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Development of Underwater Image Enhancement Model using Radial and Multi Level Vector Corrections

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Abstract -Underwater scene reconstruction is the one of the prominent research area for the ocean studies. The images captured underwater is degraded due to various parameter lies within the deep water e.g. absorption of natural light by the tiny creatures, sea plants refraction due to water densities and pressure etc. The images captured underwater situations need to be restored correctly to extract more information. In this work underwater images has been taken for the experimental image restoration or enhancement. To achieve higher information from degraded image an efficient methodology has been adopted which works on different channels of the i.e. red, green and blue to separate the level of informationneed to extract precisely. The idea involves normalization of vectors for reduce the effect of blur, reflection and lighting problems followed by the light adjustments and thresholded radial correction mechanism. The experimental outcomes has been evaluated on the visibility metric CNR and entropy, and found better visibilitymetric in proposed work. The efficiency of the algorithm is also clear from the experimental results.

Keywords-Ocean photography, underwater scene, normalizing vector, thresholded radial approach, CNR, Entropy.

I. INTRODUCTION

When image are taken in turbid media such as underwater, hazy or noise conditions, the visibility of the scene is degraded significantly. This is due to the fact that the radiance of a point in the scene is directly influenced by themedium scattering. Practically, distant objects and parts of the scene suffer from poor visibility, loss of contrast and faded color. Recently, it has been seen a growing interest in restoring visibility of images altered due to such atmospheric conditions. Recovering this kind of degraded images is important for various applications such as oceanic engineering and research in marine biology, archaeology, surveillance etc.

Underwater visibility has been typically investigated by involving acoustic imaging and optical imaging systems. Acoustic sensors have the major advantage to penetrate water much easily despite of their lower spatial resolution in comparison with the optical systems. However, acoustic sensors become very large when aiming for high resolution outputs. On the other hand, optical systems despite of several shortcomings such as poor underwater visibilityhave been applied recently by analysing the physical effects of visibility degradation. Mainly, the existing techniques employ several images of the same scene registered with different states of polarization for underwater images but as well for hazy inputs. As well, dehazing techniques have been related with the underwater restoration problem but in our experiments these techniques shown limitations to tackle with this problem.

Therefore, it will be important to pre-practice these photographs ahead of exploitation usual graphic running approaches. Today before-processing strategies commonly only center on no-uniform lighting or maybe coloration rectification and quite often involve added information about the planet: equally detail, distance object/television camera or even water system choice. The protocol planned therein is a argument-cost-free criteria which usually decreases subaquatic perturbations, along with helps graphic choice without using almost any understanding and also with virtually no homo argument modification.

The effect is often a online files data compression considering that the distinction, or maybe miscalculation, image offers lower variance along with randomness, plus the reduced- cross television graphic may possibly represented with lessened taste thickness. Further info compression setting can be accomplished through quantizing the difference images. These types of actions usually are next recurring to be able to reduce the lower-pass impression. Looping on the process in properly enhanced weighing scales generates a chart information construction.

The forward-scatter component represents the light scattered forward over a small range of angles relative to the propagation direction. The forward-scatter component originates from the same scene point as the direct component, but enters the imaging device at a different angle and causes the same object point to be detected at different adjacent image points separated by a distance Yi as shown in Figure.

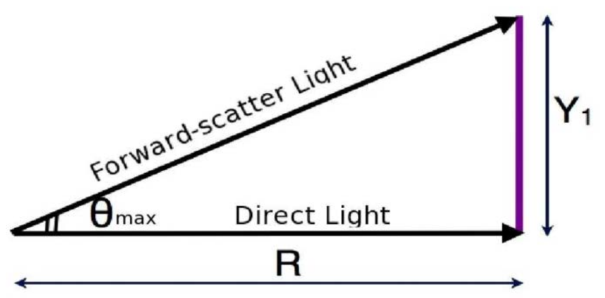


Figure 1.1 The amount of image point misplacement due to forward-scatter light is Y1. Back-scatter Component, L3

Optical back-scatter does not originate from the scene, so it does not contain any scene information. It is the scattered light from particles between the camera and scene. Optical back-scatter adds extra illumination to the image intensity. This extra intensity causes a reduction in image contrast. The optical back-scatter component is the main contribution to contrast loss.

II. Underwater Imaging

To understand why underwater images are degraded, the propagation of light in a water medium is studied. First, light scattering and extinction are explained followed by an explanation of underwater image geometry. A physical model of the three basis intensity components of underwater image are described in more detail.

- Scattering

Optical scattering happens when a light beam interacts with a particle. The level of optical scattering varies for different sizes of particles. The pattern of the scattering depends on the ratio of particle size to the light wavelength. Very small particles, such as molecules in the atmosphere, tend to scatter isotropically. This type of scattering can be explained by Rayleigh theory (McCartney 1976). When the size of particle is larger than the wavelength of visible light, the scattering pattern is more complex and is concentrated in the forward direction. The Mie theory is used to describe scattering by such particles (McCartney 1976). Figure shows the pattern of scattering for different sizes of particle.

From figure 1.2 (a) size: smaller than one tenth of the wavelength of light. (b) size: approximately one fourth the wavelength of light. (c) size: larger than the wavelength of light.

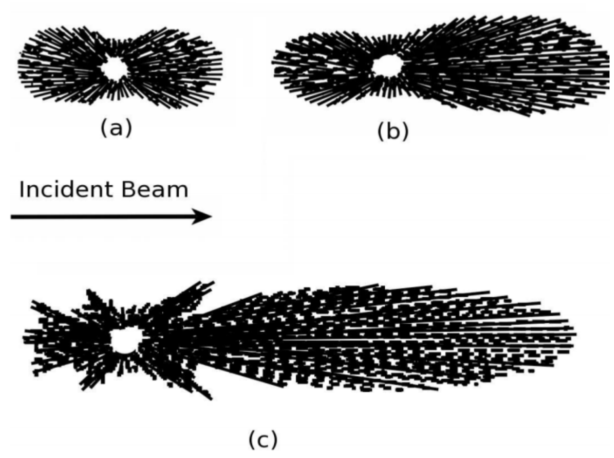


Figure 2.1Scattering pattern for different sizes of particles.

- Optical Forward Scatter

Light scattered in the same direction as the source light is known as optical forward scatter. When the particle diameter is larger than the scattering wavelength, the pattern of scattering usually shows some peaks at other angles. If the angle is small, then the phenomenon is known as small angle forward scattered in literature (Kopeika, I.Dror & Sadot 1998).

- Optical Back-scatter

The light scattered back toward the light source from suspended particles, which are between the camera and the object, is known as optical back-scatter or back-scattered light.

Underwater Image Enhancement Techniques

- Homomorphic Filtering

Homomorphic blocking is often a frequency filtering approach. These technique all of us used by correcting not for uniform miniature. It truly is promotes the particular comparison from the photograph. Homomorphic filtering provides improvement over some other tactics as it corrects not consistent easy as well as hones the advantage at the same time.

- Wavelet DE noising

In camera images along with critical photos Gaussian noise is usually provide. Gaussian sounds are definitely additional amplified by homomorphic filtering. A step involving p-noising is important in order to curb the idea. In comparison to additional delaware-noising methods rippling denoising present’s best effects.

- Contrast Stretching and Color Correction

Comparison stretch is usually often known as standardisation. This is a simple advancement technique in which comparison within the picture is improved upon through extending kids regarding high intensity ideals.

- Histogram Equalization

Histogram is defined as the statistical probability distribution of each gray level in a digital image (Balvant Singh, Ravi Shankar Mishra, Puran Gour, 2011Histogram equalization is a technique inside impression control of contrast modification while using the images histogram.

III. PROPOSED WORK

Proposed work Image restoration of underwater image isbased on a robust underwater image enhancement using multi stage normalized vector corrections and thresholded radial corrections. The block representation of proposed work has been shown in figure 3.1.The implementation of proposed work has done on Matlab.

Proposed underwater image enhancement has the following blockslisted as follows.

1. Normalizing Vectors of Image

I basically find two definition of normalization. The first one is to "cut" values too high or too low. i.e. if the image matrix has negative values one set them to zero and if the image matrix has values higher than max value one set them to max values. The second one is to linear stretch all the values in order to fit them into the interval [0, max value].

2. Adjust RGB layers

Segment image in to three layers RGB, balance each layer color properly to enhance the visualappearance of image.True color RGB images can look gray and they will have red, green, and blue channels that are all exactly the same.

3. Apply Absolute Summed Colors

Apply absolute summed color on RGB layer adjusted image.

4. Apply Normalized Vectors on Modified Image

Apply Normalized Vectors on modified color image to enhance its visual appearance.

5. Light Adjustment

Adjust brightness and contrast of imagepixels

6. Threshold Radial Correction (TRC)

It is different level thresholds as level threshold divide the entire image into different levels such as light, dark, brighter according to gray scale levels and then applied the radicalcorrection on that region differently.

The Process flow of proposed work has been shown in figure 3.2. The steps of execution of process flow aregiven in figure.

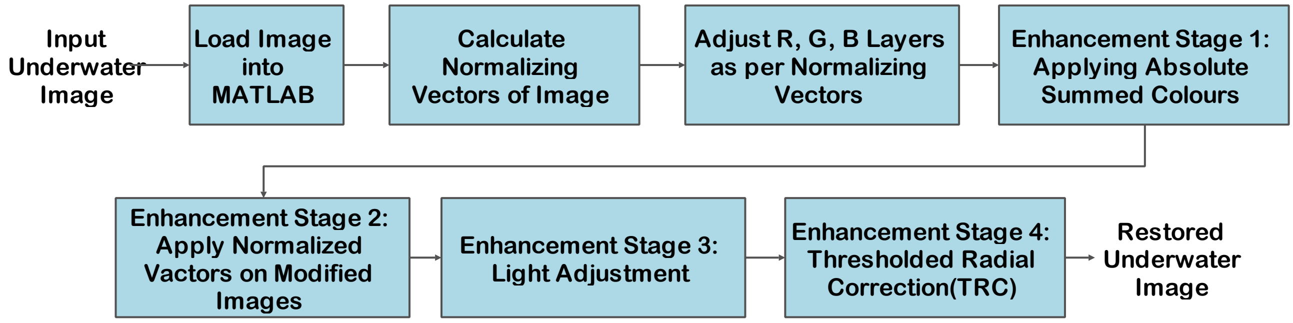


Fig.3.1 Block Diagram of proposed work.

Step:1 Start Simulation with Matlab environment

Step:2 Initialization of Enhancement Model

Step:3 Select Image need to be corrected/ enhanced

Step:4 Load Image into Matlab and Process

Step:5 Calculate Normalizing Vectors of Image

Step:6 Adjust RGB Layers as per NormalizingVectors

Step: 7 Enhancement Stage 1: Applying Absolute Summed colors

Step: 8Enhancement Stage 2 Apply normalized vectors on Modified Image

Step: 9 Enhancement Stage 3 Light Adjustment

Step: 10 Enhancement Stage 4Thresholded Radial Correction (TRC)

Step: 11 Save Enhanced Image

Step: 12 Calculate CNR and Entropy and DisplayResults.

Step: 13 End Process

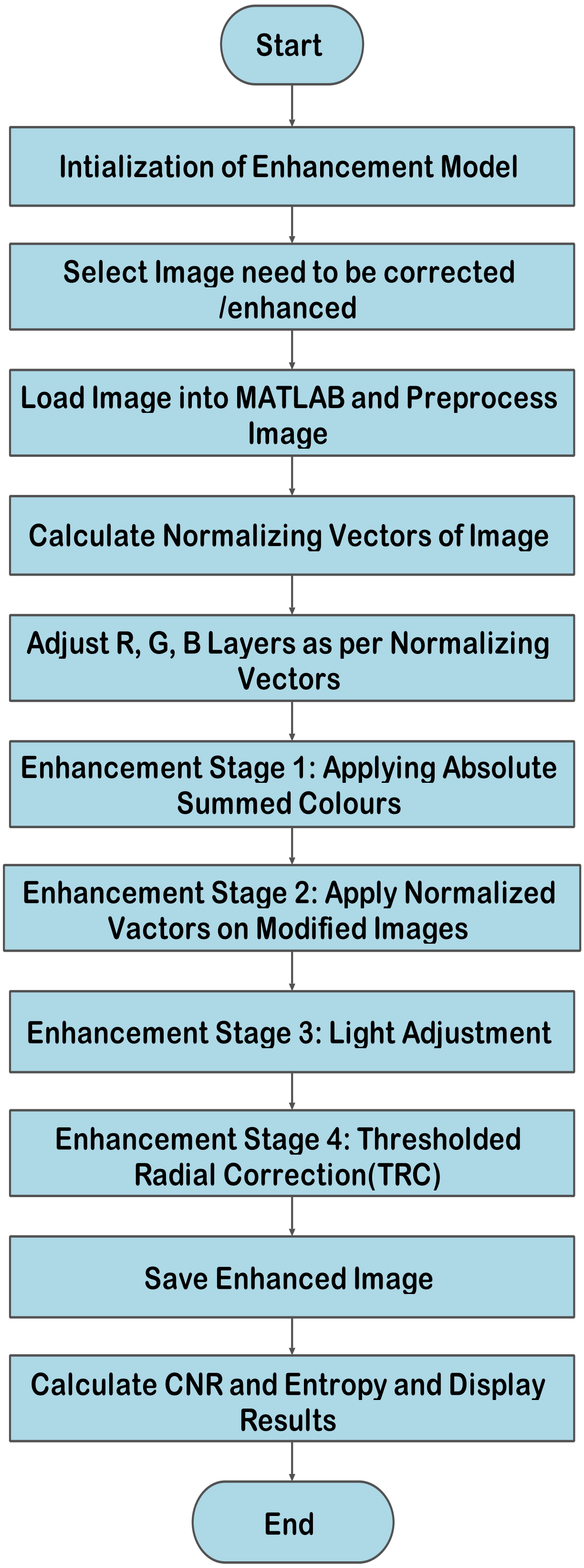


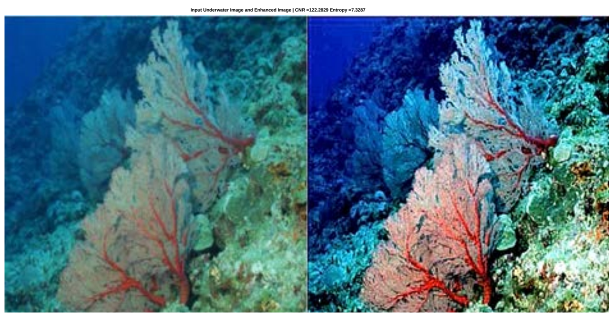
Figure 3.2 Flow chart of proposed work

IV. RESULT ANALYSIS

The Simulation of proposed underwater image enhancement has been done on Matlab Simulink. The outcome of proposed work has been shown infigure 4.1.Figure 4.1 (a) shows left hand side underwater test image and figure 4.1 right hand side enhanced image.

Figure 4.1 (b) shows the input underwater test image left hand side and enhanced test image right hand side.

(a)



(b)

(c)

(d)

Figure 4.1 Experimental Results of (a) FISH, (b) REEF, (c) ROCK and (d) SAND images.

Third test image has been shown in figure 4.1 (c) Rock image left hand side underwater image and right hand side enhanced under water rock image.

Anunderwater Sand image has been shown in figure 4.1 (d) at Left hand side underwater image and enhanced image at right hand side.

The Visibility Matrix Based on CNR has been shown in table 1 for all four sample input images Fish, Reef, Rock, Sand. Also the value of CNR has been compared with existing work.

The comparison chart for CNR has given in figure 4.3.The entropy evaluation of each image has been listed in table 2. The comparison plot of Entropy has been illustrated in figure 4.3.

Table 1 Visibility Matrix Based on CNR

Image	*Previous Work [1]*	*Proposed Work*
Fish	68.7454	72.707
Reef	113.087	122.2829
Rock	88.2907	103.2767
Sand	75.6957	90.9316

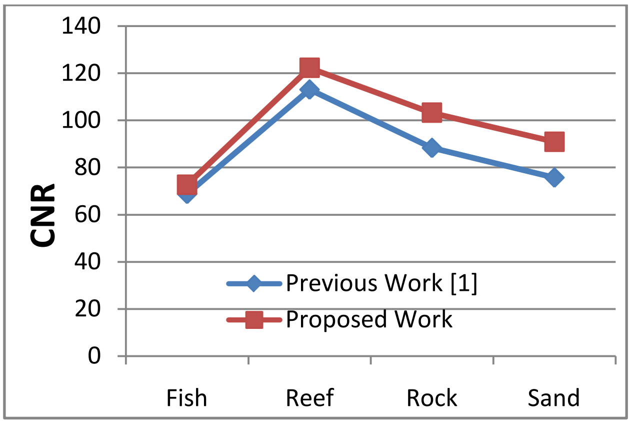


Fig. 4.2 CNR Comparison Chart.

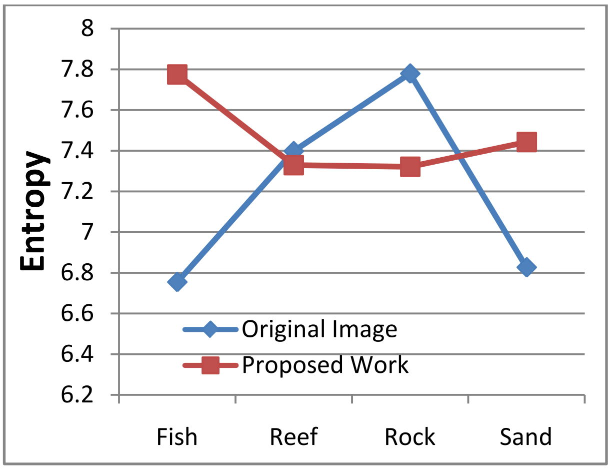


Fig. 4.3 Entropy Comparison Chart.

Table 2 Entropy

Image	*Original Image*	*Proposed Work*
Fish	6.7545	7.7737
Reef	7.3974	7.3287
Rock	7.7787	7.3211
Sand	6.8268	7.4421

V. CONCLUSION

Digital image processing is the utilization of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, the advanced image processing has numerous favorable circumstances over simple image processing. It permits a significantly more extensive scope of algorithms to be connected to the information and avoid problems, for example, the development of clamor and signal distortion during processing. Since images are characterized more than two measurements advanced image processing might be displayed as multidimensional frameworks. In this work a robust underwater image enhancement using multi stage normalized vector corrections and threshold radial corrections approach has been considered for image enhancement.A comparative analysis of underwater image enhancement approaches based on CNR and entropy has observed that proposed approach has batter performance as compared to existing base work approach.

Emergent underwater image resolution approaches along with system pass are important to adapt and expand in the techniques devised, which can greatly help in evaluating the data coming from 3 dimensional landscape data. However in future design a close look assures to have more information revealing underwater images as compared to the techniques previously used.

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