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Enhancement of Gray Level Image by Fuzzy and Filter Technique

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Abstract: ***The main motive behind Image Enhancement is to provide better and improved result. Fuzzy technique and the filter technique can be used to reduce the noise effect from an image. The proposed algorithm enhance the grey scale image by filtering and then Fuzzy logic algorithm applied on it. This results to improvement in the image from low contrast to high contrast and then compared the result from original image. The proposed method give improved value. The resultant image have high PSNR value which indicates high quality of an image with less noise and much brightness.***

1. Introduction

Image enhancement includes betterment of the images and it is done by different techniques. So we can also say that it is used to change the visual appearance of the image. Image enhancement is not a challenging task but to opt a better technique is difficult .Enhancement can be done on different parameters such as denoising, deblurring, sharpening the edges or set the pixels etc.

Image enhancement is classified in different categories:

1) Frequency Domain Method, that includes fourier transform of an image
2) Spatial Domain Method ,that operates directly on pixels
3) Fuzzy Domain Method, it manage uncertainity or imperfection of the image and capable of imitating the behavior of human expert.

2. Image Enhancement

The basic principle of image enhancement technique is to process an image so that result will be more suitable and improved. It is a collection of technique to seek better result in the image and it is often used to increase the contrast in the image and make some modification in the input image. Image enhancement refers to the operation on the image that improves the quality of an image in order to overcome the weakness of human visibility.

3. Grey Scale Image

Grey scale image composed solely of grey varying from black to white i.e from weaker intensity to the higher or the amount of light and the value of each pixel is a single sample representation means it capture the intensity of light in pixels.

4. Fuzzy Technique

Fuzzy logic is a shape of many-valued logic or probabilistic logic, it deals with approximate values rather than fixed and exact. It has been prolonged to cope with the concept of partial truth where the truth range between completely true and absolutely false. Fuzzy units are units whose factors have levels. In the fuzzy approach the fuzzy set membership functions are used for grey color or color intensity properties. It improves the speed and quality of the enhancement for color images histogram method are used to preserve the original color composition RGB color image is converted to HSV(Hue, Saturation and Intensity) here hue is color contain saturation refers to bright light used to reduce the color content and V is the intensity of color.

5. Proposed Methodology

The objective of the proposed algorithm is used to supply better results to enhance the visibility of the digital images. In the proposed method the approach focus on Input picture RGB image is converted into HSV. H and S are concatenated to V and received HSV is transformed to RGB.

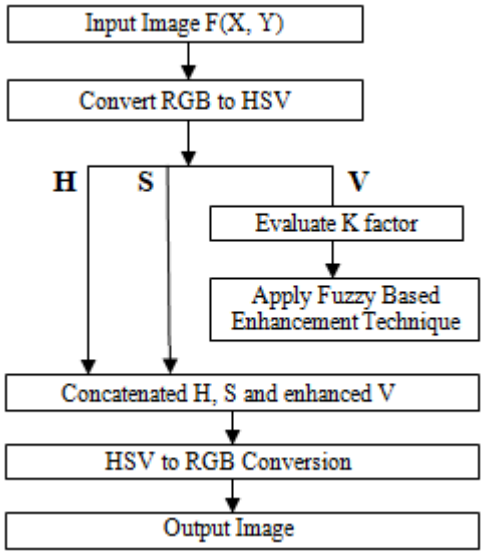

Figure 1: Algorithm for Image Enhancement

6. Filter Technique

Filter is a technique used for enhancement of an image that includes smoothing, sharpening and enhancement on the edges. Filtering is a method in which value of any given pixel in the output image is determined by applying some

algorithm to the value of the pixels.Filier is used to change the visual appearance of an image

6.1 Median Filter

It is a non linear digital filtering technique use to remove noise from an image. Noise is a result of errors in the image acquisition and the results include in pixels value. There are different ways by which noise is generated in the image .If the scanned image from photograph made on film trey film grain is a source of noise. It is normally used to reduce the noise from an image. It preserve the edges and remove the noise from images.

6.2 Fuzzy Set

A set is defined as a collection of properties each is defined as a member of set .So the characteristic value range between 0 or 1.A classical set X is called universe whose element are denoted by x i.e. X={x1,x2,x3…..xn }.

Consider a subset A with of set X with the element x and x is member of A if :

μ_A(x=1) if x€A
μ_A(x=1) if x€A
μ_A(x=0) otherwise

So fuzzy set A is defined as :

A = {(x, μ_A(x)) : x€A}

Where μ_A(x) is the membership function for a fuzzy set.

7. Membership Function

An image X of size M*N have grey level ranges from L_{min} to L_{max} can be modeled as an array.Each element in the array is the membership value representing the degree of brightness of grey level 1.In the Fuzzy set we can write

$\mu_{ij} = (X_{ij} - X_{min}) / (X_{max} - X_{min})$

Where $\mu_{i,j}$ denotes the degree of brightness possessed by grey level intensity $x_{i,j}$ of (i,j)th pixel.

8. Histogram Equalisation

It is a technique to enhance the image by adjusting image intensity. The output of the histogram approximately matches with the specified histogram. It enhance the contrast of an image. By default Histogram equalization function histeq tries to match a flat histogram with 64bins.

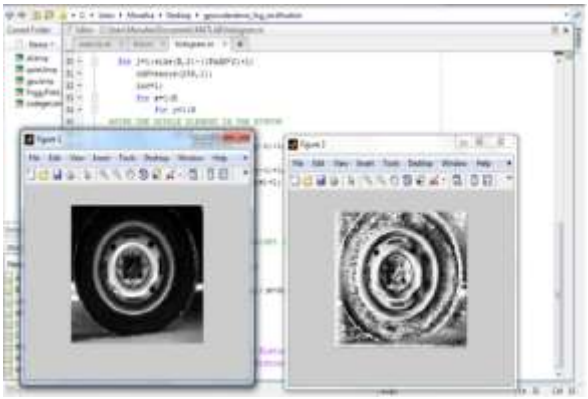

Figure 2: Original Image

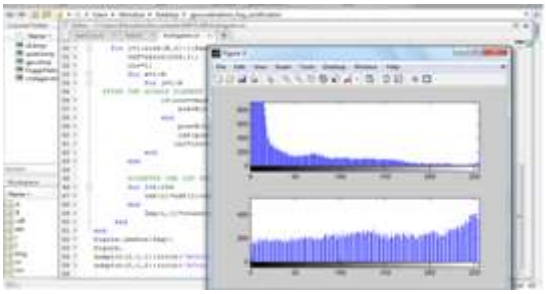

Figure 3: Histogram of an Image

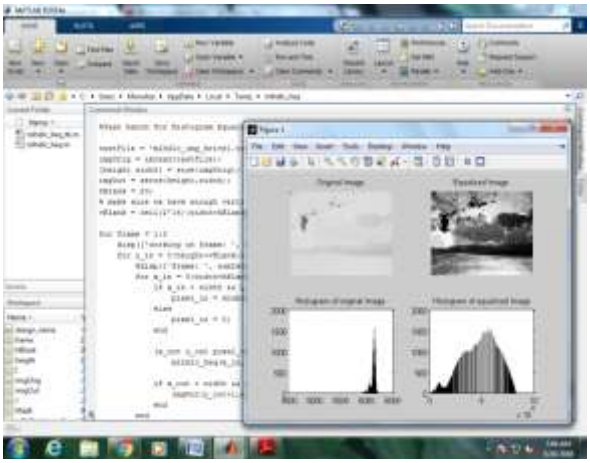

Figure 4: Histogram Equalisation

9. Testing and Analysis

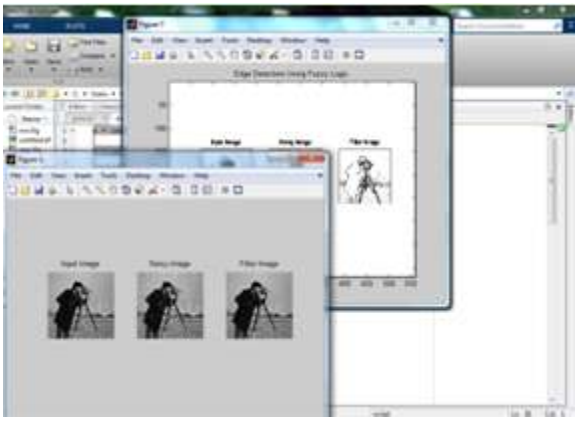

Figure 5: Filter Image

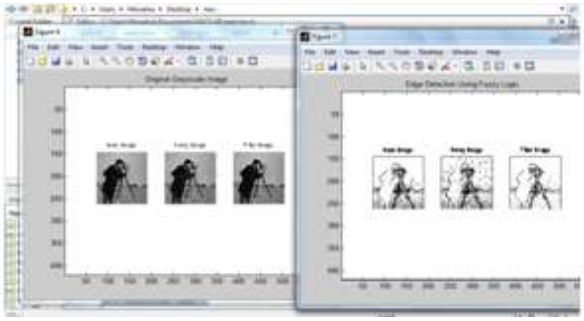

Figure 6: Edge Detection

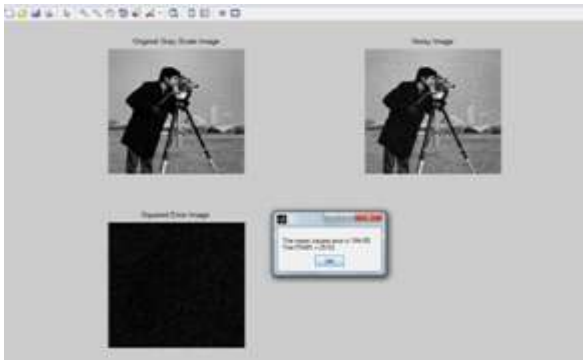

Figure 7: PSNR Value before fuzzy technique

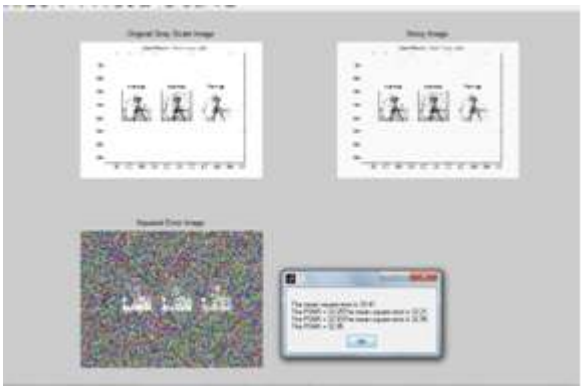

Figure 8: PSNR Value after fuzzy technique

10. Results

Proposed algorithm applied on many images. On the basis of PSNR value it can be analyzed that the resultant of the combination of filter and fuzzy technique give the improved result. Following steps should be taken to obtain the PSNR value for an image:

Step 1: Mean of an image

$$\mu = \sum_{l=0}^{l=L-1} l * p(l)$$

Here L = maximum intensity level of the grey scale image
P(l) = Probability Density Function of the image

Step 2 find the standard deviation

$$\sigma = \sqrt{\sum_{l=0}^{l=L-1}(l-\mu) * p(l)}$$

Step 3 find the PSNR value of the image
PSNR= 10log(L-1)2/ 10*log10(256^2/MSE)
Where MSE =Mean squared error of the image
MSE=$\frac{1}{m*n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j)-K(i-J)]$^2

OR

MSE=sum (sum(mseImage))/(rows*columns)
Higher PSNR value indicate higher quality of an image

Table I: Comparison of PSNR Value

S. No	Image Name	PSNR Value Original Image	PSNR Value by Proposed Algorithm		
1	Camera man.tif	25.47	33.71	32.94	32.97
2	Forest.tif	32.86	33.29	33	32.95
3	Tire.tif	26.22	38.72	32.91	32.9

Table II: Comparison of MSE Value

S. No	Image Name	MSE Value Original Image	MSE Value by Proposed Algorithm		
1	Camera man.tif	186.14	33.32	33.08	32.89
2	Forest.tif	100.8	32.83	33.22	32.94
3	Tire.tif	156.35	33.5	33.63	32.89

11. Conclusion and Future Scope

The main focus of the research paper is given on image enhancement by applying fuzzy technique and filter. Experiment was done on the low quality image initially and compare the result with the proposed method and the real method. In the recent years many method proposed for the enhancement. and the evaluation of technique is done by the compairing the PSNR and MSE value. The results are much improved by this method. The algorithm is tested on different images and obtained that brightness is improved.

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