Analysis of Alleviating the Artifacts and Enhancement of Underwater Images

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Abstract: In the Image processing, the quality of pictures is very vital for human interpretation. In the underwater approach, on account of the multi scale fusion strategy the contrast of image may reduce and causes a blurring effect and degradation which may cause performance degradation. So, we introduce a color attenuation prior model, for color enhancement of underwater image. Our vast advantageous evaluation reveals that our processed images are composed of better brightness even when expose to darkness, better contrast and sharp edges as well.

Keywords: *Fast Guided Filter, PSNR, MSE, SSIM, Dehaze*

1. INTRODUCTION

From the ancient times, when we compare the ordinary pictures with beneath water pictures, It suffer from severe poor visibility as well as ensuing from the attenuation of the light. It can happen owing to the effects of light absorption and scattering. Our planned methodology aims to reinforce the underwater image quality for better infrastructure of underwater images. Getting clear pictures from underwater will always be an important issue in the field of ocean engineering. The blurred images acquired from the underwater suffer from low visibility due to scatters and merger, leading to contrast distinction and color distortion. Its really laborious to accumulate viewable pictures at short or long distances in underwater because of the absorption and dispersion nature of ocean water. Eliminating these effects has been the main target of the underwater imaging research areas and community for decades. However, some recent advances in software, hardware and logarithmic ways has led to some enhancements in many application areas.

The picture quality, acquiring from the underwater pictures has always played a crucial role in scientific missions like observance ocean life, taking population cencus, and figuring out geologic or biologic atmosphere. To get clean and clear beneath ocean images will be always somewhat difficult. The reason behind it is the light which reverberation of light, scattering and deflection which causes dimness and the color change occurs due to the sunlight attenuation. Haze, which is like blurry, foggy, or misty, which can form by the suspended particles like minerals, sand, which is seen in lake, seas, rivers etc. The absorption and scattering of light beam is, when the ray reflected light from the object propagates toward the camera, the suspended particles like sand, mineral are met by a portion of the sunlight.

2. RELATED WORK

Codruta O. Ancuti et al. [2], have presented an approach for augmenting videos and photos of under the water. The scheme builds on the basic principle of fusion methods and does not require any excess information when compare to the single original image. Owing to the Multi scale fusion strategy, the contrast of the image may decrease and can cause a fading effect and some features are degraded due to the mismatch of the fusion strategy.

Nicy Johnson et al.[10] in their, 'Haze Removal using Color Attenuation Prior 'paper brought a new method for the removal of haze called color attenuation prior. Here, a depth map is created from a previous linear model. We will next find the transmission map from this to recover the depth information better and they can find the scene radiance easily and haze removal is done efficiently. Color Attenuation Prior is much better than the old methods. In this method they find the depth map using a linear model.

Krati and Neha' [7] says, for the haze image's scene depth, a model which is linear, and is created by the linear CAP based de haze method. A learning method which is termed as supervised learning method is used for parameter learning of this model through which the underwater depth information can regain. Relying on a particular method in the depth map, the scene radiance of the hazy image can be recovered efficiently. By appropriately choosing weight maps and inputs, a multi-scale fusion strategy can be used efficiently to de haze images.

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Sonam Bharal [11] has discussed about the 'Various Underwater Image Enhancement Techniques'. Enhancement of image improves the image information content and alters the visual impact of the image on the observer. Image enhancement escalates the image features and it emphasizes its edges, contrast and includes operations such as contrast stretching, noise clipping, pseudo coloring, noise filtering etc to improve the view of images.

3. MATERIALS AND METHODS

For modeling the image's depth, by making a linear model, and studying about the model's parameters, we will be able to recover the information regarding depth. The enhancement of the underwater image color can also be done using depth map of the image. It is based on atmospheric scattering model. In this technique saturation and brightness values of an image is considered.

3.1. Image Acquisition

Image Acquisition is a process getting an input image using image processing algorithms for underwater image enhancement processes. The acquisition stage is the first stage of any vision system. After obtaining the image, some kinds of processing methods can be applied to the image for performing different vision tasks.

3.2. Pre processing

The purpose of pre processing is to meliorate the data in the image by crushing the unwanted image data distortions or raising some image features which are vital for further processing.

3.3. Fast Guided Filter

This kind of filter is for edge-aware, edge-preserving image filtering, which has high speed, nice visual quality, and easy implementation as well. It is suitable for enhancing the local contrast and the definitions of edges in each region of an image. We use fast guided filter imaging for smoothening the image.

Algorithm

M0 = f subject sample (M, s), N0 = f subject sample (N, s) r0 = r/s
Mean M = f mean (M0, r0)
Mean N = f mean (N0, r0)
Corr M = f mean (M0 , ∗ M0 , r0)
Corr MN = f mean (M0 ∗ N0 , r0)
Var M = corr M – mean M ∗ mean M cov MN = corr MN − mean M ∗ mean N
a = Cov MN / (Var M +) y = mean N – x∗ mean M Mean x = f mean (x, r0)
Mean y = f mean (y, r0)
Mean x = fupsample (mean x, s)
Mean y = fupsample (mean b, s)
q = Mean x ∗ M + mean y

3.4. De hazing Algorithm

For the image enhancement, the color attenuation prior method is very efficient. Firstly we will create a model, which is linear, to find out the depth information and to learn the parameters. Now we can create a depth map from this. The linear model creation, with an accurate expression, is as follows:

$$\mathbf{h(p) = \alpha 1 + \alpha 2b(y) + \alpha 3t(y) + \psi(y)}$$

Where,

p - Position lies in the image
h - Scene depth
b - Component of brightness
t – Component of saturation
α1, **α2**, **α3** – Unknown linear coefficients

3.4.1. Scene Depth Restoration

The influence of the air light will also increase, when the haze dense is high. Then we may able to find the difference in the luminance and saturation and for finding haze intensity as well. As the concentration of the haze increases, the difference found here also increases. The white or gray light, increases brightness and reduces saturation. The haze intensity raises along with the scene depth change, by assuming that they both are positively related.

3.4.2. Estimation of transmission map

This is finding the value of pixels inside the depth map. Then we generate the random atmospheric light which has edge preserving property. The scattering (atmospheric) model has been rampantly used to amplify the hazy or blurred image H(z) formation, where x is the index of pixel, is shown as:

$$H(z)*R(z)*m(z) + K\{1- m(z)\}$$
$$m(z) = e\text{-}\beta d\ (z)$$

Where,

H - Hazy image

R - Scene radiance representing the haze-free image

K - Atmospheric light

T - Transmitting medium,

m**(z)** **-** Transmitting medium indicating the portion of the light

e - Scattering coefficient of the atmosphere

d - Scene depth

3.4.3. Atmospheric Light Estimation

The white objects that are seen in an image have, eminent luminance value and low saturation value. So our proposed system here tend to focus on the image object with white colour as distant, but this may lead to incorrect or inaccurate calculations of depth By taking into account, each neighborhood pixel we will be able to solve it. The repaired or solved maps are composed of dark colors in regions with less haze and vice versa.

3.4.4. Scene Radiance Recovery

The estimation of the medium transmission and repairing of scene radiance is by knowing about the image depth and the atmospheric light,. In order to recover the scene radiance, we use the equation as:

R (z) = {(H(z) –K) m(z)} + K

K - Atmospheric Light

m(z) - Transmission Map

3.5. Contrast Enhancement

It is a process that makes the features of te images exposes more clearly by making optimal use of the colors which are available on the display. We use Adaptive Histogram Equalisation (AHE) for Contrast Enhancement, which is a computer image processing technique used to improve contrast in images.

4. RESULTS AND DISCUSSIONS

4.1. PSNR (Peak-Signal to Noise Ratio)

PSNR is abbreviation of Peak Signal-to-Noise Ratio, which is for measuring the image quality based on the differences in two image's pixels Also termed as ratio of a signal and degrading noise powers, which affects quality. The original data is the signal and error is noise.

PSNR can be defined as:

$$\mathrm{PSNR} = 10\ log\frac{s^2}{MSE}$$

Where,

s = pixel value 255 for an 8-bit image.

PSNR is basically an SNR (Signal-to-Noise Ratio), when all the pixel values equals the maximum possible value.

4.2. MSE (Mean Square Error)

Mean Square Deviation (MSD) of an estimator used for, measuring the average of the errors' squares, between the compressed and the original image MSE is always non-negative and values closer to zero are better. By making the average of input and output images' pixels(original and resultant respectively), Mean Square Error can be calculated accurately

$$\mathrm{MSE} = \frac{1}{\mathrm{NM}}\sum_{m=0}^{M-1}\sum_{n=0}^{N-1} e(m,n)^2$$

Where,

$e(m,n)^2$ – Squared difference between the original and the deformed image.

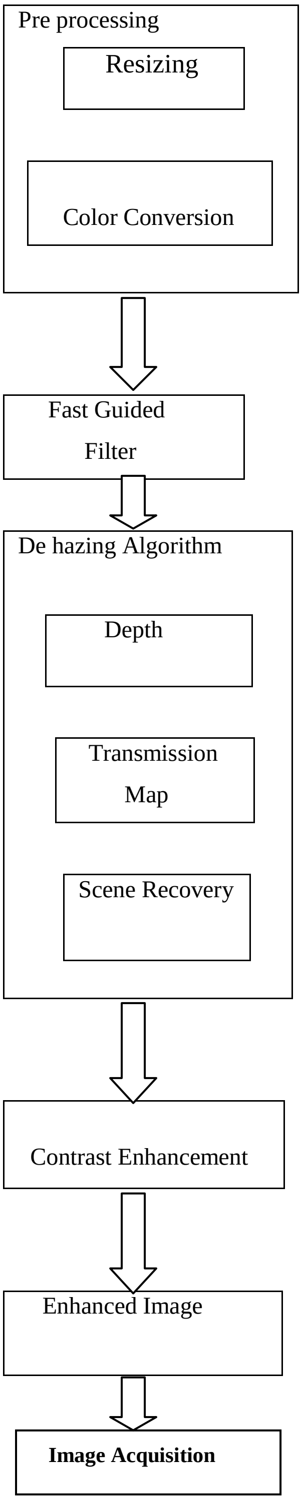

Fig1. Block Diagram for Underwater Image Enhancement

However, mean square error (MSE) and peak signal-to-noise ratio (PSNR) are voluminously used for measuring the degree of image distortion for a long time.

3.1 SSIM (Structural SIMilarity Index)

In the Image processing era, Structural Similarity Index (SSIM), which is a metric used for measuring the corruption of quality of the pictures. The corruption or degradation may occur due to the compression of data or transmission losses. A full referent metric, which requires two images namely reference and processed image, is termed as an SSIM. SSIM is designed to improve on methods like PSNR & MSE. Three samples are introducing here, say, luminance(l), contrast(c), and structure(s), and the SSIM formula measurement is based on 3 comparison measurements, between the samples of x and y. The individual comparison functions are:

$$l(x,y) = \frac{2\mu_x \mu_y + c1}{\mu^2 x + \mu^2 y + c1}$$

$$c(x,y) = \frac{2\sigma_x \sigma_y + c2}{\sigma^2 x + \sigma^2 y + c2}$$

$$s(x,y) = \frac{\sigma_{xy} + c3}{\sigma x + \sigma y + c3}$$

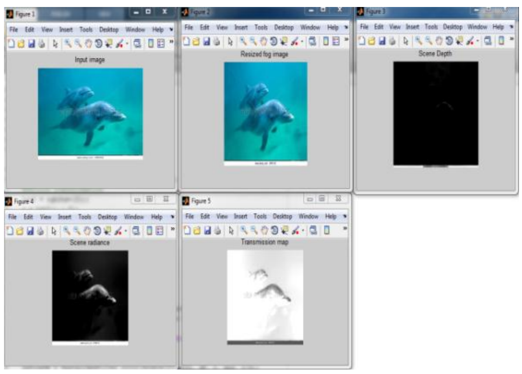

Fig.2: Output Screenshot

5. CONCLUSION

We have analyzed, our method contributes greatly in uplifting the visibility of underwater images and outperform the other methods. It can recover high quality images with fine details and edges. We can compare the output with existing papers, can produce better output. We can improve color mapping for depth image with better output. The Strategies have shown that our approach can augment a voluminous series of underwater pictures with high justness and precision and also the ability to retain the crucial blurred features and edges as well.

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