# A Survey on Various Underwater Image Enhancement Techniques

Shrinivas Shirkande[1], Dr. Madhukar J. Lengare[2]

Research Scholar, Faculty of Engineering, Pacific Academy of Higher Education & Research University Udaipur, India

Faculty of Engineering, Pacific Academy of Higher Education & Research University Udaipur, India

**ABSTRACT**: This paper depicts submerged picture upgrade strategies by studying past research work. The Scattering impact and shading change impact consolidated outcomes in lessen perceivability and corruption of nature of picture. Submerged pictures are by and large influenced with poor perceivability, poor lucidity and poor shading contrast. There are a few creators who worked over a similar subject, proposed diverse techniques for submerged picture improvement. Picture improvement as an action of patching up gauges of info picture for better comprehension without bounds watchers. In picture improvement, more concentrate is on picture highlights like show, differentiation, shine and edges of photos. In this paper, we propose Wavelength Compensation and image dehazing (WCID) and wavelet transform to improve the submerged picture quality.

**KEYWORDS**: Image Dehazing,dark channel prior, wavelet transform, refraction and scattering, WCID

## I. INTRODUCTION

Advanced image transforming includes the adjustment from claiming advanced information to enhancing those picture qualities. Expanding clarity, sharpness What's more subtle elements for features from claiming premium towards majority of the data extraction What's more further examination need aid attained utilizing advanced image transforming. Advanced image transforming includes those changes for advanced information to moving forward the picture qualities. Expanding clarity, sharpness What's more subtle elements about offers from claiming premium towards data extraction Also further Investigation need aid attained utilizing advanced image transforming [28]. Catching reasonable pictures on submerged situations will be a critical issue from claiming sea building. Cloudiness may be initiated by suspended particles for example, such that sand, minerals, and plankton that exist on lakes, oceans, also streams. Similarly, as light reflected from Questions propagates to those camera, distribute of the light meets these suspended particles.
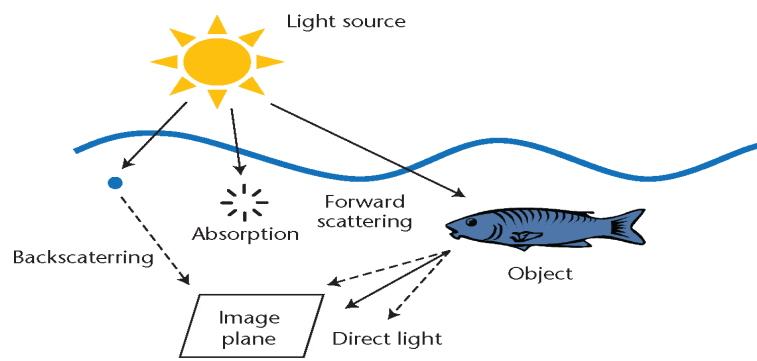


**Figure(a): Scattering and Light absorption underwater Source: Drews, et al (2016)**

Also light absorption wonder submerged which degrades those picture caliber [29]. As stated by Jaiswal and Padole (2016) picture upgrade strategies and de-noising are especially extremely critical in the event from claiming enhancing those pictures personal satisfaction of the submerged pictures [17]. Exploring those globes submerged for Examine purposes, with assess those living surroundings investigation of the seafloor is utilized. WCID aides in disposing of the distortions because of dissipating from claiming light and transform clinched alongside color. The calculations for WCID aides Exceedingly to restoring the color equalization of the picture What's more dispose of cloudiness. Wavelet conversion speaks to signs with a helterskelter level about sparsity. The dissipating Also light absorption wonder submerged which degrades the picture personal satisfaction demonstrated by the above figure (a)..

Anuradha Also Kaur (2014) accounted that submerged pictures need aid poor done nature due to the light exhibit in the water [6]. It is exceptionally troublesome Also discriminating to catch an acceptable picture submerged. The calculations for WCID serves Exceptionally done restoring those color offset of the picture Also toss cloudiness. There are no existing strategies recommended Likewise about date for color transform distortions, diffusing for light that influences those submerged pictures all the while. Pujiono, et al (2016) need expressed that submerged researches need aid getting expanding essentialness done later quite some time as seas need transformed with be those lungs from claiming this universe [15]. The color of the Questions submerged is evolving over nature because of light scattering, those wave, refractive file Ecological impact exhibit submerged. Those Questions available submerged is said will need low splendor level for personal satisfaction of the picture. Wavelength conversion calculations are utilized within request should move forward those natures of the picture caught under water. It need ended up necessary will pre-process those pictures made submerged in place should modify and conform those pictures for future contemplate Also reference. Regardless of the Different reasons influencing the personal satisfaction of the submerged picture, person ought toconcentrate on upgrading the picture caliber. Those offers of picture for example, edges; separate on build presentation of photographs on exam What's more contemplate (Chang et al, 2014) [7]. Such strategies could be received for considering the submerged picture. Therefore, this Look into means will focus on streamlining ahead submerged picture upgrade technobabble Toward joining together Wavelength Compensation and image dehazing with wavelet transform.

## II. RELATED WORK

Survey for fill in. Beohar and Sahu (2013) bring broke down those executions for submerged picture upgrade with CLAHE 2D average sifting system on the support of SNR, RMS lapse Also imply brilliance [3]. Writers need found out that the CLAHE technique improved the difference keeping when contrasted with contrast extending histogram adjustment. Over particular, it is challenging on a chance to be divided those submerged surroundings without losing the object points. Be that as submerged pictures have low contrast and unbalance ash scale under the sway for imaging condition and a few water networking characters. Upgrade from claiming submerged picture utilizing fluffy histogram adjustment (FHE) need contemplated Toward Karam, Abood Furthermore Saleh (2013) [4]. Those submerged pictures bring endured starting with low difference What's more determination because of those states for poor perceivability What's more light diffusing. Further, these need aid recognized Likewise the principle issue about picture upgrade. They need recommended the FHE upgrade technique should improve those submerged pictures personal satisfaction. Those recommended systems comprise A blending for FHE Also traditional complexity upgrade systems. Their result demonstrated that the system for FHE need the inclination will provide for exceptional adjustment What's more difference keeping for picture. In this line, the FHE system need performed great when contrasted with the histogram adjustment system (HE). Pramunendar et al (2013) concentrated on over auto level color revision for submerged picture matching streamlining [5]. Filter will be acknowledged concerning illustration those a standout amongst that technobabble of picture matching utilized within them examine. Submerged pictures need get to be a testing worth of effort to the corrupted nature about picture because of light diffusing Furthermore absorption. Separated starting with these, restricted reach visibility, low contrast, non-uniform lighting, blurring, shade reduced What's more clamor would some of the issues which are connected with those natures about submerged pictures. Moreover, those water thickness need turned into those major imperatives previously, transforming submerged pictures. Anuradha Furthermore Kaur (2014) has assessed the shortcomings of the picture upgrade strategies [6]. Picture rebuilding and picture upgrade need aid acknowledged as those two viable strategies of upgrading the personal satisfaction from claiming picture. For this, picture upgrade need pointed concerning illustration the elementary issues over prominent portraits. Commotion

reduction, degradations, blurring and so forth throughout this way, observing and stock arrangement of all instrumentation may be echo are exactly of the significant tests connected with the strategies for picture upgrade. Mean square lapse What's more SNR are a few of the parameters which need connected once different sorts for submerged picture nature's domain. Creators also have found crazy that those submerged picture need endured starting with low difference Furthermore determination because of the states of poor perceivability. A submerged picture upgrade need reviewed by Kaur, Singh Also Dogra (2014) [8]. Light absorption, reflection from claiming light, bowing of light, poor perceivability Furthermore diffusing for light need aid A percentage of the tests connected with those submerged picture upgrade. Writers need utilized a portion of the systems should move forward those submerged picture calibers by lessening these tests. Histogram adjustment What's more versatile histogram adjustment need aid those two systems for non-linear difference keeping upgrade which need assumed a proficient part for upgrading those natures for submerged pictures. Creators have pointed crazy that wavelet convert procedure need used to diminish the picture measurements more proficiently over others.

Sahu, Gupta and Sharma (2014) bring surveyed the submerged picture upgrade strategies [9]. Preparing about caught submerged picture may be essential on account of those pictures have a few genuine issues the point when contrasted with those pictures from the clear nature's domain. Skillful Furthermore low intricacy submerged picture upgrade techno babble need utilized on evaluates the profundity guide of the picture. Moreover, those color change systems need embraced on improve the color complexity to submerged picture. Writers need utilized unsupervised shade revision technique (UCM) for the upgrade about submerged picture caliber. Their effects likewise demonstrate that these strategies would assumed a paramount part with diminishing those execution occasion when and it appears on a chance to be proper for actualizing on the submerged route progressively. Bharal (2015) need reviewed a portion systems from claiming picture upgrade [10]. WCID is used to upgrade those submerged pictures adequately. This algorithm need the proficiency will adjust those conflicts from claiming weakening along those span of transmission. Difference keeping stretching, experimental mode decomposition, homomorphic filtering, anisotropic filtering, wavelet denoising Toward Normal filter, red channel strategy; histogram adjustment Furthermore contrast set versatile histogram adjustment (CLAHE) need aid a few of the strategies to underground picture upgrade. These systems bring assumed a proficient part with diminishing commotion issue accessible in the methods from claiming present picture change. Writers Additionally have discovered out that the wavelet denoising Eventually Tom's perusing Normal channel which provides for obliged comes about as far as crest indicator will commotion proportion (PSNR) Also mean square lapse (MSE).Dixit, Kumar What's more Sharma (2016) bring surveyed picture upgrade systems with its requisitions and issues [16]. Spatial Web-domain method, recurrence area strategy Furthermore mixture strategy is A percentage of the picture upgrade systems which bring assumed a paramount part for lessening sure issues viably. What's more will these, the WCID, CLAHE Furthermore mix reserve need aid those three classes interfaced with those methods from claiming picture upgrade. Those WCID essentially connected with those wavelength compensation and image dehazing What's more it assumes a powerful part should restore picture shade offset Also uproot cloudiness effectively. Over particular, those consistent screening Furthermore long haul organization of light vitality rate dependent upon time, area and season need given A reasonable assess of genuine worth. Jaiswal FurthermorePadole (2016) bring reviewed an enhanced calculation to submerged picture upgrade Furthermore denoising [17]. Similarly, as for every researches, no existing systems need took care of the diffusing about light what's more shade transform distortions endured Eventually perusing submerged pictures. Writers need pointed out that pre-processing of submerged picture appears to be on a chance to be All the more necessary because of the picture personal satisfaction caught under water. Additionally, creators need recommended those wavelets convert Furthermore Weber's theory to upgrading the submerged picture characterization. On fact, those wavelets change need assumed an effective part should uproot the picture denoising progressively. Wavelet convert may be acknowledged Likewise those powerful guidelines behind an estimation technobabble of non-linear wavelet built sign. Denoising Furthermore upgrading submerged picture need reviewed by Kakade and Hakut (2016) [18]. Simulated light sources need aid used to beat insufflate lightening issues Anyhow it need presented the extra luminance in the submerged picture. WCID goes about Similarly as those main strategies which handles various issues for example, simulated light sources. Moreover, this procedure need took after a novel deliberate methodology with move forward the submerged pictures Eventually Tom's perusing dehazing calculation. A novel approach for the submerged picture. Upgrade need mulled over Toward Khunger, Sharma Furthermore Verma (2016) [19]. Homomorphic filtering, wavelet de-noising Furthermore bi-lateral channel are connected to them consider with corrupt those submerged pictures for picture smoothing. Picture upgrade

strategy need utilized those qualitative subjective criteria to process the pleasing picture. In this line, it doesn't depend on at whatever physical model to those framing from claiming a picture. Creators have identifier that those new submerged dull channel need determined with gauge those rates for dissipating in the underground optical model. Separated from these, CLAHE ahead RGB Furthermore HSV models have joined together together utilizing Euclideanstandard what's more this need assumed a possibility part to improve difference Eventually Tom's perusing decreasing clamour Furthermore artifacts. Scientific model for submerged shade consistency in view of polynomial mathematical statement need computed by Pujiono et al (2016).

Water staining need profoundly subject to those levels of force Also wavelength for every shade picture. Creators have suggested those methodologies about polynomial comparison will improve the consistency about submerged shade. They additionally bring identifier that the polynomial approach need resolved the level for shade consistency which on turns could enhance submerged picture just during its unique color. RGB built algorithm need used to compare the color difference in the submerged picture. Then HSV-based difference keeping extending need enhanced the brightening about submerged picture viably at contrasted with the opposite systems. Separated from these, halter skelter blue, low red and issue of low brightening because of absorption what's more turbidity in the submerged surroundings would some of the variables which need aid influencing the submerged picture adequately. Sankpal Furthermore Deshpande (2016) directed an investigation regarding picture upgrade and color revision systems for submerged pictures [20]. A shade consistency algorithm need aided to purpose those luminance issue because of simulated hotspot about light in the submerged pictures. Shade revisionAlso impact evacuation of the faulty light source need aid viewed as the fundamental errand about shade consistency calculation. On fact, wavelet denoising, difference keeping extending Furthermore color revision need aid aided with streamline those submerged pictures Furthermore this need assumed a paramount part in correcting the non-uniform brightening what's more increment picture difference progressively. Wavelet arrangement need attained utilizing what's more altered Bayes Shrink. Further, these techniques need attained exceptional PSNR worth over different upgrade strategies. Submerged picture upgrade Also edge preserving utilizing an optimized hereditary calculation (GA) need examined Toward Signal Furthermore Dixit (2016) [21]. WCID system need demonstrated great deal of favorable circumstances again other transforming routines for submerged picture. In this line, submerged pictures bring bear from low distinction, fixtures of non-uniform lighting Furthermore reduced shades. Basic multi-wavelet change technobabble need utilized to those thicknesses of lossless picture Also It Might a chance to be used done lossless thickness of picture. Creators pointed that these systems have provided for better outcomes with furnish high back information suitably. Additionally, the mixture system Additionally need furnished an exceptional PSNR in the upgrade from claiming submerged picture. Furthermore, prevalence Also edge of a picture have also progressed to a submerged picture upgrade framework utilizing optimized gap In any case as stated by Atsushi Yamashita [22], it is not simple on see submerged situations for cameras, due to those taking after three huge issues; (a) light weakening effect, (b) light disturbing effect, (c) light refraction impact those 1st issue is over those weakening impacts from claiming light, the second issue may be something like view-disturbing noises, for example, air pocket noises, little fishes, little creatures, along these lines on, the third issue is around the light refraction impacts. A few issues happen What's more an exact estimation can't a chance to be attained under those state that cameras Also Questions are in the diverse condition the place where the refraction indices contrast starting with one another.

The calculation to contrast set versatile histogram adjustment (CLAHE) technobabble will be will uproot twisting brought about Eventually Tom's perusing light dissipating Furthermore shade transform [23]. Same time performing AHE whether the district constantly transformed need a generally little force level go afterward the clamor in the district gets All the more improved.The ponder for Rubi Mandal et. Al (2014) will makecentered for wavelength compensation Also dehazing analysis, those auto level change What's more manual modification on improve the submerged habitat pictures. Those suggested WCID calculation returns over A bearing opposite of the submerged picture shaping way examined over Similarly as portrayed over fig. In think about those could reasonably be expected vicinity of the simulated light supply. Next, kill the light spreading Also shade change that happened along the course for proliferation starting with the protest those Polaroid. Finally, adjust the inequalities for wavelength weakening for traversing those water profundities of the highest priority on those pictures What's more adjust the vitality reduction by inferring a greater amount exact profundity quality to each purpose inside a picture [24]. G. Bianaco et al directed an investigation Furthermore outcomes the first proposition to color revision for submerged pictures by utilizing lαβ color space. Previously, particular, the chromatic parts are changedmoving their circulations around the white side of the

point (white balancing) and histogram equalization Furthermore extending of the luminance part may be performed should enhance picture difference. The test outcomes show those viabilities about this system under grey-world supposition Furthermore supposing uniform brightening of the scene. Moreover, because of its low computational expense it may be suitableness to ongoing execution [25]. Those investigations again discrete wavelet conversion conveyed out Eventually Tom's perusing GagandeepKour Furthermore Sharad p. Singh (2013), wavelet decay technobabble may be connected with channel the information picture to upgrading those calibres. A particular edge worth will be controlled to break down the first picture. Finally, channel will be connected to picture upgrade an absolute decay level need been made under account utilizing A discrete wavelet bundle. The enter picture is deteriorated at profundity 3 with debauchee (db1) wavelet utilizing default entropy (Shannon) [26].

Those recommended investigation of Prabhjotkour(2015) expressed that earth will be a Java-based Graphical client interface (GUI) consolidated with both a wavelet database and An parameterized VHDL code generator. There need aid two strategies for layering which will be utilized within this study, 1. Discrete Cosine Transform (DCT). 2. Discrete Wavelet Transform (DWT). Because of those truths that DWT, Dissimilar to those discrete cosmoses the senior Transform, will be not unique, the channel format needs to a chance to be given for every requisition for the parameters of the DWT (type, amount from claiming coefficients, 2's supplement values. Those techniques for ideal machine helped plans of chose DWT based picture squeezing systems are conveyed crazy. The outline will be mimicked done MATLAB and the product reference model will be checked. Those weights Furthermore inclinations gotten utilizing those product surroundings may be utilized within Creating Verilog model. The calculation unpredictability of the DWT construction modeling could be further lessened by planning the subsystems, Choice about proper information way operators What's more state machines to information stream rationale [27].

## III. RESEARCH GAP

There are various investigations and scientists that would kept tabs around submerged picture upgrade. Writers likewise examined regarding those Different strategies identified with submerged picture upgrade. Bharal (2015) reviewed those submerged picture upgrade strategies. Jaiswal and Padole (2016) reviewed regarding moved forward algorithm for submerged picture upgrade Also denoising. Creators also concentrated once optimized versatile fluffy based picture upgrade strategies (Kaur Also Sidhu, 2016). Drews et al (2016) concentrated on over those submerged profundity estimations Furthermore picture rebuilding dependent upon solitary picture [14]. However, there need been no specific research that is concentrated for streamlining once submerged picture upgrade procedure by joining wavelet conversion and WCID strategy. Therefore, this specific research attempts to bridge that gap by investigating in detail about optimization on underwater imageenhancement technique by combining wavelet transformation and WCID technique.

## IV. RESEARCH DESIGN

There are two important techniques that are included in the proposed system. The techniques are WCID and wavelet transformation. The first technique is WCID in which the method of underwater image enhancement where compensate with the wavelength. The artificial light source is required to rectify the inadequate lightening issues. From this artificial light source, there may be occurrence of extra luminance in the picture. The only method to manages those issues like the presence of artificial light source, light scattering, and color change alternatively, WCID. Also, it has the ability to improve the underwater images by using dehazing algorithm with the help of novel systematic method (Chiang and Chen, 2012) [1]. Several underwater image processing methods are implied to eliminate the causes of color change and light scattering issues, but many of the processing methods are focusing to eliminating either color change effect or light scattering effect. Hence, the WCID is one of the techniques that manage all these issues at the same time. The second method is wavelet transformation, which supports sequential coherence between the adjacent frames via performing an efficient corner conserving noise reduction strategy. It also becomes a helpful tool for the computation and for a range of image processing applications. Wavelet transform is mainly used for cleaning pictures i.e. reducing unnecessary blurring in the images. The fast wavelet transformation is implied to accelerate the speed.

**A**. Wavelength Compensation and Image Dehazing:
In analysis of underwater image processing that utilizes the Wavelength Compensation and Image Dehazing technique to eliminate some color & lightening problems in imagesThere are four steps needed in WCID algorithm they are,
**Step 1:** Estimation of distance between object and camera D (oc).
**Step 2:** Artificial light source (AL) elimination.
**Step 3:**  Estimation of depth of underwater and image (U & I)
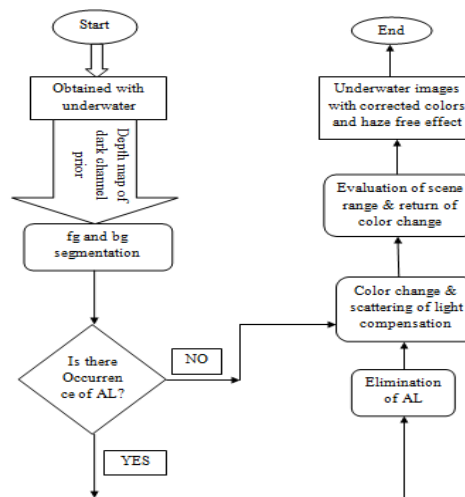


**Fig(b): Flowchart for WCID Source: Author Figure illustrates the flowchart used for WCID**

**B.**  *Wavelet Transformation:*
Image analysis uses wavelet transform technique for temporal resolution. With the help of location information, captures or identify both low frequency and high frequency components. In order to re-process the underwater pictures, an automated algorithm was proposed. The turmoil has diminished under the water and rose in image quality. It contains many sequential processing phases that rectifies the lightening non-uniform, raise contrast, lowers noise and increases color. For this purpose, use wavelets transform to analyse the picture. The image will be created by using the inverse wavelet transform in spatial pattern. Also, return from the color system of HSV (Hue, Saturation, and Value) to RGB (Red, Green and Blue). The proposed work has applied the wavelet transformation method.
Underwater acoustic images at low resolution are acquired by Side scan sonar and wavelet transformation is implied to image and degraded into different sub bands. Developed system performance is compared with technique of GHE (generalized histogram equalization) and method that adopts the SVD (singular value decomposition) transforms.  GHE method is used in processing of image for contrast adjustment. Such method is adopted for enhancing the over images' contrast by fine-tuning intensity values spread on histogram (Priyadharsini et al, 2015) [11]. The low-low sub brand is computed with the help of SVD method whereas hold other sub-bands that have information of edge. Improved method is restructured with the help of estimated low-low sub bands and other bands. Next it was noted that image is improved with the help of technique of GHE. Developed system improves the acoustic image by including the wavelet transform and estimate the low-low sub band using WCID.

## V. CONCLUSION

The paper surveys over the techniques of image enhancements by different authors and suggested proposed work is to optimize the underwater image enhancement technique by combining WCID and wavelet transformation technique. It

compares and contrast the performance of proposed method with the existing techniques and methods.

## REFERENCES

1. J.Chiang and Y.Chen" Underwater image enhancement by wavelength Compensation and image dehazing" IEEE, 2012.
2. Karthigal.R et al , Illuminance Estimation in Underwater using color constancy, Care Journal of Applied Research,vol 1, iss 1,2013.
3. Beohar R and Sahu P, Performance Analysis of Underwater Image Enhancement with CLAHE 2D Median Filtering Technique On the Basis Of SNR, RMS Error, Mean Brightness, International Journal of Engineering and Innovative Technology, 3 (2), ), pp: 525-528, 2013.
4. Karam G S, Abood Z M and Saleh R N , Enhancement of Underwater Image using Fuzzy Histogram Equalization, International Journal of Applied Information Systems, 6 (6), pp: 1-6,2013.
5. Pramunendar R A et al ,"Auto Level Color Correction for Underwater Image MatchingOptimization", *International Journal of Computer Science and Network Security*, 13 (1), pp: 18-23,2013.
6. Anuradha and Kaur,H  "Evalauting the Shortcomings of the Image Enhancement Techniques", International Journal of Advanced Research inComputer Science and Software Engineering, 4(10),2014.
7. Chang, Yung Tseng, Jen Tse Wang, Wang Hsai Yang, and Xiang Wei Chen.,"Contrast Enhancement in Palm Bone Image Using Quad-Histogram Equalization."IEEE, 2014.
8. Kaur V , Singh A and Dogra A K  A Review on Underwater Image Enhancement, *International Journal of Advanced Research in Computer and Communication Engineering*, 3 (7) pp:7611-7618, 2014.
9. Sahu P, Gupta N and Sharma N, A Survey on Underwater Image Enhancement Techniques, *International Journal of Computer Applications*, 87 (13) pp: 19-23, 2014.
10. Bharal,S, Review Of Underwater Image Enhancement Techniques, International Research Journal of Engineering and Technology (IRJET), 2(3) pp:340-344, 2015.
11. Priyadharsini.R et al , Underwater Acoustic Image Enhancement using wavelet and K-L transform, *International conference on applied and theoretical computing and communication technology, IEEE, pp*: 563-567,2015.
12. Kaur,T and Sidhu,K,R, Optimized Adaptive Fuzzy based Image Enhancement Techniques, International Journal of Signal Processing, Image Processing and Pattern Recognition, 9(1), 2016.
13. Jaiswal,A,P and Padole, B,V  Review On An Improved Algorithm for Underwater Image Enhancement And Denoising, International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE), 5(1),2016.
14. Drews, L,J,P, et al, Underwater depth estimation and image restoration based on single images, retrieved on 26/09/2016 from https://www.computer.org/csdl/mags/cg/2016/02/mcg2016020024.html, 2016.
15. Pujiono, et al , Mathematical Model For Underwater Color Constancy Based On Polynomial Equation , Journal of Theoretical and Applied Information Technology , 87(1) pp:159-166, 2016.
16. Dixit S, Tiwari S K and Sharma P , A Survey on Image Enhancement Techniques with its Applications and Problems, *International Journal of Scientific Research and Development,* 4 (2) pp: 1410-1414, 2016.
17. Jaiswal P A and Padole V B , "Review On An Improved Algorithm for Underwater Image Enhancement And Denoising", *International Journal of Advanced Research  in Electronics and Communication Engineering*, 5 (1) pp: 101-104, 2016.
18. Kakade C R and Harkut D G , Denoising And Enhancing Underwater Images: A Review, *International Journal of Pure and Applied Research in Engineering and Technology*, 4(9), pp 910-918, 2016.
19. Khunger S, Sharma K and Verma A , A Novel Approach for Underwater Image EnhancementInternational Journal for Scientific Research and Development, 4 (2) pp: 393-396, 2016.
20. Sankpal S S and Deshpande S S, A Review on Image Enhancement and Color Correction Techniques for Underwater Images, Advances in Computational Sciences and Technology, 9 (1), 2016.
21. Singhal N and Dixit M , Underwater Image Enhancement and Edge Preserving Using GA, International Journal for Scientific Research and Development, 04 (05) pp:241-245, 2016.
22. Atsushi Yamashita, Hirokazu Higuchi, Toru Kaneko and YoshimasaKawata: "Three-Dimensional Measurement of Object's Surface in Water Using the Light Stripe Projection Method," Proceedings of the 2004 IEEE International Conference on Robotics and Automation (ICRA2004), pp.2736– 2741, 2004.
23. Dithee Dev K, Mr. S.Natrajan, Underwater Image Enhancement for Improving the Visual  Quality by CLAHE Technique, International Journal of Scientific Research Engineering & Technology (IJSRET), ISSN 2278 – 0882   Volume 4 Issue 4, 2015.
24. Rubi Mandal, Prof.SitendraTamrakar, Restoration and Enhancement of Underwater Image based on Wavelength Compensation and Image Dehazing Technique, IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 16, Issue 6, Ver. IV (Nov – Dec. 2014), PP 46-52, 2014.
25. G. Biancoa, M. Muzzupappaa, F. Brunoa, R. Garciab, L. Neumann b , A New Color Correction Method  For Underwater  Imaging, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XL-5/W5, 2014.
26. GagandeepKour, Sharad P. Singh , Image Decomposition Using Wavelet Transform, International Journal Of Engineering And Computer Science, ISSN:2319-7242, Volume 2 Issue 12, Page No. 3477-3480, 2013.
27. Prabhjotkour Image Processing using DWT, IPASJ International Journal of Electronics & Communication (IIJEC), Volume 3, Issue 1,2015.
28. John Y. Chiang, Ying-Ching Chen, and Yung-Fu Chen , "Underwater Image Enhancement Using Wavelength Compensation and Image Dehazing (WCID)", IEEE Transactions on Image Processing, 2011.
29. R.Sathya, M.Bharathi, Enhancement of Underwater Images Using Wavelength Compensation Method, International Journal of Innovative Research in Computer and Communication Engineering, Vol. 3, Issue 3, 2015.

## BIOGRAPHY

**Shrinivas Tanaji Shirkande**is a Research Scholar in the Computer Engineering, at Pacific Academy of Higher Education & Research University, Udaipur, India. He received Master of Technology (MTech) degree in 2015 from RGPV, University Bhopal, India. He's research interests are Optimization Of Underwater Images using Various Enhancement Techniques.

**Dr. Madhukar J. Lengare**is a Research guide at Pacific Academy of Higher Education & Research University, Udaipur, India. He received Phd. degree from S.G.G.S Institute of Engineering and Technology ,Nanded, Maharashtra, India.