Journal of Engineering and Applied Sciences 13 (11): 3916-3921, 2018
ISSN: 1816-949X

Quality Measures Technique for Underwater Images Using Artificial Neural Network

Priya Sahotra and Simrandeep Singh
Department of Electronics and Communication Engineering,
Chandigarh University, 140413 Gharaun, Punjab, India

Abstract: The visibility in underwater images is usually bad because of the attenuation of light in water that causes the dizzy contrast and the color variation. In this proposed research an innovative and productive approach for underwater image quality enhancement will have presented. The proposed method intends to prepare better underwater image contrast, increase image details with fewer losses in information and reduce noise by applying an innovative procedure of using contrast stretching to produce two different images with different contrasts. Capturing images through digital camera or smart phones has become simple nowadays. Because of the enhancement of camera properties, image in underwater and low light conditions is suffered from exposure problem. The proposed method is combination of different methods which is successful in magnify the capture in underwater by using the artificial neural network. Underwater image quality measures technique for underwater images using artificial neural network will have proposed. The underwater image quality measures technique is proposed for the image quality improvement on the basis of three different techniques. For the recognition of suitable pixel sets from the underwater image we use image colorfulness, sharpness and contrast based pixels and train a proposed system to classify that pixel set by using Artificial Neural Network (ANN). At last performance metrics of proposed underwater image quality measures is calculated and compared with previous existing research.

Key words: Image enhancement, Underwater Image Quality Measures (UIQM), Underwater Image Colorfulness Measure (UICM), Underwater Image Sharpness Measure (UISM), Underwater Image Contrast Measure (UIConM), Artificial Neural Network (ANN)

INTRODUCTION

The endeavor of image enhancement is to get better observation of image for viewer and supplies magnify input from automatic image processing techniques. It consists of two parts: spatial domain image enhancement method is used to handle directly on pixel sets and frequency domain image enhancement methods is used to handle on the fourier transform of an image which has no regular method for controlling the good image enhancement for human observation. So, image enhancement techniques are used as pre-processing technique. Image enhancement is an important technique for image processing applications. It uses pair of techniques that try to improve the visual manifestation or to convert the image to an application enhanced fitted to the analysis by an individual or machine. Point processing techniques are among the simplest of all image enhancement techniques. These include, image restoration techniques require parameters like scattering coefficients, attenuation coefficients. For this, preprocessing of an underwater image is used in proposed research to devoted image enhancement methods which do not have related information of the environment.

Panetta *et al*. (2016) proposed human-visible-inspired under water quality measures shows the feature measuring techniques like UICM, UISM and UIConM and under water quality measure technique for selecting optimal parameters used in underwater enhancement algorithms but the improvement is not appropriate according to the requirement, so, some enhancement should be needed. Lee *et al*. (2012) proposed image contrast enhancement methods using classified virtual exposure image fusion uses, an image fusion method, known as classified virtual exposure image fusion, used in image enhancement. Result shows on four different images that uses the proposed method is more efficient than other methods but information losses are more. Wang *et al*. (2013) proposed automatic local exposure correction using bright channel prior for under-exposed images shows the problems related to exposure correction for images. To solve this bright channel prior is used which is used for solving the problem of noise appear

Corresponding Author: Priya Sahotra, Department of Electronics and Communication Engineering, Chandigarh University, 140413 Gharaun, Punjab, India

during the exposure correction (Singh and Kapoor, 2014; Wang *et al*., 1999; Chen and Ramli, 2003; Kim, 1997). The Underwater Image Quality Measure (UIQM) have three characteristic measures, Underwater Image Colorfulness Measure (UICM), the Underwater Image Sharpness Measure (UISM) and the Underwater Image Contrast Measure (Ghani and Isa, 2015; Schettini and Corchs, 2010; Chiang and Chen, 2012) (UIConM). In this proposed algorithm which is based on the enhancement, each interruption is corrected successively. The first step is to remove the noise effect from the underwater image. In these conditions visibility is zero. Appropriate techniques to find out the most suitable pixel set from the underwater image.

MATERIALS AND METHODS

The efficiency and accuracy of underwater image quality measures technique for underwater images using artificial neural network, several experiments with this procedure are performed on underwater images. In propose research several steps will use to detect the suitable pixel region sets and enhance the underwater image. The methodology of propose research is:

Underwater Image Colorfulness Measure (UICM): In water, color start attenuate slowly depend on the wavelength of colors. Red color fades mainly because of its small wavelength as compare to the other color. That's why underwater images suffer from a bluish or greenish appearance after the capturing of the image under the water. Underwater image enhancement algorithm should be used for better execution of color. This technique only modifies the color of the underwater image by using their color feature. There is the two color elements associated with RG and YB are shown:

$$RG = R\text{-}G$$

$$YB = \frac{R+G}{2}\text{-}B$$

Underwater Image Sharpness Measure (UISM): In this technique sharpness of the underwater image plays important role. Sharpness of an image is the significant photographic image quality factor used for determines the quantity of an imaging scheme. It is also useful measurement technique of information and gives the information about the border between different tones of colors. It contain the bar pattern of spatial frequency. This characteristic is associated with the conservation of detail or edge of the underwater image. The blurring effect creates break down of image sharpness. To regulate the sharpness of boundary for an underwater image, the edge detection technique is firstly applied to each RGB component. The UISM technique is formulated as shown in:

$$UISM = \sum_{c=1}^{3} \lambda_c EME(\text{grayscale edge}_c)$$

$$EME = \frac{2}{k_1 k_2} \sum_{l=1}^{k1} \sum_{k=1}^{k2} \log\left(\frac{I_{max,k,l}}{I_{min,k,l}}\right)$$

In the above equation the image is divided into k_1, k_2 blocks (I_{max}, k, l) and (I_{min}, k, l) that gives the relative contrast ratio within each block and the EME measures in each RGB color component.

Underwater Image Contrast Measure (UIConM): This is the division between the brightest and darkest part of the underwater image. By increasing the contrast of the image it may increase the separation between bright and dark parts which makes shadows darker and highlight brighter portions. Lowering the contrast of an image means bring the shadows up. In underwater images, contrast decay is caused by backward scattering and we can enhance the underwater image by using increment and decrement in darker and brighter areas of the underwater image. In UIConM technique the contrast is calculated by using the log AMEE measure on the intensity image as:

$$UIConM = \log AMEE\ (\text{Intensity})$$

where, the log AMEE is:

$$\log AMEE = \frac{1}{k_1 k_2} \otimes \sum_{l=1}^{k_1} \sum_{k=1}^{k_2} \frac{I_{max,k,l}\, \theta I_{min,k,l}}{I_{max,k,l\otimes}\, I_{min,k,l}} \times \log\left(\frac{I_{max,k,l}\, \theta I_{min,k,l}}{I_{max,k,l\otimes}\, I_{min,k,l}}\right)$$

In the above equation the image is divided into k_1, k_2 blocks (I_{max}, k, l) and (I_{min}, k, l) shows the approximate contrast ratio and the EME measures in each RGB color component. After these steps combined the all image quality measure method and develop a new method which is known as under water image quality measure. This technique underwater is basically the combination of existing and separate image measurement techniques. It is used for analyzing the underwater image quality equivalent to human observations. Every characteristic is used for measuring the underwater image processing task. In the underwater image quality measure technique, we go the more accurate and enhanced result for the underwater image (Fig. 1). The comparison of colorfulness measures, sharpness measures, contrast measures, combination of all techniques. The equation of overall underwater image quality measure using the given equation:

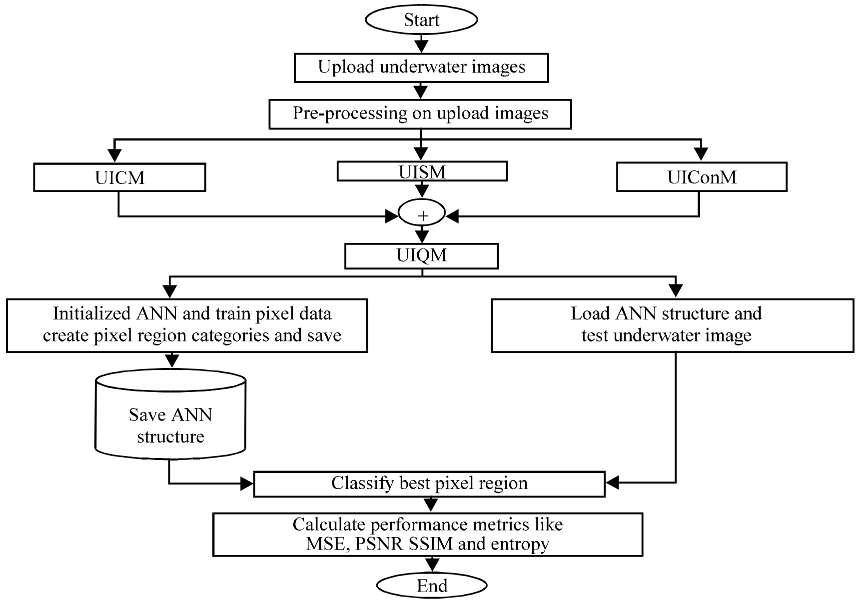

Fig. 1: Flow chart of proposed research

$$UIQM = c_1 \times UICM + c_2 \times UISM + c_3 \times UIConM$$

In the above equation all the parameters are combined linearly. Initialized artificial neural network with pixels set of underwater images as an input of artificial neural network. Train artificial neural network underwater images pixel sets and according to training find out best and appropriate region of that pixel by using this we can enhance the underwater image quality. Automatic algorithms help in controlling the neural network to perform well in the medical field. This network is the widespread method that contains elements which operate parallel. A neural network is used in a specific task by balancing the weights between elements. After the classification of best and appropriate pixel regions compute the performance metrics like MSE, PSNR, SSIM, entropy of original underwater image and entropy of enhanced underwater image. MSE: the mean square error of an estimator is used to convey the difference between the values implied by an estimator and the quantity being estimated:

$$MSE = (1/N)\ i|x(i)-e(i)|^2$$

Where:
x = Original
e = Restored image, respectively
N = The number of pixels in the images

PSNR: this is the ratio between the most realizable power of signal and corrupting noise that influence the consistency of its representation. It is given by:

$$PSNR = 10*\log\ (255*255/MSE)$$

Entropy: it is used for calculating the details of the output image. By using given formula we calculate the entropy of original and enhanced image. Entropy = summation (p.*log2 (p)) SSIM: it is used for calculating the comparison between the images. This is helpful in calculating image quality. This is used to improve is quality of an images:

$$SSIM = \frac{(2_{m1m2}+c1)(2_{s1s2}+c2)}{(m1^2+m2^2+c1)(s1^2+m2^2+c1)}$$

Where:
m1 and m2 = Average of row and column data
s1 and s2 = Variance of row and column data
c1 and c2 = Stabilize variables with weak denominator

Figure shows the underwater image quality measures technique for underwater images using artificial neural network. By using above procedure we achieve better results which are well described in the next study.

RESULTS AND DISCUSSION

The simulation and the results of the proposed research are shown in this study. There are some algorithms which are used in the proposed simulation research:

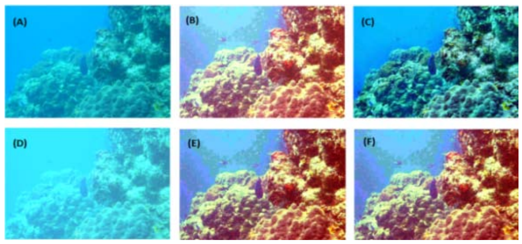

Fig. 2: A-F) Results of underwater image enhancement

Algorithm 1st; UIQM algorithm:
Upload underwater image
Apply pre-processing on uploaded image
Initialized UIQM with UICM, UISM and UIConM
For I = 1 to all pixels of image
UIQM = C_1xUICM+C_2*UISM+C_3*UIConM
End
Save all data in as an input of artificial neural network

Algorithm 2nd; ANN Algorithm:
Load canny-data
Training_data = canny_data
Initialize ANN
Generate group of data = group
Set iteration = 50
For I = 1 to iteration
Weight = canny_data (i)
  Hidden_Neurons = [10] (tansig)
  Net_algo = trainlm
  Generat Net structure of ANN (net)
  Net = train (net, Training_data, group)
End

Save net as a training data and simulate with test data and find appropriate results for proposed research with artificial neural network. Main Fig. 2 Window is the title page of proposed research and there are two options 1st is START and 2nd is EXIT. There are three section 1st is image loading, 2nd is pre-processing and 3rd is quality measure panel. The simulation results of quality measure technique are proposed in this research and the performance metrics for all quality measure technique with their values are calculated. The simulated result with different quality measure is given in Fig. 2.

Figure 2 shows the different types of the quality measure technique and where (a) original underwater image, (b) enhanced image using the UICM, (c) enhanced image using the UICM, (b) enhanced image using the UISM, (d) enhanced image using the UIConM and (e) enhanced image using the UIConM with artificial neural network. After the simulation we can calculate the performance metrics like quality measure, MSE, PSNR and entropy of enhanced image.

Figure 3 and Table 1 show the graphical representation of entropy difference between original and enhanced image for proposed research and we compare the proposed entropy difference with previous research and founded that the proposed entropy difference is less as compare to the previous research. Table 2 and Fig. 4 show the graphical representation of PSNR value for proposed research and we compare the proposed PSNR with previous research and founded that the proposed PSNR is better as compare to the previous research by using the artificial neural network.

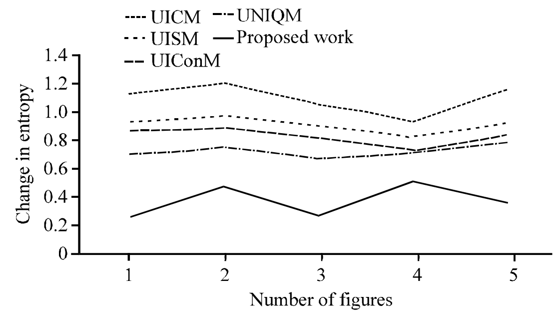

Fig. 3: Entropy comparison of proposed research

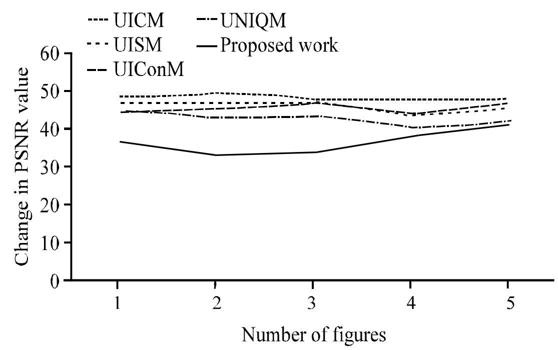

Fig. 4: PNSR comparison of proposed research

Table 1: Comparison of variation in entropy

UICM	UISM	UIConM	UIQM	Proposed work
0.87	1.14	0.71	0.94	0.26
0.89	1.21	0.76	0.98	0.47
0.81	1.06	0.68	0.89	0.27
0.74	0.94	0.74	0.83	0.51
0.85	1.17	0.79	0.93	0.36

Table 2: Comparison of PSNR

UICM	UISM	UIConM	UIQM	Proposed work
44.24	36.20	44.31	46.42	48.36
42.47	32.74	45.28	46.82	48.92
43.28	33.47	46.28	46.66	47.28
39.74	37.92	43.72	43.29	46.97
41.92	40.72	46.37	45.27	47.72

Table 3 and Fig. 5 show the graphical representation of MSE value for proposed research and we compare the proposed MSE with previous research and founded that the proposed MSE is less as compare to the previous research.

Table 3: Comparison of MSE

UICM	UISM	UIConM	UIQM	Proposed work
2.48	15.23	2.43	1.46	0.63
2.41	12.72	5.22	1.17	0.46
3.43	13.46	6.23	1.69	0.94
2.63	17.72	3.77	1.64	0.96
1.69	10.63	6.33	1.43	0.88

Table 4: Comparison of quality measure

UICM	UISM	UIConM	UIQM	Proposed work
10.26	0.46	1.83	0.62	0.72
11.75	0.46	1.56	0.94	0.76
9.560	0.46	1.85	0.92	0.73
10.84	0.46	1.82	0.84	0.79
8.360	0.46	1.79	0.75	0.85

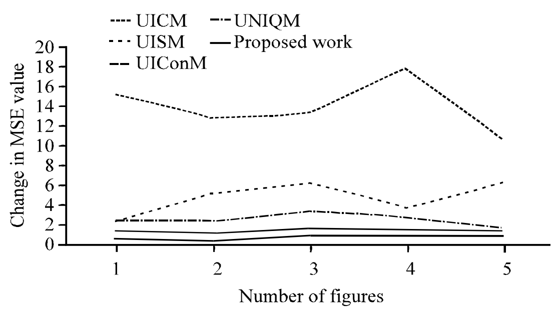

Fig. 5: MSE comparison of proposed research

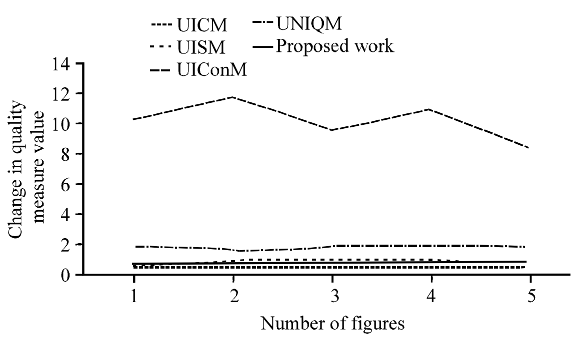

Fig. 6: QM parameters comparison of proposed research

Table 4 and Fig. 6 show the graphical representation of quality measure value for proposed research and we compare the proposed quality measure with previous research. In the proposed research the quality measure is calculated in the basis of UIQM technique with artificial neural network.

CONCLUSION

A novel non reference underwater image quality measure technique is representing by using the artificial neural network. An outrageous pattern is seen in applying the algorithm to enhancing underwater imagery. Note down how the isolated structures, invisible in the original, are clear in the processed image using the UIQM with artificial neural network. Underwater image quality measures technique is propose for the image quality improvement and underwater image quality measures technique is develop on the basis of three different techniques. We can say that the Underwater Image Quality Measures (UIQM) technique is the combination of different techniques. For the detection of suitable pixel sets from the underwater image we use image colorfulness, sharpness and contrast based pixels and train propose system to classify that pixel set Artificial Neural Network (ANN) will have used. In ANN first part is training and second is classification, so, ANN will be trained by sample of pixel sets, so in classification they can easily detect that pixel region by using underwater images will be enhanced. So in proposed research we combined the artificial neural network with UIQM to achieve better simulation results. The experimental results analyzed that proposed method using UIQM with artificial neural network provides good results having values MSE just near about 0.6, PSNR is more than 48, QM is more is also better with proposed research and entropy is better for enhanced images.

REFERENCES

Chen, S.D. and A.R. Ramli, 2003. Contrast enhancement using recursive mean-separate histogram equalization for scalable brightness preservation. IEEE Trans. Consum. Electron., 49: 1301-1309.

Chiang, J.Y. and Y.C. Chen, 2012. Underwater image enhancement by wavelength compensation and dehazing. IEEE. Trans. Image Process., 21: 1756-1769.

Ghani, A.S.A. and N.A.M. Isa, 2015. Enhancement of low quality underwater image through integrated global and local contrast correction. Appl. Soft Comput., 37: 332-344.

Kim, Y.T., 1997. Contrast enhancement using brightness preserving bi-histogram equalization. IEEE Trans. Consumer Electron., 43: 1-8.

Lee, C.H., L.H. Chen and W.K. Wang, 2012. Image contrast enhancement using classified virtual exposure image fusion. IEEE. Trans. Consum. Electron., 58: 1253-1261.

Panetta, K., C. Gao and S. Agaian, 2016. Human-visual-system-inspired underwater image quality measures. IEEE. J. Oceanic Eng., 41: 541-551.

Schettini, R. and S. Corchs, 2010. Underwater image processing: State of the art of restoration and image enhancement methods. EURASIP J. Adv. Signal Process., 2010: 1-14.

Singh, K. and R. Kapoor, 2014. Image enhancement using exposure based sub image histogram equalization. Pattern Recognit. Lett., 36: 10-14.

Wang, Y., Q. Chen and B. Zhang, 1999. Image enhancement based on equal area dualistic sub-image histogram equalization method. IEEE Trans. Consumer Electronics, 45: 68-75.

Wang, Y., S. Zhuo, D. Tao, J. Bu and N. Li, 2013. Automatic local exposure correction using bright channel prior for under-exposed images. Signal Process., 93: 3227-3238.