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Restoration of Obscured Images

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Abstract: *The underwater image processing area has received considerable amount of attention within the last decades, showing important achievements. The underwater image suffers degradation due to scattering and absorption and image has corruptions such as haze and noise. Image quality is often degraded during acquisition, compression, and transmission. Examples of typical deterioration include JPEG block artifact, resolution loss as a result of capture equipment pixel limitations, noise spots introduced at high ISO, and picture blur caused by lens out-of-focus. In our project we use enhancement and restoration algorithms. Image enhancement and restoration is a procedure that attempts to improve the quality of image by removing the degradation while preserving the underlying and significant image characteristics. We use Contrast Limited Amplification using Histogram Equalization (CLAHE), Rayleigh Distribution and Relative Global Histogram Stretching (RGHS) for enhancement of the image. Dark Channel Prior (DCP), Maximum Intensity Projection (MIP) and Underwater Light Attenuation Prior (ULAP) for image restoration*

Keywords: Underwater Image Processing, Image Enhancement, Contrast and Color Enhancement, Noise Reduction, Scattering and Absorption, Underwater Light Attenuation Prior.

I. INTRODUCTION

Underwater photos are primarily distinguished by their poor visibility, because light is progressively attenuated as it moves through the water, which leaves the scenery with low contrast and haze. The visibility distance is restricted by light attenuation to roughly twenty meters in clear water and to five meters or less in muddy water. Absorption (which takes away light energy) and scattering (which changes the direction of light path) are the factors causing the light attenuation process. The overall quality of underwater imaging systems is impacted by the processes of light absorption and scattering in water.

Enhancing and restoration of image is done for analyzing and researching the objects and the aquatic animals. Underwater image enhancement refers to the process of highlighting particular information of an image, as well as weakening or removing any unnecessary information according to certain needs. The process of restoring a picture from a deteriorated copy, typically, a blurry and noisy image is known as image restoration. The image can first be enhanced and later restored by removing haze, increasing contrast, and enhancing color in the RGB channel.

The methods used in this project are Contrast Limited Amplification Histogram Equalization (CLAHE), Dark Channel Prior (DCP). CLAHE, is an image enhancement technique and DCP is an image restoration technique. These techniques are capable of extending the range of underwater imaging, improving image contrast, light and resolution. The output shown can be analyzed side by side the input image and the output images can be found as much clearer image than the original image which can be used for research purposes.

1.1 Terminology

- **Histogram-** An image histogram is a gray-scale value distribution showing the frequency of occurrence of each gray-level value. For an image size of 1024 × 1024 × 8 bits, the abscissa ranges from 0 to 255; the total number of pixels is equal to 1024 × 1024.
- **Light Attenuation-** The process of light loss due to absorption and scattering in the water column is called the attenuation process.
- **Spatial Filtering-** Spatial filtering is a process by which we can alter properties of an optical image by selectively removing certain spatial frequencies that make up an object.

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- **Pixel-** is the basic unit of programmable color on a computer display or in a computer image. Pixels are the smallest unit in a digital display.
- **Density Slicing-** A technique normally applied to a single-band monochrome image for highlighting areas that appear to be uniform in tone, but are not.

II. LITERATURE REVIEW

Title: Practical Method for the Underwater Image Enhancement with Adjusted CLAHE
Author: Omer Deperlioglu, Utku Kose
Published Year: Sep 2018

In this paper the author reveals that there are several methods for underwater image enhancement. But most of them contains advanced techniques such as artificial intelligence or some procedure requires expertise knowledge. This study has proposed a practical method to improve underwater images easily. This method consists of the methods like: histogram equalization and contrast-limited adaptive histogram equalization. The performance test of the proposed method has been assessed by using the entropy value, PSNR (Peak Signal to Noise Ratio) and the MSE (Mean Square Error) considering some existing methods in the literature. The obtained results indicate that the introduced method is very efficient and successful to improve all kind of underwater images.

[2] Title: Underwater image quality enhancement through composition of dual-intensity images and Rayleigh-stretching
Author: Ahmad Shahrizan, Abdul Ghani and Nor Ashidi Mat Isa
Published Year: Feb 2015

This paper proposes a method of enhancing the quality of underwater image. The proposed method consists of two stages. In the first stage, the contrast correction technique is applied to the image, where the modified Von Kries hypothesis is applied to the image and stretching the image into two different intensity images at the average value with respects to Rayleigh distribution. In the second stage, the color correction technique is applied to the image where the image is first converted into hue-saturation-value (HSV) color model. The modification of the color component improves the image color performance. Qualitative and quantitative analyses indicate that the proposed method performs better than other state-of-the-art methods in terms of contrast, details, and noise reduction.

[3] Title: Shallow-Water Image Enhancement Using Relative Global Histogram Stretching Based on Adaptive Parameter Acquisition
Author: Dongmei Huang, Yan Wang, Wei Song, Jean Sequeira and Sebastien Mavromatis
Published year: Jan 2018

This paper proposes a simple yet effective shallow-water image enhancement method - relative global histogram stretching (RGHS) based on adaptive parameter acquisition. The proposed method consists of two stages: contrast correction and color correction. Firstly, the contrast correction in RGB color space equalizes G and B channels and then re-distributes each R-G-B channel histogram with dynamic parameters that relate to the intensity distribution of original image and wavelength attenuation of different colors under the water. The bilateral filtering is used to eliminate the effect of noise while still preserving significant details of the shallow-water image and even enhancing local information of the image. The color correction is performed by stretching the 'L' component and modifying 'a' and 'b' components in CIE-Lab color space. Due to the relative concentrated distribution and low histogram range, underwater images often have low contrast and visibility. Histogram stretching is therefore followed to provide a better pixel distribution of the image channels to the whole dynamic range and thus improve the image contrast. Experimental results reveal that the proposed method can achieve better perceptual quality, higher image information entropy, and less noise, compared to the state-of the-art underwater image enhancement methods.

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[4] Title: Single Image Haze Removal Using Dark Channel Prior
Author: Kaiming He, Jian Sun, Xiaoou Tang1
Published Year: Sept 2015

In this paper the author proposes a simple yet effective image prior - dark channel prior to remove haze from an input image. The dark channel prior is a kind of statistics of the haze free outdoor images. DCP is an underwater image de-hazing algorithm that combines three main stages that are homomorphic filtering, double transmission map and dual-image wavelet fusion. A novel algorithm based on the underwater dark channel prior is proposed in this paper to restore the underwater image and improve its contrast and color saturation. It is based on a key observation that most local patches in haze-free outdoor images contain some pixels which have very low intensities in at least one-color channel. Using the DCP with the haze imaging model, we can directly estimate the thickness of the haze and recover a high-quality haze-free image. Results on a variety of outdoor haze images reveals the power of the proposed prior. As a further matter, a high-quality depth map can also be obtained as a by-product of haze removal.

[5] Title: Initial Results in Underwater Single Image De-hazing
Author: Nicholas Carlevaris-Bianco, Anush Mohan, Ryan M. Eustice
Published year: Dec 2015

This paper proposes an algorithm for eliminating the effects of light scattering, referred to as de-hazing, in underwater images. The key contribution is to propose a simple, but effective, prior that exploits the strong difference in attenuation between the three image color channels in water to estimate the depth of the scene. Then we use this estimate to reduce the spatially varying effect of haze in the image. This method works with a single image and does not require any specialized hardware or prior knowledge of the scene. An up-to-scale depth map of the scene is produced as a by-product of the de-hazing process. The results are presented over multiple real underwater images and over a controlled test set where the true colors and target distance are known. Underwater images often suffer from low contrast and color degradation because light is scattered and absorbed when traveling through water. Such images with different color tones can be shot in various lighting conditions, making enhancement and restoration difficult.

[6] Title: A Rapid Scene Depth Estimation Model Based on Underwater Light Attenuation Prior for Underwater Image Restoration
Author: Wei Song, Yan Wang, Dongmei Huang and Dian Tjondronegoro
Published year: Sept 2018

This paper proposes an effective and rapid scene depth estimation model based on underwater light attenuation prior (ULAP) for underwater images and train the model coefficients with learning-based supervised linear regression. With the correct depth map, the transmission maps (TMs) and the background light (BL) for R-G-B light are easily estimated to regain the true scene radiance under the water. In order to evaluate the superiority of underwater image restoration using our estimated depth map, three assessment metrics demonstrate that the proposed method can enhance perceptual effect with less running time, compared to four state-of-the-art image restoration methods.

III. EXISTING SYSTEM

The existing system is a one step process meaning that it applies the same algorithm for any kind of corruption in the image. Existing system tries to remove all kinds of noises in the images by just one algorithm. While trying to adjust one parameter it may affect the other parameter and may result in loss on information. The system applies the algorithm and directly produces the output, the user cannot understand the intermediate changes occurring in the image.

3.1 Disadvantages of Existing System

- A set of algorithms is directly applied on the image which may result in loss of information.
- The existing system does not provide an option for the type of algorithms to be applied.
- The system cannot differentiate between the types of corruption in the image.

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- The user cannot see the intermediate steps.

IV. PROPOSED SYSTEM

A web application where user can upload as input and get restored image as output by applying the desired algorithm.
Benefits of Proposed System

- Images can be enhanced and restored based on the type of corruption in the image and a chosen algorithm tracking.
- A single platform for image enhancement and restoration for underwater images where the expert can select the type of algorithm.
- Image restoration works for giving a better image for research study and discovering the activities underwater.

4.1 Advantages of Proposed System

- Images can be enhanced and restored based on the type of corruption in the image and a chosen algorithm tracking.
- A single platform for image enhancement and restoration for underwater images where the expert can select the type of algorithm.
- Image restoration works for giving a better image for research study and discovering the activities underwater.
- Image enhancement works even for remote sensing images which are images taken by satellites.
- An easy to use and single platform which is solely for experts which is usually not available for them.
- The proposed system also shows the intermediate stages and histogram graphs for the image.

V. REQUIREMENT AND SPECIFICATIONS

A. Functional Requirements

- **Image Enhancement:** This functionality offers three options for selecting the suitable enhancement algorithm to be applied to the input image.
- **Image restoration:** This functionality offers three options for selecting the suitable restoration algorithm to be applied to the input image.
- **Papers:** This functionality allows the user to view the papers that were referred to develop this project.
- **Algorithms:** This functionality gives the description of the algorithms that are used.
- **Input Image:** This functionality allows the user to upload the image of the appropriate format such as .jpeg, .jpg , .png.

B. Non-Functional Requirements

- **Accuracy:** The restored images should be as accurate as possible in terms of the details and features of the original image. This means that the restoration algorithm should be able to recover as much of the obscured information as possible without introducing artifacts or distortions.
- **Speed:** The restoration process should be fast enough to be practical for real-world applications. This means that the algorithm should be optimized for efficiency and speed, without sacrificing accuracy.
- **Availability:** The system shall achieve 100 per cent availability at all times.
- **Robustness:** The restoration algorithm should be robust to variations in the input data, such as differences in image resolution, lighting, and other environmental factors. This means that it should be able to handle a wide range of image types and conditions.
- **Usability**: The web application should have a user-friendly interface that is easy to navigate and understand. Users should be able to upload and restore images with minimal effort and with clear feedback on the progress and results of the restoration process.

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C. Hardware Requirements

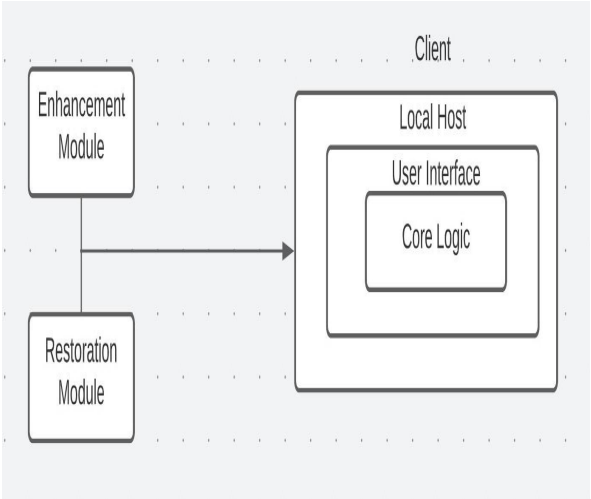
- Operating System: Windows 10 and above
- Coding Language: Python3, HTML, CSS
- Tools : Atom,Windows PowerShell, Visual Studio Codes
- Database : MySQL

D. Software Requirements

- Processor : Intel i5
- Ram : 8GB
- Storage Space : 1TB
- Display Resolution : 1920*1080

VI. SYSTEM DESIGN

A system architecture is the conceptual model that defines the structure, behaviour, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviours of the system. The above figure depicts the system architecture wherein the two modules, Enhancement and Restoration modules can be accessed on the client side on the local host port (public deployment in future version).System architecture conveys the informational content of the elements consisting of a system, the relationships among those elements, and the rules governing those relationships. Here the user interface enables user to use the core logic of the application, which are the two modules afore mentioned. Internally these modules further contain algorithms to be chosen. User can also review the algorithm steps and study the research paper involved - all these interactions are allowed using user interface.



VII. ACTIVITY DIAGRAM

A flowchart is a type of diagram that represents a workflow or process. The flowchart shows the steps as boxes of various kinds, and their order by connecting the boxes with arrows. In the above figure we are restoring obscured or corrupted images which are done mainly for underwater images, In this there are 2 parts that is Enhancement and Restoration.

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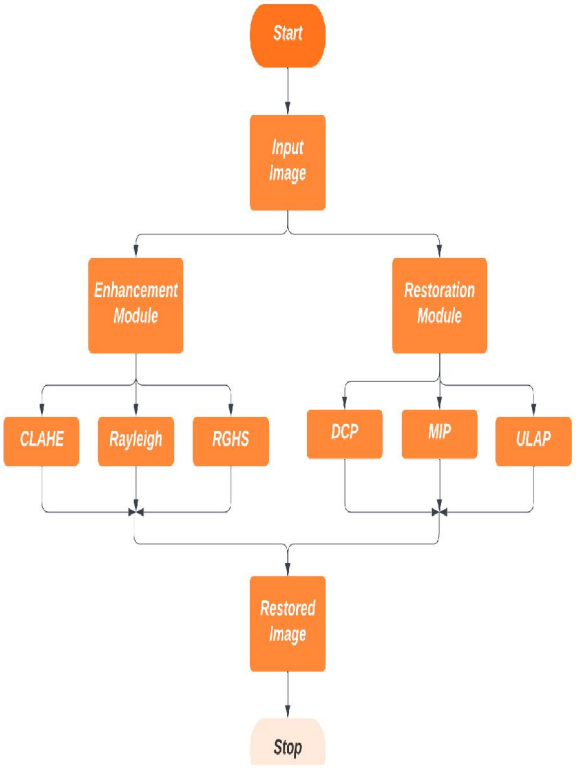

VIII. RESULTS

Image 1: CLAHE output

Image 2: DCP output

Image 2: RGHS output

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IX. CONCLUSION

Quality improvement methods of single underwater images based on image enhancement and color restoration are comprehensively reviewed. Underwater images have many factors like scattering and absorption of light, intensity, contrast and so on, that affect the quality and clarity of the images. It is very difficult to handle these factors using only one algorithm. Hence this system uses different algorithms to handle different challenges. System also shows the difference in the histogram of the original images and the processed images to analyze the changes done to the images.

REFERENCES

[1]. Jose-Luis Lisani, Ana-Belén Petro, Catalina Sbert, Amaya Álvarez-Ellacuría, Ignacio A. Catalán, Miquel Palmer, "Analysis of Underwater Image Processing Methods for Annotation in Deep Learning Based Fish Detection", *IEEE Access*, vol.10, pp.130359-130372, 2022.

[2]. Qi Chen, Ze Zhang, Gelun Li, "Underwater Image Enhancement Based on Color Balance and Multi-Scale Fusion", *IEEE Photonics Journal*, vol.14, no.6, pp.1-10, 2022.

[3]. Eunpil Park, Eunsung Jo, Jae-Young Sim, "Underwater Image Enhancement Using Realistic Dataset With Turbidity and Color Distortion", *2022 Asia-Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA ASC)*, pp.804-808, 2022.

[4]. Songlin Jin, Peixin Qu, Ying Zheng, Wenyi Zhao, Weidong Zhang, "Color Correction and Local Contrast Enhancement for Underwater Image Enhancement", *IEEE Access*, vol.10, pp.119193-119205, 2022.

[5]. Soo-Chang Pei, Chia-Yi Chen, "Underwater Images Enhancement by Revised Underwater Images Formation Model", *IEEE Access*, vol.10, pp.108817-108831, 2022.

[6]. JunNan Liu, YanHui Wei, ZhiLin Liu, WenJia OuYang, "Improving the Stability of Underwater Image Recovery via Multi-stage Integrating Enhancement", *2022 IEEE 24th International Workshop on Multimedia Signal Processing (MMSP)*, pp.1-7, 2022.

[7]. Yanhua Peng, Yipu Yan, Guoyu Chen, Haibei Lan, "An underwater image enhancement method based on color correction and transmission rate estimation", *2022 IEEE 24th International Workshop on Multimedia Signal Processing (MMSP)*, pp.1-6, 2022.

[8]. Jie Yang, Xiaokui Ren, "Underwater Image Enhancement Method Combining Detail Enhancement and Exposure Fusion", *2022 IEEE 5th International Conference on Information Systems and Computer Aided Education (ICISCAE)*, pp.26-31, 2022.

[9]. Tianshun Chen, Liran Shen, Yunsheng Fan, Chengjie Wang, Chenglong Sun, "Underwater Image Enhancement Based on Improved Haze-lines Prior and Histogram Distribution Prior", *2022 5th International Conference on Intelligent Autonomous Systems (ICoIAS)*, pp.60-65, 2022.

[10]. Arpad Kis, Horia Balta, Cosmin Ancuti, "Effective restoration of underwater images to improve local feature matching", *2022 International Symposium ELMAR*, pp.195-198, 2022.

[11]. C. O. Ancuti, C. Ancuti, C. De Vleeschouwer, and P. Bekaert, "Color balance and fusion for underwater image enhancement," IEEE Transac- tions on Image Processing, vol. 27, no. 1, pp. 379–393, 2018.

[12]. G. Kaur and M. Kaur, ''A study of transform domain based image enhancement techniques,'' Int. J. Comput. Appl., vol. 152, no. 9, pp. 25–29, Oct. 2016.

[13]. S.L. Wong, Y.P. Yu, N.A.J. Ho, R. Paramesran, Comparative analysis of underwater image enhancement methods indifferent color spaces. International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS),pp. 034–038 (2016).

[14]. Z. Li, J. Zheng, Edge-preserving decomposition-based single image haze removal. IEEE Transact Image Process 24(12),5432–5441 (2015).

[15]. P.L.J. Drews, E.R. Nascimento, S.S.C. Botelho, M.F.M. Campos, Underwater depth estimation and image restoration basedon single images. IEEE Comput Graphics Appl 36(2), 24–35 (2016)

[16]. H. Zhang, X. Liu, Z. Huang, Y. Ji, Single image dehazing based on fast wavelet transform with weighted image fusion.IEEE International Conference on Image Processing (ICIP), pp. 4542–4546 (2017).

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[17]. S. Jian and W. Wen, ‘‘Study on underwater image denoising algorithm based on wavelet transform,’’ J. Phys. Conf. Ser., vol. 806, p. 012006, Feb. 2017.

[18]. Y. Wang, J. Zhang, Y. Cao, and Z. Wang, ‘‘A deep CNN method for underwater image enhancement,’’ in Proc. IEEE Int. Conf. Image Process. (ICIP), Beijing, China, Sep. 2017, pp. 1382–1386.

[19]. M. H. Asmare, V. S. Asirvadam, and A. F. M. Hani, ‘‘Image enhancement based on contourlet transform,’’ Signal Image Video Process., vol. 9, no. 7, pp. 1679–1690, Oct. 2015.

[20]. M. Grigoryan and S. S. Agaian, ‘‘Color image enhancement via combine homomorphic ratio and histogram equalization approaches: Using underwater images as illustrative examples,’’ Int. J. Future Revolution Comput. Sci. Commun. Eng., vol. 4, no. 5, pp. 36–47, May 2018.