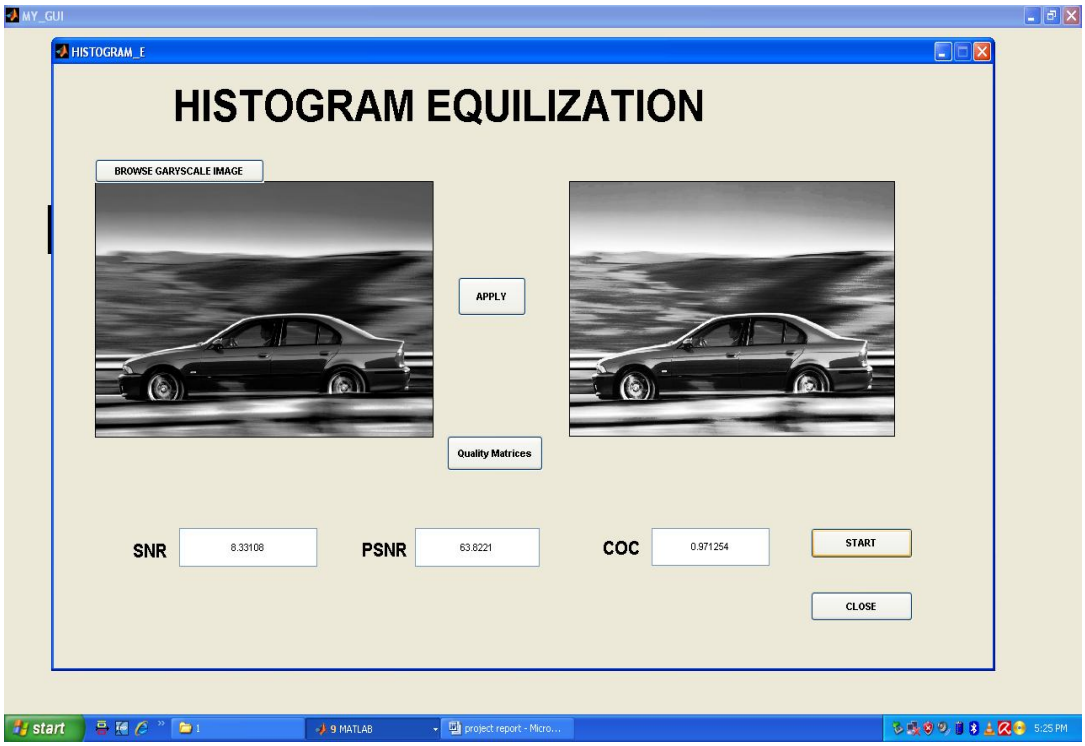

Figure 3: Histogram Equilization Technique

5. CONCLUSION

Due to the limited dynamic ranges of current imaging devices, images captured in real world scenes usually exhibit poor and low contrast, which may make important image features lost. Computer vision algorithms may also have difficulty processing those images. Various image enhancement techniques have been developed. Some of those techniques are simple spatially-independent methods, like gamma adjustment, histogram equalization and logarithmic compression. However, those simple methods are global processing based and generally have very limited performance. Image enhancement processes improve the visual appearance of an image or convert the images to a form better suited for analysis by a human or machine. The presented contrast enhancement techniques are effective in enhancing natural images.

Table 1: Comparison of different image enhancement techniques using metrics:

Method	SNR	PSNR	CoC
Gamma correction	1.43601	56.927	0.99894
Contrast Stretching	0	55.491	1
HE	**8.33108**	**63.8221**	**0.971254**

PSNR = Peak Signal to noise ratio , **SNR** = Signal to noise ratio, **CoC** = Coefficient of correlation .

After comparing the different methods using metrics the PSNR value of HE is best as greater the PSNR value, the best is the quality.SNR value of HE is the highest. The value of PSNR and SNR should be greater than one. More the value best is the method for future use.T he value of CoC should lie between 0 and 1.The value of CoC nearer to 1 give the good result.

From these three techniques, Histogram Equalization gives best result and give extra information. As a result, natural images that have been applied with this technique appear to be clearer and hopefully would ease further analysis by viewers.

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