UCDA: AN OPTIMAL UNDERWATER IMAGE EVALUTION USING COLOR DEPENDABILITY ALGORITHM

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ABSTRACT

The quality of an underwater image is degraded due to the effects of light scattering in water, which are resolution loss and contrast loss. Contrast loss is the main degradation problem in underwater images which is caused by the effect of optical back-scatter. The research work proposed a method to improve the contrast of an underwater image by mitigating the effect of optical back-scatter after image acquisition. The proposed method is based on the inverse model of an underwater image model, which is validated experimentally in this work. It suggests that the recovered image can be obtained by subtracting the intensity value due to the effect of back-scatter from the degraded image pixel and then scaling the remaining by a factor due to the effect of optical extinction. The research study is observing the underwater image enhancement in the presence of noise and blur. The formal framework of 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. The dark channel prior is a kind of statistics of the haze-free underwater images. It is based on a key observation - most local patches in haze-free underwater images contain some pixels which have very low intensities in at least one color channel.

Key word: *Underwater, Contrast, Morphological Filter, SIFT, HSV, Entropy.*

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1. INTRODUCTION

Imaging systems positioned near the ocean often suffer in performance, perceptually and objectively, because of atmospheric turbulence, fog, sun-glare, camera motion from wind buffeting and many other adverse weather conditions. For long distance imaging, the most prominent are camera motion, fog, atmospheric turbulence and blur (from optics and atmosphere).

The specific imaging environment addressed in this article is an optical system that is observing targets of interest with the optical axis being parallel with the horizon (over-the-horizon viewing). The environment itself will have fog or haze, wind and heat that cause eddy currents which are observed as turbulence in an imaging system. Underwater images can suffer from different types of degradations including color loss, noise due to floating particles, low contrast, skewing and blurring [1].

The primary aim is to restore scenes captured through a dynamic refractive medium. Even though visibility is limited to few tens of meters inside water, imaging through dynamic water surface is important for coral reef monitoring, examining the contamination of shallow waters, mapping the distribution of vegetation, seabed sediments etc. [2]. These capabilities find applications in commercial fishing zones as well as in boat safety.

2. ARCHITECTURE

There are four modules. They are:

1. Color Feature Extraction
2. Estimating the Light Source of Illumination
3. Gaussian derivative for gradient approach
4. Color constancy methods

2.1 Color Feature Extraction

A color image is a combination of some basic colors. In each individual pixel of a color image (termed 'true color') down into Red, Green and Blue values. The RGB color extracted features should be invariant to different photometric and geometric changes and should have minimum information to distinguish between the object which they describe and other objects.

The Underwater digital images convey information at different levels and in order to represent most of the image information, it is necessary to use different features at the same time. Therefore, the thesis work proposed, extracts many features from images to represent the color and texture.

These features are: co-occurrence matrices, color histogram, entropy, mean and standard deviation of wavelet transform, color moments and Weibull parameters. Among these features, some of them are for representing the color information and the others are for texture information.

2.2 Estimating the Light Source of Illumination

The color constancy algorithms are based on simplifying assumptions such as restricted gamut's (limited number of image colors which can be observed under a specific illuminant), the distribution of colors that are present in an image (*e.g.* white patch, grey-world etc.) and the set of possible light sources.

The Collection of underwater images is taken under the different light source that is used to estimate the color of the light source. The dimensions should be Px3, where P is the number of data points and 3 is the number of color channels. To estimate the color of the light source to compute the canonical range's for the light illumination type (i.e., pixels, Edges and Gradient).

2.3 Gaussian Derivative for Gradient Approach

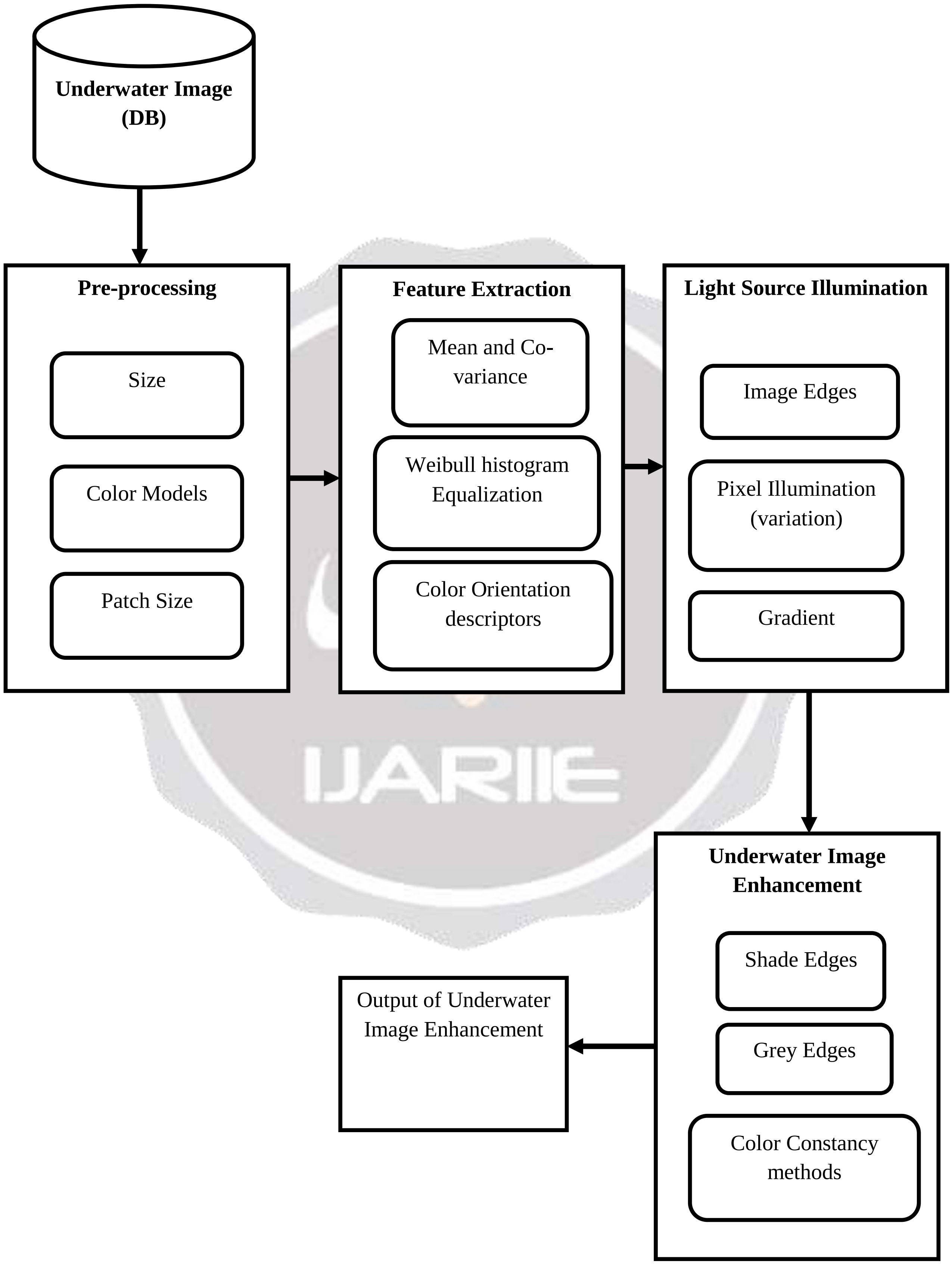
Image structures are valuable identification cues in determining which type of scene the image is taken from. In the power spectrum (distribution of edge responses) of an image is characteristic for the type of scene. The features derived from the power spectrum and Weibull distributions have successfully been applied.

2.4 Color Constancy Methods

The Image enhancement algorithm of image white path describes the texture pixels in points of maximal reflectance of RGB.

In color constancy the green patch continues to appear green, the white patch continues to appear white, and all the remaining patches continue to have their original colors. The shades-of-grey algorithm is the method to improve the performance of Grey –world. The image Edge reflection, which assumes that the average edge difference in the scene is achromatic.

The method is based on the observation that the distribution of color derivatives exhibits the largest variation in the light source direction.


Underwater Image (DB)
Pre-processing
Size
Color Models
Patch Size
Feature Extraction
Mean and Co-variance
Weibull histogram Equalization
Color Orientation descriptors
Light Source Illumination
Image Edges
Pixel Illumination (variation)
Gradient
Underwater Image Enhancement
Shade Edges
Grey Edges
Color Constancy methods
Output of Underwater Image Enhancement

3. IMPLEMENTATION

3.1 Image Pre-processing

Getting better de-noising image some pre-processing should be done before wavelet threshold de-noising. The pre-processing is done by two ways. Very first we will use Homomorphic filtering technology to eliminate the non-uniform illumination and balance contrast. In the second case will apply the Gaussian low pass filtering for smoothing the image.

The following reasons specify why the preprocessing is necessary for underwater images.

- Underwater image degradation is due to specific transmission properties of light in the water like absorption and scattering.
- Specificity of environment like light changing, water turbidness, and blue hue is more or less predominant when vehicles move.
- Specificity of video captures like unknown rigid scene and unknown color or low light sensitivity due to Marine snow.
- The preprocessing is required for underwater images due to poor capture image quality. In this preprocessing is done by Homomorphic filtering and Gaussian filtering.

3.2 Convolution

The Gaussian smoothing operator is a 2D convolution operator that is used to `blur' images and remove detail and noise. In this sense it is similar to the mean filter, but it uses a different kernel that represents the shape of a Gaussian hump.

The idea of Gaussian smoothing is to use this 2D distribution as a *'point spread'* function, and this is achieved by convolution. Since the image is stored as a collection of discrete pixels we need to produce a discrete approximation to the Gaussian function before it can perform the convolution.

In theory, the Gaussian distribution is nonzero everywhere, which would require an infinitely large convolution kernel. Once a suitable kernel has been calculated, then the Gaussian smoothing can be performed using standard convolution method

3.3 Color Constancy Methods

The Color constancy is based on following two approaches which are categorized into different color constancy techniques. They are:

- Pixel Based Approach.
- Edge Based Approach

Pixel Based Approach: Pixel Based color constancy algorithm focuses on the estimation of illuminant using only the pixel values in an image. These algorithms process all the pixel values of an image to estimate the light source.

Edge Based Approach: Pixel based method is extended to edge based color constancy algorithms, since most of the details in an image is represented by its edges. Various image derivatives (i.e. edges) are calculated for estimation of color of light source.

3.4 Performance Evaluation

To demonstrate the performance of underwater image enhancement on real data for restoring images degraded by skew and motion blur due to circular ripples. The performance of the proposed underwater image enhancement algorithm is evaluated both objectively and subjectively by utilizing color patches and real images downloaded from Google website.

Both results demonstrate superior haze removing and color balancing capabilities of the proposed methodology over traditional dehazing and histogram equalization methods. The restored results of [8] are again blurred. Although the results of [18] are reasonably sharp, deskewing has not been achieved satisfactorily.

4. EXPERIMENTAL RESULTS

Fig 1. Input image

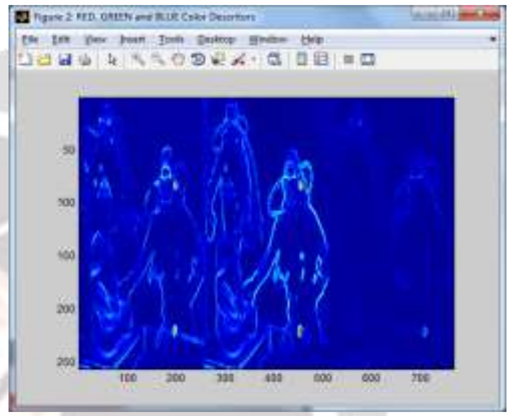


Fig 2. Red, Green, and Blue Color Descriptors

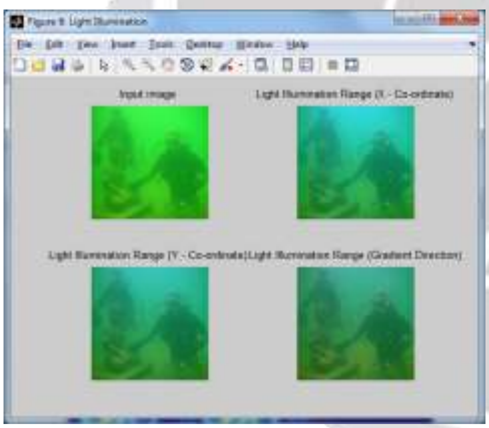


Fig 3. Light illumination

Fig 4. Final Result image

5. CONCLUSION

The research presents a new optimal technique which combines the various meadows and adjusts to the problem of image dehazing, image de-noising and image de-blurring. Resolution loss and contrast loss are two of main types of degradation in underwater images.

There are due to the effects of small angle forward-scattered light and back-scattered light respectively. Although both of these problems degrade the image quality, the problem of contrast loss is less difficult to mitigate than that of resolution loss.

The results show that the proposals generated the extremely significant. It has been observed that as the Peak Signal Noise Ratio (PSNR) and Structural Similarity Index Measure (SSIM) prevents the image quality.

The research work implements a underwater image enhancement of Colour Dependability Algorithm (*CDA*) both on light illumination and shades color models to enhance underwater images.

In order to demonstrate the usefulness of this approach, to developed an interactive software tool to be used for underwater image enhancement. First of all, it performs contrast stretching on RGB color model. Secondly, it performs saturation and intensity stretching on Weibull histogram color model.

The advantage of applying two stretching models is that it helps to equalize the color contrast in the images and also addresses the problem of lighting. By applying the proposed approach, to produced promising results. The quality of the images is statistically illustrated through the histograms.

5.1 Future Work

The algorithm of the proposed method is written in MATLAB programming language, such as in order that the algorithm can be used commercially.

In future the Contrast Enhancement Turbulence Mitigation system could be an extra option for processing underwater images in digital cameras, or an enhancement option for image editing software.

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