IJCRT.ORG ISSN : 2320-2882
INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

Underwater Image Enhancement Using Convolutional Neural Network

[1]Dr.G Rosline Nesa Kumari [2]P Sunil kumar[3]Siripurapu Praveen [4]Sunkari Sri Chaitanya Kumar [5]Somu Ram Chowda Reddy

[1] professor, School of Computing, Department of Computer Science and Engineering, Bharath Institute of Higher Education And Research, Chennai, India- 600073.

[2,3,4,5] Student,, School of Computing, Department of Computer Science and Engineering, Bharath Institute of Higher Education And Research, Chennai, India-600073

Abstract— The proposed CNN-based method consists of several stages. Firstly, a large-scale underwater image dataset is collected and preprocessed to remove noise and artifacts. Subsequently, a deep CNN architecture is designed and trained using a combination of supervised and unsupervised learning techniques. The CNN model is trained to learn the complex mappings between degraded underwater images and their corresponding enhanced versions. The training process involves optimizing network parameters to minimize a defined loss function, thus enabling the network to capture relevant features and patterns for image enhancement.

Keywords—: Iteration, Image enhancement, Color contrast, Hybrid filter, Noise reduction, CNN.

I. INTRODUCTION

The oceans is vital to the survival of Earth's life because it contains an incredible variety of strange, nameless organisms as well as large quantities of energy. As a result, a lot of people all across the world are working hard to do some serious high-tech marine research. Experts strive to collect high-resolution undersea images for use in fields as diverse as mobile robots, search and rescue the analysis of man-made objects, environmental surveillance, including real-time guidance. The chemical & physical features of underwater environments, though, have a profound effect on underwater photography quality, creating challenges that are simpler to overcome in surface photography. Underwater photographs, for example, always have a colored tint, such as a greenish- blue tint due to the different absorption proportions of blue, green and red photons.

The importance of restoring high-quality undersea pictures for fields like coastal environment and underwater archaeology cannot be overstated. Underwater imaging and sensing for robots. Light is continually being reflected and deflected by air particles before it reaches the camera. There is hardly much water. In water, the dissipation rate of light varies with its wavelength. Images shot underwater seem blue because red is more affected than green or blue. Artificial light is often used to supplement natural light for underwater imaging. Lighting situations underwater with artificial light is a common way to improve photographs taken there.

underwater picture has a bright spot in the centre. When compared to images taken on land or in the sky, the predominant hues in underwater photography tend to be blue and green. However, vision is drastically reduced due to the substantial absorption coefficient in water in comparison to air and the increased incoming light dispersion. In addition to those that are somewhat near in certain conditions, have very poor visibility and little contrastwith their environment.

II. LITERATURE SURVEY

A innovative approach to improving undersea photos that can gradually adjust colours, focus, and brightness. This is because the suggested solution incorporates both multi-channel colour compensation and colour correction. A Gauss dispersion pyramids as well as the brightness constrained adaptable normalisation both help with the problem of blurred details and poor contrast [1]. The suggested technique centres on four fundamental tenets: colour compensation, color management, details enhancement, & contrasts improvement. Both statistical & perceptual evaluations show that the suggested technique successfully eliminates picture blur, achieves retouching, and vastly improves image quality.

Underwater photos often have distorted color & blurry features because of absorption coefficient, diffraction, & scatter that depends on the light's wavelength that is being used to capture the image. [2,3]We suggest an innovative system for enhancing visual feature data, named SGUIE- Net, and show how to use semantics as rising instruction by training improvement features for different regions. With this in mind, we present a semantics region-wise improvement modules to best learn local enrichment characteristics for semantics areas with multi-scale perceptions. Having fed them as supplementary characteristics into the

This study proposes a unique architecture for integrating submerged item identification and picture restoration using a common core with FPN. When utilized to enhance the common structure's generalization ability as well as flexibility to the aquatic realm, the loss among the restored image as well as the input image [4] Improved semantics & texture data across both shallow and deep levels are suggested to be integrated using a UFPN. Our technique has been shown to achieve 1.4%mAP & 1.0%mAP in thorough testing and thorough evaluations upon that URPC2020 datasets.

In order to get superior marine photographs, the authors of this research advocated the use of an ADMNNet. We suggest ADMB to enhance the variety of image features by trying to merge the characteristics of various RFs into a solitary framework, as opposed to established CNN-based UIE channels, which participant consent a remedied RF dimensions of neurones in one set of feature. For instance, ADMB is comprised of a MCAM & DFSM. [5,6] Since embedded particulates absorb and dispersion of light, it's common for captured submerged photos to experience from significant quality deterioration, including such color changes & degradation of clarity. To address these degenerative concerns, we present a DJCNET that uses two independent branches to maintain the diverse and distinctive qualities of undersea pictures. [7] The selected absorbing of lights in waters as well as the elimination of distortions are the goals of the development of the light absorbing correction branches, while the adjustment of the blur generated by dispersion is the focus of the layout of a light dispersion corrections subsidiary.

Because of the enormity of the aquatic ecosystem, the data included in a single submerged picture is inadequate, making it difficult to match the objectives of marine studies. [8] In this work, the authors offer a MFPF approach to improving the graphical fidelity of undersea photos by identifying & combining several characteristic prior record of the pictures. This layout takes full benefit from the advancements in white balancing, assisted filtration, & various exposure series technologies. [9] Additionally, it improves marine photography by fusing together characteristics from different scales. From these experiments, we learn that this design effectively addresses a wide range of degeneration issues, eliminates excessive augmentation, and enhances shadowy areas by using a multi-feature previous fusion technique.

III. EXISTING METHODOLOGY

As a method for modifying intensity in image analysis, proposed method takes use of the picture's distribution. This method often improves the general contrast of several photographs when the useful information they contain is expressed by near contrasting ratios. This modification may be used to more uniformly distribute the intensities over the histogram. The result is that areas with little local contrast may gain it. Histogram equalisation is used to effectively distribute the most common pixel intensity. This effect is particularly effective when the foreground and backdrop of a photograph are the same tone. In instance, this method may increase the amount of clarity in underexposed or overexposed photographs, as well as enrich x-ray images of skeletal anatomy.

The system's invertibility and simple method are two major strengths. For this reason, in principle, the initial histogram may be restored by knowing the histogram-based algorithm. This does not need a lot of processing power. The technique's lack of selectivity is one of its drawbacks. However, the amount of useable signal may decrease as a result of the viewpoints of ambient noise.

Histogram Equalization Calculation:

$$(v) = round\left(\frac{cdf(v)-cdf_{min}}{(M*N)-\ cdf_{min}} * (L-1)\right)$$

cdf(v) – Cumulative Distribution Function of the histogram table.

cdfmin – Minimum Cumulative Distribution Frequency.

M – Width of the gray scale Image.

N – Length of the gray scale Image.

L – Number of grey levels used (Usually 256)

Note : The cdf must be normalized to [0, 255]

Data augmentation may also be used on color photos by applying the same method separately to the blue, green, and red components of the image's Rgb data. Applying the same method on the blue, green, and red components of an RGB picture, nevertheless, may result in observable modifications to the image's colour balancing when the operation adjusts the respective proportions of the hue regions. If the picture is transformed to some other colour palette, like Lab colors space & HSV/HSL colors language in specific, the approach may be applied to the luminance or values channels without affecting the tone or chroma of the picture. Equalization histograms may be performed in a number of ways in three-dimensional space. Histogram in 3D colour space was used by Venetsanopoulos & Trahanias.

On the downside, it causes whitening, where brighter pixels are more likely to be selected than darker ones. To achieve this, Han advocated using a novel functional form determined by the iso-luminance surface.

IV. PROPOSED METHODOLOGY

There are two main components of the proposed technique for enhancing images: contrast restoration & color management. Once the channels have been divided up, the improved Van Schick concept is implemented. The average (Ravg, Gavg, and Bavg) of the three color channels are determined.

The sample mean, determined by averaging those three parameters, is then used to set the standard and target levels, instead of the greatest value. The two extra streams are divided by the integrators A & B, that are in turn obtained using equation(1.1) as well as (1.2).

$$A = \frac{\mathrm{median}(R_{avg},G_{avg},B_{avg})}{\min(R_{avg},G_{avg},B_{avg})} \qquad ----(1.1)$$

$$B = \frac{\mathrm{median}(R_{avg},G_{avg},B_{avg})}{\max(R_{avg},G_{avg},B_{avg})} \qquad ---(1.2)$$

The spectrum of the picture is then extended evenly. The distribution is then divided into a lower & a higher half, determined by the median value. The histogram's minimum and maximum values are each expanded to cover the whole span of the Distribution function. The distribution of the resulting picture is then extended worldwide. Once an average has been determined, the histogram is split into a lower & upper section. Using the Raleigh distributions as a baseline, the minimum and maximum ranges of the graph are expanded to include the whole contrast ratio. A Rayleigh distributed was stretched using the formula(1.1). Integrating the stretch & Rayleigh formulae yields this expression. Pixels "pin" represents the source pixels, while "imin" & "imax" represent the lowest and highest intensities in the given picture channels. The variable an of the distributed.

V. STRUCTURED FLOW DIAGRAM AND APPROACH

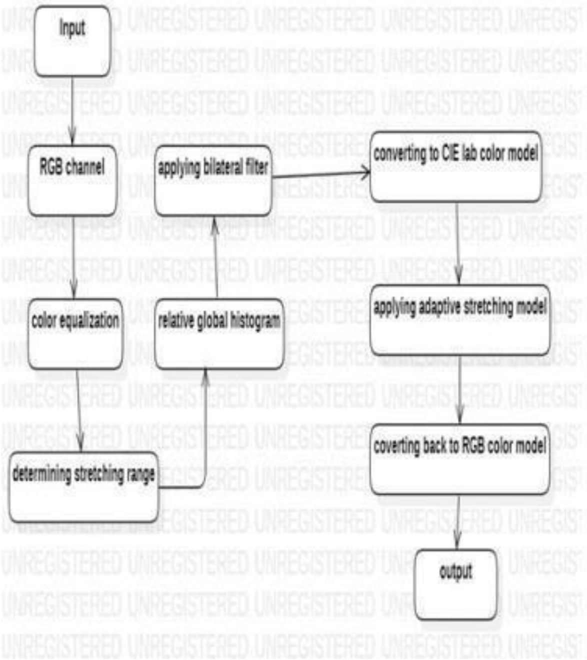

Fig.1. Flow Diagram of our system

Color restoration & RGHS are applied to the picture after B, G, R channels have been decomposed. Following the abovementioned conversion, the bidirectional filtering is used to eliminate the noise while maintaining the intended bright undersea picture's finer features. That way, the hue cast & contrast adjustment that come from light absorbing and scattering will be gone. To adjust for such "a" & "b" elements in CIE-Lab colour spaces, the "L" element of the picture is extended worldwide throughout in the color grading step. The brilliance & intensity of the colours in the picture will be improved by the adaptable extending of "L", "a", & "b." In the last phase, we use five different amounts. There are three primary stages in our suggested procedure: Adjusting the contrast, adjusting the colours, and evaluating the overall quality are the three main steps.

A) Extension & Contraction in the CIE-Lab color model -

The picture will undergo hue restoration when the RGB brightness modification has been made. The procedure involves converting the submerged picture to the Cie space to improve colour accuracy. The Cie-lab space defines image brightness as the "L" element, with L = 100 indicating the highest possible image and L = 0 indicating the lowest possible image. If both a and b equal 0, the colour channels will show completely neutral grayscale. It is necessary to alter the "a" and "b" constituent hue gradients at outputting to get the specific color restoration. The "L" factor may also be used to adjust the overall contrast of the picture. Initially, the Cie scheme breaks down the relatively shallow picture into its constituent components. Ranges between 0.1% to 99.9% are expanded to ranges [0, 100] when the "L" factor is added using quadratic sliding extending mentioned in (8). The numbers at the bottom and top.1% of the picture are both fixed at 100. The interval [- 128, 127] represents the possiblevalues for the "a" & "b" elements, with middle value meaning 0. Extending "a" with "b" results in the S-shaped curves of the theory (2).

$$p_\chi = I_\chi * \left(\varphi^{1-\left|\frac{\ }{128}\right|}\right), X \in \{a,b\} \qquad ---(2)$$

The numbers are exponentially extended in this formula, thus the nearer they are to zero, the more they are extended. Color & contrast are what really make or break an image's legibility. There is enough contrast between foreground and backdrop that objects can be distinguished. Its "L", "a", & "b" bits of the CIE-Lab color image are dynamically extended before being merged and translated down to the Rgb image. The ultimate, perceptible outgoing picture may be made by adjusting the intensity and colours of the image pixels.

B) The Color Space of the CIE-Lab -

The Cielab system, often referred as the L*a*b* hue orbit, was established by the Intergovernmental Panel on Lighting. CIELAB must always be referenced to by adding an asterisk (*) after the word "Lab" to prevent any potential misunderstanding with Hunter Lab. There are three numbers involved in representing colour there: L* for how bright something is, a* for how reddish that was, b* for how bluish that was, & y* for how yellowish that was. The CIELAB is developed to be a homogeneous sensory field, thus a given quantitative increase would map to a matching observed color changes. Despite its lack of complete sensory uniformity, the LAB space has found practical use in business for detecting small change in color.

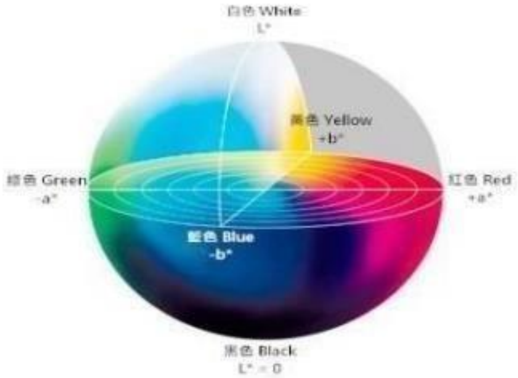

Fig.2. CIE-Lab color space

In its three dimensions, the CIELAB region encompasses the whole spectrum of colours visible to the human eye. An adversary duo is made up of red with green, while a competitor pair is made up of blue & yellow, according to the adversary colour model in human sight. The brightness factor L*, or "Lstar," sets 0 as black & 100 as white. Neg numbers on the a* axis are towards the green adversary colour, while values are towards the red adversary colour. Blue & yellow are opposites on the b* axis, having negative sign moving away from blue & positive values moving towards yellow. Visual system is sensitive to a wide range of colours, hence the a* & b* vectors have no limits and therefore can readily go above 150, dependent on the baseline white. Unfortunately, for the sake of efficiency, software packages often limit these numbers. Clamping a* & b* towards the spectrum 128 to 127 is typical in situations when integer mathematics is being applied, for illustration.

Fig.3. Comparison of before and after use of our model images

VI. CONCLUSION

The method of Relative Global Histogram Stretching is an improvement over the standard Histogram Equalization. The revised Von Kreis theory is easily implemented by extending the global histogram, splitting it, and reassembling the bottom & top halves of the graph to use the mean or midway. When making adjustments to colours, we use the HSV paradigm to get good results. We analysed the issues plaguing shallow-water photos and the methods currently used to enhance depth map, then we satisfactorily proposed a new method dubbed RGHS for enhancing a wide range of shallow-water pictures. Our proposed procedure, which considers both the spectral allocation feature of the picture as well as the aquatic transfer properties of numerous light streams, begins with a juxtaposition adjustments based on a simple histogram stretch with vibrant specifications acquirement in the Rgb model. After that, adjustments are made to the hue, saturation, lightness, and brightness according to the CIE-Lab colors space.

We compared our proposed method to the standard techniques for dehazing, which rely on distribution bending in the RGB & HSI/HSV colour models. Both quantitative & qualitative analysis shows how much better our method is at bringing out features & minimising noise in photographs captured in intertidal zone. The incorporation of gaussian dispersion into the RGB or CIELab colour is useful for studies involving other types of image data. However, our proposed technique has shortcomings whenever it refers to boosting submerged photographs since it does not account for the significant damage canal in high groundwater images that ignores the energy retardation along the line of dispersion between scene as well as the top. As a matter of fact, deep sea images obtained at depths of more than a thousand metres are not used to test many of the methods meant to improve underwater photography.

In summary, we establish that proposed method serves the goal of contrast correction. The main problem with this technique, however, is that it reduces the amount of colour pixels. is used in Rayleigh stretching to adjust colour and contrast. On the other hand, the saturation of the red hue is far too high. As a result, the photo may contain shades of red. Consequently, RGHS is the method, used for both color calibration & contrasting restoration by eliminating the R component, to get over this problem. As a result, there will be no over-saturation of the Red channel. We conclude that relative global histogram stretching is preferable than histogram equalization.

REFERENCES

[1] Zhang, Weidong, et al. "Underwater image enhancement via minimal color loss and locally adaptive contrast enhancement." IEEE Transactions on Image Processing 31 (2022): 3997-4010.

[2] Liu, Risheng, et al. "Twin adversarial contrastive learning for underwater image enhancement and beyond." IEEE Transactions on Image Processing 31 (2022): 4922-4936.

[3] Zhou, Jingchun, Dehuan Zhang, and Weishi Zhang. "Underwater image enhancement method via multi-feature prior fusion." Applied Intelligence (2022): 1-23.

[4] Ding, Xueyan, et al. "A unified total variation method for underwater image enhancement." Knowledge-Based Systems 255 (2022): 109751.

[5] Jiang, Qun, et al. "Two-step domain adaptation for underwater image enhancement." Pattern Recognition 122 (2022): 108324.

[6] Zhuang, Peixian, et al. "Underwater Image Enhancement With Hyper-Laplacian Reflectance Priors." IEEE Transactions on Image Processing 31 (2022): 5442-5455.

[7] Sun, Kaichuan, Fei Meng, and Yubo Tian. "Progressive multi-branch embedding fusion network for underwater image enhancement." Journal of Visual Communication and Image Representation 87 (2022): 103587.

[8] Kang, Yaozu, et al. "A Perception-Aware Decomposition and Fusion Framework for Underwater Image Enhancement." IEEE Transactions on Circuits and Systems for Video Technology (2022).

[9] Sharma, Shobha, and Tarun Varma. "Graph signal processing based underwater image enhancement techniques." Engineering Science and Technology, an International Journal 32 (2022): 101059.