

“Performance analysis of different Image Enhancement Algorithms”

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Abstract:- This project proposes different enhancement algorithms for blur images. It is useful to apply image enhancement methods to increase visual quality of the images as well as enhance interpretability and visibility. An Empirical Mode Decomposition (EMD) based blur image enhancement algorithm is presented for this purpose. EMD is a signal decomposition technique which is particularly suitable for the analysis of non-stationary and non-linear data.

An Empirical Mode Decomposition (EMD) based blur image enhancement algorithm is presented for this purpose. EMD is a signal decomposition technique which is particularly suitable for the analysis of non-stationary and non-linear data. In EMD, initially each spectral component of an blur image is decomposed into Intrinsic Mode Functions (IMFs) using EMD. The lower order IMFs capture fast oscillation modes (high spatial frequencies in images) while higher order IMFs typically represent slow spatial oscillation modes (low spatial frequencies in images). Then the enhanced image is constructed by combining the IMFs of spectral channels with different weights in order to obtain an enhanced image with increased visual quality. The weight estimation process is carried out automatically using a genetic algorithm that computes the weights of IMFs so as to optimize the sum of the entropy and average gradient of the reconstructed image.

Keywords: Image Enhancement, Contrast Stretching, Histogram Equalizations, IMF, Sharpening image. Empirical Mode Decomposition.

I. Introduction

Image enhancement is the process of adjusting digital images so that the results are more suitable for display or further image analysis. For example, you can remove noise, sharpen, or brighten an image, making it easier to identify key features.

Image enhancements techniques are used to make images lighter or darker, or to increase or decrease contrast, or to remove undesired

characteristics of an image such as color cast. The aim of image enhancement is to improve the interpretability or perception of information in images for human viewers, or to provide 'better' input for other automated image processing techniques.

Low contrast reduces the visual quality of digital images. This affects the clarity of resulting printouts, and further processing of these images. Presently, several software tools used in research and scientific laboratories as well as in industry are used to filter out the undesired characteristics. Most existing software tools used for image enhancement are semi automated; however, these tools are applied to normal images, and are not suitable for underwater images.

They do not always work as expected with underwater images and videos. Learning to manipulate the color in underwater images and videos through computer editing software requires patience and expertise.

Physics based approaches are not suitable for color correction. In order to address issues, it is important to develop an image enhancement technique that can improve the quality of the underwater images by reducing color cast and improving the contrast.

Earlier enhancement algorithm has restricted visibility, it gives clear image upto 20 meters from viewer, in order to overcome this drawback proposed algorithm is used. It is used to improve image quality, compensate attenuation effects, enhance contrast, adjust colors, suppress noise and blur from the images.

II. Literature Survey

EMD has been proposed by Huang as a non-linear and non-stationary time frequency data analysis method. In EMD main process is to perform shift operation on the original data series until the final series are stationary, and thereby decompose the entire signal into several intrinsic mode function and residue.

EMD is a signal decomposition technique in which spectral component of an blur image is decomposed into IMFs. Then enhanced image is constructed by combining the IMFs [1]. The weight estimation process is carried out automatically using a genetic algorithm that computes the weight of IMFs so as to optimize entropy and average gradient of the reconstructed image [1].

Histogram Equalizations methods preserve the input brightness on the output image with a significant contrast enhancement, they may produce images with do not look as natural as the input ones. The basic idea of Histogram Equalizations method is to re-map the gray levels of an image [2].

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.

III. Implementations of Image Enhancement techniques

The following Image Enhancement techniques are used to accomplish the Goal of System, they are mainly as:

1. Contrast Stretching

2. Histogram Equalization

3. An Empirical Mode Decomposition (EMD)

1. Contrast Stretching: - Contrast stretching separate the image in two parts the black and the white one, on the m value, and the transition between these parts is a slope that could be more or less smooth and it depends on the e value.

Partial contrast stretching: Partial contrast is a linear mapping function that is used to increase the contrast level and brightness level of the image. The technique is based on the original brightness and contrast level of the images to be adjusted. First the system will find the range of where the majority input pixels converge for each color space. Since the input image is in RGB color space, so it is necessary to find the pixels range between the red, blue and green intensities. Then, the average of these three color space will be calculated to obtain the upper and lower color values by using the following formula:

$$\text{maxTH} = (\text{maxRed} + \text{maxBlue} + \text{maxGreen})/3$$

$$\text{minTH} = (\text{minRed} + \text{minBlue} + \text{minGreen})/3 \quad (1)$$

maxRed, maxBlue and maxGreen are the maximum color level while minRed, minBlue and minGreen are the minimum color level for each color palette respectively. maxTH and minTH are the average number of maximum and minimum RGB color space. maxTH and minTH will be used as the desired color ranges for all the three color palettes.

Next is to start with the mapping process. The mapping function is as follows:

$$P_K = \frac{(\text{max} - \text{min})}{(f_{\text{max}} - f_{\text{min}})} (q_K - f_{\text{min}}) + \text{min} \quad (2)$$

Where

P_k : Color level of the output pixel

q_k : Color level of the input pixel

f_{min} : Maximum colour level values in the input image

f_{max} : Minimum colour level values in the input image

min : Desired minimum colour levels in the output image

max : Desired maximum colour levels in the output image

2. Histogram Equalization: - Histogram equalization makes the histogram to expand between all the ranges (0,255) and gets more smooth transitions between the pixels of the image. The algorithm average time is 0.1590 seconds for a 240x320 image. It is quite fast because we can process more than 6 images per second.

Algorithm to find histogram:-

1. Check color of each pixel of image.
2. Get current intensity for each pixel of image.
3. Apply the intensity transformation function for histogram equalization is

$$T(r_k) = \sum_{j=1}^k p(r_j)$$

i.e. we add the values of the normalized histogram function from 1 to k to find where the intensity r_k will be mapped. The range of the equalized image is the interval [0,1].

4. Then apply normalized histogram function i.e. histogram function divided by total no of pixels of image.

$$p(r_k) = \frac{h(r_k)}{n} = \frac{n_k}{n}$$

Fig 1:-Histogram Equalization

It gives measure of how likely is for a pixel to have a certain intensity.i.e.it gives the probability of occurrence the intensity.

5. Apply normalized histogram function to each component of pixel

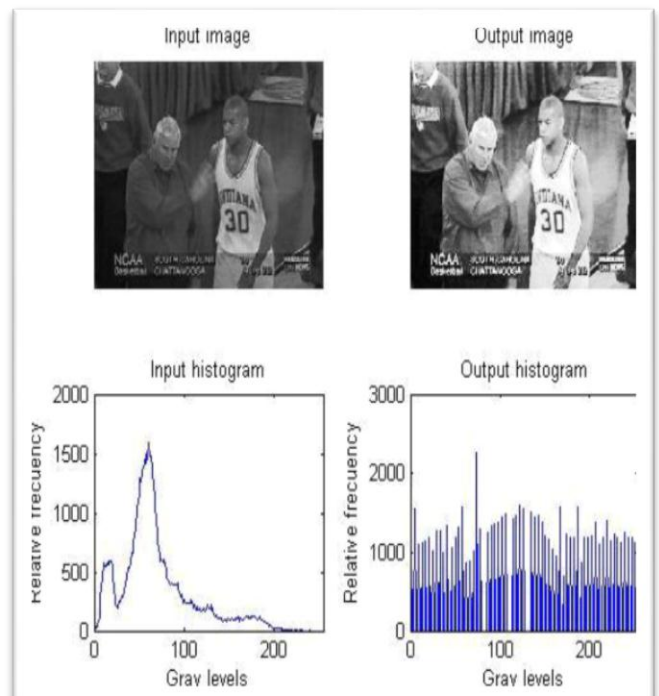
i.e.red,green,blue.

6.Restore the new component value of each pixel.

3. Empirical Mode Decomposition (EMD):- Image will be enhancing with the help of decomposition and genetic algorithm.

A.Decomposition:-The decomposition procedure of 2D-EMD is as follows:

1. Find all points of 2D local maxima and all points of 2D local minima of $input_{IK}(i, j)$.
2. Produce the upper envelope ($e_{max}(i, j)$) by 2D spline interpolation of local maxima and the lower



envelope ($e_{min}(i, j)$) by 2D spline interpolation of local minima.

3. Compute the mean of the upper and lower envelopes:

$$e_mean_{IK}(i,j) = (e_{max}(i, j) + e_{min}(i, j))/2.$$

4. Subtract the envelope mean from the input signal:

$$h_{IK}(i,j) = \text{input}_{IK}(i,j) - e_mean_{IK}(i,j)$$

5. Compute the stopping criterion as

$$Eps = \frac{\sum_{i=0}^H \sum_{j=0}^W |e_mean_{IK}(i,j)|}{H*W} \quad (3)$$

Where, H and W show the dimensions of the image.

Check if the envelope mean satisfies the iteration stop criterion for the current IMF. If the stop criterion for the current IMF falls below a small threshold such that $eps < \tau$, where τ is a small threshold, the sifting process is stopped for the current IMF (assume at step $k = K$), and the current IMF is obtained as $IMF_1(i, j) = h_{IK}(i,j)$. If the stop criterion is not met, the next iteration is started with $input_{i(k+1)}(i, j) = h_{IK}(i, j)$ and this process is repeated from step 1 to find the current IMF.

6. If the current IMF is obtained successfully, the residue signal $R_1(i, j)$ is computed as $R_1(i, j) = input_{i1}(i, j) - IMF_1(i, j)$. If the residue does not contain any more extreme points the EMD decomposition process is terminated. Otherwise the next IMF is computed from step 1 using the residue as input i.e. $Input_{(i+1),1}(i, j) = R_1(i, j)$

B. Genetic Algorithm: - The genetic algorithm is a population-based iterative optimization method. Instead of just pushing iteratively a single candidate toward the optimal solution, it acts on a set of such solution candidates by simultaneously exploring several zones of the search space and by combining promising solution candidates, hopefully for the better.

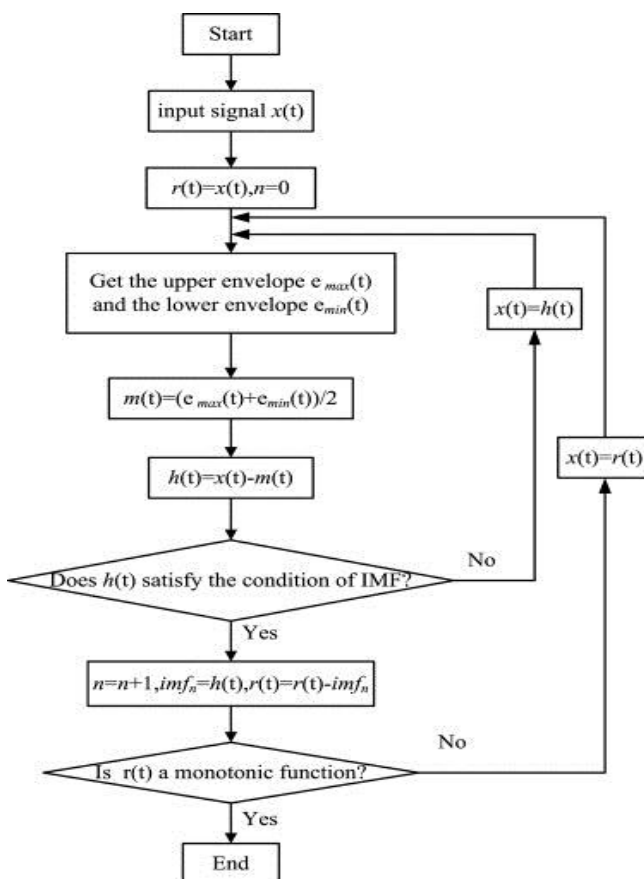
1. Generate the initial population (values) randomly (between 0 and 1) for the initial weight set of (3), and then normalize the values so that their sum equals unity. Each weight set represents an individual in the GA.

2. For each individual, calculate the objective function, namely the sum of the entropy and average gradient. The main aim is to find a weight set that maximizes the objective function. Evaluate the fitness of the

current solution, i.e. the performance of the individual to be a good solution.

3. Select individuals from the population as parents based on their fitness value to contribute to the next generation. In this paper we use the roulette wheel as the selection technique. The idea behind the roulette wheel selection technique is that it gives each individual a probability that is directly proportionate to their fitness. Then individuals are chosen based on these probabilities.

4. Generate children from parents by applying



crossover and mutation.

5. Replace the current population with the children to form the next generation and evaluate the fitness value of all children using the objective function.

6. Check the stop criterion. The stop criterion used in this paper is the total number of generations. If the stop

criterion is not met, return to step 3. If the stop criterion is met, the algorithm is stopped. Select the best individual based on fitness as the best solution.

This

Individual gives the best weight set that maximizes the sum of the entropy and average gradient.

In EMD Flowchart, where

- X(t): input image
- And t=(I,j) special domain element
- Monotonic function means (is it satisfying condition of IMF)

Fig 2:-EMD Flowchart

IV. Result Analysis

V.CONCLUSION

In this paper, we have discussed Blur images can be of poor quality due to limited range of light, low contrast. We have proposed an Empirical Mode Decomposition (EMD) based enhancement method for blur images. The proposed approach efficiently removes the bluish color cast and improves the contrast. It also improves the visual quality of an image.. In order to evaluate the performance of the proposed method, we compared our results with the existing methods, Histogram Equalization and Contrast Stretching .

VI. References

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1.After performing enhancement algorithms on image resulted image will be generated.

2.Experimental result will be calculate by considering entropy and average gradient values together.

3.For deciding better result the visual performance of all three algorithms will be consider which is calculated by average gradient and entropy.

The average gradient of an image of size WxH pixel is defined as:

$$grad_avg = \frac{1}{W \times H} \sum_{i=1}^W \sum_{j=1}^H \sqrt{\left(\frac{\partial I(i,j)}{\partial i}\right)^2 + \left(\frac{\partial I(i,j)}{\partial j}\right)^2}$$

Where I(i,j) is the pixel value of the image at the (i,j) position.

The entropy of an image is defined as:

$$H = -\sum_{i=0}^{L-1} P_i \log_2 P_i$$

Where, L is number of possible pixel values.

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