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Using a Fusion Algorithm for Underwater Image Enhancement, Colour Balancing, Contrast Optimisation, and Histogram Stretching

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Abstract: For the improvement and restoration of underwater photos, a fusion algorithm is suggested. Histogram stretching, contrast enhancement, and colour balancing are all done. reducing the impact of colour shift, the scalar values of the R, G, and B channels are updated to ensure that the distributions of the three channels in the histogram are consistent. An optimized contrast algorithm is used to establish the best transmittance rather than refining it as is done in dark channel prior based restoration. A histogram stretching approach based on the red channel is presented to further enhance the brightness and contrast of underwater photos. Experimental underwater photos are processed to assess the efficiency of the suggested fusion technique. Research indicates that underwater image quality has greatly improved in terms of both subjective and objective evaluation. The proposed method for processing underwater images is contrasted with a few such methods. Results of comparing show that the chosen approach has an edge over others.

I. INTRODUCTION

The undersea mission is difficult in human ocean exploration and usage the obtaining To accomplish underwater tasks including underwater item localization, marine life detection, underwater archaeology, underwater environment monitoring, underwater search and salvage, underwater maintenance, etc., analysis of underwater data is essential. An major source of underwater information is provided by underwater optical images. Sadly, underwater images captured by camera sensors are prone to degrade because of the inherent attenuation and light dispersion in water. Attenuation typically causes a hue shift, while scattering of light blurs and reduces contrast in an underwater image. Although underwater light emission's physical properties have a significant impact on underwater photographs, they are not the only phenomenon that influences underwater visibility and image quality. Advanced imaging tools like the multistate underwater laser line scan system or divergent-beam underwater Lidar imaging (UWLI) system can be used to capture high-quality underwater photos. The high cost of the equipment is the biggest barrier for users. The method of image processing is another option for obtaining high-quality underwater photos. It is differentiated by excellent effectiveness and minimal expense.

Underwater image processing has grown in popularity in recent years between those involved in underwater technologies. Underwater image processing usually involves two methods: image enhancement and restoration. The foundation for picture restoration is a physical model of the original and recovered images. A restoration procedure focuses on image degradation. Instead of the deterioration process and the physical model of imaging for image restoration, the focus of image enhancement is mostly on the augmentation of pixels of images according to some subjective qualitative criteria. When it comes to computation complexity, picture enhancing methods are typically easier and quicker than image restoration methods that use convolution and deconvolution operations. Many different underwater picture enhancing techniques have been presented during the past ten years. The use of a method created by the wavelet transform and the differential evolution algorithm was addressed by Guraksin et al. The underwater picture and video enhancement based on Retinex was presented by Tang et al.

Although being widely utilised and being able to analyse underwater photos, these enhancement algorithms have several inherent flaws. To improve images using gamma correction, a histogram with a roughly uniform distribution is obtained. Alas, the processed image can retain some of its finer characteristics. Also, the histogram peak may have too enhanced data. In deep waters, where there is significant red light attenuation, the wavelet transform typically fails to handle photos taken there.

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II. FUNDAMENTALS OF UNDERWATER IMAGING

In water and air, light propagation acts differently. There are a number of significant elements that affect the attenuation and scattering of light during its propagation through water. Light is suppressed because water has a thicker structure than air.

Visible light scatters and absorbs in water at specific wavelengths. Light scattering is caused by suspended particles in water, which also affects however much light is transmitted.

There are many different sorts of noise, such as marine snow that increases light backscattering. The light scattering is also affected by salinity and temperature. In summary, light attenuation and scattering in water are more severe than in air. As a result, optical images taken underwater are more likely to blur and have less contrast.

III. METHOD DESCRIPTION

Three methods, including a colour balance algorithm, an optimised contrast technique, and a histogram stretching algorithm based on red channe, are suggested to enhance the quality of underwater photos.

IV. PROPOSED METHODOLOGY

A. Algorithm For Color Balance

An photograph captured in a foggy atmosphere appears to be similar to one captured in an underwater setting.To deal with underwater photos, some dehazing techniques (such DCP) are used. The outcomes, however, are unsatisfactory. The primary explanation is that different settings attenuate light in different ways. The attenuations of lights with various wavelengths are virtually same in outdoor hazy conditions.

Light attenuations in aquatic environments change depending on the wavelength. shows three randomly chosen hazy pictures together with the related histograms. It is evident that the peaks, troughs, and grayscales of the histograms for the various channels (three channels for an RGB image) are extremely similar.

V. PSEUDO CODE FOR COLOR BALANCE

1) *Input:* Any degraded image from underwater.
2) *Output:* Enhanced image of the input with all balanced colours.

a) Figuring out the average value for a single channel for R, G, and B, correspondingly. The average scalar value can be found.
b) Determine the differences of single channel value dr, dg, and db by comparing m average with the average single channel values of mr, mg, and mb.
c) Move the single channel values of the three channels to a similar place in accordance with the findings of step 2 and the single channel values of the three channels.
d) Returning the processed image of the input.

VI. LITERATURE REVIEW

The field of picture enhancement has been the subject of extensive research. Iqbal et alunsupervised .'s colour restoration technique is used to enhance poor-quality photos. Munteanu and Rosa have applied GA to evolutionary algorithms for image improvement.

Outcomes are assessed by contrasting linear contrast stretching and histogram equalisation. The outcomes demonstrated that this method performs better in both subjective and objective assessments. Both the background variance and the detailed variance were computed. A colour image improvement technique based on ensemble empirical mode decomposition (EEMD) and GA is presented by Bakhtiari et al. in.

There are various classes that can be used to organise the current underwater dehazing procedures. The methods that make use of specialised hardware belongs to an important class. As an illustration, the divergent-beam underwater Lidar imaging (UWLI) system takes turbid underwater images using an optical/laser sensing method. These sophisticated acquisition systems are unfortunately exceedingly expensive and energy-intensive.

Polarization-based techniques make up a second class of techniques. These methods make use of many shots of the same scene taken at various polarisation levels by spinning a polarising filter attached to the camera. For instance, to estimate the transmission map, Schechner and Averbuch use the polarisation associated with backscattered light. Although useful for recovering far-off regions, polarisation techniques cannot be used for video collection.

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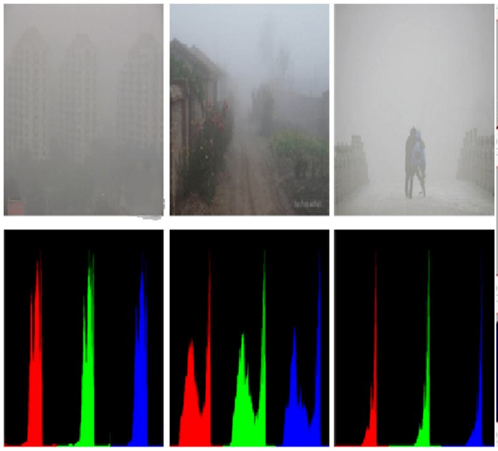
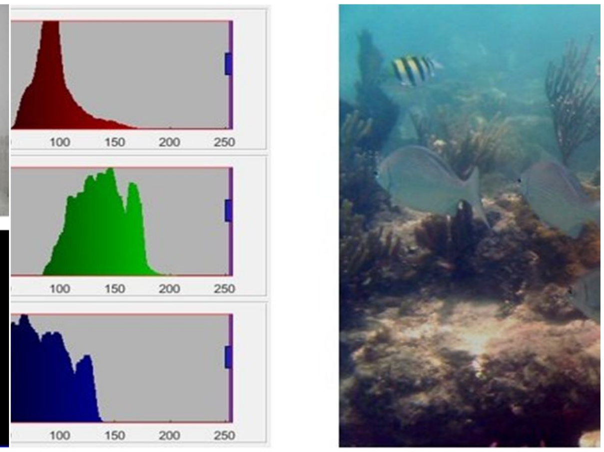
VII. RESULTS

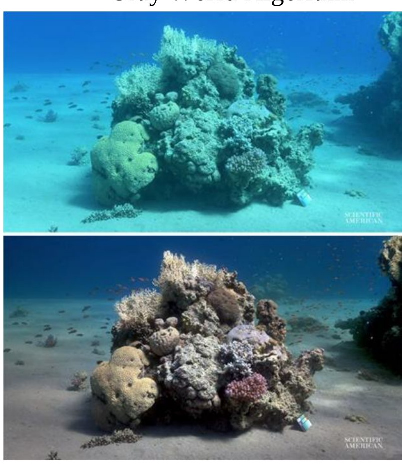
Foggy image Histogram



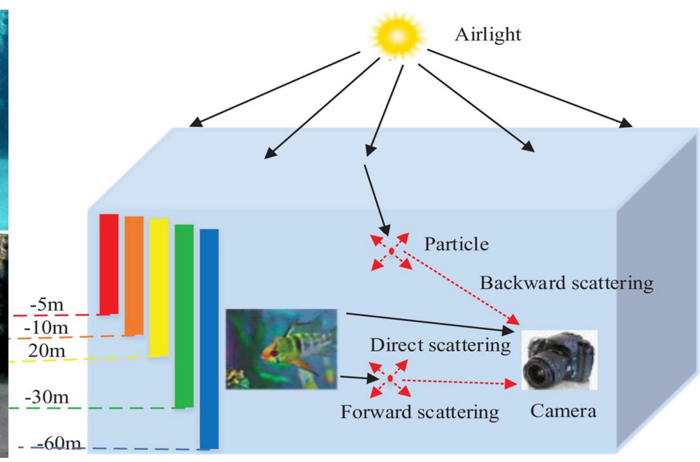
Under Water image histogram



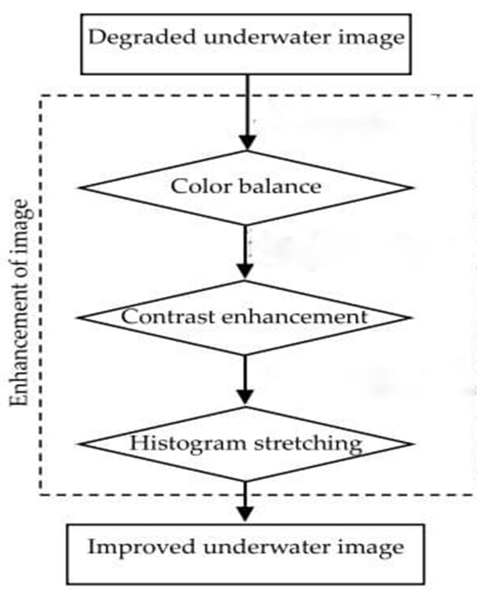
Gray World Algorithm



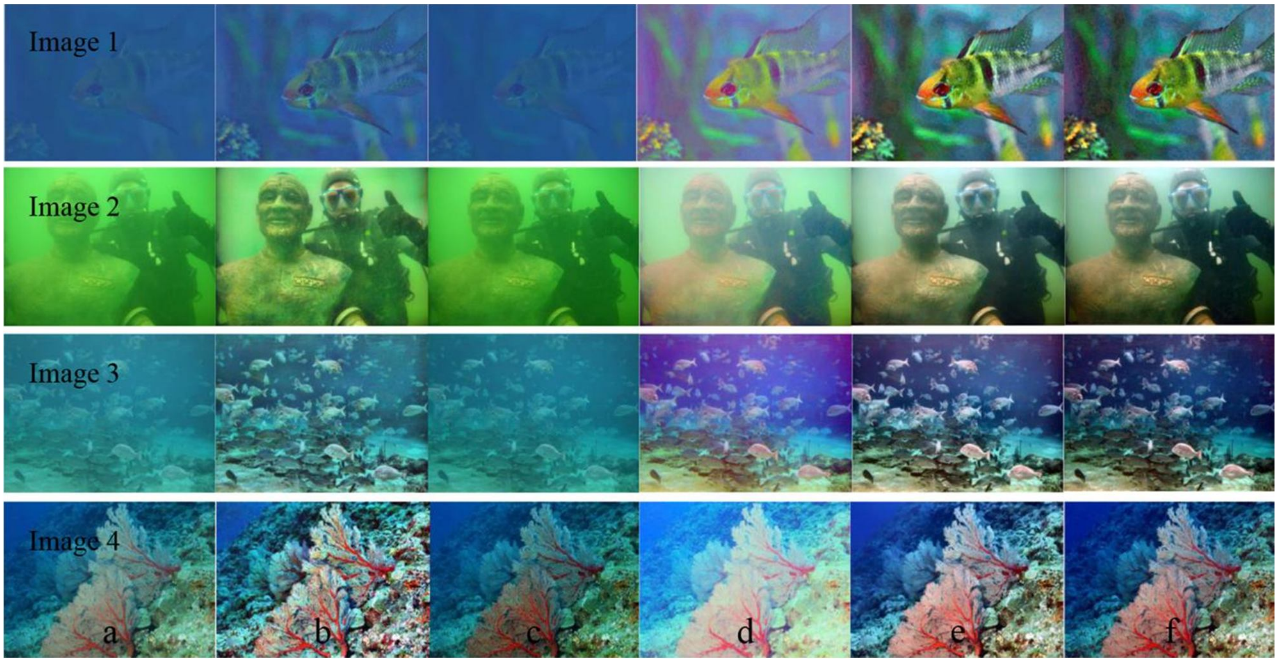
Color Correction Preview



Flow Chart of Process



Final Output



VIII. CONCLUSION

In this study, a fusion technique for underwater image restoration and enhancement is proposed, which combines colour balancing, contrast optimisation, and red-channel-based histogram stretching. A unique colour correction algorithm is suggested to correct the colour deviation of underwater photographs by comparing the histogram distribution properties of underwater images and foggy images in the air. Subsequently, image dehazing is performed using an improved contrast method.

A new histogram approach based on the red channel is suggested to enhance the contrast and clarity of underwater photos after dehazing in accordance with the features of underwater light attenuation. Underwater photos are improved by removing colour deviation, ambiguity, and enhancing contrast thanks to the proposed fusion algorithm. Experiments show how useful and adaptable the suggested approach is. The suggested algorithm is also contrasted with a few conventional algorithms, such as MSRCR, RCP, UDCP, a contemporary algorithm, GAN, and RAHIM. Comparative results demonstrate the suggested algorithm's superiority over the competition in terms of both capacity and resilience. Together with evaluating the aesthetic effects, objective measurements like RMS, UCIQE, PSNR, and SSIM are utilised to assess the benefits of the suggested fusion technique. Future research will focus on refining the real-time effectiveness of the suggested algorithm and treating image noise removal in more detail. On the basis of the recovered photos, research on underwater item detection or tracking in real-time will also be done.

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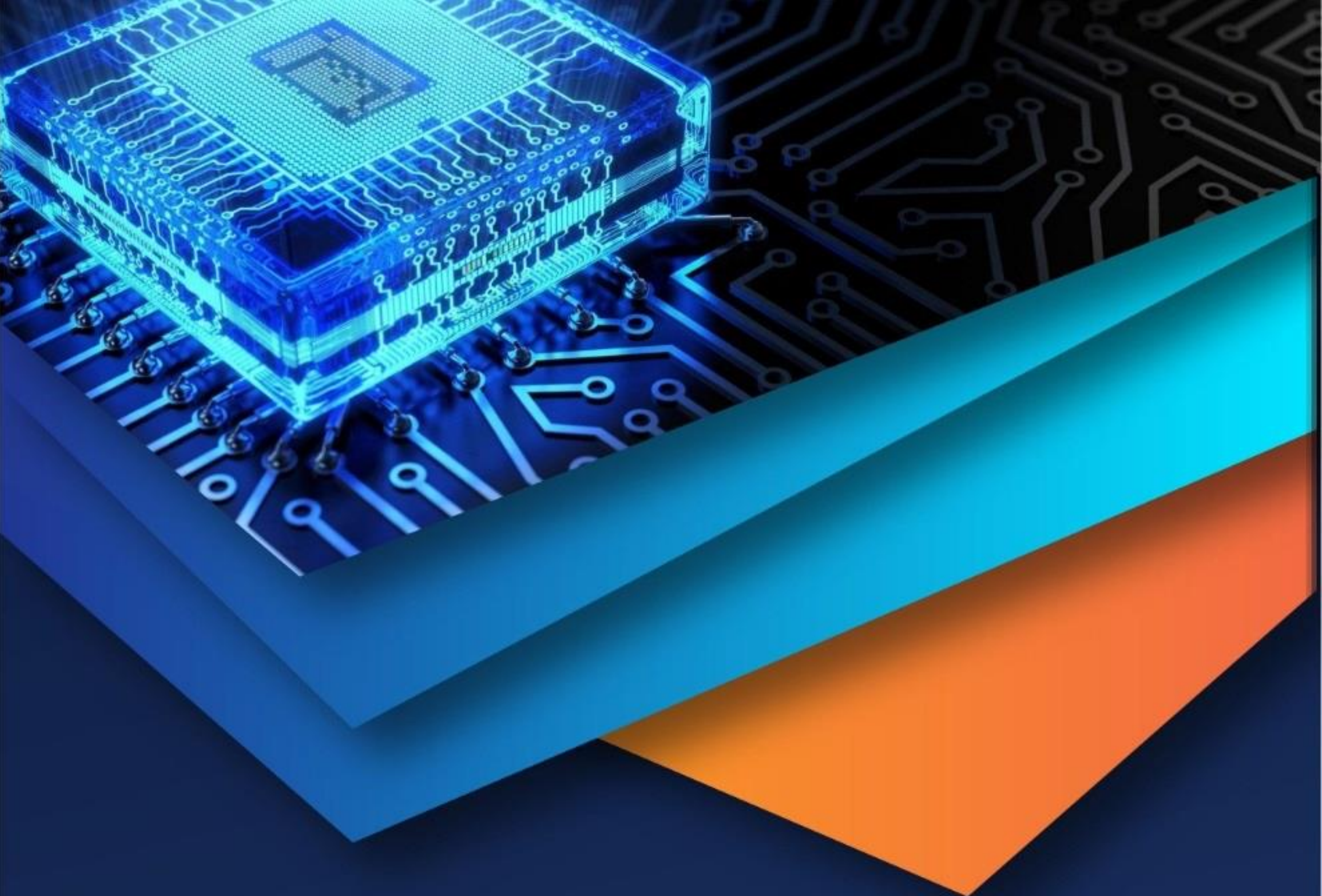

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