IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 11, Issue 3, March 2024

DOI: 10.17148/IARJSET.2024.11342

Underwater Image Enhancement using Deep Learning

Dhulipalla Tejaswi[1], Yerru Charitha[2], Menikonda Harika[3], Tummalacharla Sreshta[4]

Assistant Professor in Department of CSE, Bapatla women's Engineering College, Bapatla, INDIA[1]

BTech, Computer science & Engineering, Bapatla Women's Engineering College, Bapatla, INDIA[2-4]

Abstract: For all researchers, recovering lost colours in underwater photographs with complete flavour is still a difficult undertaking. A physically realistic model was provided, and it was demonstrated that the atmospheric image creation model's broad application to underwater photographs was partially to blame for this problem. The updated model demonstrated that: 1) the attenuation coefficient of the signal is not constant throughout the scene but rather depends on reflectance and object range; and 2) the back scatter coefficient, which controls the increase in backscatter with distance, is different from the attenuation coefficient of the signal. Here is the method that uses RGBD photos to recover colour using an updated model. Using the darkest pixels and their known range information, the Sea-thru approach estimates backscatter. The range-dependent attenuation coefficient is then obtained using the spatially variable illuminate. It is demonstrated that the approach utilizing the updated model performs better than the models utilizing the atmospheric model. With the aid of potent computer vision and deep learning algorithms, the regular removal of water will lead to the opening up of enormous underwater datasets for technical development, intriguing potential for underwater research, and conservation.

Keywords: Underwater, image, colour, Sea-thru

I. INTRODUCTION

Underwater image colour reconstruction is a difficult task for which there is presently no widely used solution. Recent research has demonstrated that the widely used image formation model was partially to blame because it was developed for the atmosphere and failed to account for the strong wavelength dependence of light underwater. The new model demonstrates that: 1) direct signals and backscattered signals are controlled by different coefficients (the previous model assumed they were the same); and 2) each of those coefficients depends on variables other than the water's optical characteristics (the previous model disregarded them). Although the updated model has better physical accuracy, its application is more challenging due to its additional factors. This section presents the Sea via approach, which describes how to estimate the parameters for improved scene recovery.

II. BACKGROUND & RELATED WORK

The attenuation coefficients should ideally be computed directly from the pictures. To do that, taking pictures of a calibration target at predetermined distances is the simplest technique. The estimated veiling-light is used to calculate the coefficients; the illumination colour is left out. To determine the attenuation coefficients per channel, the grey-world assumption was employed. Some mitigate this issue by employing fixed attenuation coefficients that are measured for a single type of water. By adding data from several images to the image creation model, known intervals were utilized to compute backscatter in addition to attenuation, so somewhat simplifying the problem. Reconstructing underwater scenes has recently been accomplished with deep networks. However, because their instruction is based solely on artificial data, the Caliber of the simulation models is crucial. Ideally, the attenuation coefficients should be calculated straight from the images.

The easiest way to achieve it is to use a camera to take images of a calibration target at predefined distances. The illumination hue is not taken into account when calculating the coefficients; only the estimated veiling-light is. The grey-world assumption was utilized in order to calculate the attenuation coefficients for each channel. Certain people lessen this problem by using fixed attenuation coefficients that are determined for a certain kind of water. The challenge was considerably simplified by using known intervals to compute backscatter in addition to attenuation by adding data from many images to the image production model. Deep networks have lately been used to reconstruct underwater sceneries. But as they only use synthetic data for their instruction, the quality of the simulation models is crucial.

DOI: 10.17148/IARJSET.2024.11342

III. METHODOLOGY

In order to provide enhanced underwater photographs with little information loss, the Proposed Algorithm entails the following phases.

A. Imaging

We need a range map of the scene, which we acquire by applying structure-from-motion (SFM), a technique that is widely used in archaeology and undersea to quantify structural complexity. We are placing objects of known sizes in this scenario because our approach demands an absolute value of z, while the SFM only provides range up to scale. When imaging from the underwater vehicles, their navigation sensors can offer height or velocity. Stereo imaging is an approach that needs two synchronized cameras and a simple in-water calibration prior to the imaging survey commencing. A new artificial intelligence program called Sea-thru is revolutionizing the field of underwater photography. Derya Akkaynak, an AI engineer and oceanographer, created it. This algorithm is capable of eliminating the resulting visual distortion caused by water, creating crisper and clearer photographs.

B. Scene Reconstruction

Due to the dispersed and absorbed light, underwater photos frequently have poor contrast and colour distortion. They are shootable in different lightening circumstances because the photos have varying colour tones, which makes restoration and enhancement challenging. A depth estimation approach for underwater sceneries has been presented, based on the image light absorption and blurriness. This method can be utilized to enhance and restore underwater photos in the Image Formation Model (IFM). Lightning circumstances in underwater photos cause them to be regularly invalidated, which results in subpar restoration outcomes. This suggested method provides a more accurate estimation of the underwater scene depth. The suggested approach works better than previous IFM-based underwater picture restoration techniques, according to experimental results on the restoration of both synthetic and actual underwater images. The colour distortion in underwater photography is a challenging issue. The Sea-thru colour correction technique "removes the water" from photos, revealing all of the saturation, natural brightness, and colour restoration. It is challenging to adjust the colour of photographs shot in saltwater since the adjustment coefficients depend on variables other than the saltwater's optical characteristics. Water obscures many computationally significant aspects of the scene, making it more difficult to apply machine learning and computer vision techniques to datasets of underwater images, respectively. Sea-thru filters out light absorption and scattering that takes place in the ocean's atmosphere by using the stored image analysis features. The software that is utilized can reverse the washed-out look, bring back the colour of photos, and successfully remove image distortion pixel by pixel. For marine biologists and other scientists interested in ocean research, it is significant since it will facilitate duties like species classification and counting in underwater photos. Sea-thru and Coral Scientists respectively open up the possibility of using computer vision and machine learning in the identification procedure. However, Sea-thru still has certain logistical challenges to overcome. For example, the software requires distance information to function, and the developers must take numerous pictures of the same landscape from different perspectives in order to gather enough data for Sea-thru to perform its magic. However, this can be avoided by the use of photogrammetric techniques, which are already used by ocean scientists to regularly measure distance. A program that Akkaynak has created appears to be able to get around some of these practical problems by functioning flawlessly and suitably with these kinds of photos.

C. Backscatter Estimation

In light of the underwater environment deviating light waves from their original direction, backscatter is the reflection of light waves bouncing on particles in the water and going into the camera. It can often block the object and highlights these water droplets. Sea-thru's image analysis takes into account the physics of light absorption and scattering in the atmosphere, which differs from that of the ocean, where light interacts with larger particles. The program then successfully reverses the distortion of the image from the water pixel by estimating backscatter and restoring lost colours. To determine the underwater range-dependent attenuation coefficient, it makes use of an estimate of the spatially variable illuminate that was computed during the model's training process. Start by dividing the range map into ten clusters, each of which represents a potential value for the previously calculated variable z (distance), in order to determine and reverse the back scatter value. Determine the ideal z correlation using the recorded image and the object's known distance. An algorithm was developed and verified using the underwater picture creation model as a foundation. The sea-thru algorithm will effectively and quickly remove water from underwater photos, opening up exciting new possibilities for underwater exploration and conservation in the future.

D. Attenuation Coefficient Estimation

We suggested a vised model that demonstrated:1) Different coefficients govern both backscattered and direct signals (assuming the same for the old model); 2) Each of these coefficients depends on factors other than the water's optical

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ⁘ Peer-reviewed & Refereed journal ⁘ Vol. 11, Issue 3, March 2024

DOI: 10.17148/IARJSET.2024.11342

properties (which were disregarded in the prior model). The updated model has better physical accuracy, but its application is more challenging due to its additional factors. In order to improve scene retrieval, the Sea-thru approach is described here, which describes how to estimate these parameters. The video is first cleaned up before being sent to the machine learning system, which will assist in identifying the minute details, tics, and gestures of the cichlid's behaviour. The algorithm can then assist Jordan in comprehending what's going on in the social lives of cichlids thanks to its amazing pattern recognition capability.

Underwater photos are not consistent, clean data, which machine learning needs to learn from. The water conditions can make it challenging for an algorithm to monitor this fish and not that fish if it is necessary. The computer will figure out, for example, that one day the underwater photos show a black and white fish amid a brown world. The fish turn green and Gray in a world of yellow the next day when an algal bloom occurs! correspondingly. Sea-thru has standardized the data and removed the water conditions that make it difficult for algorithms to interpret underwater photographs and human analysis. It's not just marine biologists who want unobscured underwater photos for their study. submerged photography is used by archaeologists to record and investigate significant discoveries, while video is utilized to explore and record shipwrecks, artifacts, and other submerged human remains.

E. Photo Finishing

The platform described uses the camera pipeline manipulation to convert the outputs of the Sea-thru algorithm to a standard colour space. It then inserts the resultant colour space into the pipeline and specifies an identity matrix for white balance. While several evaluations on the restoration and improvement of underwater images have been published, they often focus on specific areas of underwater processing. For example, Sahu et al. presented a restricted set of techniques for enhancing underwater images, while Kaeli et al. concentrated on algorithms for colour correction of underwater images. Additional elements of underwater optical processing were studied by Lu et al. and Han et al. These included underwater picture restoration, underwater image de-scattering, underwater image quality evaluations, and upcoming trends and difficulties in the processing and design of underwater images.

F. Results

Finally, we have a user interface that allows us to upload one image, retrieve its enhanced version, and upload a folder containing underwater photos from which we can extract the enhanced images.

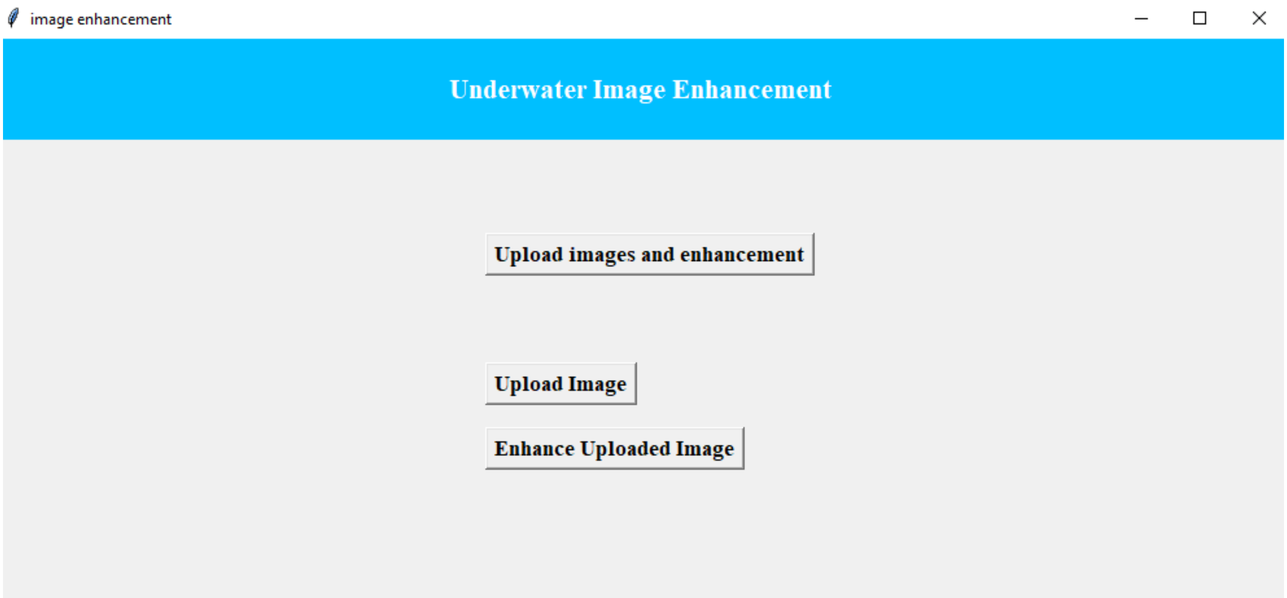

Fig. 1 User interface

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
Impact Factor 8.066 ⁙ Peer-reviewed & Refereed journal ⁙ Vol. 11, Issue 3, March 2024
DOI: 10.17148/IARJSET.2024.11342

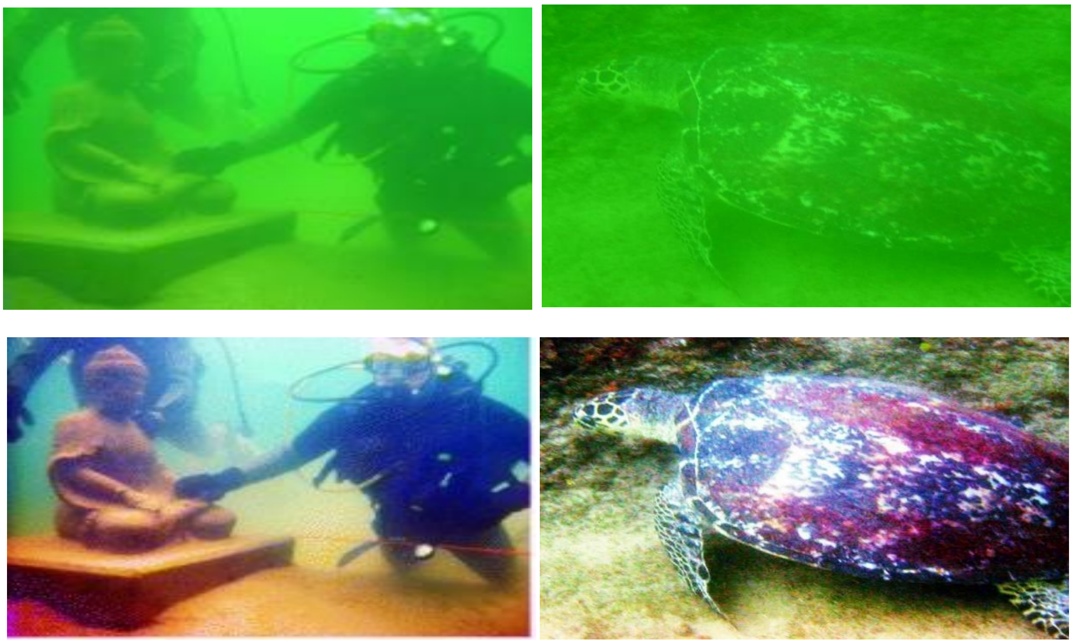

Fig 2 Enhanced Images

IV. CONCLUSION

As a result, the low contrast value the main issue with the processing of underwater images is being fixed. While it is relatively easy to adjust the contrast of conventional atmospheric photographs, underwater images are extremely complex to correct using this method, which results in significant information loss. When computing the output, time and memory are also managed to minimize information loss.

REFERENCES

[1]. Raimondo Schettini &Silvia Corchs (2010), "Underwater Image Processing: State of the Art of Restoration and Image Enhancement Methods", Hindawi Publishing Corporation EURASIP Journal on Advances in Signal Processing, pp.11-12
[2]. Jichang Guo and Chongyi Li (2015), "Underwater image enhancement by dehazing and colour correction", Journal of Electronic Imaging, pp. 2-5.
[3]. Xiangyu Deng , Huigang Wang and Xing Liu (2019), "Underwater Image Enhancement Based on Dehazing and Removing Light Source Colour", Natural Science Foundation of China, IEEE, pp. 114308
[4]. Miao Yang, Jintong Hu, Chongyi Li, Gustavo Rohde, Yixiang Du, Ke Hu (2019), "An In-depth Survey of Underwater Image Enhancement and Restoration", Natural Science Foundation of Jiangsu province, IEEE, pp123639 – 123645.
[5]. Poonguzhali E, Aravindhar S, Natesa Kumar V A (2020), "Underwater Image Enhancement using PCNN and NSCT fusion", International Research Journal of Engineering and Technology (IRJET), pp 2370-2371.
[6]. Yakun Gao, Haibin Li, and Shuhuan Wen (2016), "Restoration and Enhancement of Underwater Images Based on Bright Channel Prior", Hindawi Publishing Corporation Mathematical Problems in Engineering, pp.2-14.
[7]. D.AkkaynakandT.Treibitz (2018),"A revised underwaterimage formation model", In Proc. IEEE CVPR, pp. 6723-6728.
[8]. D. Akkaynak, T. Treibitz, T. Shlesinger, R. Tamir, Y. Loya, and D. Iluz (2017), "What is the space of attenuation coefficients in underwater computer vision?", In Proc. IEEE CVPR, pp. 3-7.
[9]. D. Berman, T. Treibitz, and S. Avidan (2017), "Diving into hazelines: Colour restoration of underwater images", In Proc. British Machine Vision Conference (BMVC), pp. 4-7.
[10]. Lu H, Li Y, Xu X, LiJ, Liu Z, Li X, Yang J, and Serikawa S (2016), "Underwater image enhancement method using weighted guided trigonometric filtering and artificial light correction" , Journal of Vision Communication and Image Representation, pp. 504-516.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

Impact Factor 8.066 ∺ Peer-reviewed & Refereed journal ∺ Vol. 11, Issue 3, March 2024

DOI: 10.17148/IARJSET.2024.11342

BIOGRAPHY

Dhulipalla Tejaswi working as Assistant Professor in Department of CSE, Bapatla Women's Engineering College. She completed her M. Tech in Computer Science Engineering from Bapatla Engineering College, Bapatla. She has 6 years of Teaching Experience in various Engineering colleges.

Yerru Charitha B. Tech with Specialization of Computer Science and Engineering in Bapatla Women's Engineering college, Bapatla.

Menikonda Harika B. Tech with Specialization of Computer Science and Engineering in Bapatla Women's Engineering college, Bapatla.

Tummalacharla Sreshta B. Tech with Specialization of Computer Science and Engineering in Bapatla Women's Engineering college, Bapatla.