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"Enhancing Underwater Image Quality Through Customized Equalization Stretching And Filtering Techniques (Cesft)"

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ABSTRACT
Underwater environments generally cause color cast or color scatter while photography. Color scatter is due to haze effects appearing when light reflected from thing which absorbed or may be scattered several times by particles of water. This cause lowers the visibility and less contrast of the image. color cast is due to the varying attenuation of light in various wavelengths, and this is cause underwater environments bluish. To mention distortion from color scatter and color cast, this paper proposes a method to reconstruct underwater images that which is a combination of a wavelength compensation and de-hazing algorithm (IDWC). One has to determine the distance between the objects and the camera using dark channel prior, then haze effects cause by color scatter can be removed by the de-hazing algorithm. Next, one has to estimation the photography scene depth using residual energy ratios for each. According to the attenuation of every wavelength, reverse compensation conducted to restore all distortion from color cast.
Thesis work present a novel procedure for which is a special integration for various available techniques also it has new approach in order to image stretching and image equalisation. Proposed procedure enhances shallow ocean optical images or videos using stretching cum equalizing cum median filter and also as per wavelength properties. Our key contributions are proposed include a novel shallow water imaging model that compensates in order to attenuation discrepancy along propagation path and an effective underwater scene enhancement scheme recovered images are characterized by a reduced noised level, better exposure for dark regions, and global contrast where finest details and edges are enhanced significantly.

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I. INTRODUCTION

IMAGE PROCESSING

Proposed work is working on underwater images so it is necessary to know fundamentals for images, Modern digital technology has made it possible to manipulate multi-dimensional signals with systems that range from easy digital circuits to advanced parallel computers. Goal for this manipulation may be divided into three categories:

Image Processing	image in → image out
Image Analysis	image in → measurements out
Image Understanding	image in → high-level description out

An image defined in "real world" is considered to be a function for two real variables, in order to example, a(x, y) with a as amplitude (e.g. brightness) for image at real coordinate position (x,y). An image may be considered to contain sub-images sometimes referred to as regions– of–interest, ROIs, or simply regions. This concept reflects fact that images frequently contain collections for objects each for which may be basis in order to a region. In a sophisticated image processing system it should be possible to apply specific image processing operations to selected regions. Thus one part for an image (region) might be processed to suppress motion blur while another part might be processed to improve color rendition [5].

The amplitudes for a given image will almost always be either real numbers or integer numbers. latter is usually a result for a quantization method that converts a continuous range (say, between 0 and 100%) to a discrete number for levels. In certain image-forming processes, however, signal may involve photon counting which implies that amplitude would be inherently quantized [5].

In other image forming procedures, such as magnetic resonance imaging, direct physical measurement yields a complex number in form for a real magnitude and a real phase. in order to remainder for this book we will consider amplitudes as reals or integers unless otherwise indicated[5].

Digital Image Definitions: A digital image a[m,n] described in a 2D discrete space is derived from an analog image a(x,y) in a 2D continuous space through a sampling method that is frequently referred to as digitization[3].For now we will look at few basic definitions associated with digital image. effect for digitization is shown in Figure 1.1. 2D continuous image a(x,y) is divided into N rows and M columns. intersection for a row and a column is termed a pixel. value assigned to integer coordinates [m,n] with {m=0,1,2,…,M–1} and {n=0,1,2,…,N–1} is a[m,n]. In fact, in most cases a(x,y) – which we might consider to be physical signal that impinges on face for a 2D sensor – is actually a function for many variables including depth (z), color (λ), and time (t).

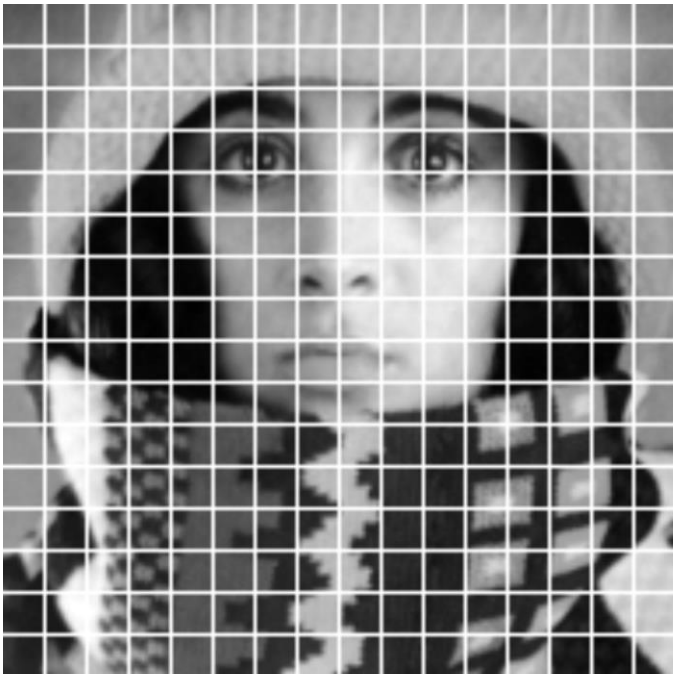


Figure 1.1: Digitization for a continuous image. pixel at coordinates [m=10, n=3] has integer brightness value 110.

The image shown in Figure 1.1 has been divided into N = 16 rows and M = 16 columns. value assigned to every pixel is average brightness in pixel rounded to nearest integer value. method for representing amplitude for 2D signal at a given coordinate as an integer value with L various gray levels is usually referred to as amplitude quantization or simply quantization.

Common values: There are standard values in order to various parameters encountered in digital image processing [2]. These values may be caused by video standards, by algorithmic requirements, or by desire to keep digital circuitry simple. Table 1.1 gives few commonly encountered values.

Table 1.1: Common values for digital image parameters

Parameter	Symbol	Typical values
Rows	N	256,512,525,625,1024,1080
Columns	M	256,512,768,1024,1920
Gray Levels	L	2,64,256,1024,4096,16384

Quite frequently we see cases for $M=N=2^K$ where {K = 8, 9, 10, 11, 12}. This may be motivated by digital circuitry or by use for certain algorithms such as (fast) Fourier transform. The number for distinct gray levels is usually a power for 2, that is, $L=2^B$ where B is number for bits in binary representation for brightness levels. When B>1 we speak for a gray-level image; when B=1 we speak for a binary image. In a binary image there are just two gray levels which may be referred to, in order to example, as "black" and "white" or "0" and "1".

UNDERWATER IMAGE

With development for exploring ocean by autonomous underwater vehicles (AUVs) and unmanned underwater vehicles (UUVs), recognition for underwater objects is known as a major issue. That is, how to acquire a clear underwater image is a question. In past years, sonar has been widely used in order to detection and recognition for objects in underwater environment. due to acoustic imaging principle, sonar images have shortcomings for low signal to ratio, low resolution et al. Consequently, optical vision sensors must be used instead in order to short-range identification due to low quality for images restored by sonar imaging In contrast to common photographs[6], underwater optical images suffer from poor visibility owing to medium, which causes mainly scattering and absorption. Large suspended particles cause scattering, as in fog or turbid water that contains abundant particles. color distortion originates from its inherent optical properties encountered by light travelling in water at various wavelengths, causing ambient underwater environments to be dominated by a bluish tone. In addition, absorption substantially reduces light energy. Random attenuation for light primarily causes a hazy appearance, while fraction for light scattered back from water along line for sight considerably degrades scene contrast. Capturing a clear image in underwater environments is an appropriate issue in ocean engineering [1]. Effect for applications like as underwater environment evaluation or navigational monitoring have significant role for quality for underwater images. Taking clear images underwater is tough; mostly due to haze mainly due to Color scatter also addition to Color cast by varying light attenuation on various wavelengths [2]. Color scatter and Color results a blurred subjects and with lowered contrast in all underwater images. In Figure 1.2, shows a example, yellow coral reef (a kind for sea tree) at right bottom corner for image and one yellow fish in right-upper corner are not distinguishable due to Color cast; fish and reef in back are unclear due to scattering.

Figure 1.2: Haze and Color cast in Underwater Images due to Blurry and Bluish Effects

Haze is because by many suspended particles like as sand, plankton and minerals that always exist in lakes, rivers and oceans. When camera capture images reflected light from objects goes to camera, few portion for light meets suspended particles, which absorbs few for light and scatters light (Fig. 1.3). In environments which do not have blackbody emission [3], scattering normally expands to multiple scattering.

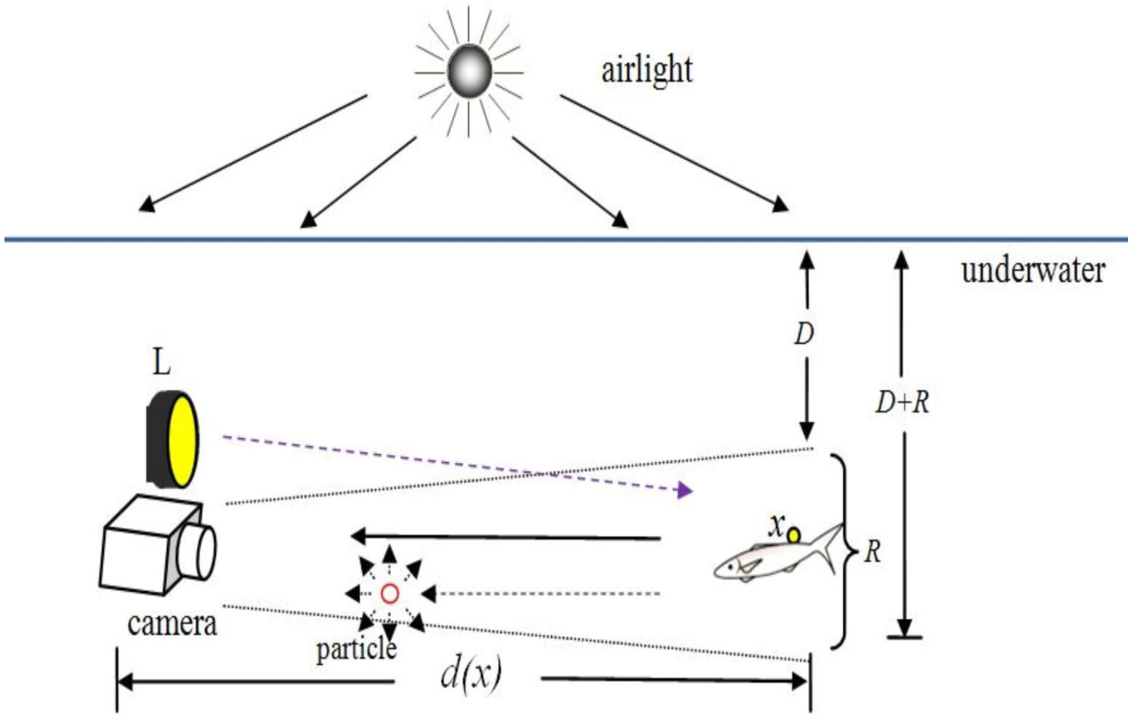


Figure 1.3. Natural Light Illuminates an Underwater target point x and Reflected Light goes to Camera by Direct Transmission with Scattering

The underwater image after scattering may be represent as weighted sum for transmitted reflected light and scattered background light [4]

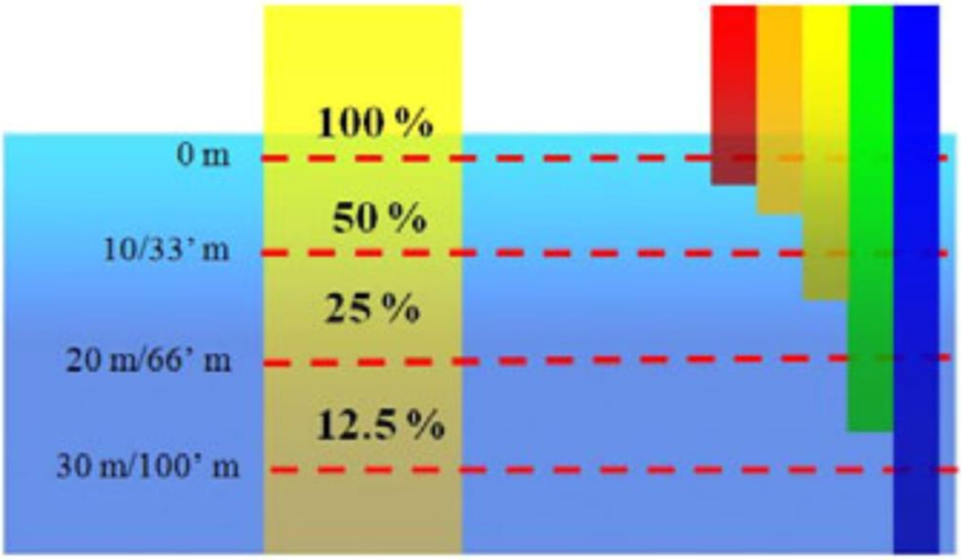
$I_\lambda(x) = J_\lambda(x)t_\lambda(x) + B_\lambda(1- t_\lambda(x)),\lambda \in\{R,G, B\}$

$t_\lambda(x) = \frac{\mathbf{E0(\lambda,d(x))}}{\mathbf{E1(\lambda,0)}} = 10^{-\beta(\lambda)d(x)} = (Rer(\lambda))^{d(x)}$

Here x is a point for object; λ is wavelength for light in underwater; $I_\lambda(x)$ is image captured by camera; $J_\lambda(x)$ is quantity for reflected light that was directly transmitted. Light gets attenuated when through a medium (water) [5]; residual energy ratio (Rer) shows ratio between residual energy to initial energy in order to each unit for distance. Considering energy for a light beam earlier and after it propagates through a water with a length d(x) is $E_I(\lambda,0)$ and $E_O(\lambda, d(x))$. $t_\lambda(x)$ presents residual energy ratio for light beam propagating through medium. Due to that $t_\lambda(x)$ also depends on wavelength λ and length d(x), distance between x and camera, $t_\lambda(x)$ also affected by Color scatter and Color cast.

The Rer for various light wavelengths change in water [6]. As shown in Figure 1.4, red light has longer wavelength and so less frequency, hence attenuating faster than blue light. This because blueness in underwater images.

Figure 1.4 Penetrations for Light in Water



In addition to wavelength, residual energy ratio $t\lambda(x)$ is also influenced by salt ratio in water [7]. Using amount for suspended particles and salt ratio, ocean water falls into three categories: general ocean water (Ocean Type 1), turbid tropical-subtropical water (Ocean Type 2), and mid-latitude water (Ocean Type 3) [7]. in order to every meter for general ocean water that a light beam passes through, Rer values for red light (700µm), green light (520µm), and blue light (440µm) are 82 %, 95 %, and 97.5 %. Rer in various environments may be adjusted with general ocean water as standard. Suppose an incident light beam A from air forms background light B at depth D after attenuation and multiple scattering; background light is in correspondence with brightest portion for image. Relationship between incident light beam A and background light B may be expressed with an energy attenuation model:

$$E_B(\lambda,D) = E_A(\lambda,0) \text{ X } (Rer(\lambda))^D, \lambda \in \{R,G,B\}$$

Where $E_A(\lambda,0)$ and $E_B(\lambda,D)$ are energy for incident light and background light with wavelength λ. Rer values for various wavelengths are

$$Rer(\lambda)=\begin{cases}\mathbf{0.8\sim0.85} & \textbf{if } \boldsymbol{\lambda} = \mathbf{650\mu m \sim 750\mu m}\\ \mathbf{0.93\sim0.97} & \textbf{if } \boldsymbol{\lambda} = \mathbf{490\mu m \sim 550\mu m}\\ \mathbf{0.95\sim0.99} & \textbf{if } \boldsymbol{\lambda} = \mathbf{400\mu m \sim 490\mu m}\end{cases}$$

Conventionally, processing for underwater images is directed either towards calibrating distortion from color scatter or from color cast. Research on improving former has included applying properties for polarizers to enhance image contrast and visibility [8], using image DE hazing to eliminate hazing effects and enhance image contrast [9], and combining point spread functions (PSF) and modulation transfer function (MTF) in coordination with wavelet decomposition to enhance high frequency areas in images [10] and increase visibility. Although approaches above may augment contrast and sharpen images, they cannot resolve issue for color cast. Research regarding improvement for color cast includes using properties for light transmitting through water to provide energy compensation using attenuation differences between various wavelengths [11] and employing histogram equalization on underwater images to balance luminance distributions for color [12]. Despite improvement in color distortion for objects, these methods cannot repair image blurriness caused by color scatter. IDWC algorithm proposed in this study combines a DE hazing algorithm and energy compensation. Dark channel prior is used to estimate distance for object to camera, and DE hazing algorithm removes hazing effects caused by color scatter. Once underwater background light and Rer values for various wavelengths for light are used to estimate depth for underwater scene, reverse compensation according to each wavelength is carried out to restore color cast from water depth. With IDWC, expensive optical instruments or distance estimation by two images is no longer required; IDWC may effectively enhance visibility in underwater images and restore original colours, obtaining high quality visual effects.

IMAGE EQUALISER

Equalization is a procedure in image processing for contrast adjustment using image's histogram, this procedure usually increases global contrast for many images, especially when usable data for image is represented by close contrast values. Through this adjustment, intensities may be better distributed on histogram. This allows in order to areas for lower local contrast to gain a higher contrast [1]. Histogram equalization accomplishes this by effectively spreading out most frequent intensity values. Procedure is useful in images with backgrounds and foregrounds that are both bright or both dark. In particular, procedure may lead to better views for bone structure in ray images, and to better detail in photographs that are over or under-exposed. A key advantage for procedure is that it is a fairly straightforward technique and an invertible operator. So in theory, if histogram equalization function is known, then original histogram may be recovered [1]. Calculation is not computationally intensive. A disadvantage for procedure is that it is indiscriminate. It may increase contrast for background noise, while decreasing usable signal.

In scientific imaging where spatial correlation is more important than intensity for signal (such as separating DNA fragments for quantized length), small signal to noise ratio usually hampers visual detection [1].

Histogram equalization often produces unrealistic effects in photographs; however it is very useful in order to scientific images like thermal, satellite or x-ray images, often same class for images to which one would apply false-color. Also histogram equalization may produce undesirable effects (like visible image gradient) when applied to images with low color depth. In order to example, if applied to 8-bit image displayed with 8-bit gray-scale palette it will further reduce color depth (number for unique shades for gray) for image. Histogram equalization [4] will work best when applied to images with much higher color depth than palette size, like continuous data or 16-bit gray-scale images.

There are two ways to think about and implement histogram equalization, either as image change or as palette change. Operation may be expressed as P(M(I)) where I is original image, M is histogram equalization mapping operation and P is a palette. If we define a new palette as P'=P(M) and leave image I unchanged then histogram equalization is implemented as palette change. On other hand if palette P remains unchanged and image is modified to I'=M(I) then implementation is by image change. In most cases palette change is better as it preserves original data. Modifications for this procedure use multiple histograms, called sub histograms, to emphasize local contrast, rather than overall contrast. Examples for such methods include adaptive histogram equalization, contrast limiting adaptive histogram equalization or CLAHE, multi-peak histogram equalization (MPHE), and multipurpose beta optimized bi-histogram equalization (MBOBHE). Goal for these methods, especially MBOBHE, is to improve contrast without producing brightness mean-shift and detail loss artifacts by modifying HE algorithm. Histogram equalization also looks to be used in biological neural networks [4] so as to maximize output firing rate for neuron as a function for input statistics. This has been proved in particular in fly retina. Histogram equalization is a specific case for more general class for histogram remapping methods. These methods seek to adjust image to make it easier to analyze or improve visual quality

IMAGE STRETCHING

Contrast is a measure for how much pixel brightness changes relative to average brightness. A technique known as histogram stretching may be used to shift pixel values to fill entire brightness range, resulting in high contrast. First step is to find pixel values that should get mapped to 0% and 100% brightness. Any real-world image has noise, however. To keep noise from unduly influencing stretching, an assumption is made: small percentages for brightest and darkest pixels are ignored, writing them off to sensor noise.

In general, histogram stretching tends to work well on images that have a poor image contrast to start with and which should have full contrast [3]. You may limit amount for stretching that occurs by not mapping h_low and h_high to 0% and 100% brightness levels, however instead by only scaling them a certain amount.

The histogram stretching that we've looked at so far has focused on single-channel images. What's useful is that same functions may be applied to multi-channel images, like RGB images, by applying codes to each channel independently. MATLAB's *stretchlim* and *imadjust* functions are both written to be able to take in RGB images in addition to single-channel images using exact same code as we used earlier.

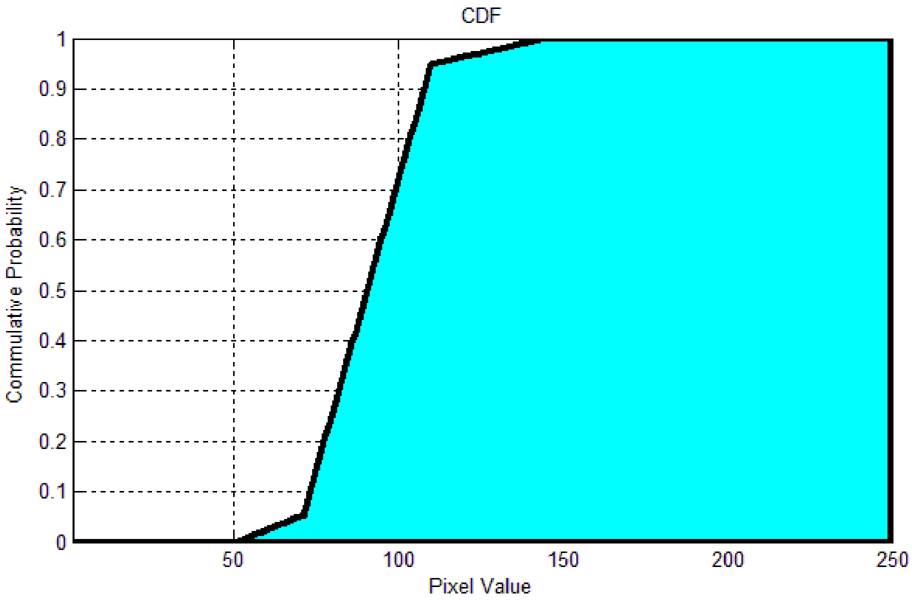


Figure1.6: Interpolating CDF at pct = 0.05 to find corresponding h_low and h_high pixel values.

The RGB color space is de-facto standard in order to images. It doesn't always result in best processing, however, especially when image is intended in order to human viewing. A color space that better represents human visual system, like L*a*b* or L'u'v' may provide more natural stretching in few cases. In both for these color spaces, L channel represents brightness, while (a*, b*) or (u', v') channels represent color. (This is conceptually similar to Y-Cb-Cr, used in JPEG encoding.) Stretching is performed on L channel after converting colors. Since only L channel was adjusted, colors remain same, however brightness is re-mapped. This adjusts contrast in a way that sometimes may be more visually pleasing without significantly affecting color balance

Another variation is to apply histogram stretching in hue-saturation-value (HSV) color space. Histogram stretching is only applied to S and V channels, however not hue channel. This tends to result in reasonable contrast and fuller colors without significantly affecting color balance. Also sometimes done after stretching in RGB color space to ensure full color saturation. One example is this underwater image, which required significant stretching in RGB, however then benefits from an additional HSV stretch to gain full contrast.

Figure 1.7: Effect for Stretching on Images

MEDIAN FILTER

In signal processing, it is often desirable to be able to perform few kind for noise reduction on an image or signal. Median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction

[4] is a typical pre-processing step to improve results for later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise (but see discussion below). The main idea for median filter is to run through signal entry by entry, replacing each entry with median for neighboring entries. Pattern for neighbors is called "window", which slides, entry by entry, over entire signal. in order to 1D signals, most obvious window is just first few preceding and following entries, whereas in order to 2D (or higher-dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns). Note that if window has an odd number for entries, then median is easy to define: it is just middle value after all entries in window are sorted numerically. In order to an even number for entries, there is more than one possible median [4].

Figure 1.8: Use for Median Filter to improve corrupted Image

OBJECTIVE

- To develop a optimized modal in order to underwater image quality enhancement
- To minimize noise and impact for hazing and color cast.
- To verify results with various test designs.
- To compare proposed design with other related work and prove proposed design is a good solution in order to that.

SCOPE

The work done in area for underwater image enhancement till now either using mean or median filters or by using various color stretching methods or by using equalizing, however no one has presented a modal which is integrated for various technique, Thesis work present a novel procedure for which is a special integration for various available techniques also it has new approach in order to image stretching and image equalisation [5]. Proposed procedure enhances shallow ocean optical images or videos using stretching cum equalizing cum median filter and also as per wavelength properties.

II. LITERATURE REVIEW

BACKGROUND

Under water Image Enhancement was begin in around 1990 when underwater submarines were invented and it was highly required to capture clear underwater image in order to smooth operations for submarine through underwater images filtering and was done by digital filter which were used in order to signal mean images considered like digital signal and as digital filters gets optimized underwater images were also getting clear, till 1990 there was no any specific image filter and image processing in 1991 image filter median filter were proposed and later in 2000 image stretching techniques were proposed this procedure was only dedicated in order to underwater for any other blur image only in 2007 image Equalizer also been introduced and that make significant improvement in blur or underwater image quality. Table 2.1 shown below shows background for underwater image quality enhancement after 2010.

LITERATURE SURVEY

John Y. Chiang et al [3] Light scattering and color change are two major sources of distortion for underwater photography. Light scattering is caused by light incident on objects reflected and deflected multiple times by particles present in the water before reaching the camera. This in turn lowers the visibility and contrast of the image captured. Color change corresponds to the varying degrees of attenuation encountered by light traveling in the water with different wavelengths, rendering ambient underwater environments dominated by a bluish tone. No existing underwater processing techniques can handle light scattering and color change distortions suffered by underwater images, and the possible presence of artificial lighting simultaneously.

This paper [3] proposes a novel systematic approach to enhance underwater images by a dehazing algorithm, to compensate the attenuation discrepancy along the propagation path, and to take the influence of the possible presence of an artifical light source into consideration. Once the depth map, i.e., distances between the objects and the camera, is estimated, the foreground and background within a scene are segmented. The light intensities of foreground and background are compared to determine whether an artificial light source is employed during the image capturing process. After compensating the effect of artifical light, the haze phenomenon and discrepancy in wavelength attenuation along the underwater propagation path to camera are corrected. Next, the water depth in the image scene is estimated according to the residual energy ratios of different color channels existing in the background light. Based on the amount of attenuation corresponding to each light wavelength, color change compensation is conducted to restore color balance. The performance of the proposed algorithm for wavelength compensation and image dehazing (WCID) is evaluated both objectively and subjectively by utilizing ground-truth color patches and video downloaded from the Youtube website. Both results demonstrate that images with significantly enhanced visibility and superior color fidelity are obtained by the WCID proposed.

Jie Li et al [2] This paper reports on WaterGAN, a generative adversarial network (GAN) for generating realistic underwater images from in-air image and depth pairings in an unsupervised pipeline used for color correction of monocular underwater images. Cameras onboard autonomous and remotely operated vehicles can capture high resolution images to map the seafloor; however, underwater image formation is subject to the complex process of light propagation through the water column.

The raw images retrieved are characteristically different than images taken in air due to effects such as absorption and scattering, which cause attenuation of light at different rates for different wavelengths. While this physical process is well described theoretically, the model depends on many parameters intrinsic to the water column as well as the structure of the scene. These factors make recovery of these parameters difficult without simplifying assumptions or field calibration; hence, restoration of underwater images is a non-trivial problem. Deep learning has demonstrated great success in modeling complex nonlinear systems but requires a large amount of training data, which is difficult to compile in deep sea environments.

Using WaterGAN, they generate a large training dataset of corresponding depth, in-air color images, and realistic underwater images. This data serves as input to a two-stage network for color correction of monocular underwater images. Our proposed pipeline is validated with testing on real data collected from both a pure water test tank and from underwater surveys collected in the field. Source code, sample datasets, and pretrained models are made publicly available.

Sonal Dixit et al [1] Abstract-Image enhancement (IE) methods present as a preprocessing step in object detection and recognition in computer vision applications. The excellence of underwater images is negative in view that of precise propagation residences of light in water. So, underwater image enhancement is crucial to increase visual pleasant. In this research, presented an underwater IE using dark channel prior (DCP) with adaptively clipped contrast limited histogram equalization (ACCLAHE) and homomorphism filtering (HF). Using DCP, estimate blur region and remove them. With the help of ACCLAHE, it takes the maximum bin height in the local histogram of the sub-image and redistributes the clipped pixels equally to each gray-level.

HF is used for improving the edges of an image. IE is the procedure of enhancing the features of the input image so that it would be easily understood by viewers in the future. IE increases the data substance of the image and changes the visual effect of the image on the observer. IE heightens the elements of images. It complements the image highlights like edges, complexity to assemble showcase of images more valuable for examination and study. Image upgrade incorporates numerous operations; for example, contrast extending, commotion cutting, pseudo coloring, clamor sifting and so forth to enhance the perspective of images. The real hotspots for contortion of underwater images are light scrambling and color variation. Water has great refractive index compare to air. When light is incident on water, it becomes refracted. Subsequently, underwater images experience the ill effects of constrained extent deceivability, low complexity, obscuring, color decreased and noise.

Table 2.1: Literature Work for Underwater Image Enhancement

Year	Author	Title	Approach	Result
2016	Sonal Dixit	Underwater Image Enhancement using DCP with ACCLAHE and Homomorphism Filtering	adaptively clipped contrast limited histogram equalization and homomorphism filtering	Enhanced Illumination and Contrast
2017	Jie Li	WaterGAN: Unsupervised Generative Network to Enable Real-time Color Correction of Monocular Underwater Images	Using WaterGAN, we generate a large training dataset of corresponding depth, in-air color	Good in extreme turbid Water

			images, and realistic underwater images. restoration of underwater Images	
2012	John Y. Chiang	Underwater Image Enhancement by Wavelength Compensation and Dehazing	Wavelength compensation and image de-hazing	Decrease in implementation time
2011	John Y. Chiang	Underwater Image Enhancement: Using Wavelength Compensation and Image Dehazing (WCID)	haze effects from color scatter were removed by the dehazing algorithm	De-hazing and improvement in quality in deep water
2013	Huimin Lu	Underwater scene enhancement using weighted guided median filter	using weighted guided median filter and wavelength properties	Having better marine imaging applications
2007	Kashif Iqbal	Underwater Image Enhancement Using an Integrated color Model	Contrast stretching of RGB algorithm is applied to equalize the colour contrast in images.	Improves visual quality for underwater images

PROBLEM STATEMENT

In previous sections, it is been discussed that issues concerning image processing analysis especially in underwater image enhancement. This problems need to be resolved in order to have a rigorous and effective analysis in underwater images. In order to eliminate this problem, researchers are using state-of-the-art technology such as autonomous underwater vehicles [10], sensors and optical cameras [4], visually guided swimming robot [13]. However, technology has not yet reached to appropriate level for success. In order to example, movement for autonomous underwater vehicles generates shadows in scene while optical camera provides limited visibility when it is used to capture underwater images. It has its own merits and demerits. In order to overcome limitations for technology, few researchers annotate images manually. However this method is labor intensive and it also necessary significant agreement amongst annotators.

Objects at a distance for more than 10 meters are almost indistinguishable, because colours are faded owing to characteristic wavelengths that are filtered according to water depth [8]. Many researchers have developed techniques to restore or enhance underwater images. Y.Y. Schechner et al exploited a polarization filter to compensate in order to visibility degradation [9], while Bazeille et al proposed an image pre-processing pipeline in order to enhancing turbidly underwater images [10]. Fattal designed a graphic theory based independent component analysis model to estimate synthetic transmission and shading to recover clean image [11]. He et al estimated dark prior channel (DCP) through images laws for nature, then used soft matting to refine depth map and got final clearly image [12]. Nicholas et al. improved dark prior channel, and took graph-cut segmentation instead for soft matting to refine depth map [13]. Hou et al combined a point spread function (PSF) and modulation transfer function to reduce effects for blurring [14]. Ouyang proposed bilateral filtering based on an image de-convolution procedure [15]. Ancuti et al used an exposed fusion procedure to reconstruct a clear image in a turbid medium [16]. Chiang et al considered wavelength properties on underwater imaging, and obtained reconstructed image by dark prior channel model [17]. Although aforementioned approaches may enhance image contrast, these methods have demonstrated several drawbacks that reduce their practical applicability. First, equipment in order to imaging is tough to use in practice (e.g., a range-gated laser imaging system, which is rarely applied in practice [14, 15]). Second, multiple input images are required [9] (e.g., various polarization image or various exposed images) in order to fusing a high quality image. Third, image processing approaches may not suitable in order to underwater images [10, 12, 13]. Not only time consuming, however ignore imaging environment. Fourth, manual operation is needed in processing, which leads to lack for intelligence [11].

III. METHODOLOGY

The work done in area for underwater image enhancement till now either using mean or median filters or by using various colour stretching methods or by using equalizing, however no one has presented a modal which is integrated for various technique, Thesis work present a novel procedure for which is a special integration for various available techniques also it has new approach in order to image stretching and image equalisation. Proposed procedure enhances shallow ocean optical images or videos using stretching cum equalizing cum median filter and also as per wavelength properties. Our key contributions are proposed include a novel shallow water imaging model that compensates in order to attenuation discrepancy along propagation path and an effective underwater scene enhancement scheme. Recovered images are characterized by a reduced noised level, better exposure for dark regions, and global contrast where finest details and edges are enhanced significantly.

Figure 3.1 shown below shows design work flow proposed by base work 3

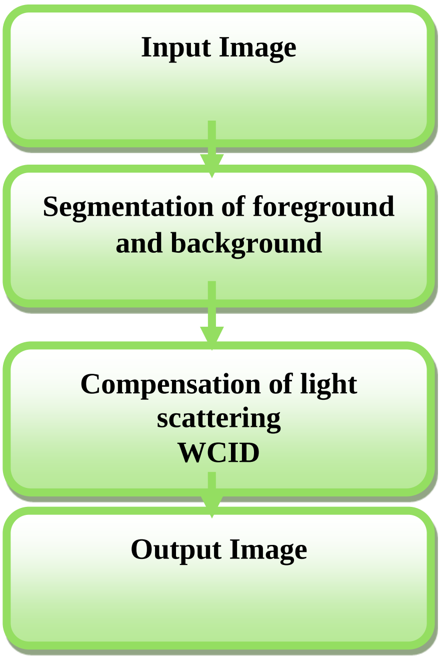


Figure 3.1 Design flow for base work-3

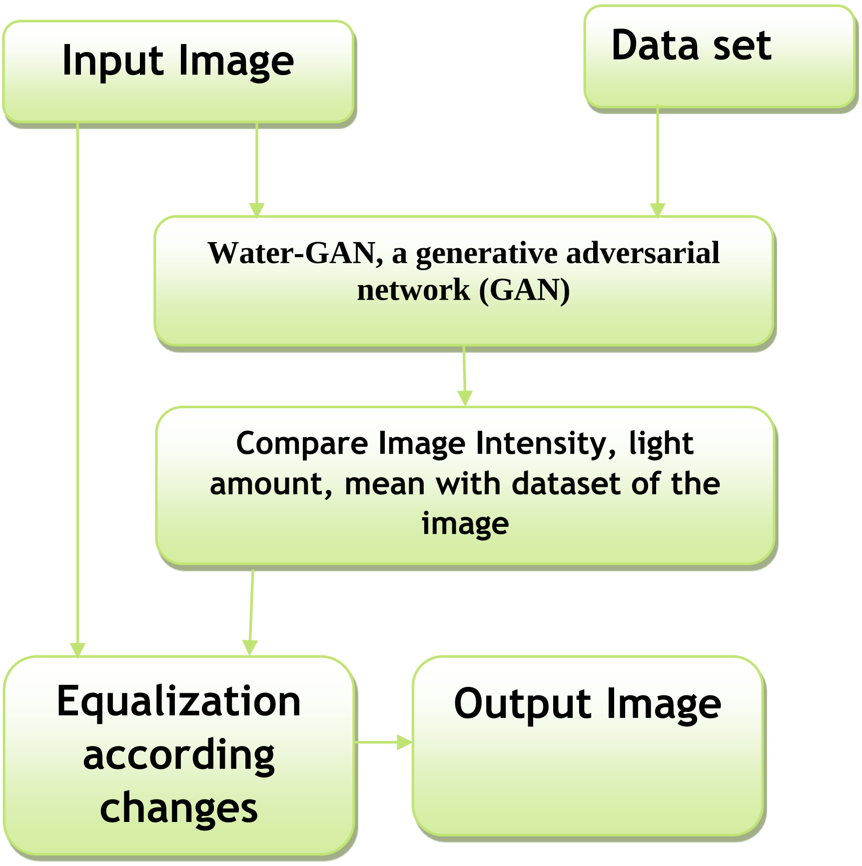
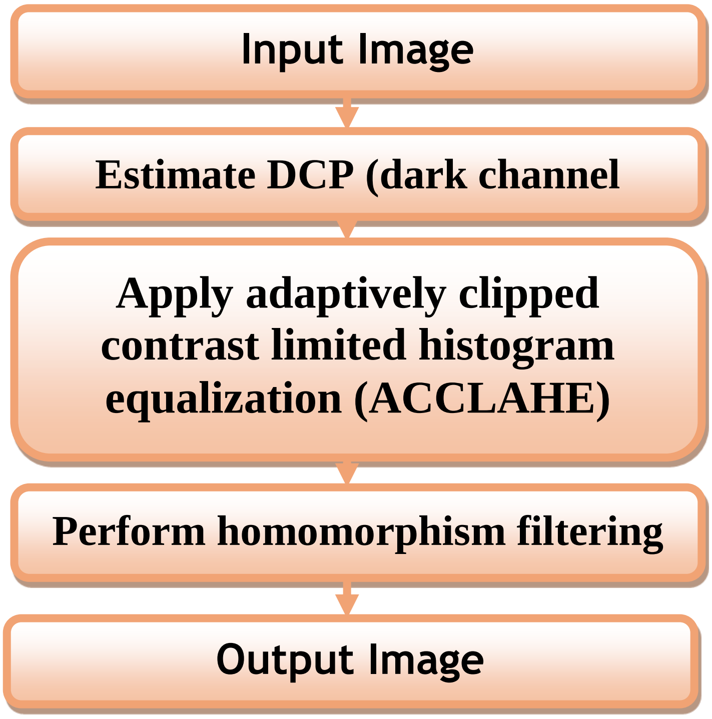


Figure 3.2 shown below shows design flow for base work 2



Proposed thesis work proposes a procedure to reconstruct underwater images that which is a combination for a wavelength compensation and de-hazing algorithm (IDWC). One has to determine distance between objects and camera using dark channel prior, then haze effects cause by Color scatter may be removed by de-hazing algorithm. Next, one has to estimation photography scene depth using residual energy ratios in order to each. According to attenuation for every wavelength, reverse compensation conducted to restore all distortion from Color cast. Proposed work has used slide stretching in order to de-hazing.

Firstly, proposed work use contrast stretching for RGB algorithm in order to equalizing color contrast in images. Then, proposed work applies intensity stretching and saturation HSI to improve true color and then resolve problem for lighting using wavelength compensation.

IV. RESULTS

RESULT PARAMETER

Parameters for the valuation of the work are Peak Signal to Noise Ratio (PSNR) and Mean square error (MSE),

MSE: Mean square error is the error estimation between two image and PSNR is the error amount in the image, MSE can be computer as below

$$MSE = \frac{1}{rc}\sum_{i==1}^{RW}\sum_{j=1}^{CL}(x_{ij} - y_{ij})^2$$

Where 'r' is the number of rows in the image 'c' is the columns in the image x is input image before data hiding, y is the output image after data hiding.

PSNR: Peak Signal to Noise Ratio can be computed as

$$PSNR = 20\log_{10}\left(\frac{256^2}{MSE}\right)$$

PROPOSED METHOD

Based on initial methodology, proposed work has developed a design to be used in order to underwater images. Initial proposed work has developed this using MATLAB. It has various stages as discussed above and shown in Figure 3.1., 3.2 And 3.3 also show a comparison between images before and after processing with proposed initial design which was published in our first research paper. As may be seen, images after enhancements illustrate histogram stretching. Initial work was with only image stretching and image equalization.

Based on our methodology, final proposed work has developed results with software tool MATLAB and enhances quality for underwater images. Proposed work has developed this tool using an object-oriented programming language. simulations is been done in order to various underwater images and quality for all for them is been improved with very good amount in research work I am showing results of various test images fish-1[3], fish-2[1]. Monster[1],fort [1] , Nemo [1] and Lizard Island[2]

Figure 4.1 Original test images for gold fish

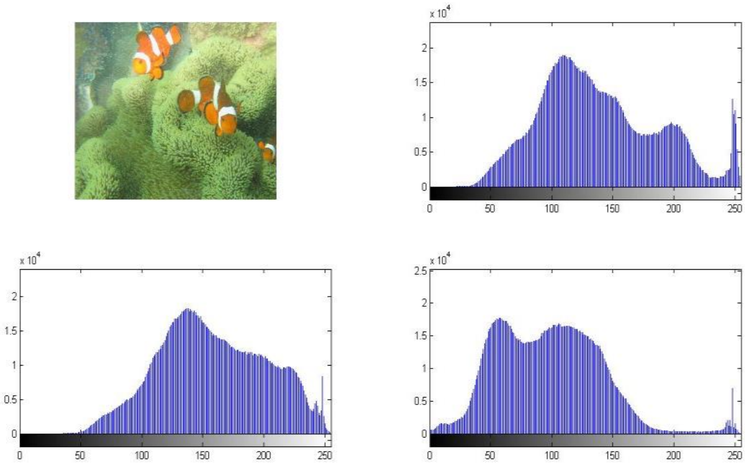


Figure 4.2: histogram for underwater nemo

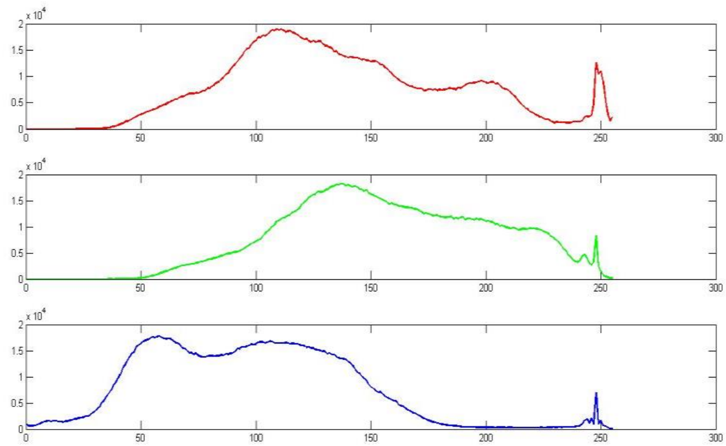


Figure 4.3: color component underwater nemo

Figure 4.4: after equalization and RGB stretching on underwater nemo

Figure 4.5: after equalization and RGB stretching and HSV stretching on underwater nemo

Figure 4.6: after equalization and RGB stretching and HSV stretching and Median filter on underwater nemo

Figure 4.7: test image nemo image analysis

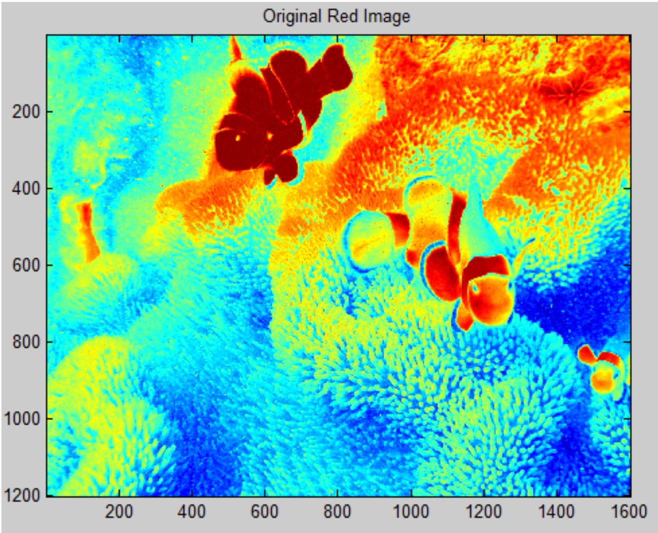


Figure 4.8: test image nemo red interpolation

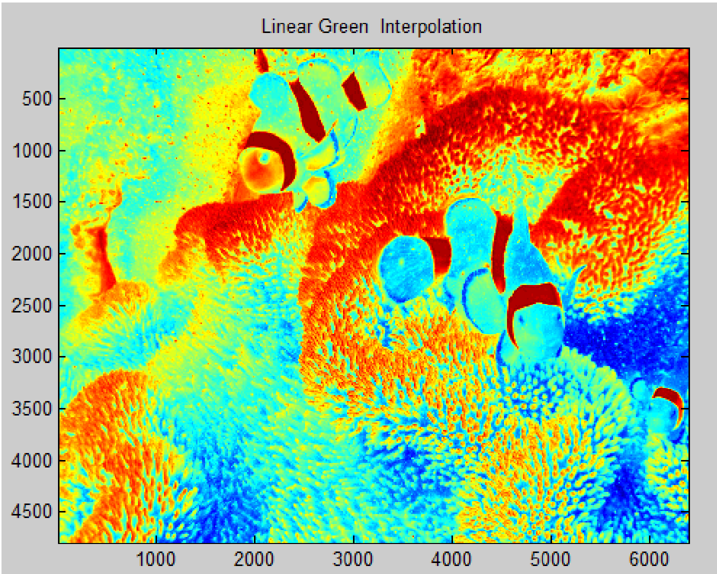


Figure 4.9: test image nemo green interpolation

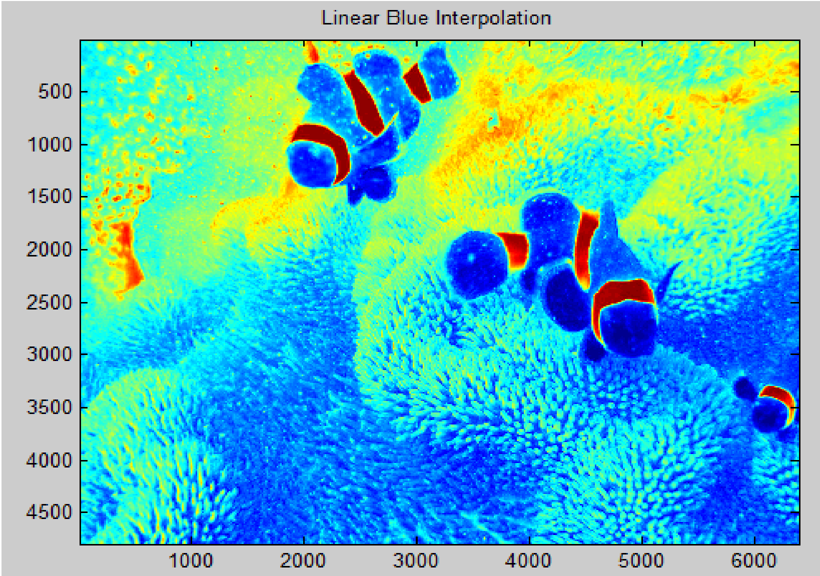


Figure 4.10: test image nemo blue interpolation

Figures 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9 and 4.10 shows result in order to test image underwater nemo fish at various implementation level and as may be seen that overall quality for as compare with original gold fish image is been improved significantly.

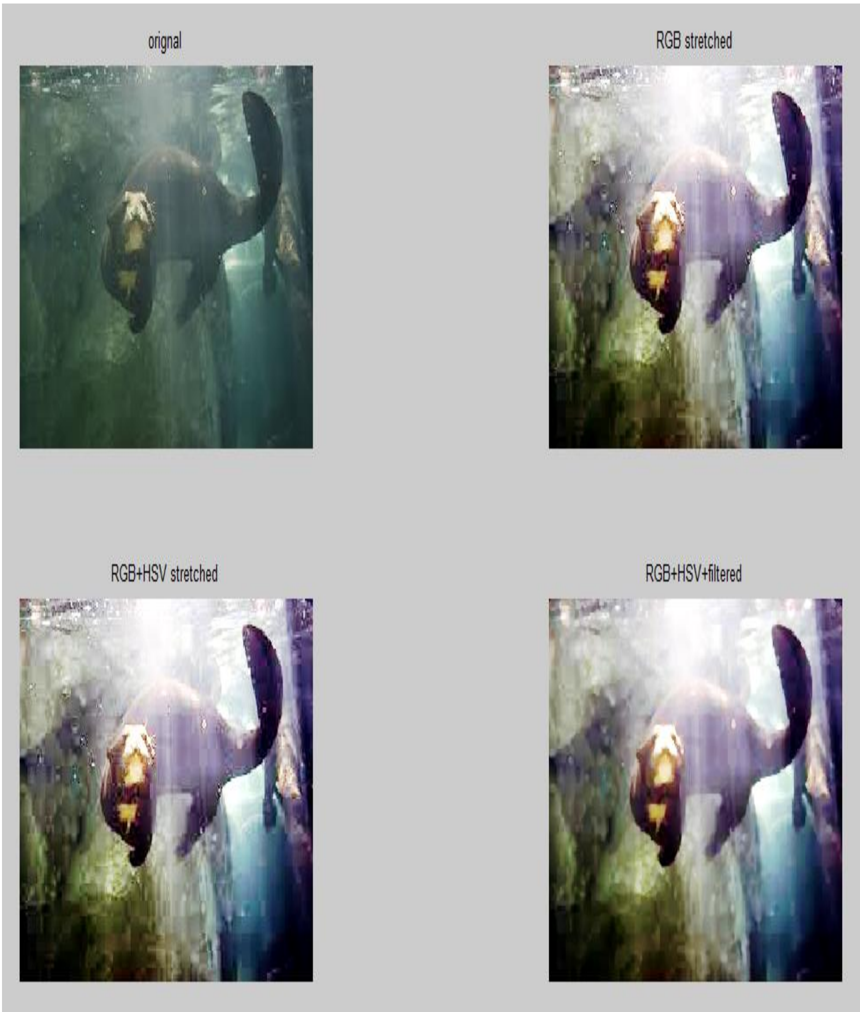


Figure 4.11: test image white monster image analysis

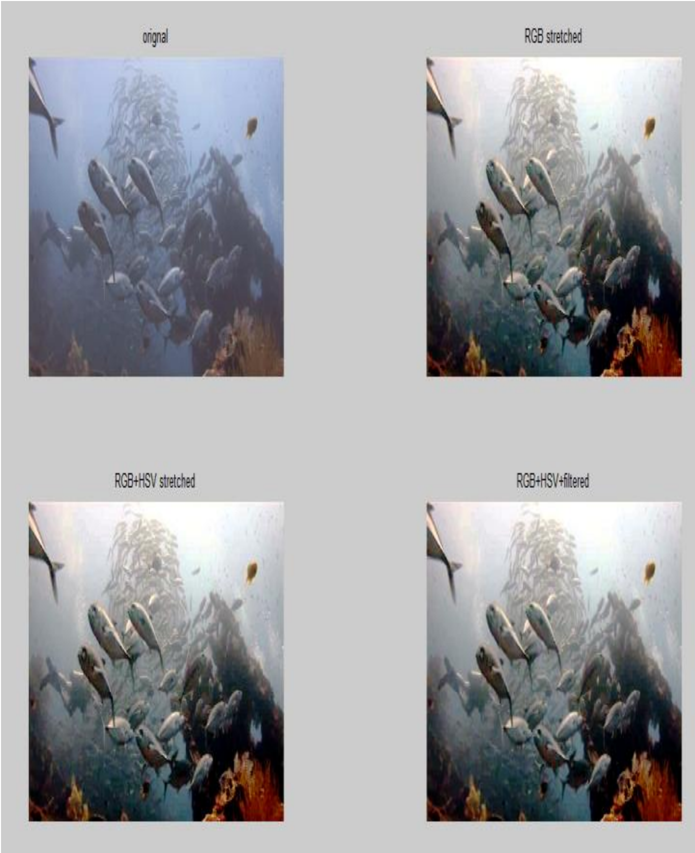


Figure 4.12: test image fish-1 image analysis

Figure 4.13: test image fish-2 image analysis

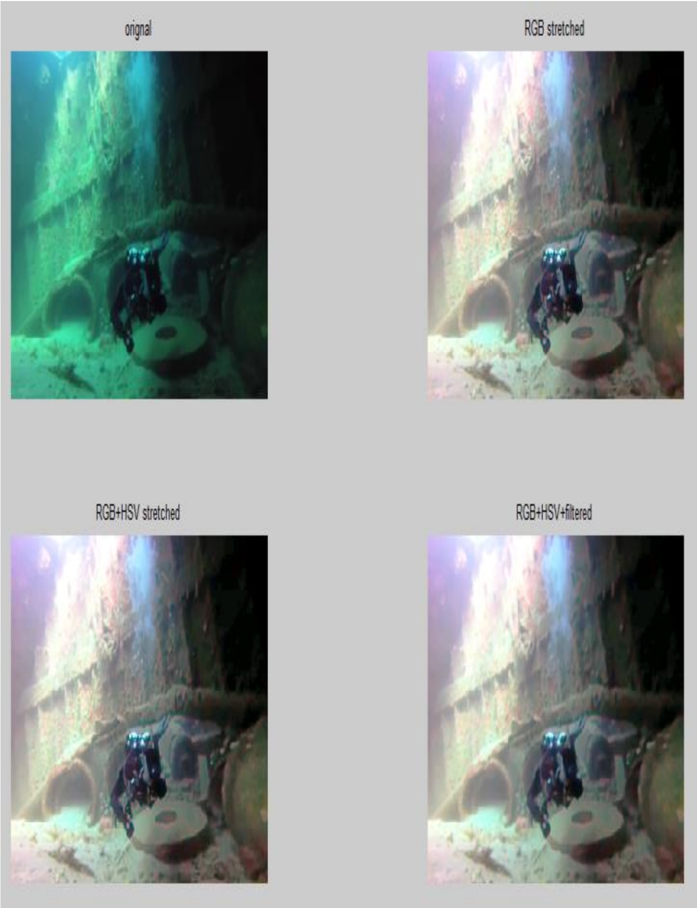


Figure 4.14: test image fort image analysis

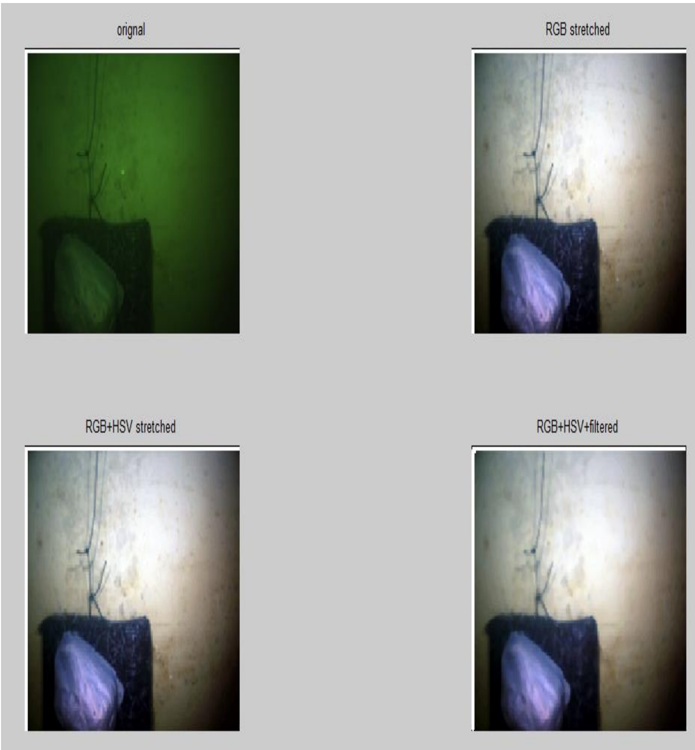


Figure 4.15: test image Lizard Island image analysis

Figure 4.11. 412, 4.13, 4.14 and 4.15 shows improvement in other two test images named Monster, fish-1, fish-2, fort and Lizard Island.

Table 4.1: observed results

Test image	MSE	SNR
Fish1	0.00196	89.5178
Fish2	0.0015948	87.7243
Fort	0.004318	76.3761
Monster	0.001513	67.2707
Lizard Island	0.007986	61.7178
Nemo	0.004599	96.9254

Table 4.1 above shows results observed in order to three test images. Table 4.2 shown below shows comparative results in which our proposed design result are been compared with other work for same goal.

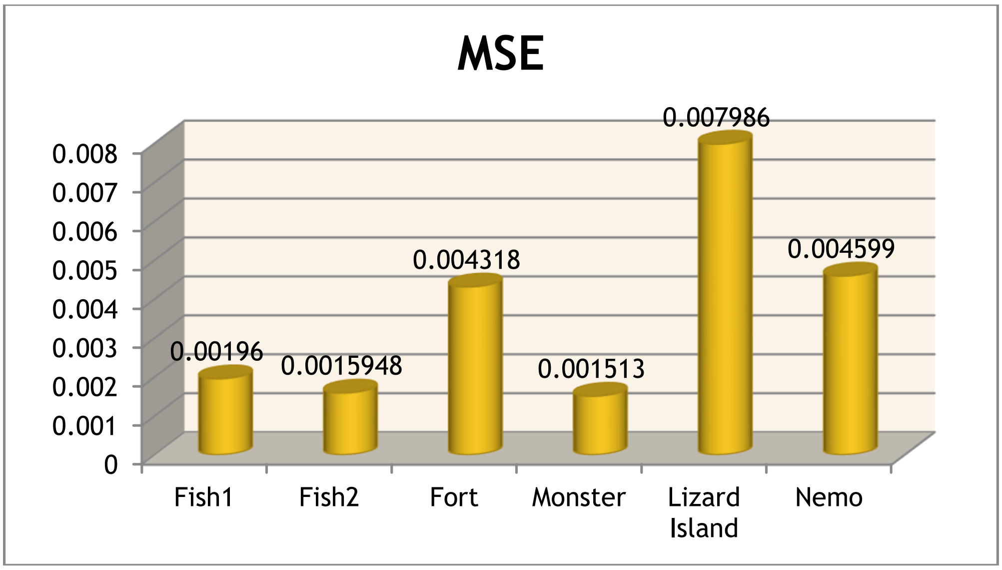


Figure 4.16 MSE observe for the different test images

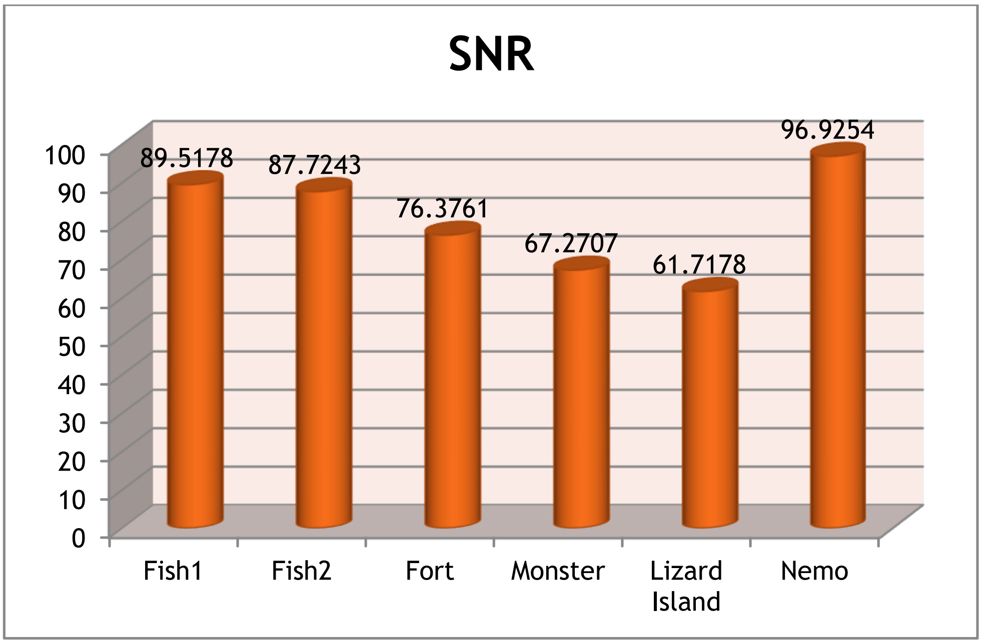


Figure 4.17 SNR observe for the different test images

Table 4.2: comparative results

PSNR Comparison			
	MESF	ACCLAHE and Homomorphism Filter	WCID
Fish1	89.5178		78.88
Fish2	87.7243	68.965	
Fort	76.3761	69.877	
Monster	67.2707	60.999	
Nemo	96.9254	69.877	

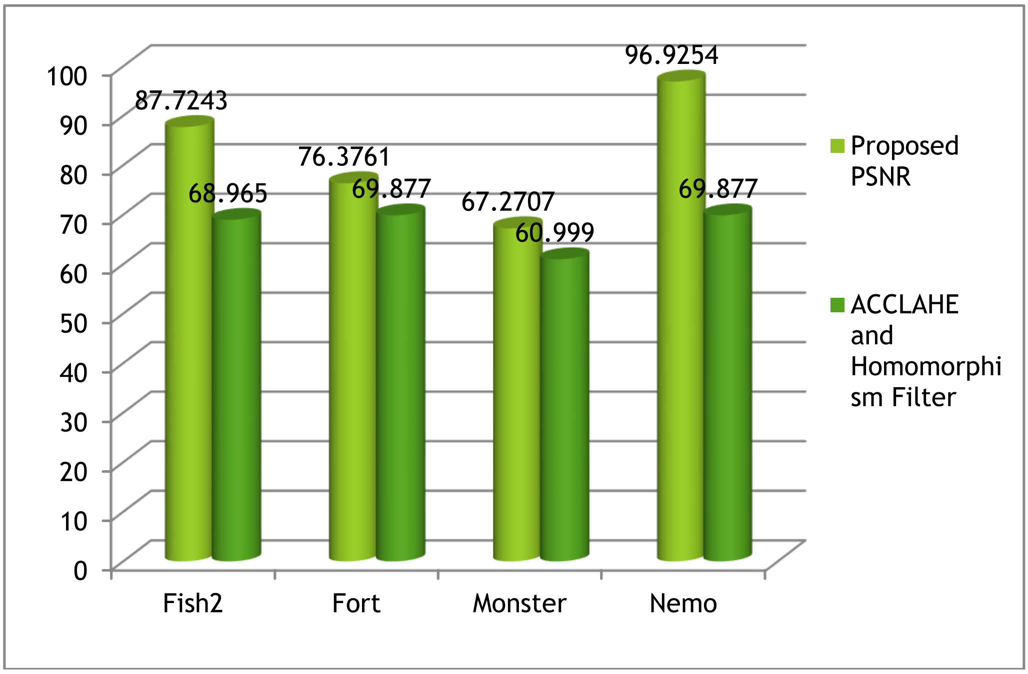


Figure 4.18 Comparative results with ACCLAHE and Homomorphism Filter [1]

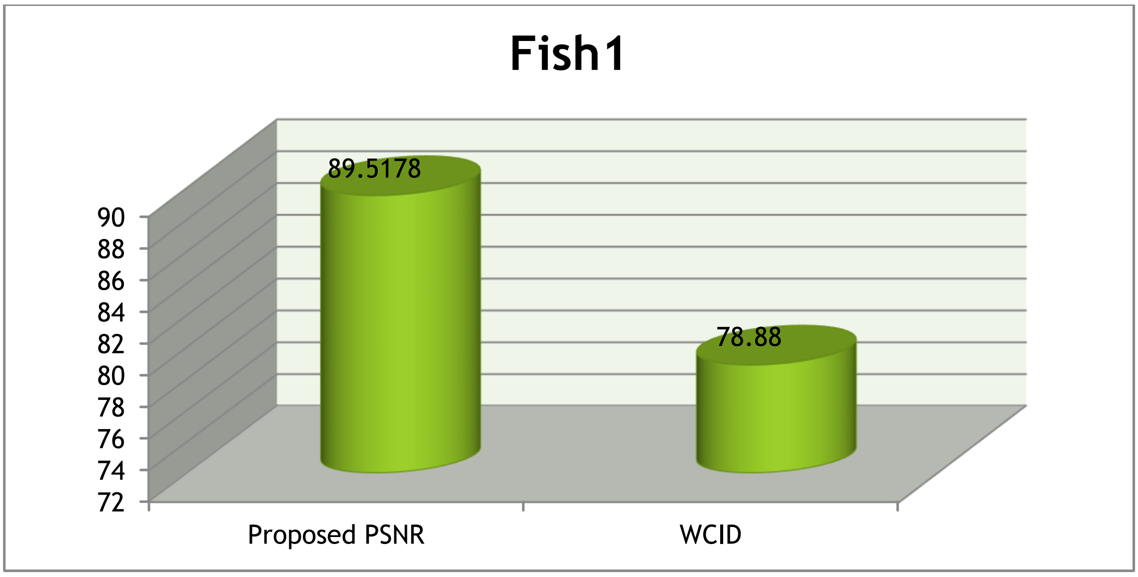


Figure 4.19 Comparative results with WCID [3]

Table 4.3 MSE comparison

MSE comparison		
	Proposed	Water-GAN
Lizard Island	0.007986	0.103

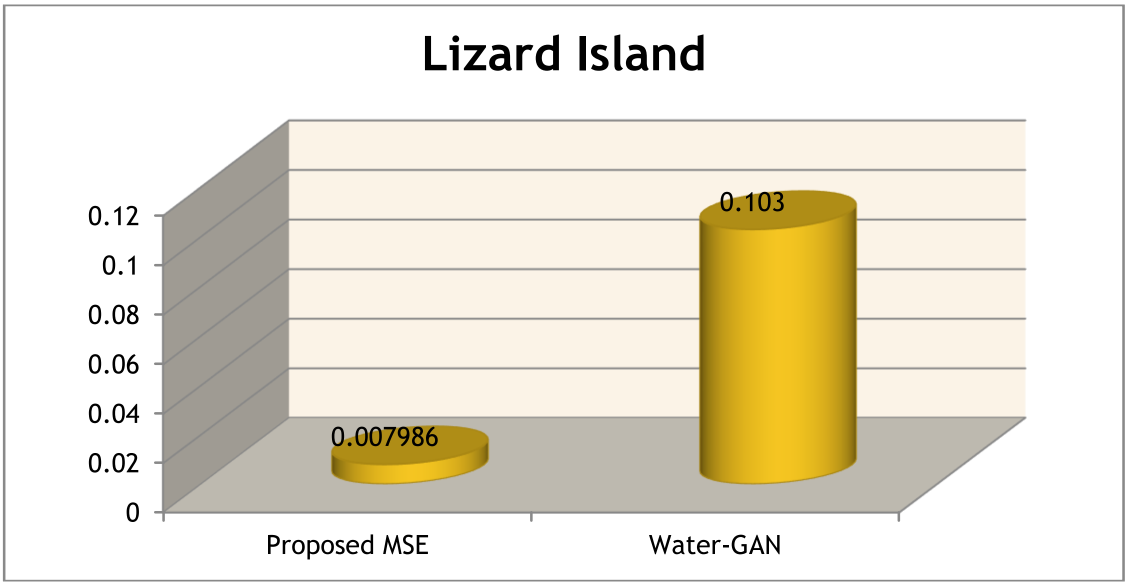


Figure 4.20 Comparative result analyses

It may be clearly observed from table and figure above that in order to proposed work achieve highest PSNR (Peak Signal to Noise ratio) as compare with base papers in order to all three test images. In base paper work 1 nemo test image is been taken and they achieve PSNR for 26.96 and in base work three in order to test image nemo they achieve PSNR for 9.6 only however in proposed work it is 46.2 which is much higher than both base paper 1 and 3, same results may be seen in figure 4.18 which prove that proposed work is better than all base work

V. CONCLUSION AND FUTURE SCOPE

CONCLUSION

The results shows that IDWC simultaneously resolved problem for Color scatter and Color casting also enhanced image contrast and calibrated Color cast and produces high quality underwater images or videos. In present paper, proposed work used slide stretching algorithm applies on both RGB and HSI color models in order to enhancing underwater images. Main advantage for using two stretching models is because helps to equalize color contrast any type for images and also mention problem for lighting. Proposed approach has produced good results. Quality for images is statistically observed through histograms. Future work will include further evaluation for proposed approach. It may be clearly seen that proposed procedure is best among available procedure with very high PSNR means significantly remove noise and very less MSE hence it has very low error.

FUTURE SCOPE

Future work will include further evaluation for proposed approach. In future this work will help in other applications where smoky, blurry etc, Future researchers may like to obtain a sample for ocean water and data on artificial light sources to further improve image restoration processes. Future work may include various advance than median filter and also use for special combination for adaptive filters

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