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Enhancement of Underwater Images using Pixel Arrangements and Image Enhancement Algorithm

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Abstract: ***Underwater image processing is faced with a number of challenges from distinct resolutions, format variations, scattering, absorption of light etc. It is also affected by contrast difference and orientation. Conveying different resolved underwater images using enhanced pixel arrangement and image algorithm. This can be proceeded by converting the multi scale fused resolution images to high resolution images. Image enhancements has some in-built pixels properties having low intensities in at least one-color channel. Such kind of images are then converted to high resolution imaging by using the tools of enhanced pixel arrangement algorithm and then the output images are clarified.***

I. INTRODUCTION

Underwater has its own environment. It is a resident for many attractions such as marine life, its landscapes, submarines, shipwrecks etc. Eventually, according to its environment even underwater photography, underwater imaging has been improving through the recent technology, research and discoveries. Mainly underwater photography is introduced and used for the archeology, inspection purposes and many more. Usually underwater images lack in the visibility and clarity of the images.

Image clarity is considered an important aspect in all the fields. Programmed frameworks are taken into consideration to obtain the clarity.

It is possible by using a concept of Image processing where differing algorithms are used to achieve the result. Assorted algorithms are used for obtaining image clarity because of which clarity is obtained to an extent these days.

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The implemented work states a programmed algorithmic work for Underwater image clarity. Underwater images obtained through the existing technology are hazy and require more concentration to read them and point out the problem.

Generally, in the images taken at the depths of water body (considering the water body taken here to be the sea) ,

The object(s) in image taken at a distance of greater or around 1000 centimeters are almost unseeable, and their color components are deeply attenuated as their composing wavelengths are lost due to the increase in the water density with depth resulting in greater water refractive index values.

Due to this underwater enhancement techniques are implemented. Orthodox image improvement methods such as the histogram equalization method, gamma correction method seems to be highly unsuitable for the same. Because of which, this paper introduces to remove haze in the captured image by pixel rearrangement as a additional measure.

First the low resolution image i.e., the image which was fused and sharpened by gamma correction radiations are converted to high resolution image which is imposed by white balancing technique, applications of pixel arrangement, and image enhancement algorithms.

The demonstrated system implements two different algorithms with required tools through which the images go through for the pixel adjustment and removal of the hazy characteristics in the produced underwater image. The algorithms are Enhanced pixel arrangement algorithm and Haze-free algorithm. The first phase of the process is by introducing the blurred or hazed image (here the low resolution image) as the input through Haze-free algorithm where the hazy particles in the underwater image are removed. The input image is processed through guided filter which performs edgy-preserving smoothing of the image using another underwater image (i.e. Guided image). Then the smoothened image goes through Soft matting where there is extraction foreground object from an image. Soft matting uses reference of a mathematical equation for obtaining precise results based on the image, the linear equation is

$(L+ \lambda U)t= \lambda t$, where L is N*N matrix (N: image size)

After the first phase (Haze-free algorithm) the obtained underwater image enters the second phase of the digitization known as Enhanced pixel arrangement algorithm where the irregular pixels of the haze-free image are arranged accordingly for turning low resolution images into high resolution images. It even deals with some AI embedded tools for the conversion of image resolution from low to high.

This works by detecting and generating patterns found in low resolution images and applying these patterns during the upsampling process to produce a good quality underwater image.

II. SYSTEM ARCHITECTURE

Illumination of the object is also heavily influenced by the diving location, due to color cast of specific locations: deeper ocean and seas generates greenish and bluish backgrounds, equatorial waters seems cyan in nature, while protected reefs usualy have exceptionally good image perceptibility.

Futhermore adding on to the problem of varying level of illumination present underwater, the particle density that the light has to travel through is several times denser than normal atmosphere in sub seawaters. As a implied result, light in sub-sea water gradually looses different wavelengths of light. From the studies of Codruta O. Ancuti ; Cosmin Ancuti ; Christophe De Vleeschouwer ; Philippe Bekaert [1] we know that red, which compares to the longest wavelength, is the first to be lost (10-15 ft), trailed by orange (20-25 ft), and yellow (35-45 ft). Pictures taken at 5 ft profundity will have a perceptible attenuation of red. Furthermore, the refractive list of water makes making a decision about separations troublesome. Along these lines, submerged articles can seem 25% bigger than they truly are. The image enhancement adopts a three step strategy to improve underwater images

1. White Balance
2. Using Enhanced Pixel Arrangement Algorithm

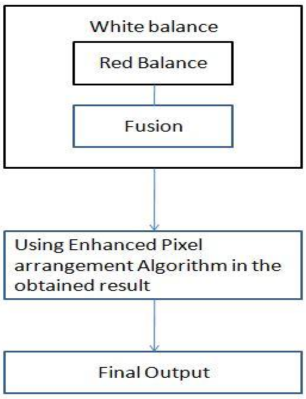

Fig 1: The effective flowchart representing the system architecture process

A. ADJUSTMENT OF WHITE BALANCE:

The white adjusting receives a two stage methodology to improve submerged pictures without turning to the express reversal of the optical model:

1. Red balancing
2. Image fusion

White adjusting basically targets making up for the subsequent shading cast brought about by the particular assimilation of hues with profundity

Image Fusion is considered to upgrade the edges and subtleties of the scene, to alleviate the loss of differentiation coming about because of backscattering (Often from the camera flash).

White-adjusting targets upgrading the picture viewpoint, fundamentally by expelling the undesired shading castings because of different enlightenment or medium constriction properties. From the studies of Codruta O. Ancuti ; Cosmin Ancuti ; Christophe De Vleeschouwer ; Philippe Bekaert [1] Large spectrum of existing white balancing methods have been considered and have identified a number of solutions and , the popular Gray-World calculation accomplishes great visual execution for sensibly twisted submerged scenes.

A.1. ADJUSTMENT OF RED BALANCE:

As mentioned previously (Sec II.1) red component is lost in underwater images. Red being a primary colour naturally induces negative effect on image quality in its absence. The green channel is generally very much safeguarded submerged, contrasted with the red and blue ones. The green channel is the one that contains rival shading data contrasted with the red channel, and it is along these lines particularly essential to make up for the more grounded weakening instigated on red, contrasted with green. In this manner, the red constriction was remunerated by including a small amount of the green channel to red. This is done by Gray-World [8] Algorithm as stated above. This is on the grounds that most customary techniques neglect to expel the shading movement, and by and large look pale blue. The Grey-World was found to be best in removing bluish tone, In any case, it was observed that this strategy experiences serious red relics. This is because of an exceptionally little mean an incentive for the red channel, prompting an overcompensation of this direct in areas where red is available, as Gray-world partitions each channel by its mean worth. Along these lines its basically meant to make up for the loss of the red channel.

To make up for the loss of red channel, we expand on the four after perceptions/standards:

1. The green channel is generally very much protected under water, contrasted with the red and blue ones.
2. Contrasted with red channel, The green channel is the one that contains adversary shading data, Therefore red lessening is repaid by including a small amount of the green channel to red.
3. The difference between the mean red and the mean green values should be proportional to the compensation.
4. To maintain a strategic distance from the rosy appearance presented by the Gray-World calculation in the over-uncovered districts the green channel data ought not be moved in areas where the data of the red channel is as yet huge. Relevant formulas have been adopted by the previous researchers on underwater images [1] to minimize the overexposure of red after processing the image better balancing the red component at the end of the process.

A.2. IMAGE FUSION

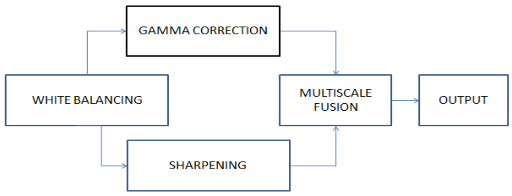

Fig 2: Strategy review: two pictures are gotten from a white-balanced form of the single input, and are blended dependent on a (standard) multiscale fusion calculation. the curiosity of our methodology lies in the proposed pipeline but also in the meaning of a white-balancing calculation that is fit to our underwater enhancement issue.

In this work we based on the multi-scale fusion standards to propose a solitary picture submerged dehazing arrangement. Our system expands on a lot of data sources and weight maps got from a solitary unique picture.

A couple of data sources is acquainted with individually upgrade the shading contrast and the edge sharpness of the white-balanced picture.The weight maps are defined to preserve the qualities and reject the defaults of those inputs, i.e. to overcome the artifacts induced by the light propagation limitation in underwater medium.

In water further than 30 ft, white balancing experiences observable impacts since the ingested hues are hard to be recuperated. To acquire our first input we play out a gamma rectification of the white adjusted picture form. Gamma adjustment targets remedying the global differentiation and is significant since, when all is said in done, white adjusted submerged pictures will in general show up excessively brilliant.

This amendment builds the distinction between darker/lighter locales at the expense of lost subtleties in the under-/over-uncovered areas.

So generally to convert a low resolution image i.e the input fused image through gamma correction to the high resolution image ,we must check for the normalized unsharp masking process i.e.,we need to check for the white balancing of the image to finally blend the image.Then we have to check for the weight of the fused image i.e., when the blending taking place in a such a way that high weight value pixels are more highlighted in the final image. After the weight balancing, naïve fusion process is applied to reconstruct the unsharpened image by normalizing the pixels weight and arranging them equally at their particular locations.

B. ENHANCED PIXEL ARRANGEMENT ALGORITHM

By and large digital pictures are defamed into pixels and every pixel compares to a whole number esteemed area. This integer valued location is then converted to a float valued location for better computation We use pixel arrangement to build up a model of the element to be confined. We apply this calculation on handled submerged picture to identify highlight up to pixel exactness. Circling match model with information picture to limit recognized component with sub pixel exactness. Most sub pixel calculations require a decent gauge of the area of the component. If not, the algorithms faces the threat of being attracted to the noise instead of desired features. In this we first have added guided filter to prevent and excess bleach to the image. Then the pixel algorithm is applied with a addition of optimization algorithm to optimize results all this is comprised

B.1. GUIDED FILTER

There are many The guided filter is used to perform edge preserving smoothing on an image, it is done using a guidance image or a second image of the same processed underwater image (duplicate image obtained) for the image filtering. The guidance picture can be simply the equivalent submerged picture or the distinctive adaptation of the picture. The filtering of the guidance image is similar to the other filtering operations to sharpen the edges. The image obtained after guided filtering is considered as the input for soft matting process. A point in any picture as a rule generally involves more than one pixel. A point doesn't have sharp edges. The edges are mostly smooth or obscured. Now considering the image in a two planes x and y, then,

$$g(x,y) = \exp\left(-\frac{x^2+y^2}{2\sigma^2}\right)$$

In this way, a point can be displayed by the 2D work M as pursues:

$$M(x,y;A,B,\sigma,u,v) = A + B\exp\left(-\frac{(x-u)^2+(y-v)^2}{2\sigma^2}\right)$$

Where, M: intensity,(x, y): any area in the picture, A: intensity of background (dark region);B: peak intensity of point (brightest region);(u, v) is the peak location, i.e., center of point;¾: amount of spread of the Gaussian.

In short-hand documentation of M(x, µ); x = (x,y) T : variable picture location;µ = (A,B, ¾, u, v)T : parameters of the point model; If the model M coordinates a point in picture I superbly, at that point,

M(x, µ) = I(x),

for all areas x inside the model M. (u, v) gives the area of the point.

Since u, v can be take on gliding point esteems, they demonstrate a sub pixel area.

A decent pixel match is found by figuring error of match E(µ):

$$E(\boldsymbol{\theta}) = \sum_{\mathbf{x}\in W} [M(\mathbf{x},\boldsymbol{\theta}) - I(\mathbf{x})]^2$$

where W is the degree of M (like a little window or template).Then we apply enhanced pixel calculation to discover the µ that limits the error E(µ).

(u, v) is the sub pixel area of the ideal µ.

Then many traditional methods such as Gradient descent, Powell's direction set method were examined for optimizing the pixel algorithm. Now based on previous studies on optimization and gradiant descent [9][10], Gradient descent was selected for further optimization.

III. EXISTING SYSTEM

Mainly underwater photography is introduced and used for the archeology, inspection purposes and many more. Usually underwater images lack in the visibility and clarity of the images. The drawbacks existing system are:

1. There is a problem in the disarrangement of the pixel arrangement in that particular multiscaled fused image.
2. Due to the pixel disarrangement not even the output image is lacking visibility but also the color and clarity of the image is lacking.
3. Haze if any wasn't corrected

IV. PROPOSED SYSTEM

In the proposed system the main advantage available is mainly that we get improvised image clearity.With the introduction to the proposed algorithms, the we tend to remove the issues with the haze and color enhancement that were previously there. The enhancement technique namely Enhanced pixel arrangement is used for further enhancement from the existing system.

The algorithm use methods of pixel arrangement which aims in diminishing spurious pixel values, superposing it with a gradient image(to reduce back lash) and adjust the missing pixel values by edge preserving and image sharpening which highlights fine minute details of image. This method is extremely direct and simple to utilize. In this method we characterize a characterize square or rectangular neighborhood and move the inside from pixel to pixel after the application of gradient filter.

V. RESULT AND DISSCUSSION

The proposed system is to implement a mechanism to improvise the recovered image quality in underwater image processing using various enhancement methods.

The methods we used here are to process the underwater image such that the output image is preferred to the original image. It adds on the red color component to the underwater images which had been severely attenuated due to depth of water ,then undergoes fusion process for pixel correction and finally is processed through our pixel algorithm to make the resultant underwater image more helpful for research of marine life and archaeological research purposes. The enhancement doesn't increase the previous information content of the input data, but increases the dynamic range of the chosen features

This paper presents the newer techniques for underwater image enhancement. Although this paper couldn't completely optimize the resultant image size, it may play a critical role in Archeological field, Underwater Life Research and for choosing different techniques for future technology to improve.

The concluded aim of designed process model is to improve the information quality in originally captured Underwater images for researchers, or to provide 'better' input for other automated image processing techniques.

Fig 3: Existing System's Processed Image

Fig 4: Image after processing with proposed system

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