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Underwater Image Enhancement using Different Techniques

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Abstract: *Underwater image enhancement techniques are essential for improving the visual quality of images captured in underwater environments. These techniques can help researchers and scientists extract useful information from underwater images, aid in environmental monitoring, and support various underwater applications such as underwater exploration, oceanography, and marine biology. Underwater image enhancement technique involves two categories-pre-processing techniques and post processing techniques.*

Keywords: Image Enhancement

I. INTRODUCTION

Underwater image enhancement is a process of improving the visual quality of images captured in underwater environments. Images captured underwater are often characterized by poor visibility, low contrast, and color distortion due to the attenuation of light as it travels through water. This can make it difficult to identify objects, recognize shapes, and extract useful information from the images. Underwater image enhancement techniques aim to address these issues by restoring the visibility, improving contrast, and correcting color distortion in the images. These techniques can be broadly classified into two categories: pre-processing techniques and post-processing techniques. Pre-processing techniques involve modifying the imaging system before capturing the image to improve the quality of the captured image. These techniques include changing camera settings, such as aperture and shutter speed, using filters to remove certain wavelengths of light, and using external light sources to illuminate the scene. Post-processing techniques involve applying various algorithms to the captured image to enhance its quality. These techniques include image dehazing, color correction, contrast enhancement, and image fusion. Image dehazing techniques aim to remove the effects of haze in the image caused by the scattering of light by water particles. Color correction techniques aim to correct color distortion caused by the absorption of certain wavelengths of light by water. Contrast enhancement techniques aim to improve the contrast of the image to make it easier to distinguish objects. Image fusion techniques aim to combine multiple images of the same scene captured under different conditions to create a single high-quality image.

II. LITERATURE SURVEY

This section discusses many methods to improve underwater image enhancement.

Underwater Image Enhancement by Attenuated Color Channel Correction and Detail Preserved Contrast Enhancement was proposed by Weidong Zhang, Yudong Wang, and ChongyiLi[1].The procedure in this case includes the following four steps: 1) ACCC; 2) enhancement of global and local contrast; 3) MSF; and 4) MSUM. Paper sujjest is a technique for color-adjusting underwater images. Due to the disparities between an underwater image's superior and inferior color channels, the inferior color channels are adjusted using specifically created attenuation matrices. Then, to increase the global and local contrast of the color-corrected image, a dual-histogram-based iterative threshold approach and a limited histogram method with Rayleigh distribution were used, producing, respectively, a global contrast-enhanced version and a local contrast-enhanced version. After the above process, employ a multiscale fusion technique to combine the complementing qualities of the global contrast-enhanced version and the local contrast-enhanced version. For the fused image's last sharpening step, a multiscale unsharp masking technique is followed. This will improve the visual quality.

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YecaiGuo ,Hanyu Li, and Peixian Zhuang introduces an Underwater Image Enhancement Using a Multiscale Dense Generative Adversarial Network[2]in 2020[2].The underwater environment can easily produce color distortion, underexposure, and fuzz in raw underwater photographs. offers a new multiscale dense generative adversarial network (GAN) for improving underwater photos to solve the aforementioned issues. The key contributions of this paper are developing a trainable multiscale dense generative adversarial network (GAN), and they are outlined below. Without first building the underwater degeneration model and image, suggest a novel multiscale dense block (MSDB). To retain the characteristics of the ground truth picture, the L1 and gradient losses are used as significant adversarial losses. Several experiments are provided to show the effectiveness of the suggested method on both synthetic and actual underwater photos, with two no-reference metrics selected for the underwater environment. The model is unable to produce artistically acceptable synthetic underwater images.

To simultaneously preserve image content and eliminate underwater noise, Xingyu Chen, Junzhi Yu, Shihan Kong, Zhengxing Wu, Xi Fang, and Li Wen create a multibranch discriminator with an adversarial branch and a critic branch[3]. There are many different underwater vision tasks that have emerged as a result of the quick advancement of computer vision and convolutional neural networks (CNN). To increase computational efficiency and improve restoration quality, the GAN-RS used a single-shot network to recover underwater visual quality. To encourage the generator to maintain image content and eliminate underwater noise at the same time, a multibranch discriminator with an adversarial branch and a critic branch was created. In addition, a multistage loss technique, a DCP loss, and an underwater index loss based on underwater properties were also studied.

Setting up an underwater picture capture system and creating a sizable Real-world Underwater Image Enhancement (RUIE) data set with three subsets were done by Risheng Liu, Xin Fan, IEEE, Ming Zhu, Minjun Hou, and ZhongxuanLuo[4]. The three subgroups Target three difficult aspects for improvement: color casts, higher-level detection/classification, and image visibility quality. In order to assess the merits and drawbacks of several methods for improving visibility and removing color casts on photos with hierarchical categories of degradation, and undertook thorough and methodical experiments on RUIE. Then install a multi-view imaging system in sea water and create the Real-world Underwater Image Enhancement (RUIE) data set, a large-scale underwater benchmark in daylight. Also carry out extensive and methodical RUIE tests to assess the performance of different algorithms.

Using the Retinex principle, an effective picture enhancing technique isYu Wang, Chong Tang, Mingxue Cai, Jiye Yin, Shuo Wang, Long Cheng, Rui Wang, and Min Tan presented the work[5]. A real-time underwater onboard vision sensing system for robotic gripping is the study's main goal.For image and video enhancement, the improved multiscale Retinex with color preservation (IMSRCP) is introduced, which offers underwater scenes with excellent definition for locating and detecting underwater targets. For power-saving GPUs placed in underwater robots, a real-time lightweight object detector (RLOD) is created. Consequently, the underwater robotic grasping performance in terms of both speed and detection is met. A practical pool is used to test vision sensing technology that is integrated into underwater robots. The accuracy is 20% less accurate, and the RLOD achieves the required detection speed at a rate 3.36 times faster than that of YOLOV3-416.

Chongyi Li, Jichang Guo, and Chunle Guo provide a poorly supervised color transfer technique to fix colordistortion[6]. an approach that eliminates the requirement for paired underwater photos for training and unknown sites are used to get underwater photos. Design a multiterm loss function incorporating adversarial loss, cycle consistency loss, and structural similarity index measure loss that makes the content and structure of the outputs the same as the inputs while the color is similar to the images that were taken without the water. This function was inspired by cycle-consistent adversarial networks. By using poorly supervised learning, this method corrects the color casts in underwater photos. Additionally, the methodology can serve as a roadmap for future studies on learning-based underwater image color correction.

To enhance and restore underwater photos, Yan-Tsung Peng and Pamela C. Cosman suggest a depth estimation technique for underwater scenes based on light absorption and image blurriness that may be incorporated into the image generation model (IFM)[7]. presented pleasingly restored and upgraded underwater photographs using both synthetic and actual underwater images with various color tones and contents. A wide range of underwater photos respond well to the suggested depth estimation.

The increasing degrees correspond to a color shift. the degree of attenuation that light moving in water experiences depending on the wavelength, making ambient underwater settings with a bluish tone dominant. There are currently no underwater processing methods that can manage the simultaneous presence of artificial lighting, light dispersion, color change distortions, and underwater images. According to a novel systematic approach put out by John Y. Chiang and Ying-Ching Chen, dehazing algorithms can be used to improve underwater photos while also compensating for attenuation differences along the propagation channel and taking the potential presence of artificial light sources into account[8].It Can successfully eliminate haze and restore the color balance of an image. To the best of the knowledge, only a very small number of methods are now available that can address both the light scattering and color change aberrations that underwater photographs experience.

Chong-Yi Li, Ji-Chang Guo, Run-Min Cong, Yan-Wei Pang and Bo Wang put forward a solution to overcome contrast and color cast that decrease the accuracy rate of underwaterobject detection and marine biology recognition[9]. Based on the principle of least information loss and the optical characteristics of underwater imaging, the dehazing algorithm may reduce the information loss of the enhanced underwater photos. Brightness and contrast can be efficiently increased using the histogram distribution-based contrast enhancement algorithm.The suggested method also introduces less noise and artifacts.

A technique to produce high-quality underwater photos was developed by Xinwei Xue, Zhenhua Hao, Long Ma, Yi Wang, and RishengLiu[10]. Nevertheless, it frequently entails creating a direct mapping between the normal and degraded images in the regular color space. It uses a new JLCL-Net that makes use of the Luminance Reconstruction (LR) and Chrominance Correction (CC) modules to extract water information for color correction and texture features for adaptive dehazing, respectively. In real-world situations, this technique performs better than cutting-edge techniques.

III. CONCLUSION

This paper provides a summary of the various techniquesfor underwater image enhancement,underwater image enhancement techniques are vital for improving the quality and clarity of images captured in underwater environments. These techniques utilize a variety of methods, such as color correction, contrast adjustment, and noise reduction, to compensate for the loss of color and detail caused by water absorption and scattering. Advancements in technology have led to the development of more sophisticated algorithms that are capable of producing high-quality images that are rich in detail and color. With the growing importance of underwater imaging in fields such as marine biology, oceanography, and underwater archaeology, the need for effective image enhancement techniques will only continue to increase.

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