Improved underwater image enhancement using convolution of features with hybrid optimization approach

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ABSTRACT

Light scattering and color change are two major sources of distortion for underwater photography. Light scattering is caused by the incidence of light on objects reflected and deflected multiple times by particles present in the water before reaching the camera. This in turn lowers the visibility and contrast of the image captured. Color change corresponds to the varying degrees of attenuation encountered by light traveling in the water with different wavelengths, rendering ambient underwater environments dominated by a bluish tone. No existing underwater processing techniques can handle light scattering and color change distortions suffered by underwater images, and the possible presence of artificial lighting simultaneously. This thesis proposes a novel systematic approach to enhance underwater images by a dehazing algorithm. The novel idea proposed in this method is to use color transfer to transform images into the same color space in order to reduce lighting in homogeneities which optimize grasshopper optimization after that threshold which come from optimization used by total variation and enhance the underwater image. The analysis of the proposed model by PSNR and MSE parameters is done and is compared with existing approaches.

Keywords ***Signal to noise ratio (SNR), Mean Square Error (WCA), Peak Signal to Noise Ratio (PSNR), Contrast Limited Adaptive Histogram Equalization (CLAHE).***

I. INTRODUCTION

Image enhancement is the mechanism to process the input image to make it more appropriate and clearly visible for the required application. Image enhancement improves the information content of the image and alters the visual impact of the image on the observer. Image enhancement intensifies the features of images [1][5]. It accentuates the image features like edges, contrast to build display of photographs more useful for examination and study. Qualitative objective approach is used in enhancing images to construct a visually impressive picture. Image enhancement includes many operations such as contrast stretching, noise clipping, pseudo coloring, noise filtering etc. to improve the view of images. Active range of the chosen features of images is amplified by enhancement so that they can be detected simply [5]. The existing research shows that underwater images bears poor quality because of nature of light. When light enters the water it got refracted , absorbed and scattered as water is denser medium then air , so the amount of light drops when it enters from air to water and got scattered in different directions [10]. Scattering causes the blurring of light and reduces the color contrast. These effects of water on underwater images are only not due the nature water but also because of the organisms and other material present in the water.

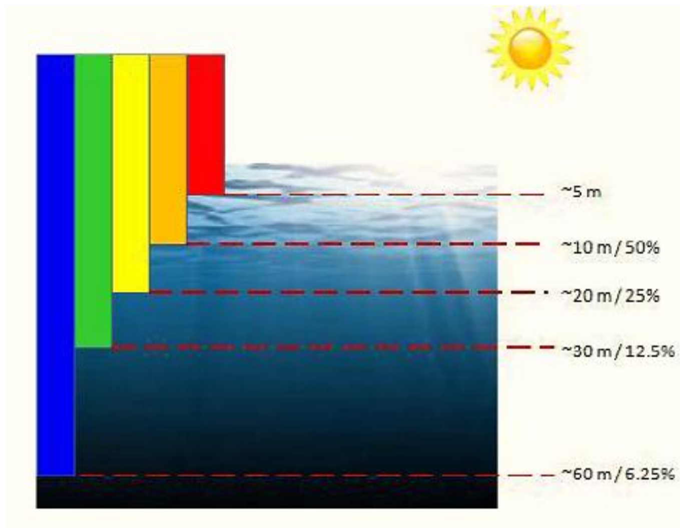

Fig.1.1 Under water Image quality [36]

Light containing different wavelengths of blue, green and red colors will make a way into water to a changeable degree. Figure 1 shows the picture about the light absorbed by water. With every 10m augmentation in depth the brightness of sunlight is going to fall by half. Almost all red colored light is decrease to 50% from the surface but blue continues to great deep in the ocean because blue color have the shortest wavelength and so it travels the longest distance in the water. That is why most of the underwater images are subjected to blue and green color.

II. LITERATURE SURVEY

Ancuti, Codruta O., et al. [1] in this paper, the author proposed color balance and fusion for under water image enhancement. This method is proposed on single image and not required any additional hardware. In this associate weight maps are used to transfer the edges and color contrast to output image. Artifacts are created in low frequency component of reconstructed images. This method improves the global contrast, edges sharpness and reduced dark regions. Huang, Dongmei, et al. [2] in this paper, the author proposed relative global histogram stretching for water image enhancement approach. This approach consists of two parts that are color correction and contrast correction. In contrast correction method RGB color space is used and redistributes each RGB channel histogram. These dynamic parameters are related to intensity distribution of original image and wavelength attenuation of different color underwater. To reduce the noise from the image bi-lateral filtering is used and enhances the local information of shallow water image. Li, Chongyi, et al. [3] under water image enhancement is done by image color correction method which is based on weakly supervised color transfer. This approach solved the problem of color distortion. In this approach multi-term loss function is used for measure adversial loss, similarity index measure loss, and cycle consistency loss. The results of the proposed approach are better in image enhancement and it improves the performance of vision tasks. Ao, Jun, et al. [4] in Underwater images the physical properties of water lead to attenuation of light which travel through water channel. This generates the low contrast and color cast in images. In this paper the author proposed the combination of two approaches that are Adaptive linear stretch method to improve the image quality at low cost at the same time. Threshold id reduced from the histogram by using adaptable threshold. This method reduces the color cast and enhances the image contrast. The computation consumption is low in the proposed method. Smita V. Pati, et.al [5] considered an approach to enhance underwater images and its quality. The proposed approach gives better result of enhancing clarity of underwater image which is very important for underwater analysis and enhancement. Shahrzad Saremi, et.al [6] proposed an optimization algorithm called Grasshopper Optimization Algorithm (GOA) and applies it to challenging problems in structural optimization. The proposed algorithm mathematically models and mimics the behaviour of grasshopper swarms in nature for solving optimization problems. The GOA algorithm was first benchmarked on a set of test problems including CEC2005 to test and verify its performance qualitatively and quantitatively. It was then employed to find the optimal shape for a 52-bar truss, 3-bar truss, and cantilever beam to demonstrate its applicability. The results show that the proposed algorithm was able to provide superior results compared to well-known and recent algorithms in the literature. Chang, Cheng-Hao, et al. [7] in this paper, the author design and implement a low-cost guided image filter for underwater image enhancement. This method is based on TSMC and CMOS technology and operates on high power to support full HD image enhancement. It provides high throughput and effective frame rate. Emberton, et al. [8] underwater image and video dehazing is done by using Haze region segmentation approach. It improves the visibility in images and videos by detecting and segmenting image regions. Illuminant elimination is done by using white balancing approach. This method reduces the color cast and

III. PROPOSED METHODOLOGY

3.1 Steps of Methodology

Step 1: Input the Image.

Step 2: Preprocessed the image and extract features.

Step 3: Apply convolution Process on image.

Step 4: After convolution low dimension matrix is produced.

Step 5: Initialize the grey wolf algorithm.

Step 6: Search local and global best by water cycle.

Step 7: Check the output is optimized or not if optimized the go to step 8 otherwise go to step 4.

Step 8: Calculate the total variation.

Step 9: Analyze the PSNR and MSE of the Image

3.2 Proposed Flowchart

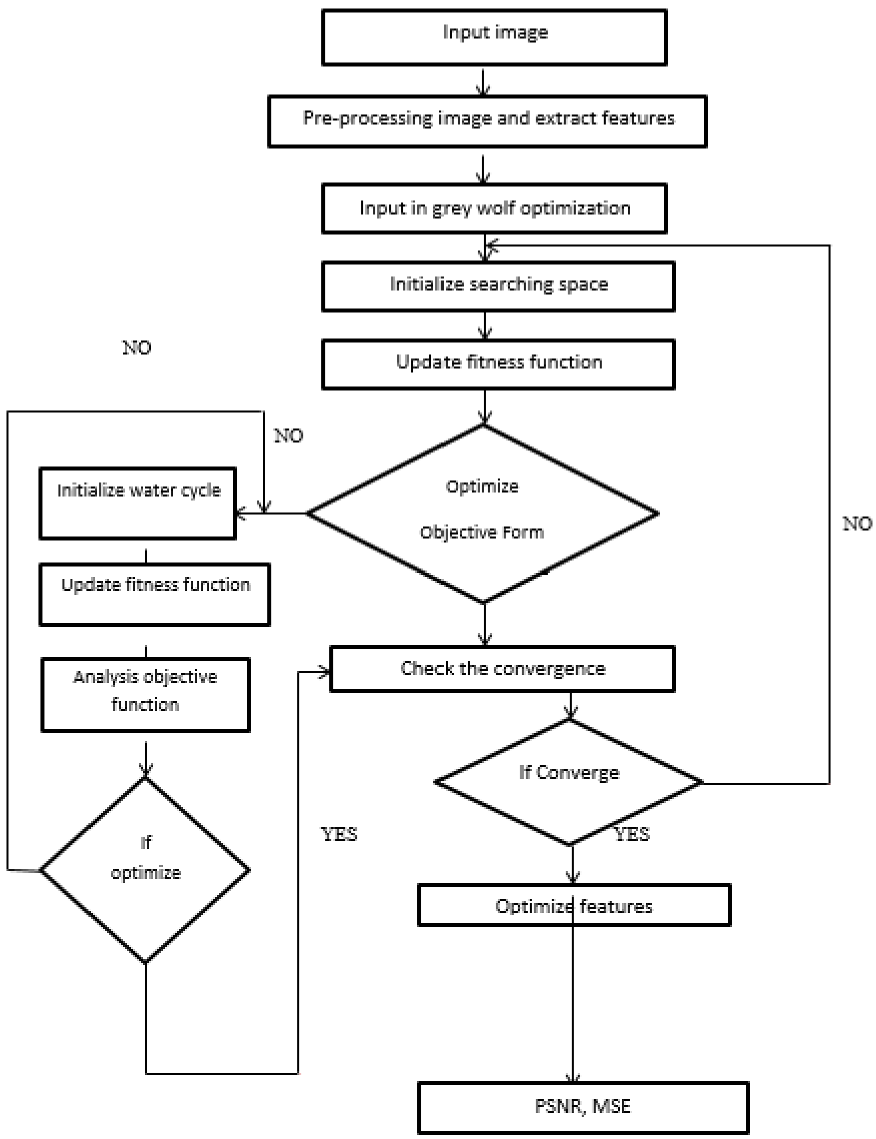

Fig.5 Flowchart Design

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IV. RESULTS ANALYSIS

4.1 Result Of Image-Based Classification

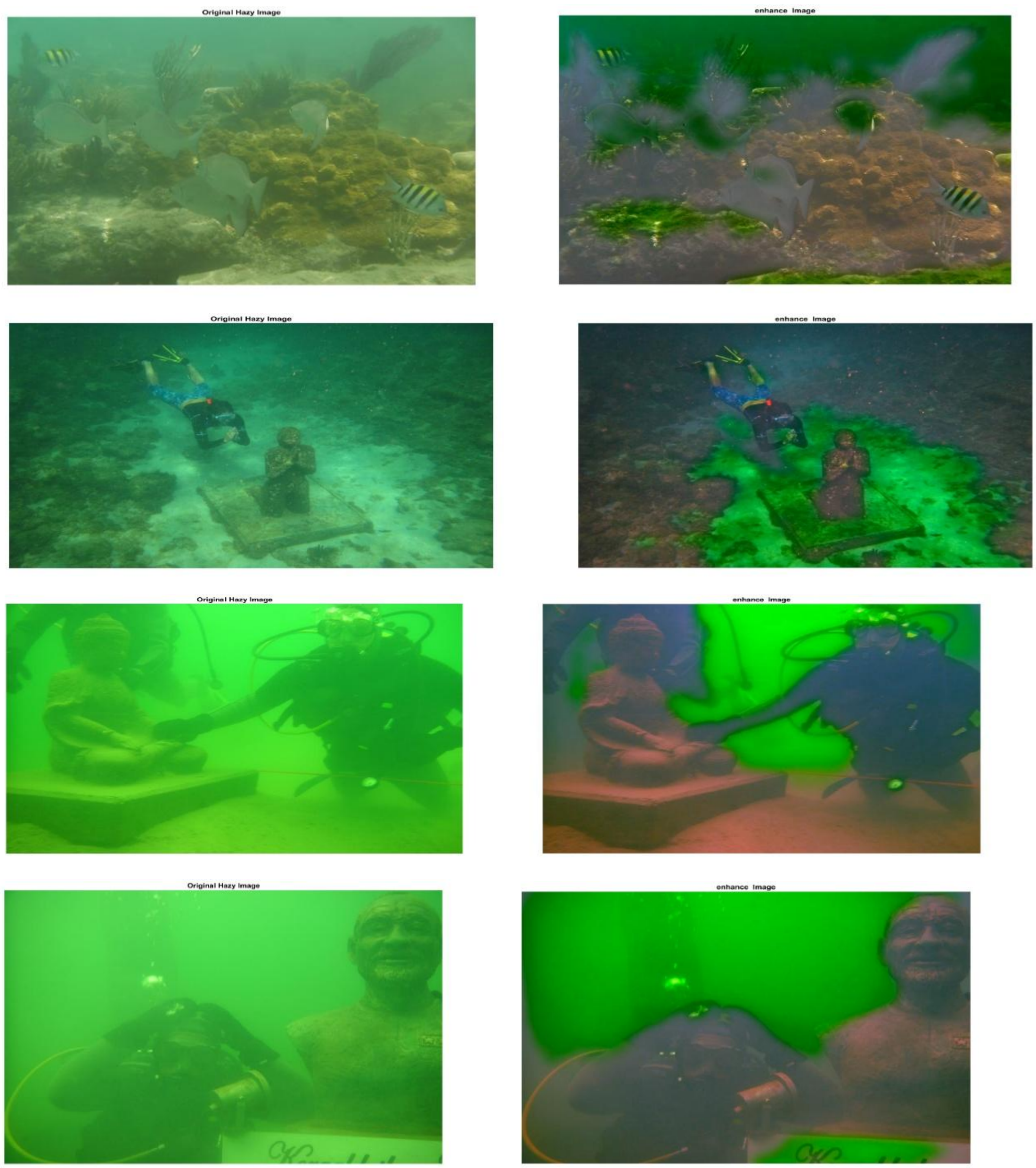

Fig.6 Existing Approach Before and After images

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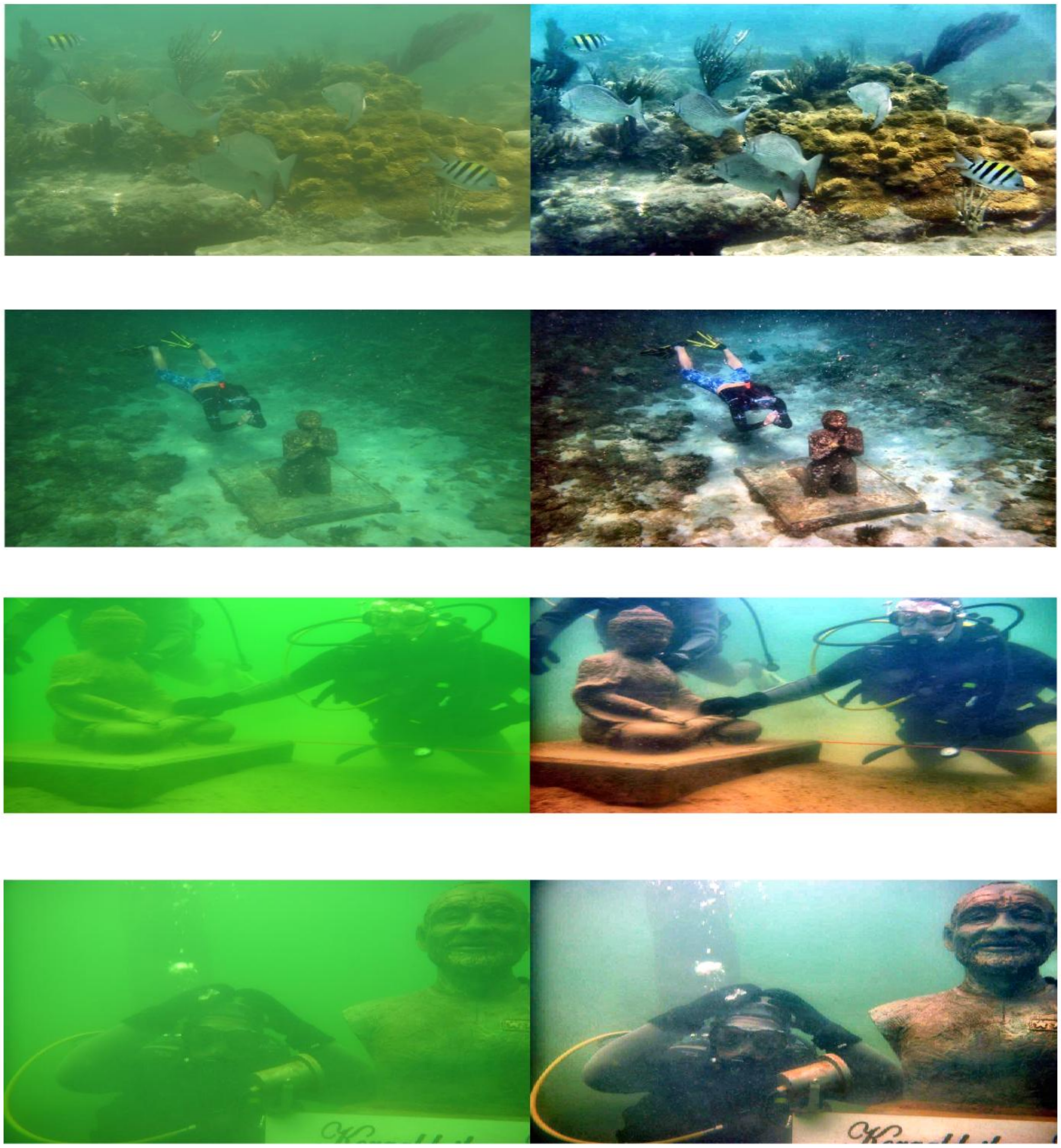

Fig.7 Proposed Approach Before and After images

5.2 Proposed Method Results

Table.1PSNR and MSE of proposed method

Image No.	PSNR	MSE
Image 1	39.13	30.45
Image 2	32.13	32.13
Image 3	30.13	50.13
Image 4	26.13	57.23
Image 5	25.25	58.23

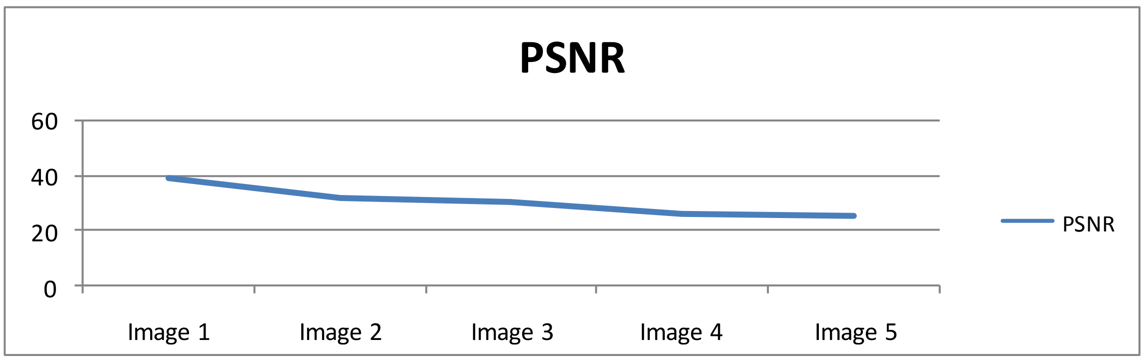

Fig.8 Graph of PSNR of proposed results

Fig.8 depicts the PSNR value of the five images in the proposed approach. In this Image 1 has PSNR value 39.13 which is highest and image 5 has 25.25 which is lowest among the all images which are undergone in this experiment.

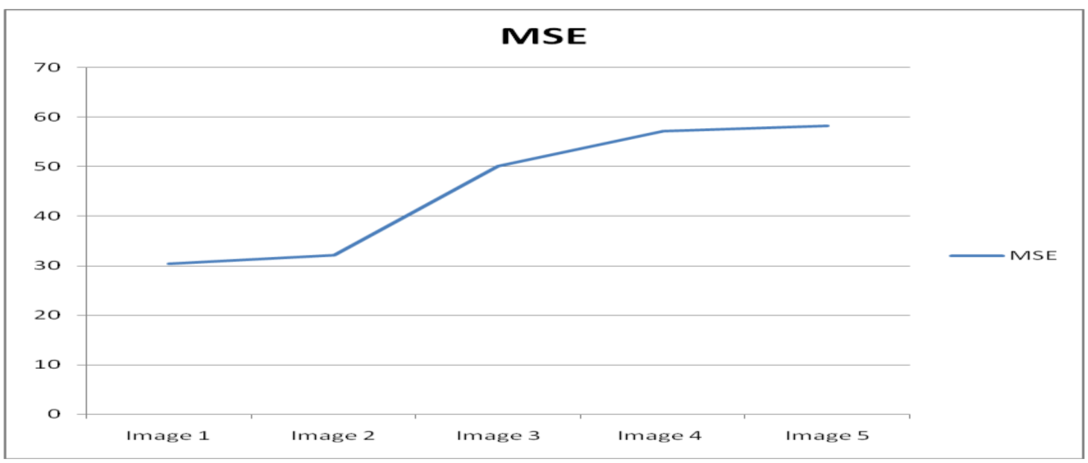

Fig. 9 Graph of MSE of proposed results

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Figure 9 depicts the MSE value of the five images in the proposed approach. In this Image 5 has MSE value 58.23 which is highest and image 1 has 30.45 which is lowest among the all images which are undergone in this experiment.

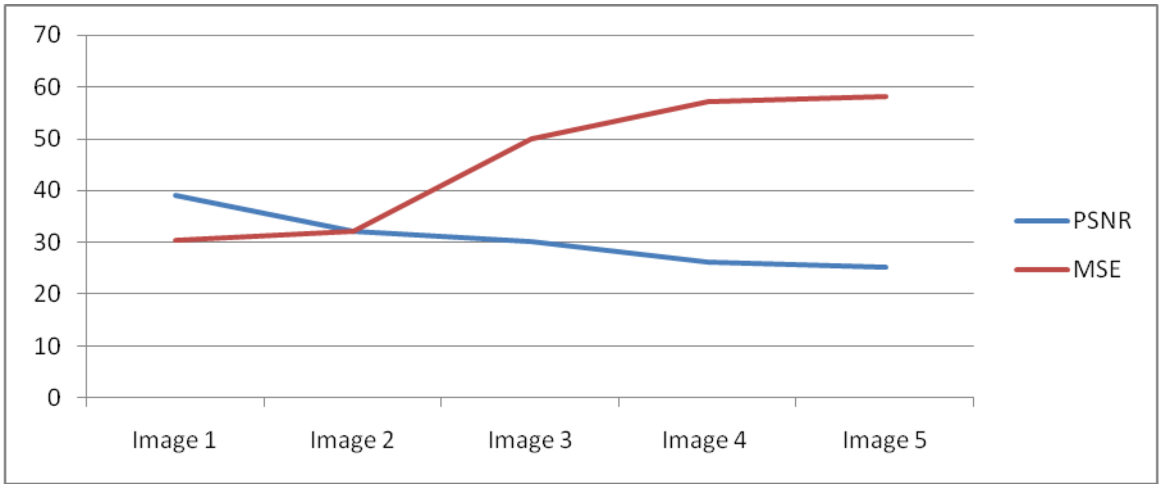

Fig.10 Graph of PSNR and MSE of proposed method

Figure 10 demonstrate the value of PSNR and MSE of five images in the proposed method. This graph shows two lines in which red line indicates the MSE value of images and blue line indicates the PSNR of the images. The position of lines changes according to the variation in the results.

Table.2 Comparison of existing and proposed results

Image No.	PSNR Existing	PSNR Proposed	MSE Existing	MSE Proposed
Image 1	32.13	39.13	45.13	30.45
Image 2	30.23	32.13	52.23	32.13
Image 3	29.13	30.13	61.23	50.13
Image 4	20.45	26.13	70.45	57.23
Image 5	20.13	25.25	71.65	58.23

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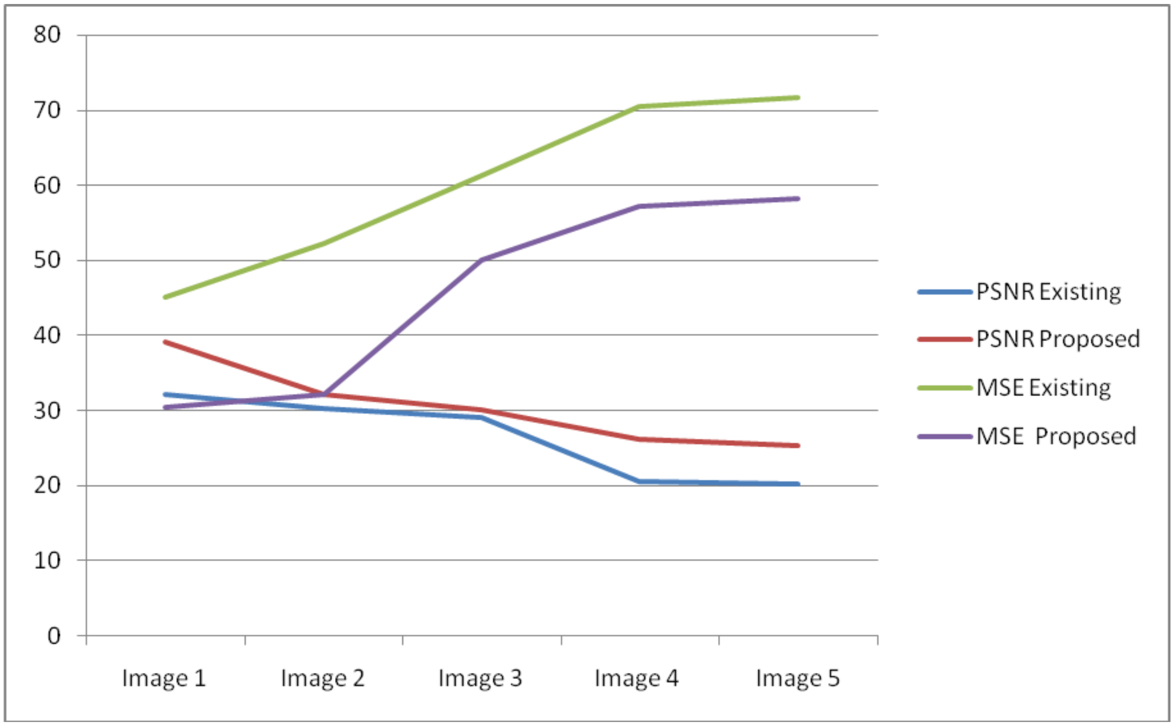

Fig.11 Graph of PSNR and MSE of proposed method and existing method

Figure 11 depicts the comparison between the PSNR and MSE of the proposed work and existing work. In this blue line shows the existing PSNR, red line shows the PSNR proposed, green line shows the MSE existing and purple line represents the MSE proposed of the images.

Table.3 Proposed and existing PSNR image iterations

Iteration	Image1(proposed)	Image1(existing)	Image2(proposed)	Image2(existing)
two	22.34	20.12	21.23	19.33
three	23.45	22.34	21.45	20.12
four	27.82	23.23	24.34	21.34
five	30.23	25.34	25.34	22.34
six	31.23	26.45	26.34	23.45
seven	33.23	28.34	27.45	26.34
eight	37.23	29.34	30.23	28.34
ten	39.13	32.13	32.13	30.23

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Iteration	image 3 (proposed)	image3 (existing)	image 4 (proposed)	image4 (existing)	image 5 (proposed)	image 5 (existing)
two	20.12	18.34	17.56	14.34	18.34	17.45
three	21.23	20.34	18.34	15.34	20.23	17.55
four	22.13	26.45	19.34	16.34	21.34	18.34
five	23.45	24.34	20.12	17.56	22.34	19
six	25.34	27.56	21.34	18.34	23.113	19.34
seven	26.34	28.45	22.34	19.34	24.12	20
eight	28.34	29	23.45	20	24.56	20.12
ten	30.13	29.13	26.13	20.45	25.25	20.14

Table.4 Proposed and existing PSNR image iteration

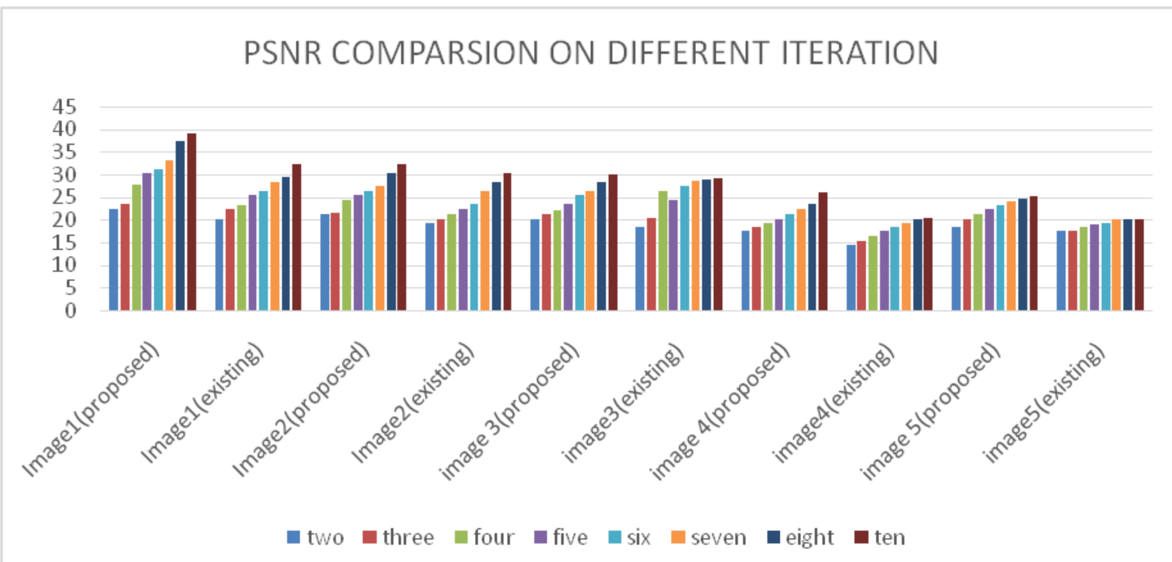

Fig.12PSNR based comparison over different iterations

V. CONCLUSION

This paper has presented a novel approach for stitching images acquired underwater which is able to tackle the problems that arise when using common image stitching methods on underwater images. In the first step, dehazing is used to improve the aesthetic quality of images as well as to improve data quality for the task of feature detection. Guided image filtering is used to speed up the process of dehazing the images. Then SIFT is used to find and match features between images and a single homography per image was used to perform alignment. In the next step, a graph cuts-based seam cutting method in the image gradient domain is used to find the optimal cut between two images in order to reduce visible seams in the overlapped regions. While producing an image with no overlaps using seam cutting, we use linear blending to reduce colour discontinuities that may still exist. A novel idea proposed in this method is to use colour normalization to transform images into the same colour space to make the stitching result even more "seamless".

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