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# Underwater Image Enhancement Algorithm for Dehazing

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***Abstract*** *- Images of outdoor scenes typically contain haze, fog, or completely different varieties of half degradation caused by helices inside the part medium absorbing and scattering light-weight as a result of it travels from the provision to the observer. Image obtained at completely different end is characterized by reduced distinction and pale colors. Whereas this impact is additionally fascinating in an original setting, it's generally necessary to undo this degradation. Climate disagrees within the main inside the kinds and sizes of the particles involved and their concentration in space. an honest deal of effort has gone into activity particle sizes and concentrations for a spread of conditions as shown in table I. as an example, many laptop vision algorithms trust the assumption that the input image is strictly the scene radiance. Once this assumption is violated, algorithmic errors area unit ruinous. One may merely see but a automotive navigation system that did not take this impact into thought might need dangerous consequences. Consequently, finding effective ways that for haze removal is associate ongoing house of interest inside the image method and laptop vision fields. This task is significant in several out of doors applications like remote sensing, intelligent vehicles, underwater imaging and much of extra.*

*Underwater Imaging might be a significant analysis house in ocean engineering. Underwater footage unit captured to explore underwater world, perform underwater Surveys, archeology, prognostication, skin-dive and underwater aquatic life etc. Underwater haze removal techniques become terribly trendy due to the use of various vision underwater applications. Exploring, understanding and work underwater activities of images unit gaining importance. Scientist's unit keen to explore inscrutable underwater world. But underwater footage has poor visibility and low distinction due to haze. Haze is development that hinders the quality of underwater footage. Haze removal might be a tough and complicated draw back as results of its supported unknown depth information. Haze degrades the scene distinction and result in weakening of colors. So, removing the haze might be a sophisticated and tough task.*

***Keywords—:*** *Image Processing, Dehazing, Visibility Restoration, Light Intensity*

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## I. INTRODUCTION

Here we have a tendency to describe a unique technique to reinforce underwater pictures by dehazing. Scattering and color modification are 2 major issues of distortion for underwater imaging. Scattering is caused by massive Suspended particles, such as murky water that contains thick Particles. Color modification or color distortion corresponds to the variable degrees of attenuation encountered by lightweight traveling within the water with completely different wavelengths, rendering close underwater environments dominated by a chromatic tone. Our key contributions are planned a brand new underwater model to compensate the attenuation discrepancy on the propagation path, and planned a quick joint pure mathematics filtering dehazing rule.

Fog, dust, haze or different sorts of region degradations area unit shaped by particles gift within the atmosphere area unit gift in out of doors pictures. associate image obtained at the different finish is characterized on the basis of reduced distinction and become less clearly visible colors. In associate creative setting, result could be fascinating thus degradation removing is required. Weather condition [1] changes in the kinds and sizes of the particles that area unit concerned in the atmosphere. For example, most of the laptop vision algorithms supported the hypothesis that the input image is dead the scene radiance, i.e. there's no result from haze. once this thought is failing, error happens in algorithmic rule and that will be extraordinarily harmful. Consequently, finding effective ways for haze removal is associate rising space of interest in the laptop vision fields and image process. This task is beneficial in completely different out of doors applications such as remote sensing, intelligent vehicles, underwater imaging and plenty of additional.

Underwater Imaging might be a necessary analysis house in ocean engineering. Underwater haze removal techniques become terribly commonplace due to the use of varied vision underwater applications. Underwater footage unit of measurement captured to means that the world at underwater. Scientist's unit of measurement keen to explore the incomprehensible underwater world. however underwater

footage has poor visibility and poor distinction owing to haze. Haze might be a natural development that decreases the visibility of underwater footage. Removal of haze might be a stern and heavy recoil as results of it is awfully based mostly on unknown information relating to depth. Haze degrades the scene distinction and end in attenuation of colors. So, removing the haze can be a modern and hard task. There unit of measurement numerous techniques developed to need away the haze from underwater footage thus image quality is inflated. Type of the underwater imaging applications unit of measurement as follows

(a)National geographic channel
(b)Underwater Surveys
(c)Marine Archaeology
(d)Marine Geology
(e)Scuba diving
(f)Sports and Education

There are strategies for addressing photo processing: one technique

(i)To recover a degraded image mistreatment a model of the degradation and of the first image formation; is that the main objective of image restoration. These ways need several model parameters that are hardly renowned in tables and might be extraordinarily variable. Depth estimation of a given object within the scene is additionally vital parameter that is needed.

(ii)For manufacturing additional visible image the image sweetening technique uses qualitative subjective standards and for image formation they do not depend on any bodily model.

## II. LITERATURE REVIEW

It was that the main degradation effects can be associated with partial polarization of light .This paper proposed an image recovery algorithm based on a couple of images taken at different orientations with a polarizer .Distance map of the scene was also derived. It resulted into improvement of scene contrast and color correction and underwater visibility range was nearly doubled. [1]

The authors given associate underwater image improvement technique mistreatment associate integrated color model. They planned associate approach supported slide stretching: initial, distinction stretching of RGB formula is employed to equalize the color distinction within the pictures. Second, saturation and intensity stretching of HSI is applied to extend verity color and solve the matter of lighting. The blue color part within the image is controlled by the saturation and intensity to form the vary from pale blue to deep blue. The distinction quantitative relation is thus controlled by decreasing or increasing its worth. [2]

The authors proposed an efficient and low complexity underwater image enhancement method based on dark channel prior. In the proposed approach to estimate the depth map of image median filter had been used instead of the soft matting procedure. A color correction method was adopted to enhance the color contrast for underwater image. The presented approach required less computing time, enhanced underwater image effectively and was suitable for implementing on the surveillance and underwater navigation in real time [3].

In this paper, the authors proposed Empirical Mode Decomposition primarily based totally underwater picture enhancement technique. The more suitable picture changed into built via way of means of combining the IMF's Intrinsic Mode Functions of spectral channels with distinctive weights which will reap an more suitable picture with accelerated pleasant. Genetic set of rules changed into used to perform weight estimation automatically. The proposed technique furnished higher interpretability, Visibility and notion of gadgets with inside the photographs. The more suitable photographs had extra visible details, higher pleasant and exact contrast. [4]

In this paper, the authors proposed a novel algorithm called Wavelength Compensation and Dehazing to enhance underwater images. The dehazing algorithm used to compensate the attenuation discrepancy along the propagation path and to take the influence of the possible presence of an artificial light source into consideration. Firstly depth map was estimated and then the segmentation of foreground and background within a scene was done. The light intensities of foreground and background were compared to determine whether an artificial light source was employed during the image capturing process. After compensating the effect of artificial light, the haze phenomenon and discrepancy in wavelength attenuation along the underwater propagation path to camera were corrected. [5]

Fog removal algorithms become more beneficial for numerous vision applications.

Following are the some limitation found from literature survey:-

1. The present methods have neglected the techniques to reduce the noise issue present in the output images of the existing fog removal algorithms.
2. Not much effort has focused on the integrated approach of the dark channel prior (DCP) and CLAHE.
3. The problem of the uneven illumination is also neglected by the most of the researchers. It degrades the performance of haze removal algorithms
4. Not much effort is done towards remote sensing and underwater images.

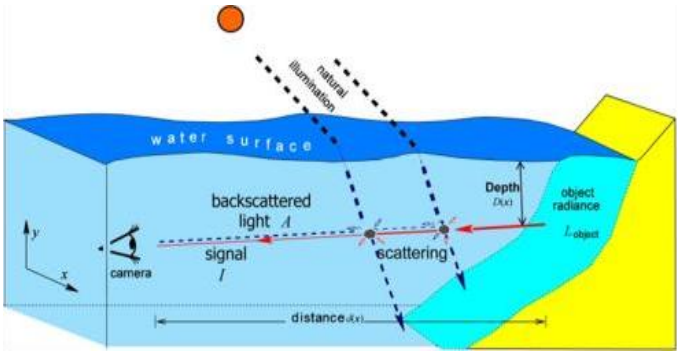



Fig1. Proposed System Architecture

## III. PROPOSED SYSTEM

Haze removal algorithms become more useful for many vision applications. No technique is accurate for different kind of circumstances. The survey has shown that the present methods have neglected the techniques to reduce the noise relation issue which is presented in the resulting images of the existing fog removal algorithms. The trouble of choppy and over illumination is likewise a difficulty for dealing methods. So it is required to modify the existing methods in such a way that modified technique will work better. In near future to overcome the problems of existing research a new integrated algorithm will be proposed. New algorithm will integrate the dark channel prior, CLAHE and bilateral filter to improve the results.

## RESULT AND ANALYSIS

### 1. Original Image

The Following Figure Shows the original image


Fig2. Input Image

### 2. Segmentated Image

Active contour is a segmentation technique that makes use of power forces and constraints to split the pixels of hobby from a image for similarly processing and analysis. Active contour is described as a lively version for the segmentation process. Contours are the bounds that outline the place of hobby in an photograph. A contour is a set of factors which have been interpolated. The interpolation system is probably linear, spines, or polynomial, relying on how the curve within the slide

The Following Figure Shows the Segmentated Image

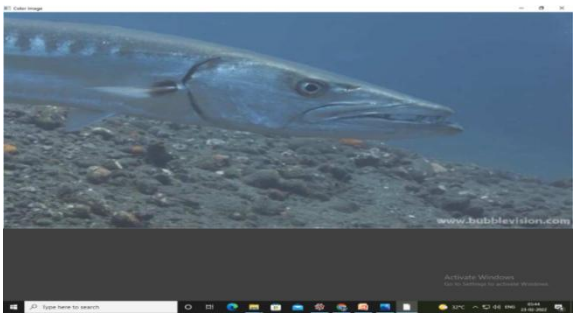



Fig 3. Segmentated Image

**3. RGB Channel**

Here are a handful of satiation areas to symbolize a photograph consisting of RGB, BGR, HSV, CMYK etc. But there may be something all of them have in common. They are the channels, which those image areas use, to together shape a photograph. Let us have a take a observe a few definitions of channels Color virtual snap shots are product of pixels, and pixels are product of combos of number one colorations represented through a chain of code. A channel on this context is the grayscale photograph of the equal length as a image photograph, product of simply any such number one colorations. Grayscale snap shots are single-channeled snap shots wherein every pixel includes simplest statistics approximately the depth of light. These snap shots are solely made of sun sunglasses of gray. Grayscale snap shots must now no longer be stressed with black and white snap shots (binary snap shots) which comprise simplest black and white pixels. In binary snap shots, both a pixel is black or its miles white. They don't have any coloration in between. But Grey scale snap shots have a extensive variety of sun sunglasses of gray of their pixels.

RGB Images:

Unlike grayscale snap shots, RGB snap shots are 3 channeled.

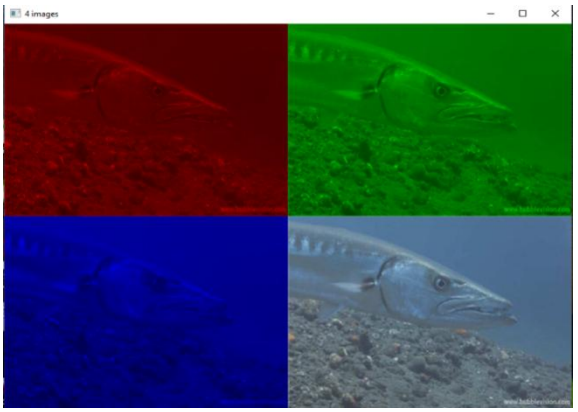



Fig 4. RGB Image

**4. Median Filter Image**

Median filtering is a nonlinear method used to remove noise from images. It is widely used as it is very effective at removing noise while preserving edges. It is particularly effective at removing 'salt and pepper' type noise. The median filter works by moving through the image pixel by pixel, replacing each value with the median value of neighboring pixels. The pattern of neighbors is called the "window", which slides, pixel by pixel over the entire image 2 pixels, over the entire image. The median is calculated by first sorting all the pixel values from the window into numerical order, and then replacing the pixel being considered with the middle (median) pixel value.

Median Filter is a simple and powerful non-linear filter.

It is used for reducing the amount of intensity variation between one pixel and the other pixel.

In this filter, we replace pixel value with the median value.

The median is calculated by first sorting all the pixel values into ascending order and then replace the pixel being calculated with the middle pixel value

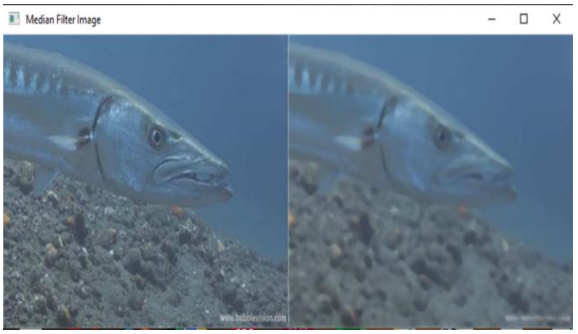



Fig 5. Median Filter Image

**5. Dark Channel Prior**

The dark channel previous rely on the subsequent observation on haze-free out of doors images: in most of the non-sky patches, a minimum of one color channel has terribly low intensity at some pixels. In

alternative words, the minimum intensity in such a patch ought to encompass a terribly low price. Formally, for a picture J,

$$J^{dark}(\mathbf{x}) = \min_{c \in \{r,g,b\}} \left( \min_{\mathbf{y} \in \Omega(\mathbf{x})} (J^c(\mathbf{y})) \right),$$

Where Jc is a color channel of J and Ω(x) is a local patch centered at x. Our observation says that except for the sky region, the intensity of J dark is low and tends to be zero, if J is a haze-free outdoor image. We call J dark the dark channel of J,

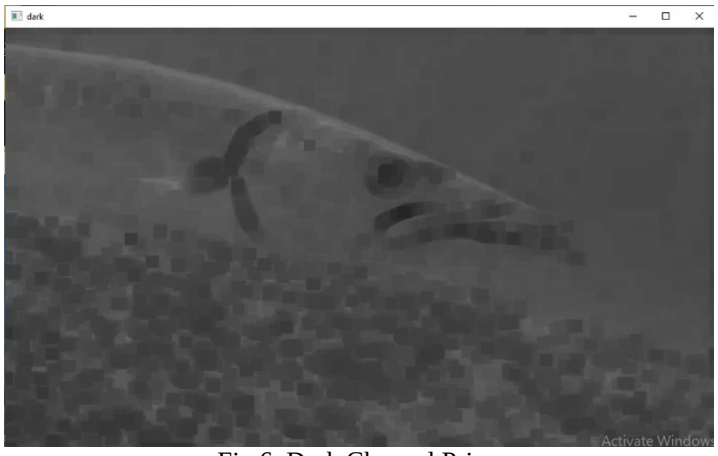
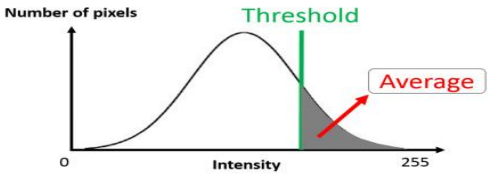



Fig 6. Dark Channel Prior

**6. Transmission Estimation**

In most of single image methods, the atmospheric light A is estimated from the most haze-opaque pixel. For example, the pixel with highest intensity is used as the atmospheric light in and is furthered refined in. But in real images, the brightest pixel could be on a white car or a white building. the dark channel of a haze image approximates the haze denseness well use the dark channel to improve the atmospheric light estimation. We first pick the top 0.1% brightest pixels in the dark channel. These pixels are most haze opaque among these pixels, the pixels with highest intensity in the input image I is selected as the atmospheric light. The color of the sky is usually very similar to the atmospheric light A in a haze image and we have:

$$\min_c \left( \min_{\mathbf{y} \in \Omega(\mathbf{x})} \left( \frac{I^c(\mathbf{y})}{A^c} \right) \right) \to 1, \text{ and } \tilde{t}(\mathbf{x}) \to 0,$$



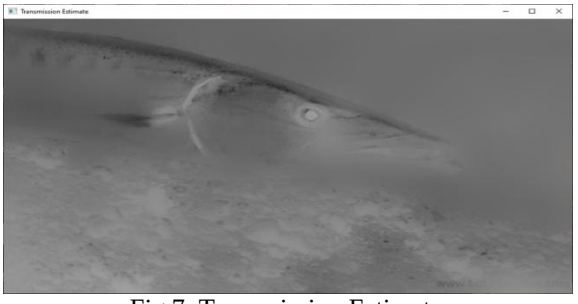




Fig 7. Transmission Estimate

**7. Haze Remove**


Fig 8. Haze Remove

**8. Recovering the Scene Radiance**

With the transmission map, we can recover the scene radiance according to Equation.

But the direct attenuation term J(x)t(x) can be very close to zero when the transmission t(x) is close to zero. The directly recovered scene radiance J is prone to noise. Therefore, we restrict the transmission t(x) to a lower bound t0, which means that a small amount of haze is preserved in very dense haze regions.

The final scene radiance J(x) is recovered by:


Fig 9. Recovering the scene radiance.

**9. UDCP Transmission**

To estimate the transmission in underwater environments which consists on an adaptation of the Dark Channel Prior (DCP), a statistical prior based on properties of images obtained in outdoor natural scenes. Our methodology, called Underwater DCP (UDCP), basically considers that the blue and green color channels are the underwater visual information source, which enables a significant improvement over existing methods based in DCP. This is shown through a comparative study with state of the art techniques, we present a detailed analysis of our technique which shows its applicability and limitations in images acquired from real and simulated scenes.


Fig10. UDCP Transmission

10. RGB Channel Plot

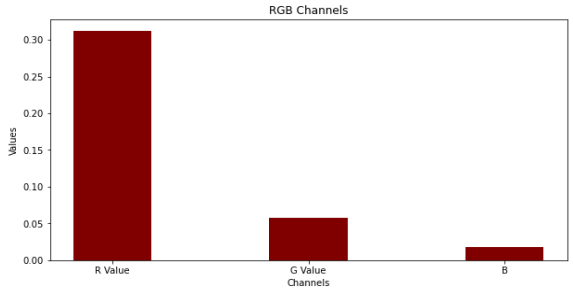



Fig.11. RGB Channel Plot

11. RGB Table

| RGB Channels | Values |
|---|---|
| R | 0.3123 |
| G | 0.0577 |
| B | 0.0176 |

Fig. 12. RGB Table

## IV. CONCLUSION

Underwater imaging is the area of image processing and it is a dynamic field. For enhancement of underwater images and videos new techniques and applications are reported routinely in new product development. For enhancement of underwater image dehazing here we propose an enhanced algorithm that work on underwater images and remove artificial lighting and maintain image quality.

In our proposed technique we are concentrated on to place the dehazed frame in the input underwater image for better quality of underwater image.

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