INTERNATIONAL JOURNAL OF SCIENTIFIC PROGRESS AND RESEARCH (IJSPR) ISSN: 2349-4689
Volume 22, Number 04, 2016

High Quality Underwater Image Reconstruction using Perceptable RGB Weighted Approach

Roopwati Thakur[1] , Prof. Nitin Choudhary[2]
1M-Tech Research Scholar, 2 HOD & Research Guide Department of Computer Science & Engg.
Kopal Institute of Science & Technology, Bhopal

Abstract - The underwater image restoration is the trends among the ocean engineering researchers to make the information clearer after capturing the images in underwater or ocean images. The underwater photography is important from exploring point of view of various researchers to find out the hidden treasures beneath the sea. The exploration can be done in terms of pictures and videos by the divers later these would help to find out the objects, species, and plants to study the underwater habitat or scenario. Usually the pictures taken from the high quality cameras the picture are affected by the several effects like blurring, colour degradation, light reflection and underwater objects etc. For the proper and efficient exploration of the underwater situations there picture should be as clear as possible in terms of colour as well the clarity. In this paper the same context has been taken into consideration and the high quality image restoration technique is proposed which is based on the perceptible RGB weighted approach to enhance the colour quality as well as clarity in the image pixels. The proposed approach utilizes mainly two stage to restore the underwater image one is colour enhancement and second is contrast toning, which adjust the effects of light reflections and low light situation. From the simulation outcomes the proposed approach proved better than the previous methodologies from the restoration it made.

Keywords - Image Restoration, Underwater Degradation, low light images, oceanic photography.

I. INTRODUCTION

Underwater image processing has received considerable attention over the last few decades due to its challenging nature and its importance for the environment. Improving the underwater image quality can be separated into two different problems known as the image restoration problem and the image enhancement problem. Image restoration aims at estimating the true scene by removing the noise and inverting the degradation process. Doing this usually requires building mathematical models of the degradation and using various signal processing filtering techniques. Classical image restoration methods are Wiener filtering and blind image deconvolution. An example of the results of image restoration is shown in Figure 1.1. On the other hand image enhancement aims at making the images more aesthetically pleasing through subjective criteria and without relying on complex mathematical models. Colour correction, contrast and brightness adjustment are good examples of

Figure 1.1: Example of underwater image restoration [1].

Figure 1.2: Example of colour correction of an underwater image. a) original image b) colour corrected image[2].

The purpose of this research is to restore the video recorded by an underwater surveillance camera back to its original quality using variations of state of the art methods. Focus will be laid on dealing with the video restoration problem and not on video enhancement. The data consists of video sequences whose quality deteriorates with time as more dirt gathers on the lens.

The deterioration of the images can be split into two different types. The first is a local blurring of the image in places where there is dirt. This blur can't be considered stationary throughout the sequence as it sometimes tends to shift slightly back and forth depending on the the water currents.

The second is noise that is present from either floating particles or camera measurement noise (errors in the analog-to-digital conversion or during the quantization). In order to maintain the video quality at a standard that allows for the monitoring of underwater environment the lens must be cleaned in regular intervals. This procedure is costly and the frequency with which it is performed could be reduced if the image is restored using image restoration techniques.

Underwater vehicles are used to survey the ocean floor, much often with acoustic sensors for their capability of remote sensing. Optical sensors have been introduced into these vehicles and the use of video is well integrated by the underwater community for short range operations. However, these vehicles are usually remotely operated by human operators : the automated processing and analysis of video data is only emerging and first suffers from a poor quality of the images due to specific propagation properties of the light in the water. To summarize underwater images suffer from limited range, non uniform lighting, low contrast, diminished colors, important blur. . . Moreover many parameters can modify the optical properties of the water and underwater images show large temporal and spatial variations. So, it is necessary to pre-process those images before using usual image processing methods. Today pre-processing methods typically only concentrate on non uniform lighting or color correction and often require additional knowledge of the environment: as depth, distance object/camera or water quality [6][7]. The algorithm proposed in this paper is a parameter-free algorithm which reduces underwater perturbations, and improves image quality without using any knowledge and without any human parameter adjustment. It is composed of several successive independent processing steps which respectively correct non uniform illumination, suppress noise, enhance contrast and adjust colors [3][4][5][8]. The pre-processing step occurs before the segmentation. In most cases, a great improvement is observed while filtering, as it is showed by the edge detection criterion.

II. UNDERWATER DEGRADATION

A major difficulty to process underwater images comes from light attenuation. Light attenuation limits the visibility distance, at about twenty meters in clear water and five meters or less in turbid water. The light attenuation process is caused by the absorption (which removes light energy) and scattering (which changes the direction of light path). Absorption and scattering effects are due to the water itself and to other components such as dissolved organic matter or small observable floating particles. Dealing with this difficulty, underwater imaging faces to many problems [1][6]: first the rapid attenuation of light requires attaching a light source to the vehicle providing the necessary lighting. Unfortunately, artificial lights tend to illuminate the scene in a non uniform fashion producing a bright spot in the center of the image and poorly illuminated area surrounding. Then the distance between the camera and the scene usually induced prominent blue or green color (the wavelength corresponding to the red color disappears in only few meters). Then, the floating particles highly variable in kind and concentration, increase absorption and scattering effects: they blur image features (forward scattering), modify colors and produce bright artifacts known as “marine snow”. At last the non stability of the underwater vehicle affects once again image contrast. Our preprocessing filter has been assessed on natural underwater images with and without additional synthetic underwater degradations as proposed in [1]. Underwater perturbations we added are typical perturbations observed and they have been tested with varying degrees of severity. We simulate blur and unequal illumination using Jaffe and McGlamery’s model [14][16], gaussian and particles noise as additive contributions to the images and finally reduced color range by histogram operation.

III. PROPOSED METHODOLOGY

The goal of this research is to find out new and efficient technique to restore underwater images for the marine scientists to explore the things without any hassle.

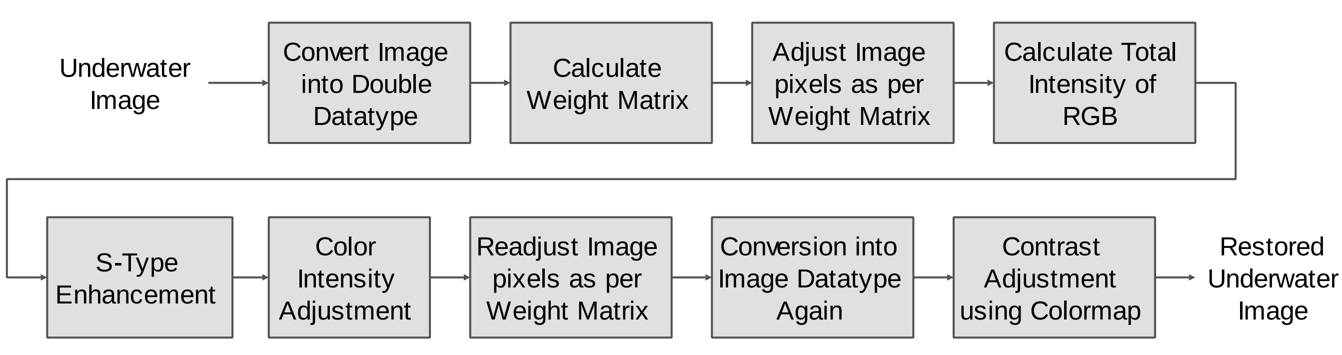


Fig. 3.1 Block Diagram of Proposed Underwater Image Reconstruction System

The technique should be automated to make observation more accurate from images taken inside the water. Data collection also improve with the help of these techniques. Basically the obstacle for capturing clear images is itself the underwater situation i.e. low light, light reflection and refractions and tiny objects inside the water.

In this research our object is to overcome and reduce the effects of these situations to some extent and this is achieved in this research work. The block diagram of the proposed methodology shown in below figure Fig. 3.1.

In Fig. 3.1 proposed image restoration system is shown where major blocks are shown for the restoration of underwater images. An algorithm to achieve proposed system is given in the flow chart below.

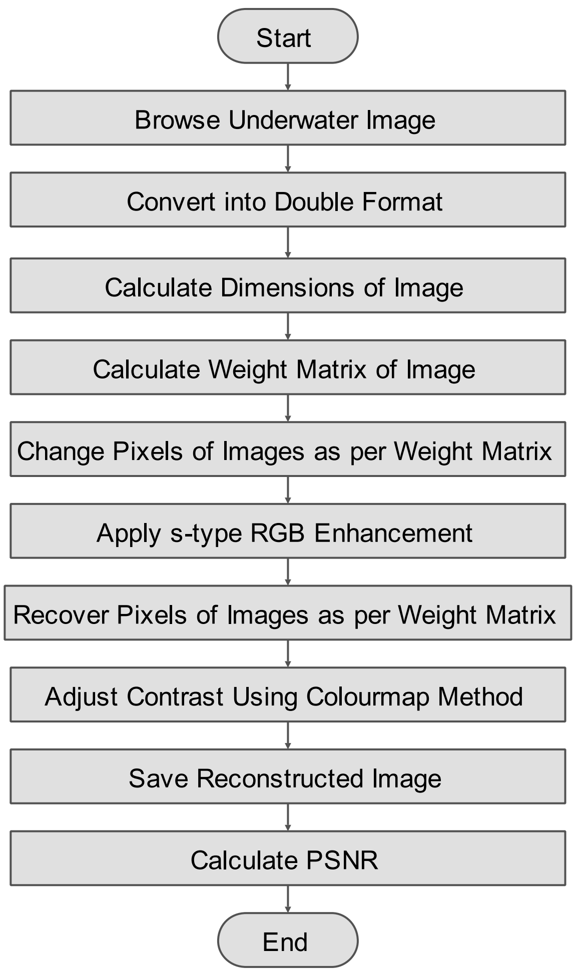


Fig. 3.2 Flow Chart of Proposed Underwater Image Reconstruction System

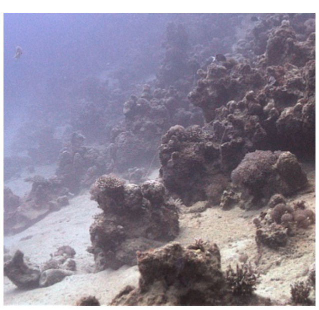
IV. SIMULATION RESULTS

The efficient underwater image restoration system shown in this paper is implemented on MATLAB and the outcomes of the restoration algorithm is given in the below figures. The proposed methodology applied on several underwater corrupted, low light images and restored images are also shown in the beside it.

Affected Underwater Image | Restored Image

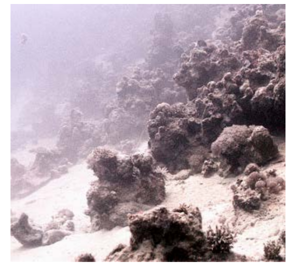
Affected Underwater Image | Restored Image

Fig. 4.1 Underwater Affected Image and Restored Image



(a)

(b)



(c)

Fig. 4.2 (a) Previous Work Reference Image, (b) Restored Image with Previous Methodology, (c) Restored Image with Proposed Methodology

Table I: Comparison of Previous and Existing Methodology

Technique	PSNR	RMSE
Previous Methodology	10.824 dB	73.624
Proposed Methodology	48.211 dB	0.995

V. CONCLUSION AND FUTURE SCOPE

From the simulation results can it can be concluded that the proposed underwater image restoration system significantly improved the colour and visual representation of the underwater images than the existing techniques. Several examples are shown in the simulation results to show the robustness of the proposed methodology. As the discussed technique is efficient and robust against the various underwater effects, this will also helpful in the normal image enhancement applications except underwater noisy situations where environmental effects are making images visually unreadable or observable.

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