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Hybrid Algorithm for Under Water Image Enhancement

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***Abstract*— Underwater Photography plays a vital role in underwater & ocean bed exploration. Also underwater image acquisition is crucial for autonomous underwater vehicles, & has an important significance in research, rescue, & exploration under ocean bed. Underwater Imaging possessed a different kind of challenge comparison to conventional photography. The equipment used for underwater photography should be water proof & resistant to water damage, but should simultaneously provide a clear field of view. Major photographic challenges involve low light at higher depths, refraction due to water density, show, blurring due to motion & water ripple. The proposed system presents a comprehensive GUI based system to correct underwater image artifacts by employing Image contrast Enhancement Techniques, Multiple Filters including custom filtering, Blind Deblurring, CLACHE Enhancement, Background Estimation & RGB-HSI Average Histogram Techniques.**

Index Terms— ***Underwater Photography, Underwater Image Enhancement, Sea Bed Exploration, CLACHE-RGB/HSV Averaging***

I. Introduction

Bitmaps are digital images. The term "bitmap" refers to how a particular pattern of bits in pixels assigns a particular color. A bitmap takes the form of an array, where the value of each element, called a pixel image element, corresponds to the color of that part of the image. The amount of data used to represent color is called the color depth. The 16-bit color depth is called HiColour, and the 24-bit color depth is called TrueColour. One way to describe an image using numbers is to advertise its contents using the position and size of geometric shapes and shapes such as lines, curves, rectangles, and circles; these images are called vectors. These numbers are given a representation that the computer understands, so that the computer can display it. Vector images are based on mathematical equations, so no matter how much the image is scaled, the image quality will not be lost, because the quality is not based on individual pixels such as a bitmap. This is called an independent decision. Sprites are also known as this animated object blocks because if you want to change an object on a background, you'll have to redraw the entire background at a time, which will be very inefficient. With sprites, you can just separate the object from the background, so it can be moved and adjusted freely and easily. Sprites are handled separately from the memory bitmap of a video display. Because sprites are just bitmaps, they are represented this way on computers.

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II. Objectives of Study

1. Design and development of a hybrid algorithm for deskewing and denoising of underwater images.
2. Development of advanced algorithm to counter motion blur occurance in underwater image(s).
3. Adaptive artificial intelligence technique used to counter motion blur and media skew in underwater image(s).
4. The proposed system may be adopted to be used on video sequences as compared to being used on only images.

5. If used for video, the non skewed or non blurred frame(s) of the underwater video can be used as a training references for vision processing algorithm proposed to further enhance deskewing and motion blur reduction efficiencies.
6. Our proposed system may focus on reduction of space and time complexity of existing methods of underwater image deskewing and deblurring.
7. Our proposed system may be adapted to counter color and contrast disbalance of underwater images in addition of primary aim of deskewing and denoising.

III. Existing Techniques

We offer an effective technique to enhance underwater images degraded by scattering and medium absorption. The way we work is a single image method that does not require hardware or specialized knowledge about underwater conditions or landscape structure. It relies on blending two images directly derived from a balanced and balanced color copy of the original degraded image. The two images to be merged, along with the associated weight maps, are defined to enhance the transfer of edges and contrast to the output image. To avoid sharp weight-map transitions to produce artifacts in reconstructed low-frequency components of an image, we also adapt to the multi-band fusion strategy. Our comprehensive qualitative and quantitative assessment reveals that our enhanced images and videos feature better exposure to dark areas, improved global contrast, and edge clarity. Validation also proves that our algorithm is reasonably independent of camera settings, and improves the accuracy of many image processing applications, such as image segmentation and key point matching. [1]
The area of underwater image processing has received considerable attention in recent decades, showing significant achievements. In this article we review some of the most recent methods that have been developed specifically for the underwater environment. These techniques are capable of expanding the range of underwater images, improving the contrast and resolution of the image. After considering the basic physics of light propagation in the aquatic environment, we focus on the different algorithms available in the literature. The conditions for which each one was originally developed are highlighted, as well as the quality assessment methods used to evaluate its performance. The

difficulty associated with getting to see objects at long or short distance in underwater scenes is a challenge for the image processing community. Even if there are many methods for image enhancement, they are mainly limited to normal images and few methods have been developed specifically for underwater images. [2]

Underwater environments often cause color dispersion and color emission during photography. The color dispersion is caused by the fog effects that occur when the light reflected by the objects is absorbed or dispersed several times by particles in the water. This in turn reduces the visibility and contrast of the image. The color dye is caused by the variable attenuation of light at different wavelengths, which makes underwater environments bluish. To address the distortion of color dispersion and color distribution, this study proposes an algorithm for restoring underwater images that combines a fading algorithm with wavelength compensation (WCID). Once the distance between the objects and the camera was estimated using a dark channel before, the turbidity elimination algorithm eliminated the effects of color dispersion. Next, the estimation of the depth of the photography scene was made from the residual energy ratios of each wavelength in the backlight of the image. Depending on the amount of attenuation of each wavelength, reverse compensation was performed to restore color distortion. An underwater video downloaded from the You-tube website was processed using WCID, histogram equalization and a traditional hazing removal algorithm. [3]

As light dims when it diffuses in water, the clarity of images or videos captured underwater generally degrades to varying degrees. By exploring the difference in the attenuation of light between the atmosphere and water, we derive a new underwater optical model to describe the formation of an underwater image in the real physical process, and then propose an efficient improvement algorithm with the derived optical model to improve the perception of underwater images or video frames. In our algorithm, a new underwater dark channel is derived to estimate the dispersion rate, and an effective method to estimate the backlight in the underwater optical model is also presented. [4]

Variable range laser imaging technology as a form of underwater detection with a long detection distance has a wide range of applications in underwater exploration, recognition, rescue and other fields. The digital image enhancement algorithm has been shown to have a significant effect to further improve the image quality of the underwater laser range imaging system. Based on previous laboratory research on underwater laser range gate imaging technology, we realize the local nonlinear improvement algorithm on the FPGA hardware platform, which obtained the underwater laser field image enhancement in real time. The experiments were carried out in 18 m long pipes filled with water to compare and analyze several improvement algorithms together. The results showed that the local nonlinear improvement algorithm on paper significantly improved image quality compared to conventional methods. Based on the in-vitro submerged range laser imaging system, the local nonlinear image enhancement algorithm operating on the FPGA platform is studied in the paper. [5]

Image enhancement is a process to improve image quality by improving its function. This article presents a comparative analysis of several improvement techniques for such underwater images. The underwater image suffers from low contrast and resolution due to poor visibility conditions, therefore, the identification of an object becomes a typical task. The processing of the captured underwater image is necessary because the quality of the underwater images affects and these images lead to some serious problems compared to the images of a lighter environment. There is a lot of noise due to low contrast, poor visibility conditions, natural light absorption, non-uniform lighting and small color variations and the blur effect in underwater images, due to all these reasons, there are several methods to cure these underwater images. , different filtering techniques are also available in the literature for the processing and improvement of underwater images. Image optimization is a technique to improve image quality by improving its features and values in RGB. The underwater image processing area has received considerable attention over the past decades, demonstrating important achievements. [6]

This article describes a novel method to improve optical images or videos of shallow water using a prior fast dark channel decalcification method. Absorption, dispersion and color distortion are three main distortion problems for underwater images. In this article, we propose a new model of shallow water images to compensate for the attenuation discrepancy along the propagation path and an effective scheme to improve the underwater scene. Recovered images are characterized by a reduced level of noise, better exposure of dark regions and an improved overall contrast where finer details and edges are significantly improved. [7]

The image taken in the water is blurry due to the multiple effects of the underwater medium. These effects are subject to suspended particles that absorb and disperse light during the image formation process. The underwater medium is not easy for imaging data and brings low contrast problems and faded colors. Therefore, during any image-based exploration and examination activity, it is necessary to improve the imaging data before going for further processing. This paper offers a wavelet-based fusion method to enhance submerged blur images by addressing low contrast and color change issues. Publicly available underwater blur images are improved and qualitatively analyzed with some modern methods.. [8]

Image optimization is the process of improving the quality of the input image so that it is easily understood by future viewers. Image enhancement improves the content of image information and changes the visual impact of the image on the observer. Enhances image enhancement image features. It highlights image features such as edges, by contrast to build a more useful image display for examination and study. Image enhancement involves many processes, such as contrast variation, noise cutting, false coloring, noise filtering, etc. to improve image rendering. The active range of selected photo features is maximized by optimization so they can be detected simply. Underwater images mainly suffer from the problem of poor color contrast and poor vision. These problems were caused by the scattering of light and the refraction of light as it entered from the rarest to a denser medium. Scattering causes light noise and reduces color contrast. These effects of water on underwater images are not only due to the nature of the water but also because of the organisms and other substances present in the water. Many techniques and methods are created by researchers to solve the problem of improving the underwater image. In this paper, various underwater enhancement techniques are reviewed and studied. The overall goal is to explore the shortcomings of previous techniques. In this article, different underwater image enhancement techniques are reviewed and studied. All revised methods improve underwater images greatly. [9]

The RGB YCbCr (RYPro) processing method is proposed for underwater images that typically suffer from low contrast and poor color quality. The degradation of image quality can be attributed to the absorption of light and the dispersion of light by particles suspended under water. Moreover, the greater the depth, the different colors are absorbed by the surrounding environment depending on the wavelengths. In particular, blue / green is the dominant underwater atmosphere known as the color layer. For further image processing, optimization remains a basic process before processing. Color equation is a widely adopted method of enhancing the image of water. Conventional methods usually involve blind coloring to enhance the image under test. In the present work, the processing sequence of the proposed method includes noise removal using linear and non-linear filters followed by adaptive contrast correction in RGB and YCbCr color levels. The performance of the proposed method is evaluated and compared with three gold methods, Gray World (GW), White Patch (WP), Adobe Photoshop Equalization (APE) and a recently developed method called Uncensored Color Correction Method (UCM). Given its simplicity and ease of calculation, it is recommended to use the suggested method for real-time applications. [10]

This paper proposed a new way to recover and improve enhanced underwater images that were inspired by the previous dark channel in the freeze image field. First, we suggested a bright channel before the underwater environment. By estimating and correcting the bright channel image, estimating atmospheric light, and estimating and improving the transmittance image, the underwater images were finally restored. Second, in order to correct color distortion, the restoration images were neutralized using the derived graph equation. The results of the experiment showed that the proposed method can effectively enhance the quality of underwater images. In this paper, a new method is proposed to restore and improve underwater images. Our algorithm was inspired by the dark channel drying the previous image. First, we suggested a bright channel before the underwater environment. By estimating and correcting the bright channel image, estimating atmospheric light, and estimating and improving the transmittance image, the underwater images were finally restored. Second, in order to further correct color distortion, we used the derived graph equation to achieve an equation between the restoration images. We conducted our experiments on four different underwater images that represent four different scenes from the underwater environment. [11]

Due to the absorption and scattering of light in the underwater environment, underwater images have poor contrast and resolution. This situation usually causes a color, which became more dominant than the others. Because of that, analyzing underwater images effectively and identifying any object under water has become a difficult task. In this article, an underwater improvement approach was proposed through the use of the differential evolution algorithm. In the approach, a contrast enhancement is made in the RGB space. By using the approach, the effects of dispersion and absorption are reduced. In water, visibility is low due to the absorption of light and radiation. As a result of these problems, underwater images have low contrasts and resolutions. In this study, an underwater image improvement approach has been proposed that uses a differential evolution algorithm based on contrast enhancement. [12]

IV. METHODOLOGY

(A) Histogram Equalization

Histogram equalization is a computer image processing technique used to improve the contrast of images. This is achieved by effectively distributing the most frequent intensity values, that is, extending the intensity range of the image. This method generally increases the overall contrast of the images when their usable data is represented by close contrast values. This allows areas of lower local contrast to obtain greater contrast. A color histogram of an image represents the number of pixels in each type of color component. The histogram equalization cannot be applied separately to the red, green and blue components of the image, as it leads to dramatic changes in the color balance of the image. However, if the image is first converted to another color space, such as the HSL / HSV color space, the algorithm can be applied to the luminance or value channel without changes in the hue and saturation of the image.

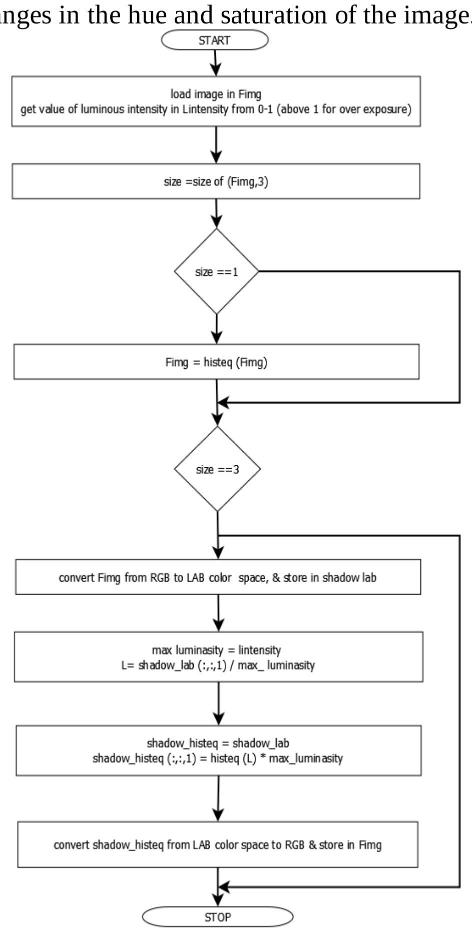

Fig. 1.1: Flow chart of histogram equalization

(B)Adaptive Histogram Equalization

Adaptive Graph Equation (AHE) is a computer image processing technique used to improve image contrast. It differs from the normal graph equation in that the adaptive method calculates many graphs, each of which corresponds to a distinct section of the image, and uses it to redistribute the image lightness values. Therefore, they are suitable for improving local contrast and edge definitions in each region of the image. However, AHE has a tendency to over-amplify noise in relatively homogeneous areas of the image. A variable of an adaptive graph equation called finite variance of an adaptive graph equation (CE) prevents this by reducing amplification.

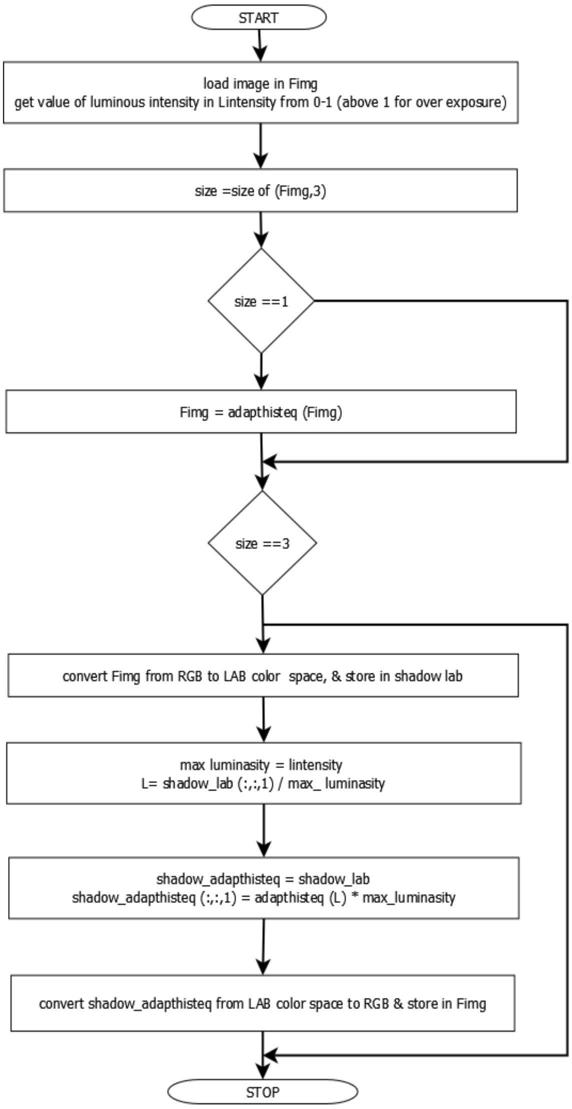

Fig. 1.2: Flow char of Adaptive Histogram Equilization

(C)Deblurr

Blurring is the process of removing blurry artifacts from images, such as blur caused by aberration blur or motion blur. Blur is usually modeled as the convolution of a point dispersion function (sometimes variable in space or time) with a hypothetical sharp input image, where the sharp input image (which is to be recovered) is unknown. as the point dispersion function. This is an example of a reverse problem. In almost all cases, there is not enough information in the blurred image to uniquely determine a plausible original image, so it is a badly posed problem. In addition, the blurred image contains additional noise that complicates the task of determining the original image. This is usually solved by using a regularization term to try to eliminate unlikely solutions. This problem is analogous to echo removal in the signal processing domain. However, when a coherent beam is used for the image, the point scattering function can be modeled mathematically. By proper deconvolution of the point spread function and the image, the resolution can be enhanced several times.

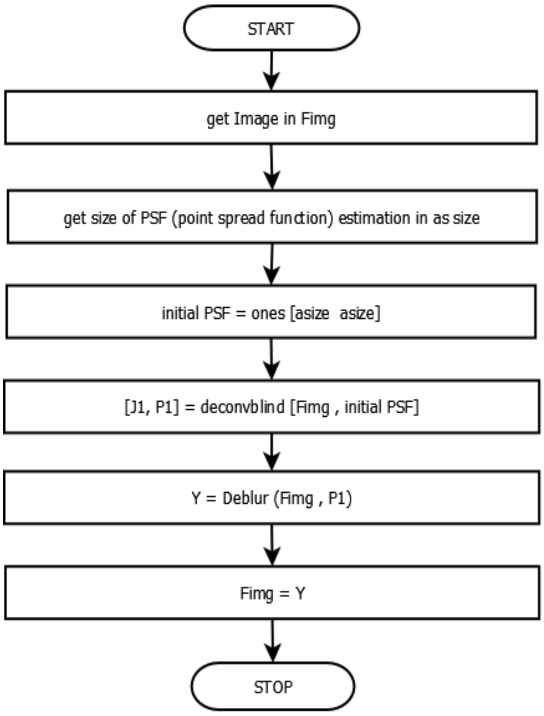

Fig.1.3 : Flow Chart of Deblur Blind

V. RESULT

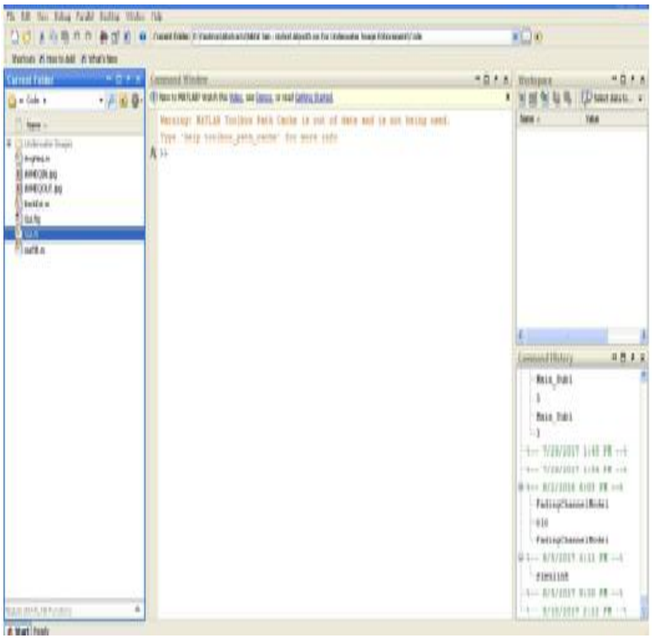

Figure 5.1 – Select the file GUI.m

In above figure we select the current folder in which we select the file GUI.m to run the code.

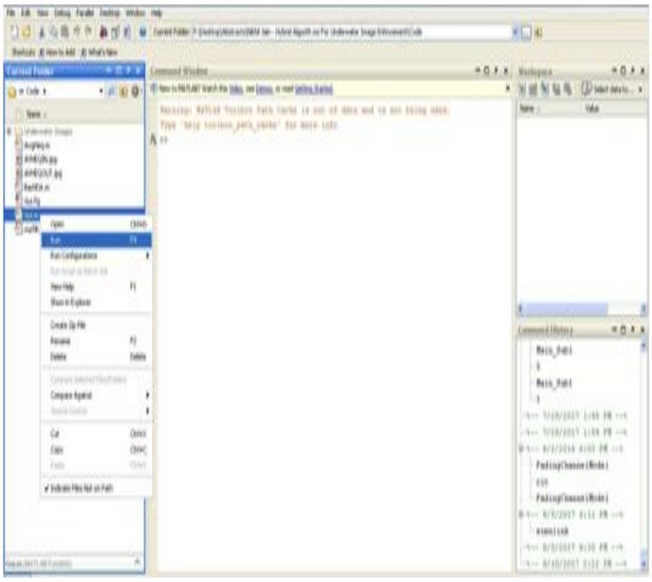

Figure 5.2 – Click on right to run

In above figure we select the file GUI.m to run the code, click right button and select run to run the code.

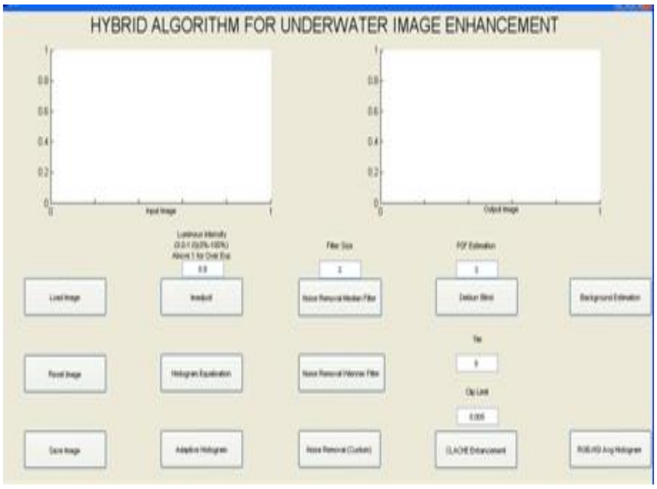

Figure 5.3 – Hybrid algorithm for underwater image enhancement

In above figure show that there is many option for image enhancement to perform hybrid algorithm for underwater image enhancement.

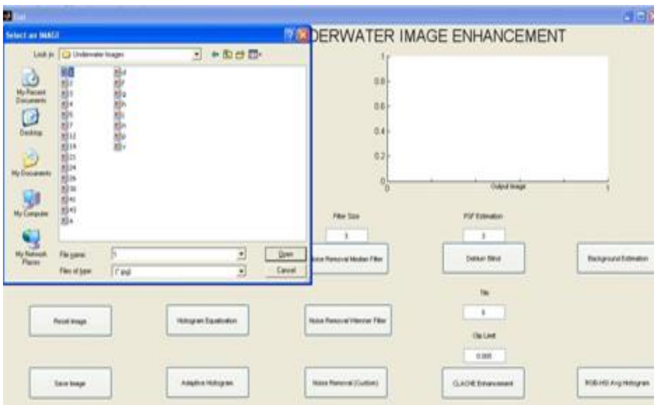

Figure – 5.4 Select the Underwater Image1

In above figure we select the underwater image name is1 and file type is jpg format.

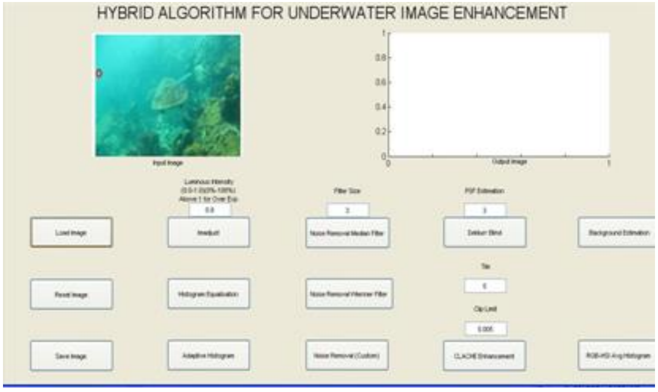

Figure 5.5 – select load image

In above figure after selecting the underwater image we load the image and we see the selected image is display as input image.

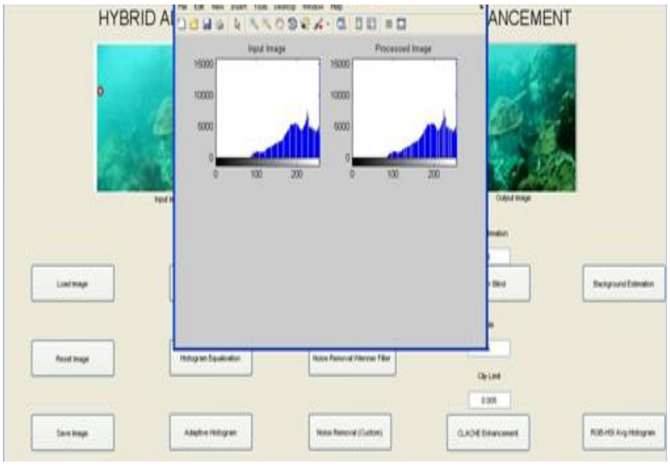

Figure 5.6 – Display input image and processed image graph

In above figure figure we see the graph of input image and process image after loading the image. And output image is also displayed.

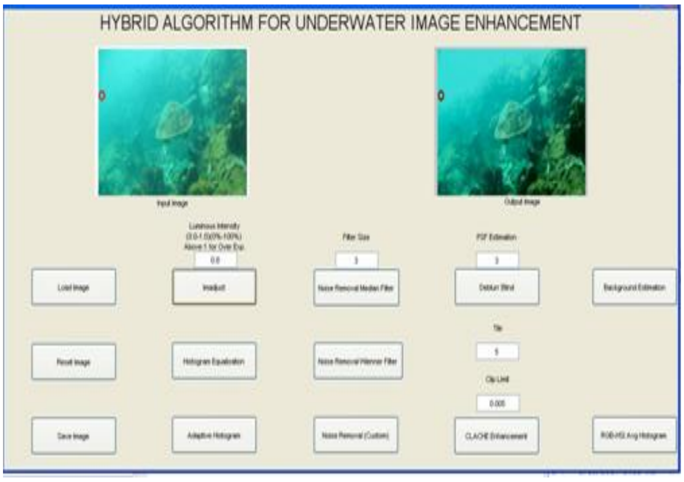

Figure 5.7 – Select imadjust

In above we select the option imadjust to adjust the image enhancement

Figure 5.8 – Select Clache Enhancement

In above figure we select the method CLACHE enhancement and apply it. Then we can see that the output image more clear than input image

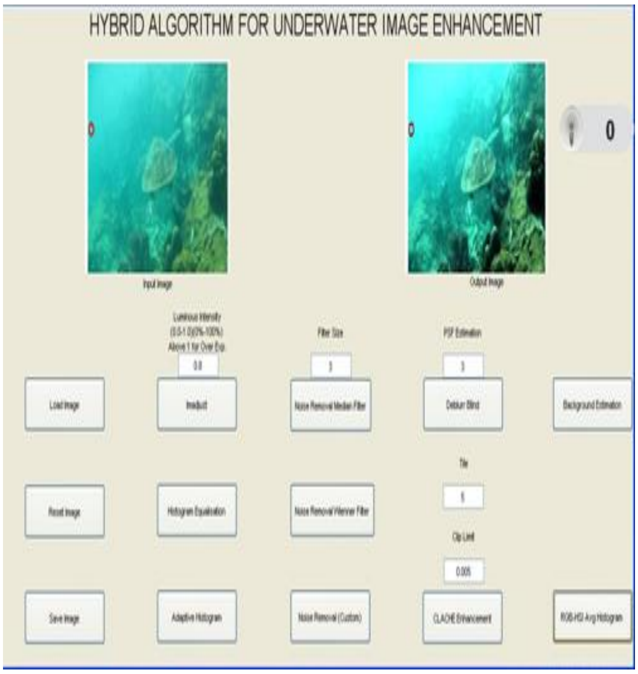

Figure 5.9 – Select RGB HSI avg histogram

In above figure we select the RGB HSI avg histogram method apply it on the image.

I have identified 6 image problems and which operation is applied to remove that problems are show in Table 1.1.

S.NO.	Image Name	Problem Identification	Operation Perform
1	I1.jpg	Refraction Color Loss, Poor Visibility	CLACHE T 5 C 0.005
2	I2.jpg	Low Contrast, Dull Colors, Poor Depth	Histogram 0.98, CLACHE T 5 C 0.005
3	I3.jpg	Over Exposure, Color Imbalance, Slight Noise	RGB-HSI, Custom 3
4	I4.jpg	Refractive Color Shift, Slight Blurr, Non – Uniform Light Distribution	Histogram 0.995, Deblurr1, RGB-HIS
5	I5.jpg	Low Lighting, Color Skew, Slight Noise	Imadjust 0.998, CLACHE, Wiener3
6	I6.jpg	Over Exposure, Reflective Artifacts, Color Imbalance	Adaptive Histogram 0.9955, RGB-HSI

Table 1.1

VI. CONCLUSION

The proposed system lays out a complete GUI based underwater image enhancement tool. It incorporates numerous enhancement methods, which can be applied over the same image one after another as per the user's requirement. The proposed system incorporates Image Contrast Enhancement using Imadjust, Histogram Equalization & Adoptive Histogram Equalization. The user can select the percentage of luminous Intensity Enhancement, from 0-100% & above 100% for over-exposure also. Similarly on array of filters is provided, the user can select between Median, Wiener & Custom designed filter. The filter window size can also specified by the user.

De-blurring is achieved by using Blind De-blurring technique. The user specifies the filter size, & point spread function (PSF) is approximated in (2-1) filter size. The approximated PSF is applied on original Image using de convolution to achieve De-blurring. CACHE Enhancement is employed with user specified tile size & clip limit using adoptive Histogram in HSI / RGB image. Background estimation is used for De-skewing the imager & remove refraction effect's such as color shift etc. RGB / HSI average Histogram is also provided to enhance the color &

luminosity, contrast of the underwater image. Thus, as demonstrated by the results above, a multi-technique comprehensive GUI tool has been presented for underwater image enhancement.

VII. FUTURE SCOPE

Underwater Image Enhancement is a critical technology for Underwater Exploration & Autonomous Underwater Vehicles. As Autonomous Underwater Vehicles aim to go deeper in underwater explorations & researchers are exploiting other autonomous technologies such as unmanned rescue, cable laying etc, the vision characteristics of underwater vehicle should be comparable to normal image. As the expectations & challenges rise, the need to adapt the proposed work accordingly arises. One of the important changes would be usage of Artificial Intelligence & Machine Learning to reconstruct images with better results. Another upgrade can be incorporation of a Self Learning model for learning lighting conditions, with various lighting, camera & lens equipment, to automatically compensate for refraction & low light effects. Also an embedded system of vibration sensors can be employed to measure water current & ripples around the camera & the object to automatically compute de-blurring parameters.

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