Image restoration under water utilising a technique for estimating scene depth

M. AKHILA [1], K.SWARNALATHA [2], M. SINDHUPRIYA [3], P.V.NANDINI [4], A.DEVAMANI [5]
[1]UG Scholar, Dept of ECE, Andhra Engineering College, Atmakur, AP, India.
[2]UG Scholar, Dept of ECE, Andhra Engineering College, Atmakur, AP, India.
[3]UG Scholar, Dept of ECE, Andhra Engineering College, Atmakur, AP, India.
[4]UG Scholar, Dept of ECE, Andhra Engineering College, Atmakur, AP, India.
[5] Associate Professor, Dept of ECE, Andhra Engineering College, Atmakur, AP, India.

ABSTRACT
Due to a lack of reference images and a constantly changing undersea environment, underwater picture restoration is a tough task. Light absorption and scattering distort the visuals. Wavelength-dependent attenuation of light occurs in deep water. Since red light has a longer wavelength than any other colour, it attenuates more quickly. A bluish-green colour is seen as the image gets deeper, obscuring much of the red substance. These photos have a fuzzy appearance, low contrast, and a colour cast. For example, specialised technology or several photographs of the same scene may be required in order to implement an existing approach currently in use. As a result, they are useless for tasks requiring real-time or video acquisition. A more effective approach of image colour enhancement and restoration should be devised. In this paper, depth map estimation and image blurriness are combined to form a new method. The depth map is created by blurring the image as light goes deeper into the water. In addition, the backlight is also gotten. IFM (Image Formation Model) is used to recreate the image with these parameters. IFM, picture restoration, image enhancing are some of the keywords.

1. INTRODUCTION

Underwater imagery plays a key part in marine engineering. Diverse fields of study can benefit greatly from underwater photographs. It is possible to record underwater photographs and films using a variety of devices, including waterproof cameras. When it comes to visibility, contrast, and illumination, underwater photographs have a number of drawbacks. This is because the organic particles distributed in water reflect light rays on their way from the item to the camera. The lack of a reference image and an underwater environment is a big hindrance to image restoration. Absorption and scattering affect light propagation in the ocean. Scattering occurs when light rays collide with suspended particles, causing light rays to refract in unexpected directions, resulting in an image that appears murky. Absorption is the process through which light rays lose energy, and it is dependent on the aqueous medium's density and turbidity, among other things. A rise in absorption rate is seen as turbidity rises in a body of water. Colors fade over time, depending on the wavelength, as the depth of the object increases. When compared to shorter-wavelength blue light, red light has a greater attenuation because of its higher wavelength. As a result, blue and green light penetrates more deeply than red and orange light does. There have been bluish-green underwater photos since then.

Restoration and enhancement are two of the techniques used to improve underwater image quality. Unsharp masking, histogram equalisation, and other techniques are used to improve the image's appearance. An identical match to the source image isn't required while enhancing the image. Restoration, on the other hand, uses modelling degradation to improve the image in the same way that the original did. The image is restored by calculating the parameters of a model for the creation of underwater images. A linear combination of the direct component and the backscattered component can be used to simulate this phenomenon. The amount of light reflected from an object's surface that reaches the camera is called the "direct component," while the rest is scattered or absorbed. Forward and backward scattering are two types of scattering. The poor contrast is caused by backward scattering, hence the forward scattering component is left out of the picture creation model. The model for image creation provided by

$$I(x) = S(x)\, t(x) + B\,(1 - t(x)) \qquad (1)$$

I(x) is the pixel-specific intensity. Scene radiance, denoted by J(x), is a measure of how much light the scene reflects back into the camera. Light that has not been scattered or absorbed is referred to as t(x). As a backlight, B can add a hazy layer to an image because of the light dispersed by the suspended particles. Image blurriness estimation, backlight estimate, depth map estimation, transmission map estimation, and scene radiance recovery are the essential procedures in this paper. BRISQUE and entropy are non-reference image quality assessment methods that are utilised to gauge the quality of the restored image, too.

For ocean exploration, the AUV is an underwater unmanned vehicle known as Autonomous Underwater Vehicle (AUV). In the case of an unfamiliar environment, it has the ability to identify it and make autonomous decisions, plan ahead, and avoid obstacles in a dynamic environment. To ensure the safety and efficiency of AUV operations, autonomous localisation is critical. Dead reckoning and acoustic beacon placement are the two basic methods of AUV localization, although their complexity and expensive instrumentation limit their use. For example, SLAM is more compact and inexpensive than inertial navigation and acoustic beacon location. There are many ways to estimate the position and orientation of a robot in an unknown environment, and one of them is called SLAM (simultaneous location and mapping). This foundation is used to build an incremental map of the surrounding environment.. In sectors including unmanned aerial vehicles, sweeping robots, autonomous driving, and intelligent wearables, academics' work on the SLAM technique has paid off. For AUV location and navigation, the use of the SLAM compared to ground and aerial unmanned systems is still in its infancy. Particle Filter and Kalman Filter were the primary tools used in AUV SLAM research. As an environmental sensor, sonar is employed [1-2].

Eighty percent of the Earth's surface is covered by water, making it an aquatic planet. Furthermore, there is a great desire to learn more about what lies beneath the ocean surface. In today's world, an image of deep seas offers the potential for a wide-ranging research of the seabed for seafloor exploration and navigation. Underwater image enthusiasts like inspecting vegetation, searching for wrecks, and searching for natural resources. If a human were to plunge deep into the ocean and remain there for an extended period of time to conduct experiments, he would encounter a number of difficulties. [1]. Unmanned remote vehicles are employed for seafloor exploration because of the above reasons.

2. LITERATURE SURVEY

TRADITIONAL TECHNIQUES FOR IMAGE ENHANCEMENT

There are several techniques which are used very frequently for processing the image to improve the visual quality. Some of them are as follows:

(i) Contrast Stretching
(ii) Adaptive Histogram Equalization

A. Contrast stretching

The contrast stretching is a method to transform high intense region of image into brighter and less intense region into more darker by using a predefined transformation function T(r) [2]. Generally, the underwater images will have less grey values. There are 256 grey values. ‘0’ indicates black and ‘255’ indicates white. In this method the current grey value of the image is stretched towards 255 i.e., from black to white, pixel by pixel. That means the contrast of the image is stretched, so that the quality of the image is improved for better vision.

For example:

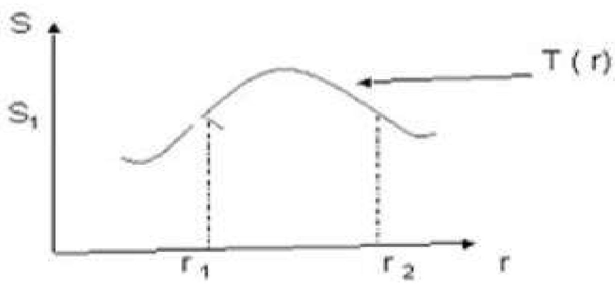

Fig.1. Two different gray levels look same

Here two different thresholds are considered for the entire image and the values between them are stretched to the maximum extent, so that the contrast increases. And more over by this method the entire global image contrast is enhanced.

Fig.2. (a) Raw image (b) Enhanced image

But the disadvantage here is that the transformation function is not unique. Depending on the application the suitable transformation function is chosen.

B. Adaptive histogram equalization

Adaptive histogram equalization is a PC based image processing technique which is used to improve the quality of image properties like contrast. It is similar to contrast stretching method but with a slight difference. It computes several intensities of specific gray value, each corresponding to a distinct portion of an image, and with the help of them intensities are rearranged by applying a suitable transformation function. For example, a simple transformation function such as each pixel transformed based on the histogram of a square surrounding the pixel [3]. Existing values will be mapped to new values keeping actual number of intensities in the resulting image equal or less than the original number of intensities. The transformation function applied on the histogram is proportional to the cumulative distributive function (CDF) of pixel values in the neighbourhood. Therefore it suits for enhancing the local details and enhancing the edge information of each region of an image.

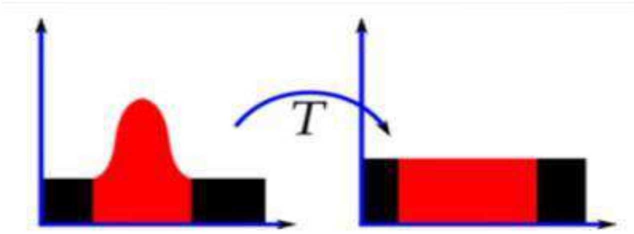

Fig.3. Histograms of an image before and after histogram equalization

Histogram equalization is a technique for changing the overall pixel intensities based on transformation function and contrast of an image. Histogram equalization is an effective technique which will benefit for the images with extreme contrast values. The limitation of this technique highlights the unwanted noise present in the background of an image and lead to loss in the information signal. It results in undesired effects in the resultant images [4].

Fig.4. (a) Raw image (b) Enhanced image

Here the noise in relatively homogeneous regions of the image are amplified which results in poor SNR. And also only the local objects of the image are enhanced and the background is left unenhanced.

3. PROPOSED SYSTEM

Depth map estimate is used to restore underwater images. Before obtaining a depth map, images with a degree of blurriness are employed. When the depth of field is raised, the image becomes more blurry. In this case, the backlight comes from the area with the greatest degree of blur and the lowest degree of variance. The brightness of the brightest pixel is used to estimate the brightness of the backlight. Objects in the foreground appear brighter than those in the background when illuminated by artificial light. This means that relying just on the brightest pixels may produce inaccurate findings. Radiance is maintained in IFM scenes by using a backlight and depth map instead. The proposed method's block diagram is shown in Fig.5.

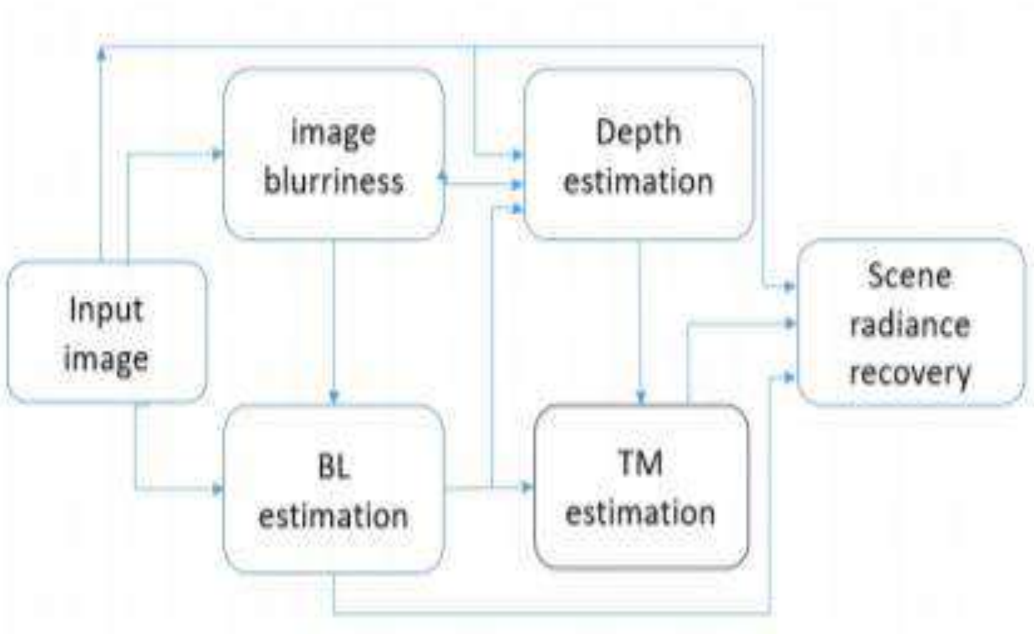

Fig.5. Block Diagram

4. RESULTS AND DISCUSSION

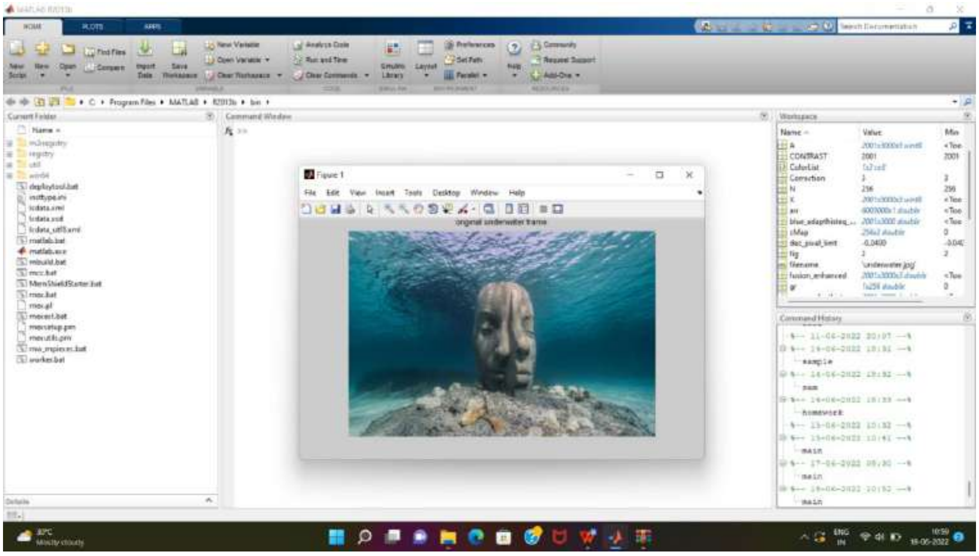

Fig 6 Input image

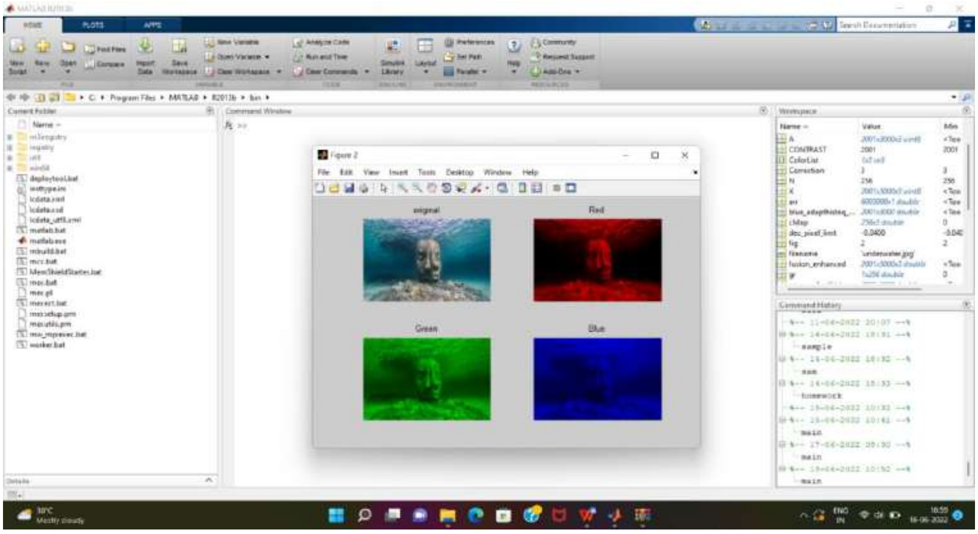

Fig 7 Color separation

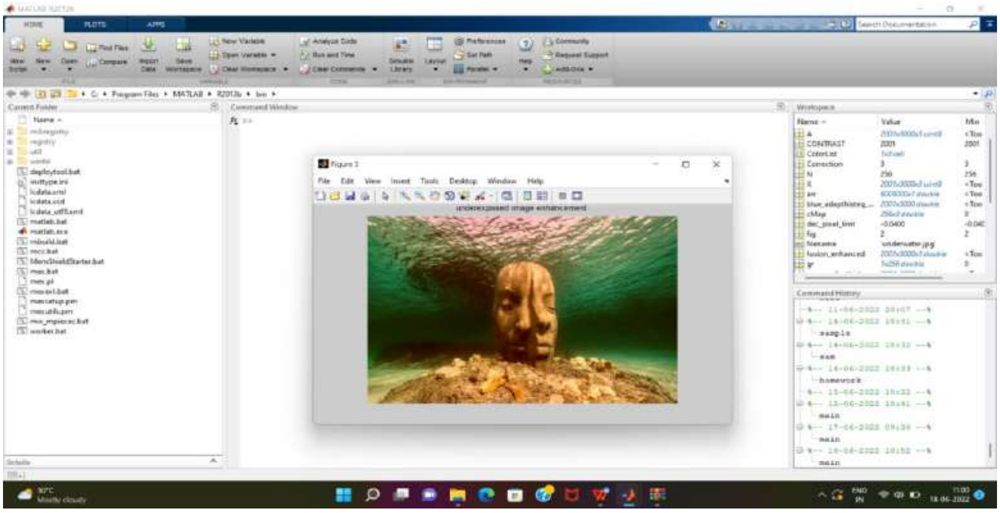

Fig 8 Saliency detection

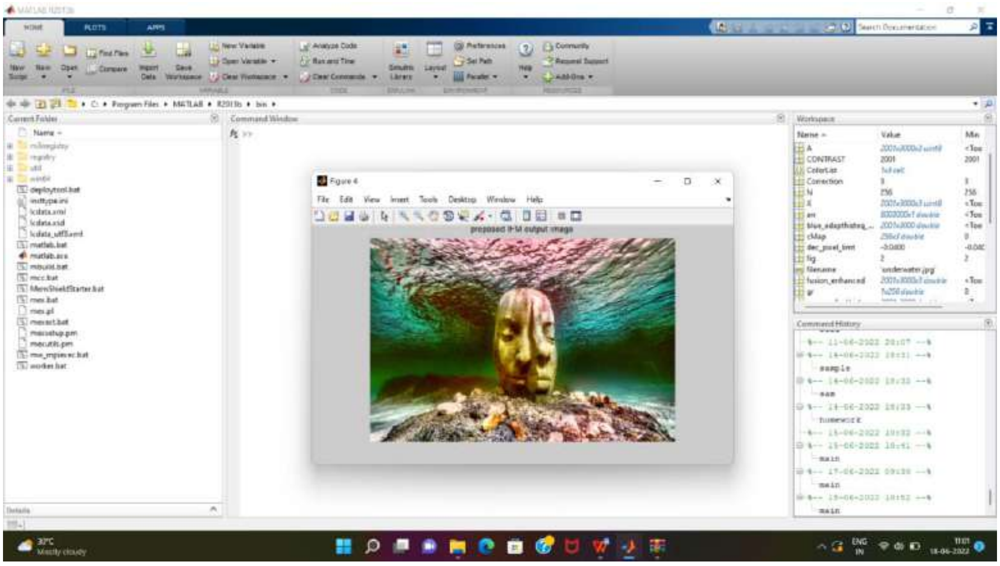

Fig 9 Output image

5. CONCLUSION

A lack of reference photos and a constantly changing undersea environment make underwater image restoration a tough task. Because they require specialised technology or several photographs of the same scene, the existing approaches do not work well in real-time or video applications. Due to the wavelength dependency of light and its attenuation, algorithms based on a single image face a number of issues. Image blur and light absorption are used to estimate depth and restore these images. Image blurriness is directly proportional to the depth of the object in the photograph. As a result, image blurriness can be used to calculate a depth map. Backlight is estimated using the area with the most blurriness and the lowest variance, thus bright foreground items are avoided. Once these parameters are determined, the model can be used to restore images. In order to use it, all you need is a single picture of the scene. An image quality metric that is non-referenced and works well with many underwater photos is the non-referenced image quality measure. Because of this, this procedure gives superior restoration results than other methods now in use.

REFERENCES

[1] Yoav Y. Schechner and Nir Karpel "Recovery of underwater visibility and structure by polarization analysis" IEEE Journal of Oceanic Engineering, 2006.
[2] Duo Min He, Gerald G L Seet "Divergent beam lidar imaging in turbid water" Elsevier Optics and Lasers in Engineering, 2010.
[3] K. He, J. Sun, and X. Tang, "Single image haze removal using dark channel prior" Computer Vision and Pattern Recognition, IEEE Computer Society Conference, 2009.
[4] Adrian Galdran, David Pardo, Artzai Picon, Aitor Alvarez Gila "Automatic red channel underwater image restoration" Journal on visual Communication Research gate, 2015.
[5] N. Carlevaris-Bianco, A. Mohan, and R. M. Eustice, "Initial results in underwater single image dehazing" in Proc. IEEE Oceans, 2010.
[6] ShuaiFang, RongDeng"Eff ective Single Underwater Image Enhancementb yFusion" Journal of Computers 2012.
[7] S Emberton, L Chittka, and A Cavallaro, "Hierarchical rank based veiling light estimation for underwater dehazing," IEEE Transaction Image Processing, 2017.
[8] K Iqbal, M Odetayo, R A Salam, A James, and A Z H Talib, "Enhancing the Low Quality Images using Unsupervised Colour Correction Method", IEEE International Conference on Systems Man and Cybernetics, 2013.
[9] A. Mittal, A. K. Moorthy, and A. C. Bovik, "No-reference image quality assessment in the spatial domain" IEEE Transaction Image Processing, 2012.
[10] WenhaoZhang,GeLi,ZhenqiangYing"Anewunder water imageenhancing method via color correction and illumination adjustment" IEEE Transaction on image processing, 2017.
[11] Taiebeh Askari Javaran, Hamid Hassanpour, Vahid Abolghasemi, "A noise immune no reference metric for estimating blurriness value of an image", Journal on Image Processing and Data Mining Elseiver, 2016.

