Underwater Image restoration using White balance mapping technique with Custom filter

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Abstract: Underwater image enhancement and restoration is a field of active research area. Enhancement and restoration techniques are used to reestablish the information which is affected by colour casting and suffer from poor visibility and lack of contrast and image content in underwater images for human viewing. The challenges of underwater photography are distortion of image clarity by skew, color imbalance, diffraction & refraction, motion blur etc.

To overcome these problems, a highly effective & efficient hybrid technique for de-skewing, denoising & de-blurring of underwater images is presented here. Intensity & color correction are provided using image contrast adjustment & histogram equalization. Noise removal is achieved using median, wiener and custom filter. Three de-blurring methods are employed viz blind, motion & Gaussian, using total variation least square method. Deskew is provided using background & white balance mapping techniques. A single tool for restoration & enhancement of underwater images using combination of various operations viz color & contrast enhancement, de-blurring, deskewing & noise removal is presented.

Index terms: weiner filtering, median filtering, Wavelength compensation, Contrast Limited Adaptive Histogram Equalization (CLAHE), white balancing etc.

I. INTRODUCTION

Photography under the water describes the procedure of taking photographs of underwater subjects while camera is also submerged underwater. Generally it is done while scuba diving, on the other hand it is also possible while plunging on the surface, snorkeling, swimming, remotely operated underwater vehicle, or from computerized cameras brought down from the surface. Be that as it may, object recognition during underwater activities is a new challenge. Creatures, for example, fish and marine warm blooded animals are ordered subjects; however, picture takers additionally seek after wrecks, scenes, spineless creatures, kelp, land highlights, and representations of kindred jumpers [1].

Few type of cameras which are used for underwater image capturing, including present day waterproof computerized cameras. The primary land and/or water capable camera was the Calypso, reintroduced as the Nikonos in 1963.

Underwater strobe

Figure 1: (a) Underwater strobe, (b) Backscatter reduction, (c) Balancing Artificial Light and Ambient, (d) providing 100% flash

Underwater photography has the majority of the issues to be perceived and the many of them can also be address Loss of light, Loss of color, Loss of contrast, Density, Refraction, Amplification, Flooding Last but not least, water is continually working to cause innumerable issues. As though its capacity to twist light, lessen points and retain hues isn't sufficient, it is likewise attempting to get into your camera which is unpleasant for underwater photography [8]. The underwater images which are captured have poor visibility and quality. So the improvement of the visibility and quality is necessary. There are numerous fields such as plant inspection, exploration of seabed's and search for natural resources, where underwater image processing is applicable. The poor visibility prevents the exploration of the seabeds.

II. REVIEW

Vivek Malik et.al [7] utilize the CODE V optical recreation programming to imitate underwater conditions and model the imaging stage, in this manner examining different parameters, for example, PSF and MTF, and we utilize the PSF to expel the underwater turbidity. **Sankalp Thakur et.al [9]** proposed a preprocessing method in view of picture to enhance the nature of underwater computerized pictures. The blended Contrast Limited Adaptive Histogram Equalization (CLAHE) has really disregarded the use of L*A*B shading picture space to enhance the picture in a successful way. Additionally, the uneven enlightenment issue is likewise overlooked by numerous analysts. **Pujiono et.al [10]** proposed to determine the different issues of existing strategies another picture upgrade procedure in view of CLAHE and L*A*B shading space is displayed in this examination paper. To beat the issue of the uneven brightening in the CLAHE yield picture has been expelled by using the picture upgrade slope minimumd smoothing. The key thought of the proposed system is to upgrade the precision of the distinctive underwater picture improvement techniques. **S. Anandalatchoumy et.al [16]** paper deal with the different commotions like Gaussian, Salt and pepper, Poisson and Speckle clamor which is denoised by various channels Median, Mean (Average channel), Wiener channel, Haar Filter and Gaussian channel. **Seongwon Han et.al [17]** In this paper, a similar report between two picture combination calculation in view of PCA and

DWT is completed in underwater picture area. **Sowmyashree M S1 et.al [18]** explained the proposed strategy centers the examination with ICM and UCM. Subjective and quantitative assessments demonstrate that the proposed strategy beats the techniques for ICM (Iqbal et al. 2007) and UCM (Iqbal et al. 2010) which are beforehand proposed by Iqbal et al. **Ricardus Anggi Pramunedar et.al [19]** contemplated three preprocessing techniques whose object was to enhance shading and differentiation of underwater pictures and increment repeatability of descriptors contrasted with unique pictures. We have likewise introduced some methods for measuring separations where we found that the IACE strategy and the technique proposed by Iqbal et al give nearly similar outcomes as far as calculation time and repeatability of SIFT and SURF descriptors.

III. PROPOSED METHODOLOGY

Underwater digital images are generally blurred, suffers from low Contrast, uneven illumination and color weakening. Therefore, our designed custom filter presents a technique based on pre-treatment of image which improves the quality of underwater digital images. As we go deeper into water, the color starts to disappear according to their wavelengths. For example, firstly red color will disappear, secondly the green color. Also blue color falls in shortest wavelength category and hence will travel largest path in water. The main goal of the algorithm is to improve the accuracy of underwater digital images enhancement method / technology.

To solve the existing problems of image enhancement technology based on CLAHE and L * A * B, we can use color space method. To overcome CLAHE output in the uneven lighting problems, the image has been removed by using image enhancement gradient-based smoothing. Put forward the key ideas of technology to improve the accuracy of the different underwater image enhancement method.

As degradation of underwater images occur due to skew and motion blur. These are the two main challenges posed to underwater photographers. Dynamic nature of water leads to skew problem in underwater images, as different amount of refraction is experienced by light rays. Non rigid deformation of scene is also sometime obtained due to space varying refraction. Image denoising is also an important method. Image denoising model promotes the elimination of noise while preserving the edges. Gaussian filter is used to solve thermal equation and input data is the noise image.

Following method is an attempt to restore the images deformed due to skew, motion blur and noise problems. First flow chart demonstrates the deskew flow chart , second one is the custom designed filter, and the third one is deblur flow chart.

3.1 Deskewing Using Background Detection and White Balance

Image deskew GUI flow chart is shown in figure 2. This flow chart explains step by step working of deskew GUI.

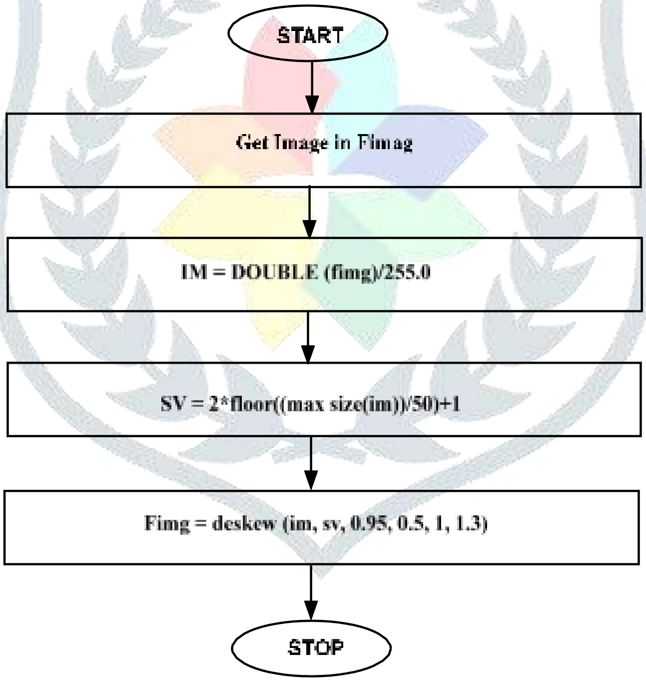

Figure 2: deskew

3.2 proposed customize filter (custom designed)

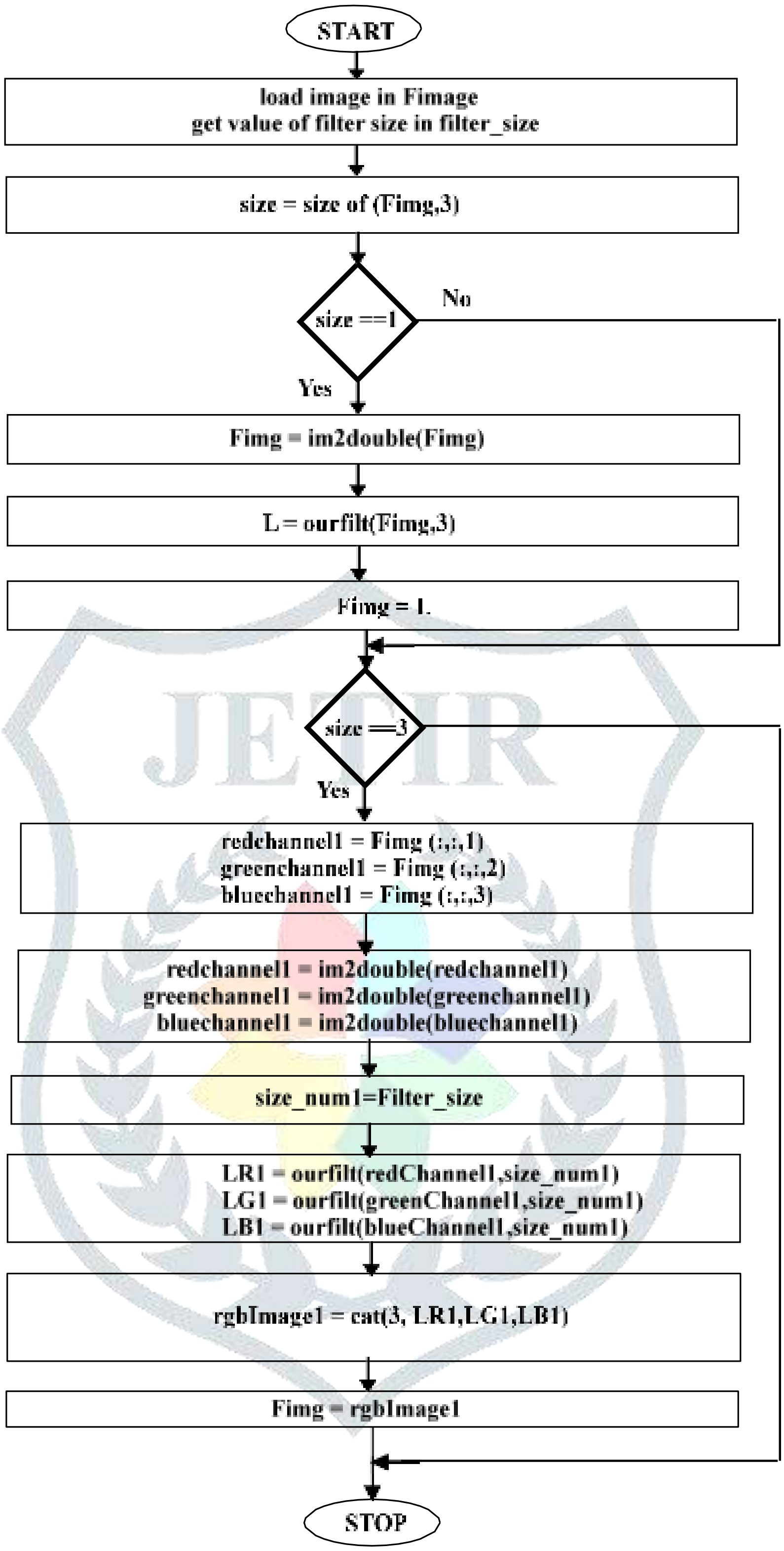

Figure 3: Custom designed filter

3.3 De-blurring Using Total Variation Constrained Least Squares Method

Image deblur blind, deblur Gaussian, deblur motion flow chart is shown in figure 4 These flow charts explain step by step working of deblur function for different operations.

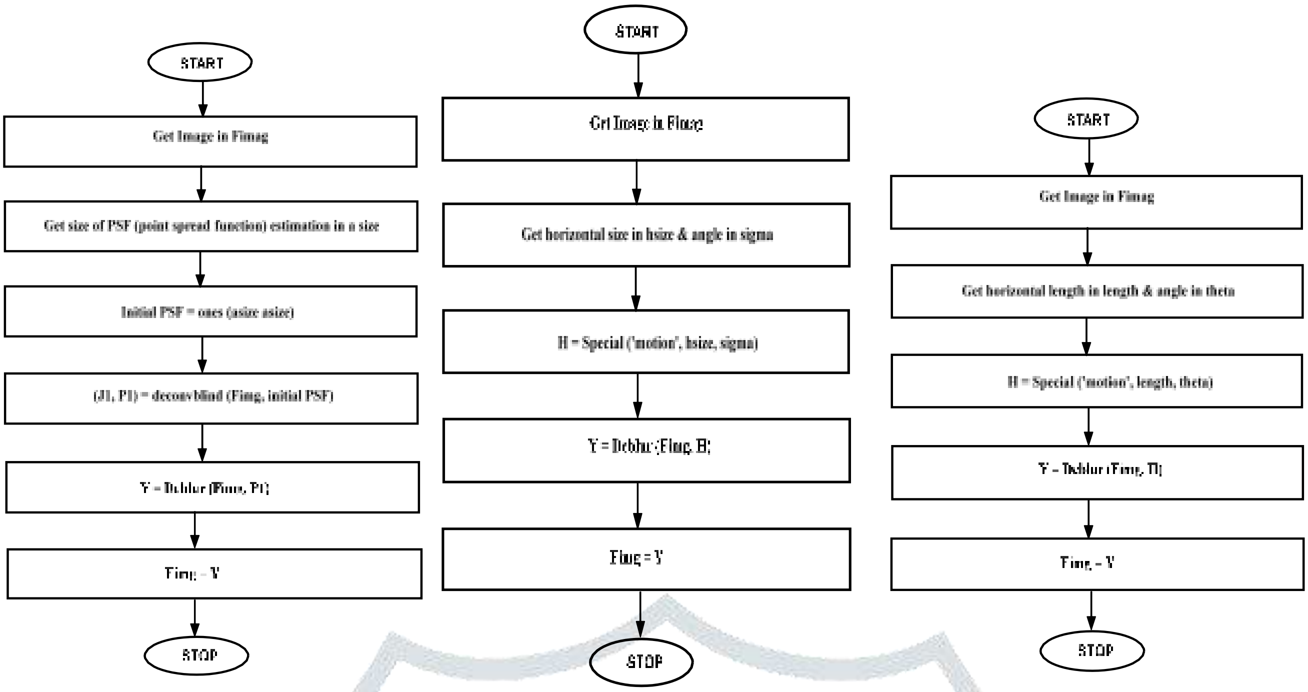

Figure 4: flow charts of Image deblur blind, deblur Gaussian, deblur motion

IV. RESULTS AND DISCUSSION

We have detected problems in some of the test images for its rectification. We have also applied corrective measures on the images that suffered from various types of underwater image degradation problems, to get the desired result. Images suffering from skew and contrast, we have solved the problem to a good extent. Blurry images are restored with the help of adaptive histogram method. Image resolution limit of images also exceeded to human viewable level.

Images identified with gaussian blur are also successfully restored in descent level. Images having motion blur are rectified with the help of deblur blind. The parameters which have been used to perform operation on images are contrast enhancement deblur, deskew and denoise. Noise removal of images are done with the help of proposed filter.

Table 1: Images used and problems identify corrective operations apply and get the results

Sr. No	Name of Image	Sample of Image	Problem Identify in image	Performed Operation on image	Result sample of Image
1	Img1		Blurry background	Adaptive histogram-0.90	
2	Img2		Contrast problem & weak Background	Adaptive histogram-0.92, proposed filter-3	
3	Img3		Skewing and contrast	Deskew, proposed filter – 3	

4	Img4		Color imbalance & contrast	Imadjust-0.88	
5	Img5		Gaussian blur	Deblur Gaussian (GF-5, SD-5), proposed filter-3	
6	Img6		Motion blur	Deblur motion	

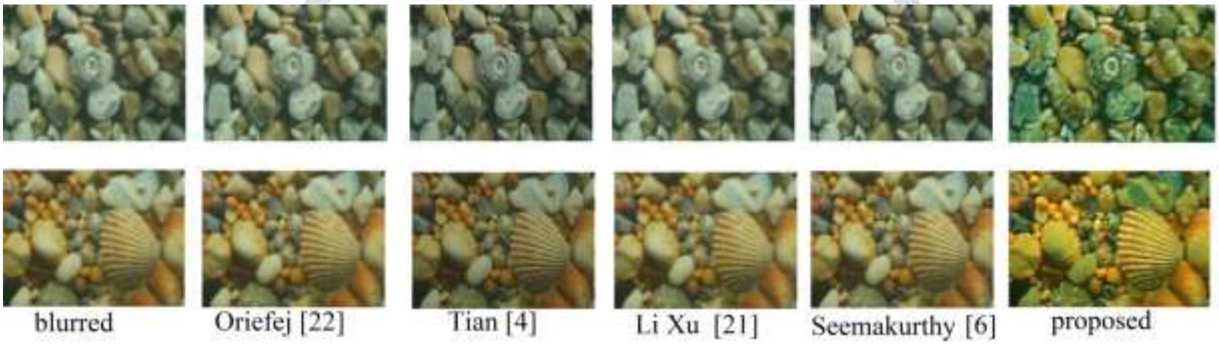

Figure 5: Result Analysis for Synthetic and Real Experiments

We have performed our methodology on the reference image of the base paper. Deskewing of underwater images by using backscatter white balance mapping technique method improved the result of signal to noise ratio values compared to base paper result and previous results. The previous results are also shown in the picture above. Pictures are characterized by various parameters; the advanced picture processing might be indicated as intricate frameworks.

V. CONCLUSION AND FUTURE SCOPE

A unique combination of various techniques to restore distorted under water image is demonstrated successfully and developed an umbrella application for deskewing, denoising, de-blurring and noise removal of underwater images is verified by results presented above. The composite tool was applied to various underwater images and claimed improvements are verified by results presented above. Various test images and various distortions were tested and the result verified the enhancement of image to a decent human viewable level. Also the custom developed filter was tested to perform well in some cases where traditional filter such as median filter and weiner filter do not produce desirable results. The result we get after the analysis of test images is increased to a good extent compared to the previous work. In comprehensive view, we have studied and implemented efficient techniques to restore distorted underwater images.

The proposed system is able to clarify images with certain degree of human perception but a lot is required to be done into this domain. One of the prime contributions can be introduction of machine learning as artificial intelligence for automated identification and rectification of distorted underwater images. Also an important aspect is to improve the image accuracy or perception by employing algorithm that process a collage of images of some area or video sequence to produce highly interleaved distortion of underwater images.

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