Real time marine video image preprocessing technique

[1] Mrs. N. Jayachandra, [2] Dr. A. R. Nadira Banu Kamal

[1]Research Scholar, [2] Principal & Associate Professor
[1]Department of Computer Science,
[1]Mother Teresa Women's University, Kodaikanal, India
[2] Mohamed Sathak Hamid College of Arts and Science for Women Ramanathapuram, India

Abstract: An efficient underwater imaging technique will help the aquaculture industry to intelligently and automatically control the marine species. The major challenges faced with marine animal detection system were limited dataset preparation, low frame rate, poor illumination, segmentation error, large dataset, overlap and occlusion, etc. The proposed preprocessing technique will automatically generate the image dataset for any input undersea water videos taken using different digital technologies like Remotely Operated Vehicle (ROV), Scuba Diving cameras with various image qualities. The dataset includes the following characteristics like image quality, shape, transformation, rotational effect, turbulent effect, two marine species in single frame and the more. Live marine animal in the open sea can be investigated to promote environmental applications like fish farming, meteorological monitoring, animal biometric analysis and monitoring. The proposed methodology incorporates acquiring the video images of the marine species and converting them into frames. Image Pre-processing techniques are applied to remove the artifacts present in the video frame. This method works in uncontrolled objects and environment, as well as difficult situations in acquiring representative samples. The proposed pre-processing method enhances the quality of the image without losing necessary and relevant information in the image. The Point Spread function is used to differentiate noisy and noiseless frames.

Index Terms **–Preprocessing, Point spread function, Poor Illumination and Frame Separation**

I. INTRODUCTION

The initial process of identification is undergone with the video processing. The digital technologies are improving to provide long time period and good resolution underwater videos to identify objects using computer vision techniques. Also, the underwater video results in poor clarity and lack in spotting exact object from the video. Thus, this phase of this work illustrates the fragmentation of the video sequences into frames set for the further process of identification and classification. This main Phase includes the following process flows. Several strategies have been adopted by researcher to enhance the sea images to support the segmentation process. In 1990 Wn. R Schneider proposed to use the colored filters in Black and White photography to change the way tones of a scene record on film. Yellow filters are commonly. Because the light coming from clouds is white, it is not affected by the filter like that from the blue sky. Hence a yellow filter causes clouds to stand out more than usual. It affects the quality of the image. This work was mainly for the images which are in the presence of air, and there were some need to be explored the underwater world too. In 2010 Iqbal, K.; Odetayo, M.; James, A.; Salam, R.A.; Talib, A.Z.H. [14] worked on "Enhancing the low-quality images using Unsupervised Colour Correction Method,", The affected underwater images reduced contrast and non-uniform color cast because of the absorption and scattering of light rays in the marine environment. For that they proposed an Unsupervised Colour Correction Method (UCM) for underwater image quality enhancement. UCM is based on color matching, contrast improvement of RGB color model and contrast improvement of HSI color model. Firstly, the color cast is concentrated by equalizing the color values. Secondly, an improvement to a contrast alteration method is useful to increase the Red color by stretching red color histogram towards the at most, similarly the Blue color is concentrated by stretching the blue histogram to the minimum. Thirdly, the Saturation and Intensity parts of the HSI color model have been useful for contrast correction to enlarge the true color using Saturation and to address the illumination problem through Intensity. In 2011 Jinbo Chen; Zhenbang Gong; Hengyu Li; Shaorong Xie, [1] proposed "A detection method based on sonar image for underwater pipeline tracker,". The surveillance and inspection of underwater pipelines are carried out by operators who drive a remotely operated underwater vehicle (ROV) with camera mounted on it. Though in extremely turbid water, the camera cannot capture any scene, even with supplementary high-intensity light. In this case the optical detection devices are unable to complete the surveillance task in recent years, forward looking sonar is broadly applied to the underwater examination, which is not subject to the control of light and turbidity. So, it is appropriate for the inspection of pipelines. But the active change of ROV by the water flow will show the way to the aim to escape from the sonar image effortlessly. In adding up, the sonar image is with high noise and little contrast. It is difficult for the operator to identify the pipeline from the images. Furthermore, the observation of underwater pipelines is deadly and time unbearable and it is easy to create mistakes due to the exhaustion and interruption of the operator. Then, the study focuses on rising image processing algorithms to distinguish the pipeline repeatedly. By means of the proposed image processing technique, firstly the images are improved using the Gabor filter. And then these images are useful for an edge detector. Lastly the parameters of the pipeline are designed by Hough transform. To decrease the search area, the Kalman filter is explored to forecast the parameters of the pipeline on the next picture. And the research is shown the vision system is on hand to the observation of underwater pipelines. In 2011 Hung-Yu Yang; Pei-Yin Chen; Chien-Chuan Huang; Ya-Zhu Zhuang; Yeu-Horng Shiau,[16] worked on "Low Complexity Underwater Image Enhancement Based on Dark Channel Prior,". Blurred underwater image is always an irritating problem in the deep-sea engineering. They proposed a competent and low complexity underwater image enhancement technique based on dark channel before. Our technique employs the median filter in its place of the soft matting method to estimate the depth map of image. Furthermore, a color improvement method is adopted to improve the color contrast for underwater image. The tentative results show that the proposed approach can well improve the underwater image and decrease the implementation time. In addition, this technique requires fewer computing reserve and is well appropriate for implementing on the supervision and underwater navigation in real time. In 2012 Chiang, J.Y.; Ying-Ching Chen, [17] researched on "Underwater Image Enhancement by Wavelength Compensation and Dehazing,". Where light scattering and color modify are two main sources of alteration for underwater shooting. Light scattering is affected by light event on objects reflected and deflected many times by particles present in the water prior to reaching the camera. This in turn lowers the visibility and contrast of the image captured. Color change corresponds to the unstable degrees of reduction encountered by light traveling in the water with diverse wavelengths, depiction ambient underwater environments conquered by a bluish quality. No obtainable underwater processing techniques can handle light dispersion and color change distortions caused by underwater images, and the probable presence of false lighting concurrently. This literature proposed a novel systematic come up to to improve underwater images by a de-hazing algorithm, to give back the attenuation difference along the broadcast path, and to take the pressure of the possible presence of a false light source into consideration. Previously the deepness map, i.e., distances between the objects and the camera, is expected, the foreground and background within a view are segmented. By managing the effect of artificial light, the haze occurrence and inconsistency in wavelength attenuation along the underwater broadcast path to camera are corrected. Secondly, the water deepness in the image scene is predictable according to the remaining energy ratios of diverse color channels obtainable in the background light. In 2012 bt. Shamsuddin, N.; bt. Wan Ahmad, W.F.; Baharudin, B.B.; Kushairi, M.; Rajuddin, M.; bt. Mohd, F., [18] developed a technique on "Significance level of image enhancement techniques for underwater images,". Underwater imaging is fairly a demanding in the area of photography specially for low resolution and normal digital camera. There are some problems arise in underwater images such as partial range visibility, low contrast, non-identical lighting, blurring, intense artifacts, color diminish and noise. This research concentrated on color diminished. Major application of typical computer vision techniques to marine imaging is mandatory in dealing with the thought problems. Both automatic and manual level methods are used to record the mean values of the stretched histogram. In 2013 Hitam, M.S.; Yussof, W.N.J.H.W.; Awalludin, E.A.; Bachok, Z., [19] has been worked on "Mixture contrast limited adaptive histogram equalization for underwater image enhancement,". By improving the quality of an underwater image has received substantial attention due to rundown visibility of the image which is caused by physical properties of the water. Here they presented a new technique called hybrid Contrast Limited Adaptive Histogram Equalization (CLAHE) color spaces that specifically developed for underwater image improvement. The technique operates CLAHE on RGB and HSV color spaces and both results are joint together using Euclidean rule. Tentative results show that the future approach considerably improves the visual quality of underwater images by enhancing contrast, as well as dropping noise and artifacts.

Codruta et. Al., (2018) has proposed Color Balance and Fusion for Underwater Image Enhancement. Introduce an effective technique to enhance the images captured underwater and degraded due to the medium scattering and absorption. Our method is a single image approach that does not require specialized hardware or knowledge about the underwater conditions or scene structure. It builds on the blending of two images that are directly derived from a color-compensated and white-balanced version of the original degraded image. The two images to fusion, as well as their associated weight maps, are defined to promote the transfer of edges and color contrast to the output image. To avoid that the sharp weight map transitions create artifacts in the low frequency components of the reconstructed image, we also adapt a multiscale fusion strategy. Our extensive qualitative and quantitative evaluation reveals that our enhanced images and videos are characterized by better exposedness of the dark regions, improved global contrast, and edges sharpness. Our validation also proves that our algorithm is reasonably independent of the camera settings, and improves the accuracy of several image processing applications, such as image segmentation and keypoint matching.

II. PROPOSED PREPROCESSING TECHNIQUE

The anticipated technique makes the utilization of cascading of two individual filters, median &wiener filters. Basically, they are utilized to eradicate impulse noise and Gaussian noise separately, But in this technique as both filters are utilized concurrently, impulse noise and Gaussian noise are removed at a time. This technique is a bidirectional process. It is usually needed for image brightness (or film density) to be uniform except where it changes to form an image. There are factors, though, that tend to create variation in the brightness of a displayed image even when no image detail is present. This difference is frequently random and has no specific pattern. In several cases, it decreases image quality and is particularly significant when the objects being imaged are small and have comparatively low contrast. This random variation in image brightness is selected noise.

This Advanced filter is the mixture of Median and Weiner filter. These two filters are organized in series to produce the anticipated output. First there is a need to expel the impulse noise and then passed to the outcome to the Weiner filter. The Weiner filter removes the blurredness and the additive white noise from the image. The outcome is not the same as the original image, but it is nearly similar. The block diagram for advanced filter is specified below in Figure 1.

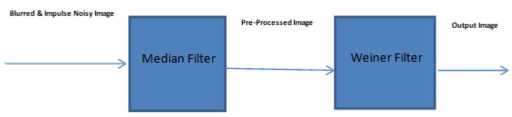

Figure 1: Proposed Filtering Technique

Image noise is the arbitrary variation of brightness or color information in images created by the sensor and circuitry of a scanner or digital camera. Image noise can initiate in film grain and in the unavoidable shot noise of an ideal photon detector.

Image noise is usually observed as an unattractive by-product of image capture. In this work, the process of de-noising the under sea water image obtains IMWIE de-nosing technique to improve the image. The IMWIE de-noising is recognized to be Hybrid Filtering of Median and Weiner filter. This development algorithm joins Median and Weiner Filters to smoothen and remove noises from the under sea water images. At long last, the result of this process seized with an exact gray scale of S' Component image of the under sea water image object. Accordingly, an enhancement juncture of the IMWIE algorithm is utilized by noise elimination. So that the two filters (Weiner and Median) are joined for ease enhancement of an image. Weiner filter undergo with two processes: Inverse Filter (High Pass Filtering) and Smoothening process (Low Pass Filtering). One is enhancing the de-noising along the edges as the strategy that utilized did not perform so well along the edges. Rather than utilizing the Median filter, the suggested technique employs the polynomial based edge detection technique. By utilizing this image improvement process, some edges are not attained well while de- noising.

III. Input Dataset

To evaluate the effectiveness of underwater video object classification for determining object species, the video collection from underwater video has been utilized. The dataset contains pre-defined training and test splits for various marine mammal species. Individual samples in the dataset are obtained from a wide variety of videos containing diverse backgrounds and water conditions. An automatic marine object detection algorithm was used to detection of object in the videos, followed by manual identification of marine object species. Sample videos of different marine animal's species are included from the dataset. This context acquits videos with low-constrained, high-quality and rough background. In most of the video processing, acquires separate detection method for various kinds of videos to determine the quality of the video, but this work proposed a framework to establish the quality. The video dataset collected and received from Scuba Diver Mr.Nick Hope taken from Bali, Indonesia using HD Camera and collected from NOAA website. Novel image enhancement technique was
proposed to identify the presence of noise in the given image[26] .

S.No	Camera Type	Water Ph Value	Salinity	Type of Sea Species	Directions
1	SeaLife 12 Megapixel Digital Underwater Camera	8.2	33	Gelly Fish	East Coast High and Low Water

Table 1: Real time Dataset collected

Videos(Sea Animals)	Place	Depth	Imaging System	Source
Copper Rock Fish	northern Gulf of Alaska to central Baja California.	90 meters.	ROV	NOAA
Gopher Rock Fish	southern Oregon to southern Baja California	80 meters		
Black-and-Yellow rockfish	southern Oregon to southern Baja California	37 meters		
Sebae Clownfish	Bali Indonesia	5m and 30m deep	Camera : Sony VX2000 in Gates housing Scopa Diving	Nick Hope Scopa Diver
Green Humphed Parrorfish				
Oriental Sweetlips				
Bicolor Angelfish				
Rhizostome Jellyfish	.			
Spotted Seahorse				
Pacific Hawksbill Turtle				

Table 2: Sample Video Dataset from Nick

Table 1 and 2 clearly indicates the real time and the sample datasets analysed using the proposed image enhancement technique.

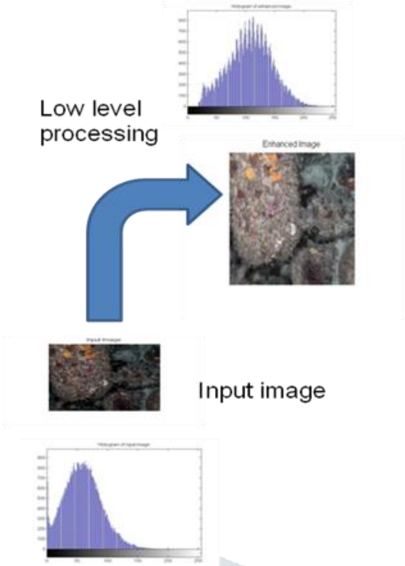

Figure 2: Proposed enhancement Technique

IV. PERFORMANCE EVALUATION

In this section, the performance assessment for the de-noising filters is depicted. The performance metrics such as Peak-Signal-Noise Ratio (PSNR), Signal-Noise Ratio (SNR) and Mean Square Error (MSE) are assessed.

S.No	PSNR	MSE	SD	SSI	SNR
1	85.660	$1.77e^{-033}$	0.001	0.959	76.845
2	87.83	$1.069e^{-044}$	0.020	0.988	83.387
3	88.67	$1.078e^{-044}$	0.011	0.966	86.489

Table 3 Performance metrics

The tabular column Table 3 clearly indicates that the proposed pre-processing algorithm results in a very good image quality which is evident from the fact that the PSNR value is above 60 Db and the Structure similarity index is close or 1 with less error specified by Structured Distortion.

PSNR Value

The PSNR block computes the peak signal-to-noise ratio, in decibels, between two images. This ratio is often used as a quality measurement between the original and a compressed image. The higher the PSNR, the better the quality of the compressed, or reconstructed image. The performance metrics for PSNR value for proposed denoising filter is assessed in figure 3.

$$PSNR = 10\log_{10}\left(\frac{R^2}{MSE}\right) \quad (1)$$

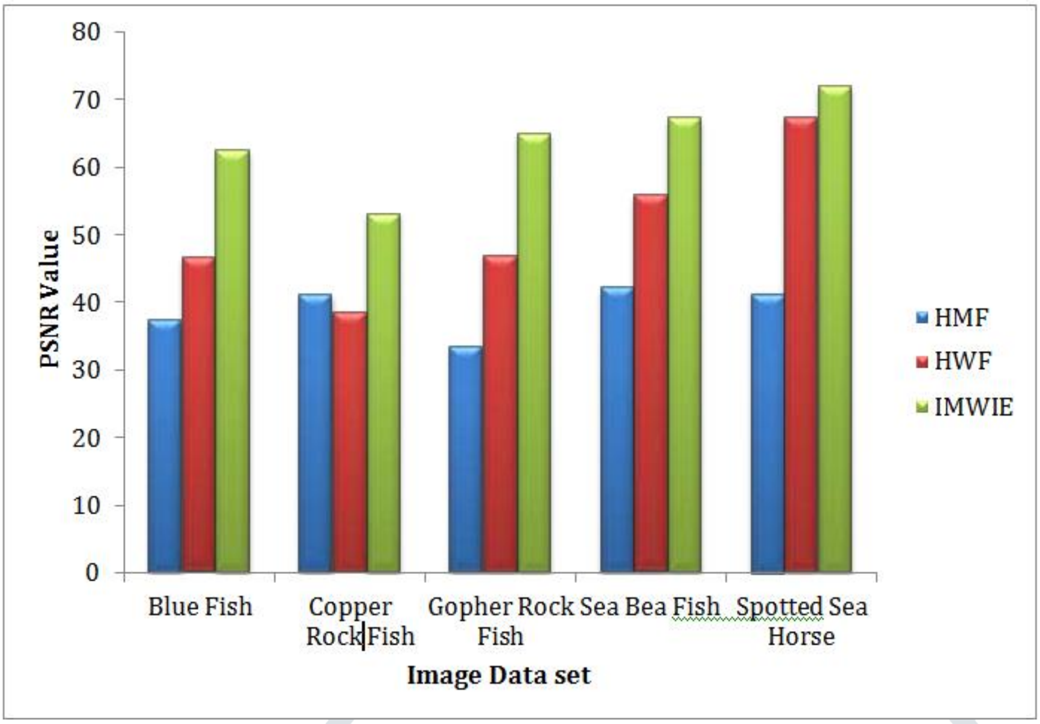

Figure 3: PSNR Value Evaluation

Image Data Set	HMF	HWF	IMWIE
Blue Fish	37.456	46.715	62.783
Copper Rock Fish	41.256	38.753	53.346
Gopher Rock Fish	33.679	47.252	65.231
Sea Bea Fish	42.346	55.863	67.382
Spotted Sea Horse	41.523	67.477	72.325

Table 4: PSNR Evaluation

Table 4 depicts the evaluation of PSNR rate for various image data set and de-noising filters. The table describes that the proposed methodology IMWIE provides high PSNR value for various set of images than other methods.

SNR Value

In order to determine the strength of a signal it is necessary to calculate what is called the **signal-to-noise-ratio** (SNR). The higher the ratio, the easier it becomes to detect a true signal or extract useful information from the raw signal. Thus, it is defined as the ratio as the power (P) of a signal to the power (P) of the background noise.

$$SNR = \frac{P_{signal}}{P_{Noise}} \quad \textbf{(2)}$$

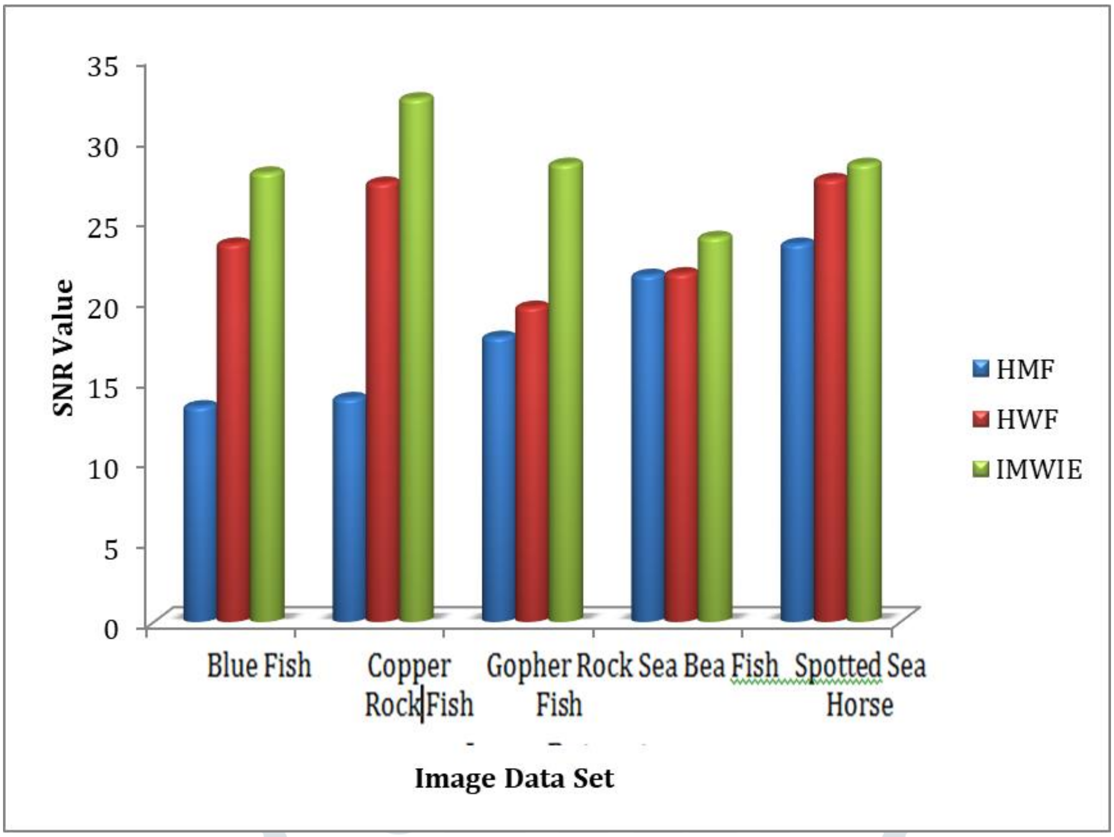

Figure 4:SNR Value Evaluation

Image Data Set	HMF	HWF	IMWIE
Blue Fish	13.3656	23.4667	27.8733
Copper Rock Fish	13.8778	27.2473	32.4789
Gopher Rock Fish	17.6797	19.5467	28.4165
Sea Bea Fish	21.5243	21.6234	23.8734
Spotted Sea Horse	23.4587	27.4733	28.4128

Table 5: SNR Value Evaluation

In Table 5, the evaluation of SNR value for image data set is illustrated. The proposed method IMWIE provides high rate for SNR value than other methodologies.

The *Mean Square Error (MSE)* and the *Peak Signal to Noise Ratio (PSNR)* are the two error metrics used to compare image compression quality. The MSE represents the cumulative squared error between the compressed and the original image, whereas PSNR represents a measure of the peak error. The lower the value of MSE, the lower the error.

	HMF	HWF	IMWIE
Blue Fish	0.6535	0.8635	0.05678
Copper Rock Fish	0.3558	0.2377	0.24536
Gopher Rock Fish	0.8565	0.8754	0.3436

Sea Bea Fish	0.5621	0.3487	0.26769
Spotted Sea Horse	0.5636	0.7534	0.27658

Table 6: MSE Value Evaluation

The MSE rate is evaluated in the Table 6. The table depicts that the method IMWIE provides less MSE rate for various image data set than other methods.

The evaluation of MSE rate is shown in Figure 5. The Figure depicts that the MSE rate for various image data set is evaluated, the proposed system IMWIE de-noising filter provides less MSE rate for all image data set.

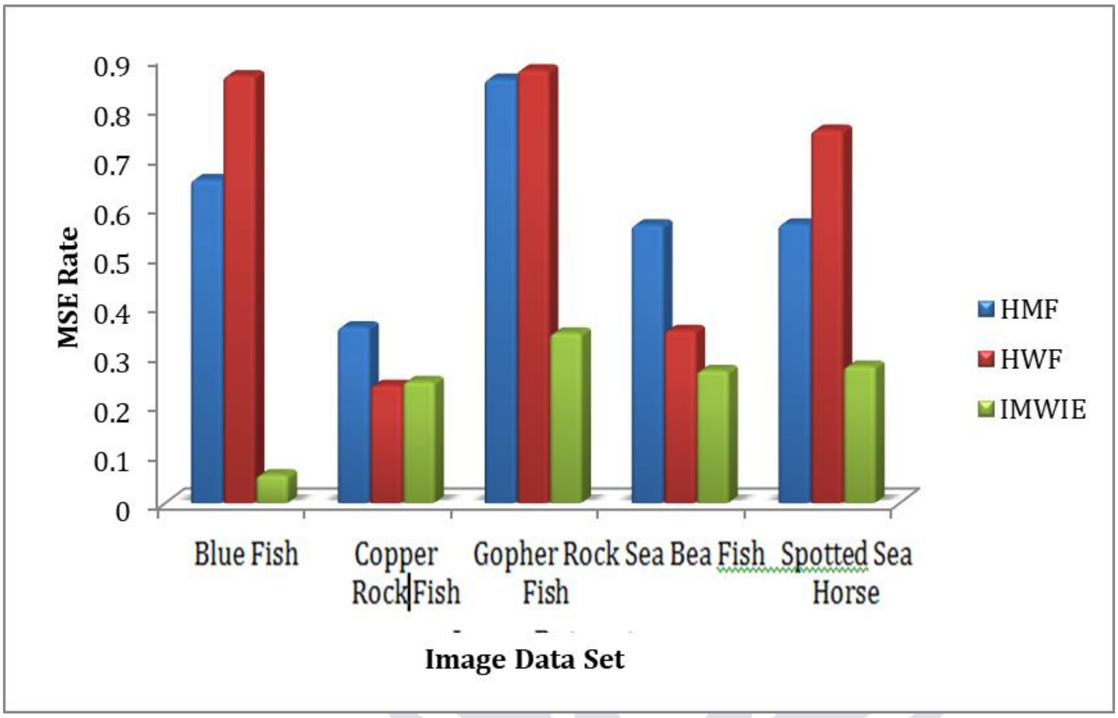

Figure 5: MSE Rate Evaluation

$$MSE = \frac{\sum_{M,N}[I_1(m,n) - I_2(m,n)]^2}{M * N} \quad \textbf{(3)}$$

V. Conclusion

The proposed architecture helps in the removal of noise from the under sea water marine animals videos efficiently through the proposed pre-processing phase. The tabular column Table 3 clearly indicates that the proposed preprocessing algorithm results in a very good image quality which is evident from the fact that the PSNR value is above 60 Db and the Structure similarity index is close to 1 with less error specified by Structured Distortion. The elementary concept of pre-processing and video pre-processing of the undersea water animals is deliberated in this work. The kinds of noises and the several de-noising filters are deliberated in this section. The anticipated under sea water image and video processing is undergone with illustrations. Finally, the performance evaluation for the proposed de-noising filters are assessed. In the future work, the brief algorithm for the region detection and object identification of the pre-processed sea marine animals with illustrations will be carried out. The future scope gives an elaborate view of the proposed segmentation technique. The preprocessed image must be segmented in order to extract the Region of Interest the fish image from the extracted preprocessed frames.

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