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AN IMPROVED METHOD BASED ON FILTER FOR ENHANCEMENT OF UNDERWATER HUMAN FACE IMAGE

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ABSTRACT

The image enhancement technique is a very important process of improving the quality of an image by improving the contrast of images. Underwater images always suffers from the low-contrast, non-uniform illumination, motion blur effect, scattering of light from different particles of different sizes, diminished intensity and color level due to poor visibility condition and suspended moving particles. For these factors, noises occur in images and reduce the effects arising out of these factors. This paper presents an efficient comparative study of the various image enhancement techniques used for enhancing underwater human face images with the proposed method with respect to PSNR values. Experiment results on underwater images from internet source shows the comparative statement method for improving the image quality. © 2012 Published by Elsevier Ltd. Selection and/or peer-review under responsibility of Global Science and Technology Forum Pte Ltd

KEYWORDS

Image Enhancement, Underwater, Noise, Contrast, filter, PSNR.

1. INTRODUCTION

Image quality improvements of underwater images are very challenging tasks in the field of Underwater Image Processing and Recognition (UIPR). A few works have been done in the field of image processing compared to other topics of image processing. The enhancement of an image is basically improving the image quality without loss of information of original image. Underwater images are normally characterized by their poor visibility because light is exponentially attenuated as it travels in the water, and the scenes result poorly contrasted and hazy. According to light attenuation, the visibility distance at about 20 meters in clear water and 5 meters or less in turbid water. The performance of underwater imaging systems is disturbed by light attenuation process which is caused by absorption and scattering. Forward scattering normally leads to blur of the image features and backward scattering limits the contrast of the images. The dissolved organic matter and other components can effect in water. The amount of light is reduced in deeper of the water and colors drop off depending on their wavelengths. The blue color can travel across the longest in the water due to its shortest wavelength. The underwater image suffers from low contrast, non-uniform lighting, blurring, limited range visibility, bright artifacts, color diminished and noise.

Manny researchers have used various techniques to improve the contrast level of underwater images. The underwater image processing has been received an important topic since last few years due to its challenging nature as due to the presence of water, a number of additional degrading factors come into the scenario. Iqbal et al has introduced an Unsupervised Color Correction (UCM) method which is based on color matching, contrast improvement of RGB color and contrast improvement of HIS color model for enhancing the low quality images of underwater images

(Iqbal et al., 2010). A recent study has developed an enhancement technique using wavelength compensation and dehazing in where light scattering and color modify are two main sources of alteration for underwater shooting (Chiang et al., 2012). Hitam et al has been improving the quality of an underwater image by presenting a new technique called hybrid contrast limited adaptive histogram equalization (CLAHE) color spaces (Hitam et al., 2013).

They operate CLAHE on RGB and HSV color spaces and both results are joint together using Euclidean rule. Prabhakar has been introduced an image based preprocessing technique comprises a combination of four filters such as homomorphic filtering, wavelet denoising, bilateral filtering and contrast equalization to enhance the quality of the underwater images (Prabhakar, 2011).

In this paper a comparative results using different filtering technique for enhancing of underwater images has been introduced. The PSNR value has been calculated and showing after using different filtering technique for underwater images (Chambah et al., 2004).

The remaining part of this paper is as organized as follows: in section 2, the overview of the system is discussed. Experimental results are demonstrated in Section 3. Finally, section 4 concludes this work

2. SYSTEM OVERVIEW

The complete block diagram of the system is given in Fig 1. All the processing steps used in this work are shown in the block diagram. In the first step, the input RGB color image has been converted into grayscale image (Rajput et al., 2013).

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Figure 1: System Diagram

In the next step, the salt and pepper noise has been applied on grayscale image. After that, the median filter, average filter and Contraharmonic filter has been applied on resulting image. The proposed method has been obtained using combination of contraharmonic filter and median filter on underwater image after applying salt and pepper noise. Finally, the proposed algorithm has been compared with images found using three different filtering techniques.

2.1 Conversion of RGB to Gray scale Image

The main objective of this step is to generate an appropriate image for subsequent processing steps. The input color image is basically a Red-Green-Blue (RGB) color space consisting three components namely Red (R) component, Green (G) component and Blue (B) component (Garcia et al., 2002). The RGB color space is not an optimal scheme for image processing for diffusion characteristic of the intensity information of RGB image across the three color components. This color space also is not efficient when dealing with "real world" images. The main drawback of the RGB color space in different applications with natural images is a high correlation between its components. For this reason, The RGB color image is converted into the grayscale image for pre-processing steps to enhance the underwater images (Mahiddine et al., 2012).

2.2. Generating Noisy Images

There are large numbers of noises are present in the underwater images. Noises caused by different blurring and lighting effects are very challenging task for removing from original images to enhance. In this step, salt and pepper noise has been added on grayscale images (Singh et al., 2011). Salt and pepper noise presents itself as sparsely occurring white and black pixels. RGB, Grayscale image and image after applying salt and pepper noise are shown in in Figure 2.

Figure 2: (a) Input RGB Image; (b) Gray Scale Image; (c) Noisy Image

2.2 Proposed three filtering technique

In this section, Median filter, Average filter and Contraharmonic filter has been introduced as follows:

2.3.1 Median Filter

The Median filter is a nonlinear digital filtering technique used to remove noise. It replaces the value of a pixel by the median of the intensity levels in the neighborhood of that pixel.

$$\hat{f}(x, y) = \underset{(s,t) \in S_{xy}}{\text{median}}\{g(s, t)\} \quad (1)$$

The value of the pixel at (x,y) is included in the computation of the median. Median filters are particularly effective in the presence of both bipolar and unipolar impulse noise

2.3.2 Mean Filter

Mean filtering is a simple and easy filtering technique to implement method of smoothing images. It reduces the amount of intensity variation between one pixel and the next. The mean filter is computed using a convolution and is often used to reduce noise in images. It computes the average value of the corrupted image $g(x, y)$ in the area defined by S_{xy} . The value of the restored image $\hat{f}$ at point (x, y) is simply the arithmetic mean computed using the pixels in the region defined by S_{xy} ,

$$\hat{f}(x, y) = \frac{1}{mn} \sum_{(s,t) \in S_{xy}} g(s, t) \quad (2)$$

2.3.3 Contraharmonic mean Filter:

The Contraharmonic mean filter of a set of positive numbers is defined as the arithmetic mean of the squares of the numbers divided by the arithmetic mean of the numbers. It yields a restored image based on the expression.

$$\hat{f}(x, y) = \frac{\sum_{(s,t) \in S_{xy}} g(s, t)^{Q+1}}{\sum_{(s,t) \in S_{xy}} g(s, t)^Q} \quad (3)$$

Where, Q is called the order of the filter. This filter is very efficient for reducing or virtually eliminating the effects of salt and pepper noise. For positive values of Q, the filter eliminates pepper noise and for negative values of Q, it eliminates salt noise.

2.4 Proposed Method

There is a common problem of low contrast of light due to which image became blurred in the underwater environment. For this, large numbers of noises are present in underwater images (Subashini et al., 2010). In the proposed algorithm, at first the salt and pepper noise is added to the image, and then the contraharmonic mean filter is applied for reducing noises from that image.

Because, contraharmonic mean filter is very effective filtering technique for reducing salt and pepper noises from underwater images (Schechner and Karpel, 2004). This filter can eliminate both salt and pepper noise separately from same image.

After that the median filter has been applied after reducing noises of image. The contrast of the image is increased for reducing of noise of image and also the illumination problem being solved to some extent. The edges of underwater image can be detected clearly which leads to good detection of objects (Jayaraman et al., 2011; Gonzalez et al., 2011).

A new feature based technique is used in the enhancement of underwater images. The illumination of light, depth of sea, moving of objects, turbulence all these can be calculated in the algorithm designed (Wang et al., 2011; Gonzalez et al., 2006).

2.5 Calculate PSNR Value

Peak signal-to-noise ratio (PSNR) is a ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. Because many signals have a very wide dynamic range, PSNR is usually expressed in terms of the logarithmic decibel scale. In this paper we compared the various enhancement techniques in terms of parameter PSNR.

3. EXPERIMENTAL RESULTS AND DISCUSSION

The overall work of proposed method has been simulated using MATLAB R2018a in a machine. The configurations of machine are 2.20 GHz Intel (R) Core(TM) i3-2328M Processor and 4.00GB of Installed Memory. The

performance of proposed technique has been analyzed using some color underwater images from internet source (Sahu et al., 2014).

3.1 Results

The experimental results have been discussed in this section and also compared with the results found in different filtering technique and proposed method. The proposed method has been applied on underwater images from internet source.

The use of contraharmonic mean filter followed by median filter has achieved the objective of reducing the problem of large number of noises present in underwater image (Raju et al., 2014; Yamashita et al., 2007).

It is observed that noises are present for low contrast, non-uniform lighting, blurring and presence of unwanted components in water. The resulting images after applying median filter, average filter, contraharmonic filter and our proposed method on underwater images are shown in (a), (b), (c) and (d) respectively in Figure 3.

Figure 3: (a) Median Filter; (b) Average Filter; (c) Contraharmonic Filter; (d) Proposed Method

The peak signal to noise ratio of the images obtained by proposed method is compared with images obtained by three different filtering techniques. It is found that the proposed technique has higher peak signal to noise ratio (PSNR) value compared to the others and it indicates better fidelity of the enhanced image.

The subjective quality of the image is increased than other images obtained by others filtering technique (Chao et al., 2010). The enhanced images are characterized by improved PSNR values, low noise levels, better exposure of dark regions. The comparison table with respect to PSNR value of enhanced underwater images are shown in Table 1.

Table 1: Comparative Results

Technique	PSNR Value
Median Filter	55.567
Average Filter	21.786
Contraharmonic Mean Filter	22.389
Proposed Method	67.523

4. CONCLUSION

The proposed combined filtering method provides a better peak signal to noise ratio in underwater human face image enhancement where the problem of low illumination and very poor contrast are prime problems for heavy noises. This method improves the underwater images captured under blurry, stormy conditions.

In future work, this method helps to enhance the underwater images in complex situation in underwater such as turbulence of the sea water, salinity and distance between the camera and for moving objects in underwater.

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