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Bright Channel Based Underwater Image Enhancement

Jinisha A. C, Dr. C. Helen Sulochana, Arul Shiya A. P
Department of Electronics and Communication Engineering, St. Xavier's Catholic College of Engineering,
Chunkankadai, Nagercoil, Tamil Nadu, India

ABSTRACT

Image enhancement technology is frequently employed in image processing because of the poor illumination colour images. In this study, we suggest a brightness enhancement algorithm built on the bright channel prior. Images with sufficient light often exhibit local patches that include a few pixels with extremely high intensities in at least one colour channel. Image improvement is possible with the help of the preceding haze imaging model. The outcomes of the experiment demonstrated that the algorithm improved images visually.

Keywords: Raspberry pi, USB camera, motor driver, motor, LCD display, road side speed sign controlling.

I. INTRODUCTION

Over the past few years, the topic of underwater picture enhancement and restoration has gained the interest of an increasing number of academics. Underwater photographs are prone to low contrast, blur, and colour distortion issues because of dispersion and absorption. Consequently, the field of underwater picture repair and enhancement has proved difficult. Figure 1 displays some images

taken in an underwater environment, and it is clear that the quality has declined.

The tracking of underwater things, 3D reconstruction of underwater objects, underwater archaeology, underwater biological study, and sea floor exploration are just a few of the numerous fields that use underwater photos to accomplish specific objectives.

The approaches used to obtain high-quality images are divided into two groups. One is image restoration and the other one is imageenhancement.Thispaper, we combined thetwo technologies and obtained satisfying results.

Figure 1. Degraded underwater image

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II. RELATED WORK

Masiet. al [1] has been worked on “Enhancement of Underwater Images with Statistical Model of Background Light and Optimization of Transmission Map”. Underwater images often have severe quality degradation and distortion due to light absorption and scattering in the water medium. A hazy image formation model is widely used to restore the image quality. It depends on two optical parameters: the background light (BL) and the transmission map (TM). Underwater images can also be enhanced by color and contrast correction from the perspective of image processing. In this paper, we propose an effective underwater image enhancement method for underwater images in composition of underwater image restoration and color correction. Firstly, a manually annotated background lights (MABLs) database is developed. With reference to the relationship between MABLs and the histogram distributions of various underwater images, robust statistical models of BLs estimation are provided. Next, the TM of R channel is roughly estimated based on the new underwater dark channel prior (NUDCP) via the statistic of clear and high resolution (HD) underwater images, then a scene depth map based on the underwater light attenuation prior (ULAP) and an adjusted reversed saturation map (ARSM) are applied to compensate and modify the coarse TM of R channel. Next, TMs of G-B channels are estimated based on the difference of attenuation ratios between R and G-B channels. Finally, to improve the color and contrast of the restored image with a dehazed and natural appearance, a variation of white balance is introduced as post-processing. In order to guide the priority of underwater image enhancement, sufficient evaluations are conducted to discuss the impacts of the key parameters including BL and TM, and the importance of the color correction. Comparisons with other state-of-the-art methods demonstrate that our proposed underwater image

enhancement method can achieve higher accuracy of estimated BLs, lower computation time, overall superior performance, and better information retention.

Zhao, et.al [2] worked on “Single underwater image enhancement using depth estimation based on blurriness”. In this paper, proposed to use image blurriness to estimate the depth map for underwater image enhancement. It is based on the observation that objects farther from the camera are blurrier for underwater images. Adopting image blurriness with the image formation model (IFM), we can estimate the distance between scene points and the camera and thereby recover and enhance underwater images. Experimental results on enhancing such images in different lighting conditions demonstrate the proposed method performs better than other IFM-based enhancement methods.

Palsson, et.al [3] researched on “Background light estimation for depth dependent underwater image restoration”. Light undergoes a wavelength-dependent attenuation and loses energy along its propagation path in water. In particular, the absorption of red wavelengths is greater than that of green and blue wavelengths in open ocean waters. This reduces the red intensity of the scene radiance reaching the camera and results in non-uniform light, known as background light, due to the scene depth. Restoration methods that compensate for this color loss often assume constant background light and distort the color of the water region(s). To address this problem, we propose a restoration method that compensates for the color loss due to the scene-to-camera distance of non-water regions without altering the color of pixels representing water. This restoration is achieved by ensuring background light candidates are selected from pixels representing water and then estimating the non-uniform background light without prior knowledge of the scene depth. Experimental results shows that the proposed approach outperforms existing methods in preserving the color of water regions.

peng et.al [4] proposed that "Underwater image restoration using deep network to estimate the background light, and scene depth". Images taken underwater often suffer color distortion and low contrast because of light scattering and absorption. An underwater image can be modeled as a blend of a clear image and a background light, with the relative amounts of each determined by the depth from the camera. In this paper, we propose two neural network structures to estimate background light and scene depth, to restore underwater images. Experimental results on synthetic and real underwater images demonstrate the effectiveness of the proposed method.

HeandPeng, et.al [5] developed a technique for "Single image dehazing with a physical model and dark channel prior". proposed a single image dehazing method that is based on a physical model and the dark channel prior principle. The selection of an atmospheric light value is directly responsible for the color authenticity and contrast of the resulting image. Our choice of atmospheric light is based on a variogram, which slowly weakens areas in the image that do not conform to the dark channel prior. Additionally, we propose a fast transmission estimation algorithm to shorten the processing time.

III. METHODOLOGY

The bright channel prior seems to be the opposite of the dark channel prior in [6]. The flow chart of our method is shown in Figure 2.

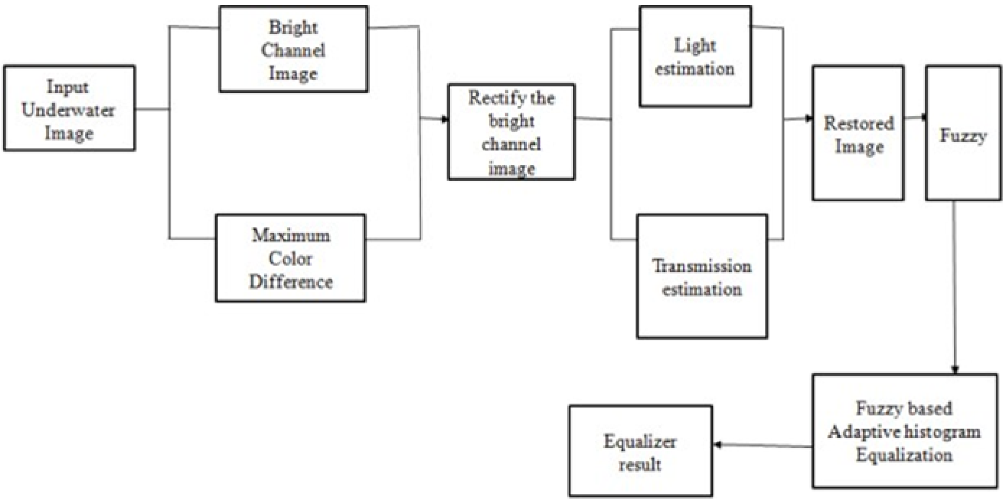

Figure 2. Flow chart of the proposed system The paper is organised as follows is

as follows: Section 3 presents the bright channel image acquisition, maximum colour difference image acquisition, bright channel image correction, atmospheric light estimation, and bright channel image correction. The validity of the suggested strategy and a few other comparison experiments are mostly examined in Section.

4. The conclusion is in Section 5.

3.1. Underwater Imaging Formation.

The concept forward by the Duntley et al.
[7] is used by many image dehazing techniques. The typical Duntley model used to eliminate fog in air is the same as the simplified underwater approach Carlevaris- Bianco developed in [8]. Therefore, to recreate the underwater photos, we employ the Duntley model:

$I(x)=J(x)t(x)+A(1-t(x))$ [1]

where,I is the observed intensity, the input degraded color image,t is the transmission image ,A is the atmospheric light,J is the scene radiance or haze-free image.

3.2. Obtain Bright Channel Image.

Assume that the atmospheric light A is known split different color channels and deform (1), we can obtain the following:

$$I^R=J^Rt + A^R\ (1-t)$$
$$1-I^G=(1-J^G)\ t+(1-A^G)\ (1-t)$$
$$1-I^B=(1-J^B)\ t+(1-A^B)\ (1-t) \qquad (2)$$

is the proportional coefficientIn our tests, we discovered that the bright channel should be the primary component to produce the rectified bright channel image and that should be greater than 0.5; at the where, and are the red, green, and blue channel images of the degraded underwater image, and are the red, green, and blue channel images of the no degraded underwater image, and are the atmospheric light of the red, green,and blue channel images of the degraded underwater image.Equation (2) is completely equal to (1). We combine the three channel images (IR,1 $-I$G, and 1 $-I$B left term of (5)) as the new degraded image

$I^{new}(x) = J^{new}(x)\ t\ (x) + A^{new}(1-(x))$. [3]

The bright channel can be defined as

$J^{newlight}(x) = \max(\max J^{new_c}(y))$ [4]

3.3. Rectify the Bright Channel Image.

The transmittance image is linearly proportional to the bright channel image, and the value of the maximum color difference image is inversely proportional to the imaging distance.In order to increase the stability, we rectify the bright channel image using themaximumcolor difference image.

The rectifying equation is

$(x) = \lambda * \text{light}\ (x) + (1 - \lambda) * \text{bgsubr}\ (x)$ [5]

where, denotes the rectified bright channel image light (x) denotes the non rectified bright channel image bgsubr (x) denotes the maximum color difference image same time, we discovered that in (15) could satisfy this need, so is captured as follows:

$\lambda = \max(\max(S))$ [6] where S is the saturation channel image of the degraded underwater image in HSV color space.

3.4. Estimate the Atmospheric Light

Although the value of ambient light is also calculated by us, in earlier sections we made the assumption that it is known. In this step, the ambient light will be estimated using the bright channel image of the damaged underwater image. In order to create the variance image, we first use the grey image of the original deteriorated underwater photograph (V). We calculate the variance of each pixel in the grayscale image within a block centred at this pixel point. Each pixel's variance within a block reveals the block's levelness. Second, we select the top 1% of the light channel's darkest pixels. Usually, these pixels are the most opaque. The pixel with the lowest value in the variance image V is chosen as the ambient light among these pixels.

3.5. Compute and Refine Transmittance Image.

We may compute the initial transmittance image of each colour channel after receiving the rectified bright channel image and the ambient light. tc(x)= [7]. where c denotes the different color channels, lightcorrect (x) denotes the rectified bright channel image, and Ac denotes the atmospheric light of each channel.

3.6. Restore and Enhance Underwater Image.

$$J^{C_{min}} = \frac{I^{C_{min}}(x) - A^{C_{min}}}{t^{c}(x)} + A^{C_{min}}$$

$$J^{C_{middle}} = \frac{I^{C_{middle}}(x) - A^{C_{middle}}}{t^{c}(x)} + A^{C_{middle}}$$

$$J^{C_{max}} = \frac{I^{C_{max}}(x) - A^{C_{max}}}{t^{c}(x)} + A^{C_{max}}$$

After obtaining

Where, Cmax is the channel whose mean intensity is the maximum among the three channels

Cmid is the channel whose mean intensity is the medium among the three channels

Cmin is the channel whose mean intensity is the minimum among the three channels

If a pixel point's intensity value in the minimumcolor channel is less than the value of atmospheric light, the intensity of that point will decrease significantly (this results in the loss of some detailed information in low intensity districts). Therefore, by applying (8) in the maximum colour channel, the pixel spots whose intensity values are lower than the ambient light are calculated. Using (8) in the minimum colour channel, one may calculate the pixel point whose intensity value is higher than the atmospheric light.

Because it is so difficult for us to esti mate the accurate transmittance () for distinc t channels, estimating the various transmitta nce images of various channels is a tough pr oblem image from 0 to a given value rather than equating it from 0 to 255.

In earlier parts, degraded photos were introd uced.Firstly, we compute the average intensity value of each channel; then we multiply the three means with three coefficients.
Next, we compare the three products with 255, respectively, and choose the smaller one as the specific value. We can see that the effect of histogram equalization on rectifying the color distortion is obvious.

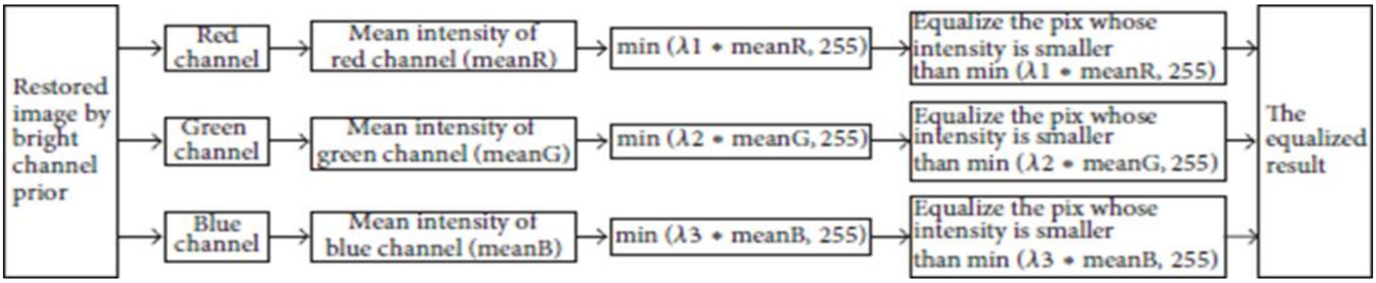

Figure 3 is the flow chart of the deduced histogram equalization method.
Figure.3. the flow chart of the deduced histogram equalization method.

IV. EXPERIMENTAL RESULTS

There are varieties of different scenesfor underwater images, so it is difficult for us to test all scenes.It is very difficult to assess the performance of an underwaterimage restoration algorithm, since there is no ground truthor uniform measure standard available. It is knownthat underwater images always appear blue or green; thesefour images represent four different scenes of underwater.The four images are shown in Figure 4.

A. Input Image dataset

In this study, the colour distortion is corrected using the inferred histogram equali sation method. We equalise the restored

Figure 4. Input image dataset

The algorithms in Tables 1 and 2 show that they can improve the quality of degraded underwater images [9, 12] and the proposed algorithms in this paper are better than the algorithms in [10, 11, 15] in increasing the visual perception. In order to compare these algorithms, we pick out two image features which are regarded as the standard of different algorithms. One is the amount of canny edge point; the other is the amount of sift feature point.

Image	Original image	Algorithm					
		[9]	[11]	[14]	[8]	[16]	Proposed
1	32343	28051	36899	32225	32343	34137	40889
2	66231	63767	63501	56837	64976	70381	72531
3	19928	18625	21267	19800	20160	20235	20062
4	9232	9592	10685	11781	9718	8709	9396

Table 1: The canny edge point amount of different algorithms.

Image	Original image	Algorithm					
		[9]	[11]	[14]	[8]	[16]	Proposed
1	2011	2494	4342	4965	2551	3370	4090
2	4061	7195	6451	9354	4061	7195	6451
3	154	804	1921	2649	154	804	1921
4	55	170	378	699	55	170	378

Table 2: The sift feature point amount of different algorithms

Considering the experiment result we can come to the conclusion that the proposed method can enhance the quality of underwater images effectively.

V. CONCLUSION

A novel technique for the enhancement and restoration of underwater images was brought in this research. The dark channel previous image dehazing served as the basis for our approach. We first suggested a bright channel before the underwater environment. The underwater images were finally recovered by estimating and correcting the bright channel image, estimating the atmospheric light, and estimating and improving the transmittance image. Second, we equalised the restored images using the deduced histogram equalisation to further correct the colour distortion.

Four separate underwater images that represent four different underwater environment settings were used in our research. Using the quantities of two feature points, we contrasted our method with another five algorithms. The results of the experiment demonstrated that the suggested method was successful in restoring the quality of underwater photos.

VI. REFERENCES

[1]. Masi .H, Song. H and Huang. D (2020), 'Enhancement of Underwater Images with Model of Background Light and Optimization of Transmission Map',IEEE Transactions on Broadcasting, vol .66 ,no.6, pp 89-112.

[2]. Matakana . L, Zhao. X, and Cosmin. P (2015), 'Single underwater image enhancement using depth estimation based on IEEE Transactions on Broadcasting Process, vol .88, no.5, pp.4952–4956.

[3]. Palsson . F, Cai. Band Tao. D (2016), 'Background light estimation for depth dependent underwater image restoration', IEEE Trans. Image process, vol .78 , no.7, pp .78-98.

[4]. Peng. A, Pan. J, Zhang. J and Yang M (2020), 'Underwater image restoration using deep network to estimate the ackground light, and scene depth ', IEEE Trans. Image process., vol. 128, no. 1, pp. 240-259.

[5]. Peng. H, Zhao. X and He. N (2017), 'Single image dehazing with a physical model and dark channel prior', IEEE. Trans. Image process vol. 149, no. 1, pp.718–728.

[6]. K. He, J. Sun, and X. Tang, "Single image haze removal using dark channel prior," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 33, no. 12, pp. 2341–2353, 2011.

[7]. S. Q. Duntley, A. R. Boileau, and R. W. Preisendorfer, "Image transmission by the troposphere I," Journal of the Optical Society of America, vol. 47, no. 6, pp. 499– 506, 1957

[8]. N. Carlevaris-Bianco, A. Mohan, and R. M. Eustice, "Initial results in underwater single image dehazing," Oceans, vol. 27, no. 3, pp. 1–8, 2010.

[9]. K. He, J. Sun, and X. Tang, "Single image haze removal using dark channel prior," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 33, no. 12, pp. 2341–2353, 2011.

[10]. K. He, J. Sun, and X. Tang, "Single image haze removal using dark channel prior," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 33, no. 12, pp. 2341–2353, 2011.

[11]. C. Ancuti, C. O. Ancuti, T.Haber et al., "Enhancing underwater images and videos by fusion," in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR '12), pp. 447–456, June 2012.

[12]. N. Carlevaris-Bianco, A. Mohan, and R. M. Eustice, "Initial results in underwater single image dehazing," Oceans, vol. 27, no. 3, pp. 1–8, 2010.

[13]. A. Galdran,D. Pardo, A. Pic´on, and A. Alvarez-Gila, "Automatic Red-Channel underwater image restoration," Journal of Visual Communication & Image Representation, vol. 26, pp. 132–145,2015.

[14]. S. Bazeille, I. Quidu, L. Jaulin, and J. P. Malkasse, "Automatic underwater image pre-processing," in Proceedings of the Car acterisation du Milieu Marin (CMM '06), pp. 145–152, October 2006.

[15]. S. Q. Duntley, A. R. Boileau, and R. W. Preisendorfer, "Image transmission by the troposphere I," Journal of theOptical Society of America, vol. 47, no. 6, pp. 499–506, 1957.

[16]. A. Galdran, D. Pardo, A. Picon, and A. Alvarez-Gila, "Automatic ´ Red-Channel underwater image restoration," Journal of Visual Communication & Image Representation, vol. 26, pp. 132–145, 2015.