White Balance and Multi Scale Fusion for Under Water Image Enhancement

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Abstract - *Unlike normal images, under water images are subjected to poor visibility, which results from attenuation of propagated light mainly because of absorption and scattering. Thus effective techniques are used to enhanced the original images which are captured in under water. Here under water image enhancement uses two principles i.e, white balanced and multi scale fusion processing. Both can give a better enhanced image. White balance concentrates on color correction mainly depends on color depth and regions, where as fusion processing concentrates on edge detection and helps in retaining the details of an input image. This method is an effective approach which is able to remove the blurriness and enhance image by using single input image. By selecting suitable weight maps and inputs, our multi scale fusion based technique will able to effectively enhance the under water images. Main advantages are high quality when compared to existing methods and less complexity i.e, doesn't require any additional information than single input image.*

Key Words: Under water image, fusion process, White balancing., Edge detection.

1. INTRODUCTION

Under water atmosphere provides many rare attractions like marine, fishes, landscape and so on. Excluding this, under water image processing is significant for various other branches of technology, for scientific research such as for under water vehicle control and various several applications.

Unlike normal images, under water images are subjected to poor visibility, which results from attenuation of propagated light mainly because of absorption and scattering. Thus effective techniques are used to enhanced the original images which are captured in under water and the images that are degraded into scattering and absorption.

Many techniques are used for image processing and few techniques are gamma correction and histogram equalization can used to enhance the images but there are limited for where propagated of light is less.

In contrast with that in this technique here under water image enhancement uses two principles i.e, white balanced and multi scale fusion processing. Both can give a better enhanced image. White balance concentrates on color correction mainly depends on color depth and regions and where fusion processing concentrates on edge detection and helps in retaining the details of an image captured.

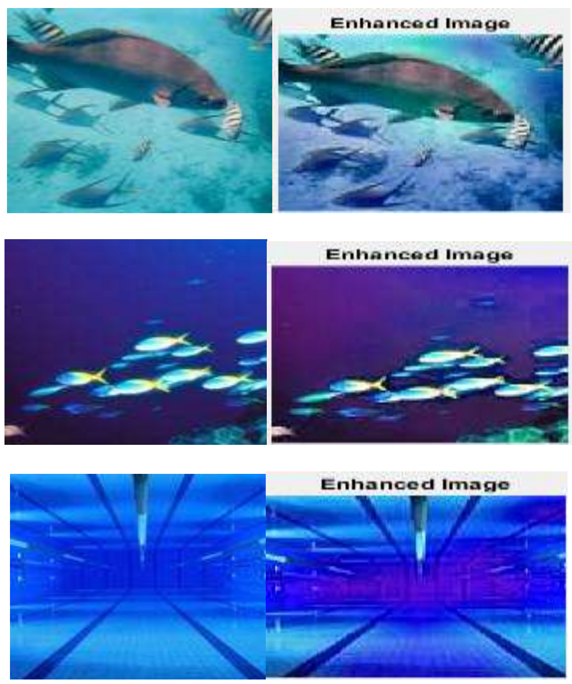
Here input image is fed and it undergoes first image processing technique i.e, white balancing after white balancing is performed and image is enhanced depending on the further requirement it is either gamma corrected or sharpening is done and the image can go through a multi scale fusion process then finally an output image will be obtained.

Entire strategy enhance on the white balanced and multi scale fusion process, it does not require any additional information or processing rather than a single input image.

2. EXISTING METHOD

Here surveys the principles and evaluated the methods that had considered to enhance the input images.

Existing under water color image enhancement techniques are Single image haze removal using



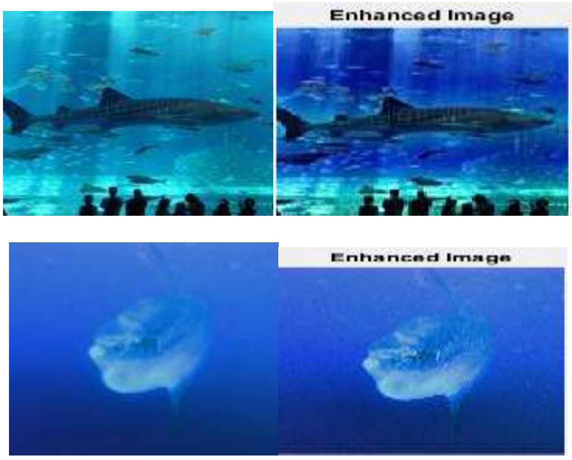


Fig-1: Output enhanced images of the existing method with under water input images.

dark channel priori[4], super resolution by descattering and fusion[3], Under water image enhancement using improved multi scale retinex and histogram linear quantification, spectral based under water image color correction method.

In dark channel priori[4], enhance the captured input images but it is not able to retain the color cast and also cannot restore the most significant features of the input images.

In existing image enhancement techniques, having light scattering and attenuation compensating method, color correcting based method but these algorithms required many number of input image frames and cause high computation time. So, proposed a retinex technique, it can able to balance in various aspects such as dynamic range, significant features of the input image and color maintenance. But from single retinex technique we can obtain either high dynamic range or low dynamic range but cannot obtain both at simultaneously. The multi scale retinex technique can be used to enhance the significant features of the input image. The effective multi scale homomorphic filter used to obtain haze removing and histogram linear quantification is used to balance the color cast and obtain effective color consistency.

The spectral based under water image color correction method is simple to estimate the transmission weight map and has the advantage of preserving the edges, eliminating unwanted noise and reduce in time consuming. The other contribution compensated the transmission by weighted guided median filter, it have the advantages of preserving the edges, eliminating the unwanted noise and reduced time consuming. However the implemented spectral based under water image color correction technique effectively generated colorful under water distorted images which are superior than the state of art techniques.

In interpolation, it is used to improve the resolution of a low resolution image. But noise and scattering images are implemented ineffectively during interpolation. However, interpolation can produce blurring and artifacts and it is also cannot reconstruct the original details of the input image.

The super resolution technique[3] is used to enhance the resolution of an image rapidly. The super resolution techniques are divided by two principles based on the inputs. There are multi input and single input. In multi input super resolution, the HRI is obtain by utilizing information from the large amount of subpixel shifted LRI of the similar input image. The important step is to estimate the motion of the input details correctly. But it is difficult to focus on motions from multiple low resolution images effectively. The single image SR is also called learning based technique. The advantage of this technique is, it doesnot require a motion of low resolution images. In this technique, every patch of LRI is compared with low resolution database in order to get the similar low resolution patches.

Depending on training database, the single input super resolution technique can be further categorize into two principles. There are external and internal database. This algorithm starts with descattering and then color correction. The performance analysis for image super resolution and descattering can be measured by PSNR and SSIM.

Table-1: Existing method results

Input img.	MSE	PSNR	SSIM
S 1	1.8536e+04	5.4505	0.00032
S 2	1.1371e+04	7.5728	0.00034
S 3	5.2722e+03	10.9109	0.0004
S 4	8.1182e+03	9.0362	0.00013
S 5	7.6122e+03	9.3157	0.0002

3. IMPLEMENTED METHOD

In this implemented technique, we are using multi scale fusion which is used to enhance the input images effectively without loosing the significant details of an input image.

From the flow chart which is shown in fig 2. States that, take an input image and fed into white balanced technique for to balanced the all the primary colors i.e, red, green and blue. Then obtained the 2 images named input image1 and input image2. The input image1 is the output of the white balance image and then input image2 is the difference of original input image and the output of white balance image. The input image1 is mainly undergoes for color correction and input image2 is obtained as unsharp image. To the input image1 we have to apply the gamma correction which helps us further difference between the darker regions and the brighter regions of an image. However the details are lost in this output image. Further corrected with the help of the input image 2.The input image 2 obtained as unsharpen made to obtain sharp image by apply sharpenning use to produce a highly enhanced fusion image.

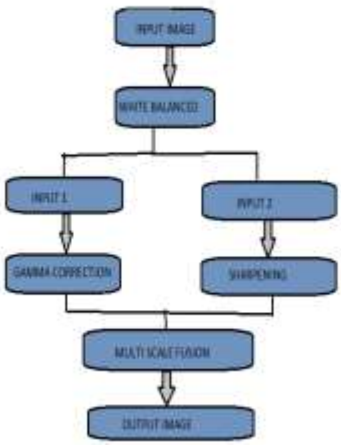


Fig-2: Flow chart

output of white balanced image. The input image1 is mainly undergoes for color correction and input image2 is obtained as unsharp image. To the input image1 we have to apply the gamma correction which helps us further difference between the darker regions and the brighter regions of an image. However the details are lost in this output image. Further corrected with the help of the input image2.The input image2 obtained as unsharpen made to obtain sharp image by apply sharpenning use to produce a highly enhanced fusion image.

3.1. White Balanced Technique

Take image as an input from the specified database[1] which having group of images with same size.

Color balancing used for color correction induced by scattering for to obtain natural atmosphere of under water images.

There are three main components in under water medium.

[1] Direct component- Light will directly reflected by object.

[2] Forward scattering- A random deviation of light requires near to the camera lens.

[3] Back scattering- It is because of flash that beats water particles and it reflects back to camera lens.

The existing techniques for color balancing are Gray world algorithm, from this obtained average reflectance in the image. Max RGB, from this obtained maximum representative of each channel. But these techniques are failed to remove the entire color cast.

So, implemented the white balancing technique, it is mainly concentrates on compensating the color cast or color depth region for ensuring color correction.

Algorithm:

→Take captured under water image as an input, this fed to white balancing.

→Generally, green color is well protect in under water environment.

→So, by using green channel we have to extract the red and blue channels at every pixel location of an image.

→For red color, Irc at each pixel location(x)

$Irc(x)= Ir(x) + \alpha [Ig(x) - Ir(x)][1- Ir(x)] . Ig(x)$

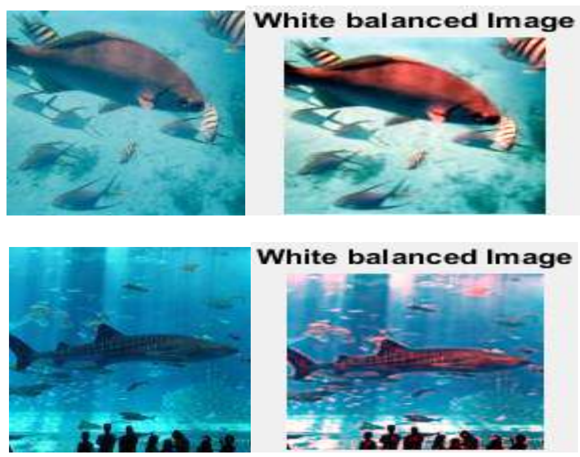
→For blue channel, Ibc at each pixel location(x)

$Ibc(x)= Ib(x) + \alpha [Ig(x) - Ib(x)][1- Ib(x)] . Ig(x)$

The normalized image rate will be in the range of [0,1].

White balancing is indicating that describes the effective of white color that is obtained on mixing the primary colours i.e, R,G,B.So, white color is the standard one to recover color cast.

This technique will remove the unwanted color cast which is accurate by the light scattering and obtained a natural atmosphere of under water image.



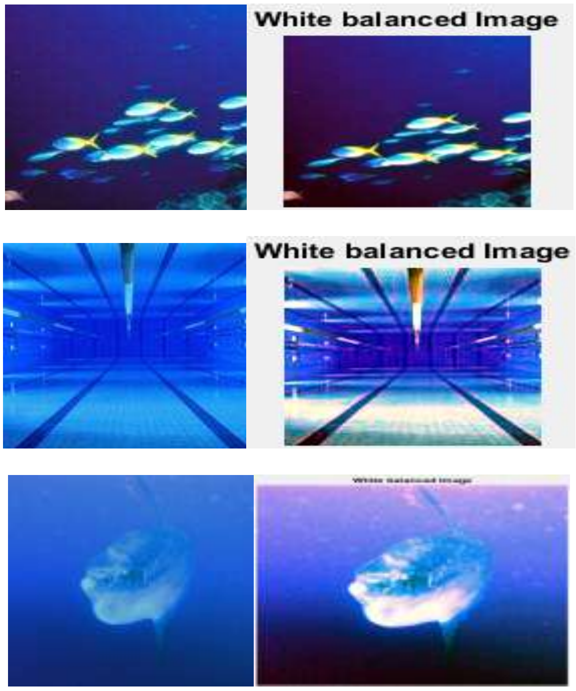


Fig-3: Input images with white balanced output images.

3.2. Multi Scale Fusion

Multi sacle fusion, mainly concentrates on edge detection and helps in retaining the details of an input image.

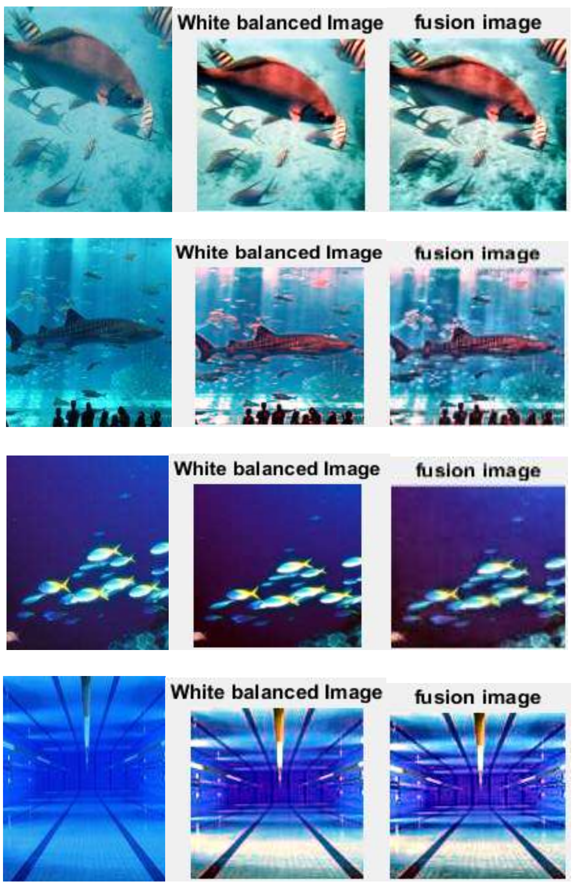


Fig-4: Input images with white balanced output images and enhanced images.

Algorithm:

→Every input is decomposed in pyramid by applying laplacian operators at various levels.

→likewise, for every normalized weight map a gaussian pyramid is determined.

→Considering the both laplacian and gaussian pyramids have similar number of levels.

→By mixing between laplacian inputs and gaussian normalized weights are executed at every level independently provides the fused pyramid.

→The reconstructed image,

$$Rl(x)= \sum_{k=1}^{K} Gl(x) \{ Wk(x) \} Ll(x) \{ Ik(x) \}$$

l→ pyramid levels, k→ no. Of I/p images

Initially performs the white balancing to the input image which is obtained from the specified data base. The input image1 will performs the gamma correction for correcting the global contrast. This will improves the difference between darker or lighter regions with improper features in under exposed regions. To compute these improper we have to derive the input image2. Here we have obtained the unsharpen image, made to obtain the sharp image by sharpening. The input image2 is the difference between the output of white balancing image and original image. Then calculate the normalized weights to these and apply the laplacian and gaussian pyramids. Both the pyramids must have the same levels.

The pyramid represents the decompose of an image into addition of band pass images. Every level of an pyramid will filtered original image by utilizing a low pass gaussian kernel and produce filtered image by a factor of 2 in the both directions.

Then, reconstructed image will obtained by mixing the laplacian and gaussian normalized weights at every level.

Then, performance analysis of this technique is discussed in experimental results.

4. EXPERIMENTAL RESULTS

The performance analysis of the white balance and multi scale fusion for under water image enhancement are discussed below.

We have many performance metrics for measuring the quality of an enhanced images. Here we are measuring the performance metrics of output enhanced images for white balanced and multi scale fusion for under water image enhancement are mean square error(MSE), PSNR and SSIM.

Mean square error(MSE) can be measured by using,

$$MSE= \frac{\sum_{M,N} [i1(m,n) - i2(m,n)].\hat{}2}{M,N}$$

Peak signal to noise ratio(PSNR) can be measured by using,

PSNR=10*[log(R*R)/MSE]/log(10)

Where,

R=1, for double precision floating point data type.

R= 255, for 8-bit unsigned integer data type.

The highest value of PSNR then obtained the high quality of an enhanced image.

Structural similarity index measurement(SSIM) can be measured by using,

SSIM(x,y) =[I(x,y).^α . C(x,y).^β . S(x,y).^r]

The range of the SSIM will be 0 to 1.

Table-2: Multi scale fusion results with different input images.

Input img.	MSE	PSNR	SSIM
S 1	1.6631e+03	15.9217	0.6811
S 2	2.9256e+03	13.4686	0.6749
S 3	294.1629	23.4449	0.8615
S 4	4.3423e+03	11.7536	0.6534
S 5	2.3383e+03	14.4418	0.6661

5. CONCLUSIONS

We have various under water image enhancing techniques but they have some limitations, where they cannot reconstruct original edges of an input image and also cannot reduce the noise effectively. So, implemented an effective technique i.e, multi scale fusion to enhance the under water images. In this technique impleme -nted based on the fusion principle and doesnot require any other information than single input image. From the experimental results, this technique is able to enhance the under water images with effective quality, will able to retain the most significant details and edges effectively.

From this we are implementing the data hiding to the under water images. Data hiding process inserts data into digital media for the purpose of security. Digital image is one of the desirable media to store data. It produce large amount for hiding secrete details which results into stego-image unnoticeable to human vision, a unprecedented steganographic technique established on the data hiding technique i.e, pixel value differencing.

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