Underwater Image Enhancement using Color Balance & Fusion Method

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Abstract

The underwater satellite photos are improved utilizing specific image enhancement technologies. This gives you a one-of-a-kind way to figure out what is actually in the picture. Because white is more induced in underwater photographs, the approach utilized to balance white color in the image. Due to processing effects, the outcome of this method is a fusion of the two pictures, one of which includes original weight maps and the other as related weight maps. As a result, it delivers a qualitative and quantitative assessment that indicates an improved image of the process when exposed to dark regions, with improved color contrast and edge sharpness.

As a result of our suggested algorithm's independence from changes in satellite (camera) settings used to acquire underwater photos, the sharpened image's accuracy improves compared to the original input. As a result, this simulator may be used in segmentation and key matching. The improved results are obtained by calculating the per-pixel weight sum of the two inputs. Because we do not employ de-convolution, the technique reduces execution time and may successfully enhance the underwater image (computationally expensive). The results of the experiments show that our technology can produce high visual quality.

Keywords Underwater Images, white balancing, color contrast, edge sharpening.

1 Introduction

Underwater image processing is a prominent area of digital image processing used in various applications. They are monitoring marine environments, for example. In the sphere of engineering, it also makes pipeline inspection easier. Underwater imaging is a complex field because of the physical features of the underwater environment. They are mainly concerned with light dispersion and absorption. Underwater photos lose contrast and suffer deterioration due to low visibility circumstances and processes such as light absorption, reflection, bending, and light scattering.

According to recent research, underwater image processing has emerged as a viable topic of digital image processing. The approaches for underwater picture enhancement are briefly covered in the next section. The remainder of the study is divided into two sections: performance examination of several Histogram equalization approaches and our suggested Color Balance method for underwater picture improvement Experimental findings for approaches with our suggested Color Balance method.

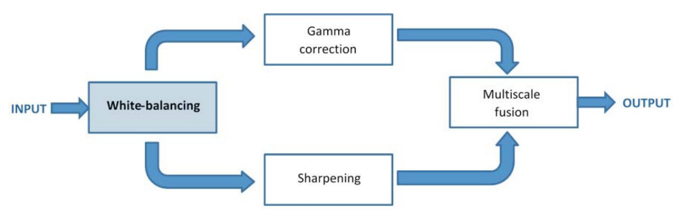

Figure 1: *Overview of the method: two images are generated from a white balanced version of a single input & fused using a multi-scale fusion process.*

This work provides a fusion-based technique for improving underwater image quality with little complexity and excellent efficiency. This procedure includes three crucial steps: The first step is to figure out how to provide acceptable inputs. Second, choose appropriate weight maps. In a nutshell, the background facts and related algorithms are presented.

2 Methodology

We adopt a single image-based technique based on the fusion concept in this approach. This is an easy and quick method for increasing the visibility of underwater photos.

Despite the lack of specialist optical models, the considered weights and defined inputs were carefully chosen to overcome the limitations of such situations. Two inputs are used to process the original picture. The image is first processed, and the white balance is set. The weights are then applied to this image, followed by the fusion of the weighted images that result. The second input processes the image in the same way. The two resulting photos are then fused to provide a superior image.

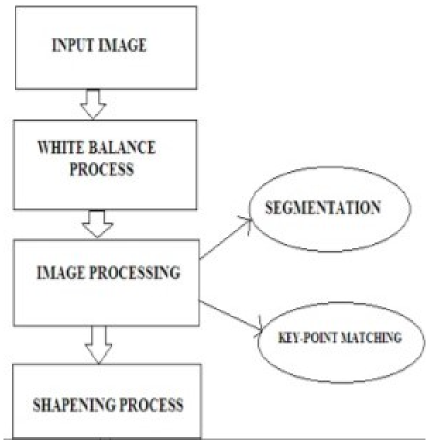

Figure 2: *Block diagram of our system*

Light absorption and scattering cause portion of the light of shorter wavelengths to scatter, while the balance of the light of other wavelengths will traverse the medium due to the varying wavelengths of light. The colour will eventually be skewed as a result of this. Simultaneously, light absorption reduces the intensity of light. As a result, white balancing is required to recreate natural light. This prepares the image for the next phase of image enhancement by reducing the considerable discrepancy between the brightness values. As a consequence, the first input is obtained.

2.1 White balancing algorithm

White balance (WB) is a photographic method for removing false colour casts so that things that are white in real life seem white in your shot. When white balancing a camera, the "colour temperature" of a light source, which refers to the warmth or redness (relative) or coolness or bluish (relative) of white light, has to be taken into account.

Although human eyes are significantly better at distinguishing white under various light sources, auto white balance (AWB) on digital cameras can be unnecessarily complex, resulting in unappealing orange, blue,or even green colour casts. Understanding digital white balance can help you avoid colour casts and recover your photographs in a wider variety of lighting situations..

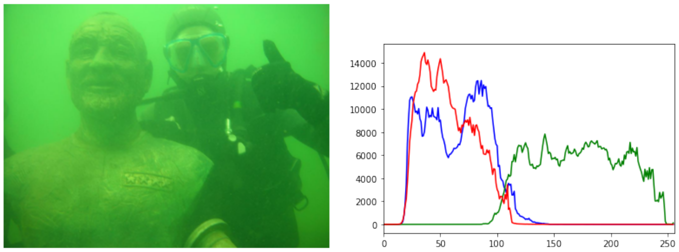

Figure 3: *(i)Underwater image. (ii)Color channel histogram of the image*

White balance is a necessary procedure that tries to improve the look of a picture by removing undesirable color casts.

White balance is a term that may be used to describe the precision with which a white color can be created by combining three primary colors: red (R), green (G), and blue (B).

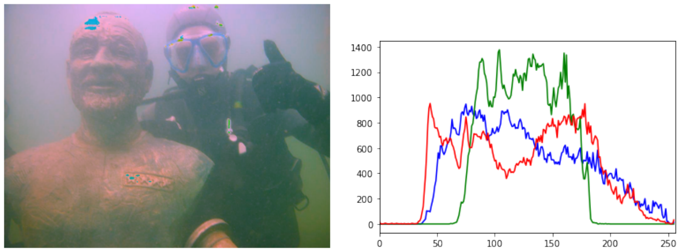

Figure 4: *(i)White balancing of underwater image and applying DCP in that result. (ii)Resultant color channel histogram*

As a result, we utilize white as the standard to restore color offset. Images will have their brightness values adjusted and compressed between [0, 1]. µI = 0.5 + _µref.

To account for the observations made above, we suggest expressing the compensated red channel Irc at every pixel location (x) as follows:

$$Irc(x) = Ir(x) + \alpha.(Ig' - Ir').(1 - Ir(x)).Ig(x) \quad (1)$$

where I(r) and I(g) signify the reddish and greenish colour channels of image I, respectively, with each channel lying within the range [0, 1] after being normalised to the higher limit of the dynamic range of them; and also I(r') and I(g') imply the average value of I(r) and I(g), respectively. Each element in the 2nd present term in Equation 1 is a direct outcome of one of the previous facts, and alpha is a constant parameter. what we've found in practise is that the value of alpha = 1 is suitable for a variety of lighting circumstances and acquisition settings.

This phase will successfully eliminate the significant discrepancy in brightness values and prepare the image for the following image-enhancing stage.

2.1.1 Segmentation (or Gamma Correction)

The purpose of doing the process of segmentation is for transformation and change a picture's portrayal into something more understandable and inspect-able. Image segmentation is a technique for identifying boundaries and objects in photographs (presence of curves, lines, and so on).

Picture segmentation, in other terms, is the process of labelling each pixel which is present in the image so that pixels which are having the same label have comparable characteristics. Picture segmentation can provide a collection of contours taken from the picture (see edge detection) or a number of segments that encompass the full image. In terms of some characteristic or calculated trait, such as colour, intensity, or texture, each pixel in a region is comparable. Adjacent areas are substantially different in terms of the same feature. (s))

2.1.2 Sharpening

A mix of resolution and acutance determines sharpness. The resolution is objective and not subjective. It is merely the picture file's dimensions in pixels. The greater the resolution of an image—the more pixels it contains—the sharper it may be, all other circumstances being equal. Acutance is a little more challenging to understand. It is a subjective measurement of edge contrast. There is no unit for acutance; you either presume or believe that an edge has contrast. To the human visual system, edges with higher contrast appear to have a more defined edge. Sharpness refers to how distinct an image's features are, particularly minute details.

Sharpening your image has three purposes: to eliminate blurring caused by camera equipment, bring attention to specific regions, and improve readability. RAW dadta from any modern camera is always little unsharp. Blur is added into the picture capturing process at every stage. When light passes through the lens elements, some definition is lost, no matter how precisely constructed they are. As the sensor analyses the photons that fall on it, the sharpest transitions are averaged out and softened slightly.

3 Results

The input image is chosen from the database folder containing all of the reference images. Following the selection of this image, the white balancing procedure begins. White balancing is the process of balancing the white and grey colour tendencies in the input. This image has been white balanced for image processing. This is made up of two techniques: segmentation and key point matching. The segmentation process eliminates extraneous characteristics from the image, leaving just the outline of the organisms (both live and non-living). One of the strategies in feature extraction that finds the distinctive spots in a picture is key point matching.

Following that, the image is sharpened using features that were enhanced during the sharpening process. The fused image sample of the input image and the sharpened image are taken to get the final output. The multi-scale fusion is based on the *Laplacian pyramid*, which decomposes an image into a sum of images, and it is applied to these images. As a result, a fused image with clear visibility of the input image is obtained as an output.

Figure 5: *Result of our underwater image enhancement technique. (L) Original underwater image. (R) Enhanced underwater image.*

4 Discussion

The residual energy ratios of various colour channels present in the background light are used to determine the water depth inside the imaging scene. Although the results of this paper show more realistic colours and crisper details, there must be some estimating mistake. Overall, our approach is able to highlight details without creating colour distortion, and numerous contrastive experiments have shown its usefulness. As a result, the visual effects are improved. Furthermore, the suggested algorithm provides a significant computational efficiency gain. Moreover, this technology requires minimal processing resources and is highly suited for real-time surveillance and underwater navigation. Even while the method, like the previous methods, performs well in general, it has a drawback when the images are characterised by non-homogeneous material in the water.

5 Applications

- Forensic department
- Military applications
- The text in the entries may be of any length.
- Water based investigation. E.g.: Research in titanic.

6 Advantages

- This process is good for the removing a small amount image source and more amount noise.
- Corrects image density and contrast.
- The text in the entries may be of any length.
- Helps to easily store and retrieve in fused form of image
- Image available in any form could be recovered and enhanced by white balancing using Gaussian filter.
- Suitable for complex tasks.

Conclusions

The input image is chosen from the database folder containing all the reference images. Following the selection of this photograph, the white balancing procedure begins. White balancing is the act of balancing the white and grey color tendencies in the input. This picture has been white-balanced for image processing. This is made up of two techniques: segmentation and keypoint matching. The segmentation process eliminates extraneous characteristics from the image, leaving just the outline of the organisms (both live and non-living). One of the strategies in feature extraction that finds the distinctive spots in a picture is keypoint matching. After that, the image is sharpened using enhanced characteristics throughout the image sharpening procedure.

The fused image sample of the input picture and the sharpened image produce the final output. The multi-scale fusion is based on the Laplacian pyramid, which decomposes a picture into a sum of images regarding these images. As a result, a fused picture with a clear view of the input image is obtained.

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