Image Enhancement by Histogram Specification

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Abstract— Shape and characteristics of the histogram plays a major role in finding the quality of an image. Histogram Specification (HS) is an image enhancement technique, where the high resolution images called Target Images, histogram of the these images are matched with each other,then best image will be selected with high PSNR value to enhance the input image .

Keywords—CDF,HE, HS,MSE, PSNR.

I. INTRODUCTION

Digital Image Processing is a broad subject and often involves procedures which can be mathematically complex, but central idea behind digital image processing is quite simple. The ultimate aim oh image processing is to use data contained in the image to enable the system to understand, recognize and interpret the processed information available from the image pattern. Applications of image processing such as these engross different processes like image/data compression, enhancement, filtering, morphing, and resizing to name a few. One major advantage of Image enhancement is improving the Interpretability or the perception of Information in images for human viewers.

Present day application requires various kinds of images and pictures as a source of information for interpretation and analysis. Whenever an image is converted from one form to another such as digitizing, scanning, transmitting, storing, etc, some of the degradation occurs at the output. Hence the output image has to undergo processes called image enhancement which consisting of a collection of techniques that seeks to improve the visual appearance of an image. Image enhancement is basically improving the interpretability or perception of information in images for human viewers and providing better input for other automated image processing techniques.

Digital images are enhanced by Histogram Equalization (HE) and Histogram Specification (HS) Methods. HS is also known as Histogram Matching method. Where HS is the extension to the Histogram equalization technique. HS can be implemented in 1.Spatial Domain 2. Frequency Domain. In this paper we are proposed Spatial Domain method, where in this domain we are directly deal with the image pixels. In Frequency domain first image will be transferred to the frequency domain means Fourier Transform of the image is computed first. In HS method the CDF (Cumulative Density Function)of target image will be matched with the other target image. Fusion is also possible at the initial stage means instead of matching the histogram of the target images to the input image but HS gives better results than the fusion method at the initial stage. After using HS fusion method can be used it may enhance the images with good clarity. We can calculate MSE ad PSNR of the output image.

HS method can be used to enhance the different characteristics of the image such as brightness and contrast, this method can also applied to the color images. In this paper HS will be applied to the gray scale target images with high clarity. HS or the histogram matching ,is a basic histogram modeling technique that transforms one histogram into another by remapping the pixel values.

II. LITERATURE SURVEY

Histogram Specification employs a simple monotonic, nonlinear mapping which reassigns the intensity values of pixels in the input image such that the target image histogram resembles each other as much as possible[1]-[3].A large research work is done for image enhancement using Histogram Specification technique[4]-[7].Most of the work uses a single image as target image. In this paper, we have proposed an Enhancement technique based on the Histogram Specification, where multiple target images are used. Where target images CDF is matched in hierarchical manner then MSE and PSNR will be calculated. The images which have the high PSNR value is considered as single target image and that image CDF is matched with input image. If the input image is from a Forest, whether in order to obtain enhanced image, all the images has to be selected from the forest category.

III. HISTOGRAM SPECIFICATION

Many applications requires a desirable shape of the histogram. The objective of histogram Specification (HS) is to generate an output image with desirable histogram. HS algorithm is given by,

1. Algorithm Histogram Specification

Read target images. Find the CDF of the target images.

$p_x(i)$ and $p_z(i)$ (i)

CDF mapping of the target image1.

$$F_x(j)= \sum_{k=0}^{L-1} px(k) \quad \text{(ii)}$$

CDF mapping of the target image2.

$$F_x(j)= \sum_{k=0}^{L-1} pz(k) \quad \text{(iii)}$$

Where k=0,1,2,……..L-1. p_x= PDF of the target images

L=Pixel values. Probability Density Function (PDF).

The target image1 is the image that will be modified so that its histogram matches to the target image2 (or a target CDF). Same procedure is followed by other target images and at the last we have to pick the image which has the maximum PSNR (Peak Signal to Noise Ratio) and minimum MSE (Mean Square Error) value by considering that as single target image and its CDF will be matched with the input image's CDF where we can see the image clarity at the end and it's the enhanced image of the input image.

Histogram Matching method.

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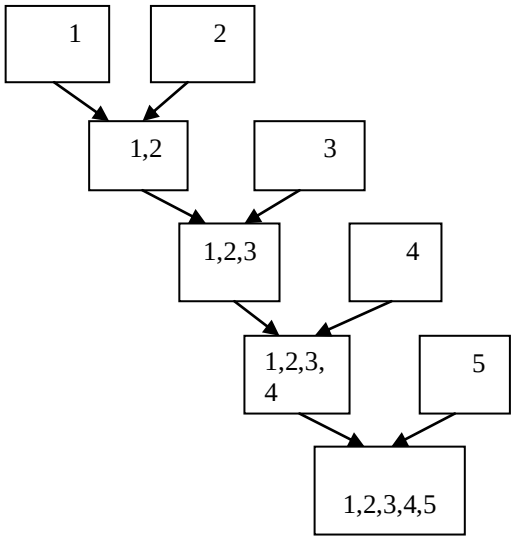
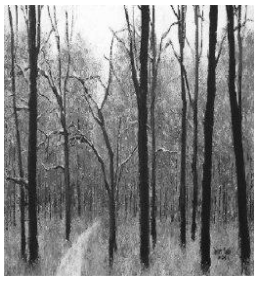


Fig.1 Histogram matching of the target images 1,2,3,4 and 5.

Target images

(a)



(b)

(c)

(d)

(e)

(f)

Fig.2 Various Target Images Considered.

IV. RESULTS AND CONCLUSION

The table below shows the results obtained considering various target images. Quality assessment of enhanced images shows that Histogram Specification of T1, T2 and T3 gives comparatively better result. The quality

matrix used for the enhancement indicates that the enhancement is better when it has lower values for MSE, MAE and a high value for PSNR.

Study with single target images show that the enhancement is better with the target T1 and T5 whereas it is comparatively poorer with the target T2 and T4.

Table I. Enhancement by Single Target Images

Input Images	MSE	MAE	PSNR	Entropy
Target 1	29.75	2.20	33.43	7.74
Target 2	154.31	15.50	26.28	7.68
Target 3	124.08	19.19	27.23	7.77
Target 4	208.05	36.26	24.98	7.41
Target 5	8.64	1.10	38.80	7.59

Table II. Enhancement by Multiple Target Images

Input Images	MSE	MAE	PSNR	Entropy
Target 1+2	252.53	34.14	24.14	7.31
Target 1+2+3	74.10	5.98	29.41	7.08
Target 1+2+3+4	184.40	30.09	25.51	6.58
Final Image	122.88	19.03	27.27	6.82

Fig.4. Original Image

Fig.4 Enhanced Resultant Image.

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