ANALYSIS ON LUMINANCE CONSERVING BI-HISTOGRAM EQUALISATION AND CLAHE FOR UNDERWATER IMAGE ENHANCEMENT

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ABSTRACT
We present a practical method in this study for improving underwater photographs that have been damaged by medium absorption and scattering. Our method uses a single picture approach and lacks technological equipment, knowledge of the aquatic environment, or understanding of scene composition. It expands on the merging of two pictures that are directly derived from an interpretation of the original degraded image that has been given colour compensation and a white balance. Edges and colour contrast are transferred to the output picture as a result of the two images to be fused, as well as the weight charts that go with them. Low vision and poor contrast are problems with photographs taken in murky watery circumstances. Therefore, there is a need to enhance imaging data from aquatic research and examination work so that it can be analysed to value the requested information. Brightness Preserving Bi- Histogram Equalisation (BBHE), a novel technique for improving contrast, is suggested in this study. The brightness enhancement of aquatic photos is greatly aided by CLAHE.
Keywords: Scattering, absorption, color contrast, BBHE, CLAHE

1. INTRODUCTION

One of the main subfields of digital image processing that finds application in many different sectors is underwater image processing. such as the observation of marine habitats. Additionally, it makes engineering piping inspection simpler. The physical characteristics of the undersea environment make underwater photography a highly difficult discipline. primarily having to do with how light is reflected and absorbed. Underwater photos lose contrast and degrade mostly because of low visibility circumstances and factors include light absorption, reflection, bending, and scattering of light.

1.1 DIGITAL IMAGE PROCESSING

With the help of computer software, you may edit digital photographs thanks to the development of digital image processing. It is a branch of signal processing that primarily focuses on visual data. The ability to apply various algorithms on a digital image as an input using digital image processing enables the stoner to provoke an affair. Depending on the requirements for a fair image, these algorithms may change from image to image.

1.2 IMAGE ENHANCEMENT

Some of the simplest sorts of image modification tools only alter a picture's contrast or brightness, or play with its grey scale or red-green-blue colour patterns. Some types of basic pollutants also enable the conversion of colour images to black and white, photograph-tone images, or the addition of visual elements.

2. EXISTING METHODS

2.1 HISTOGRAM EQUALIZATION: When the data of the image is represented by contrast values, histogram equalisation typically increases the overall contrast of images. One histogram can more evenly disperse the intensities. The most common intensity values are successfully spaced out to achieve histogram equalisation.

Images with bright backgrounds and dark cores can benefit from using this technique. The system's relatively easy design and invertible operators are two of its key advantages. However, if the histogram equalisation function is known, the original histogram can also be recovered. The magpie is a drawback of the method. It can reduce the useable signal while boosting the contrast of the background noise.

2.2 ADAPTIVE HISTOGRAM EQUALIZATION

Utilising psychophysical bystander studies, adaptive histogram equalisation (AHE) and intensity windowing have been contrasted. Clinical CT (motorised topographic) pictures of the coffin were displayed to enduring radiologists. The croakers were also shown the photos that had been reprocessed with both AHE and intensity windowing. In some of the photographs, appropriate fake lesions had been added. Their delicacy was evaluated when they were asked to determine the likelihood that a certain image included the fake lesion. As a result, further analysis of AHE utilising controlled clinical trials is recommended. The findings of these trials demonstrate that there was no significant difference in the capacity of the two styles to display luminance contrast for this specific individual task.

3. LITERATURE REVIEW

An adaptive underwater image restoration system that makes use of CycleGAN and DCP was the foundation of Bing Zheng's Multi-Scale Adversarial Network for Underwater Image Restoration in 2019. But with an uneven illumination, this model is unable to produce a believable image.

A survey on DHE (Differential Gray-Levels Histogram Equalisation) and (AGW) Adaptive Grey World was conducted in 2018 by author Siaw-Lang. Both of these approaches were effective. Utilising the DHE technique, which manipulates the intensity components of the raw underwater image, the AGW method removes the colour cast of the image and enhances contrast. The undersea image's quality is considerably improved by this parallel arrangement. The DHE produces the best results for images with low contrast, but it may produce subpar results for images with high contrast.

Using a transmission map based on reflection-decomposition, Miao Yang's offshore underwater image restoration project will be completed in 2020. To improve clarity, the estimation was based on dark channel reflection-illumination decomposition and local backscattering lightning estimation. However, it only produced mediocre clarity restorations for additional objects in the images.

The outcome of the suggested technique is not the best, according to a method for adaptively choosing regularisation parameters that was proposed in 2021 by Qingliang Jiao's Underwater Image Restoration that employed BRISQUE, FADE, and NIQE. But when the restored images are combined, the suggested algorithm can still be regarded as a superior underwater image restoration technique to the alternatives.

4. SOFTWARE REQUIREMENT

MATLAB: Matrix Laboratory is referred known as MATLAB. Deep literacy and machine literacy, signal processing and communication, image and videotape processing, control systems, test and dimension, computational finance, and computational biology are just a few of the operations that may be performed in business and academia with MATLAB.

With the control system responsible for issuing orders, administering, and regulating the nature of the other system, MATLAB enables control to the coloured systems and bias. wireless transmission. It is the most often used phrase to describe the connection of two biases with wireless signals. impacts of the internet The network of automobiles, prejudice, house furnishings, and other electronic gadgets prejudice is what allows the prejudice to affect the information. Benefits of MATLAB It provides the IDE that calculates matrices and uses direct algebra the fastest.

BLOCK DIAGRAM

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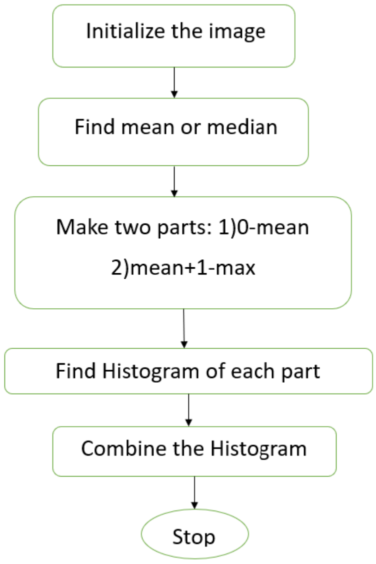

Fig. 1: BBHE Block Diagram

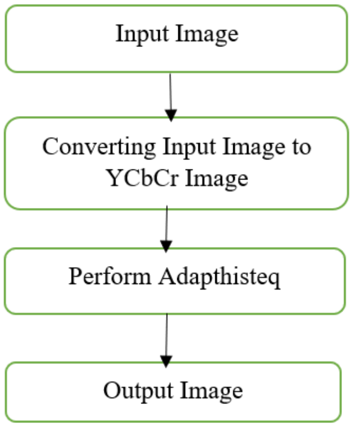

Fig. 2: CLAHE Block Diagram

5. PROPOSED METHODOLOGY

BBHE: One of the popular techniques for boosting the differentiation of provided pictures is histogram equalisation (HE), which results in a performing image with a constant distribution of the slate conditions. It improves overall contrast by flattening and extending the image's histogram's dynamic range. When a picture has to be improved, HE has been used extensively, similar to medical image enhancement. Because the "asked" histogram is flat, the mean brilliance of the proposition's affair image is always in the middle of the input means. In some procedures where brilliance preservation is required, this characteristic is not acceptable. To solve such issue, brightness-preserving bi-histogram equalisation (BBHE) has been suggested.

To address the aforementioned issues with the standard histogram equalisation, a new extension of the histogram equalisation called the mean Brightness-preserving Bi-Histogram Equalisation (BBHE) is presented. The main goal of the suggested approach is to save the image's mean brightness while also saving brightness.

The input image's histogram is first divided in half by its mean using BBHE, resulting in two histogram ranges that do not overlap. It then separately equalises the two sub-histograms. It has been analysed that

ISSN PRINT 2319 1775 Online 2320 7876

  UGC CARE Listed (Group -I) Journal Volume 10, Iss 1, Jan 2021

when the input histogram has a quasi-symmetrical distribution around its mean, BBHE can retain the original brightness to a considerable extent.

The following shows the brightness preserved image:

Fig. 3: Input image for BBHE method

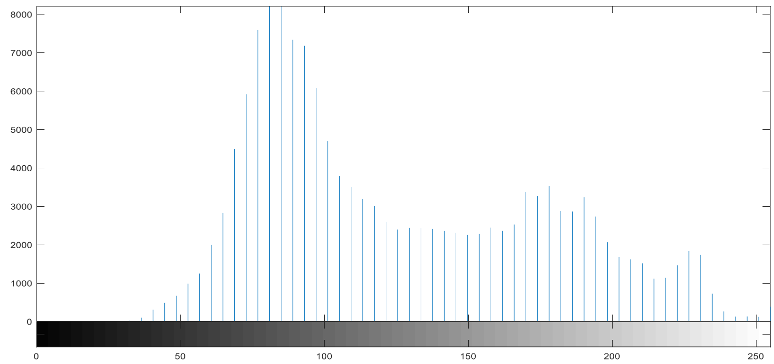

Fig. 4: Histogram of Input BBHE Image

The minimum mean image is calculated which is a MEAN 0 or black gray level image:

Fig. 5: Minimum Mean Image

The maximum image is calculated which is a MEAN 256 or white gray level image:

Fig. 6: Maximum Mean Image

The two histogram equalized images are combined to form a single image. Hence, we can see that brightness has been preserved.

Fig. 7: Brightness Preserved Image

The histogram of the above image is:

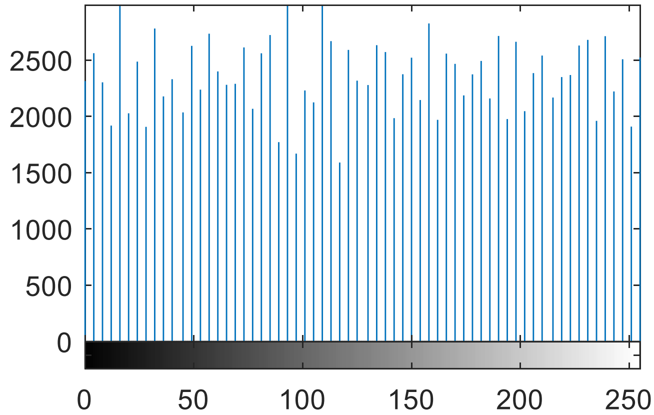

Fig. 8: Histogram of Brightness Preserved Image

As we can see the histogram of output image, the histogram is properly spreaded between 0-250.

The PSNR, SNR, MSE, and SSIM values are calculated for input and output images.

The Peak-SNR value is 25.7917

The SNR value is 20.4330

The mean-squared error is 171.3614

The SSIM value is 0.9756.

CLAHE

Because the global histogram equalisation amplifies noise in relatively homogeneous regions, it can exacerbate the point loss problem in the dark regions of the image while solving the over-enhancement issue. Contrast limited adaptive histogram equalisation (CLAHE), a solution, was put out to address this issue. The well-known block-based processing known as CLAHE can overcome noise issues in the homogeneous zone of a picture caused by excessive histogram equalisation. The CLAHE method varies from regular HE in that it uses tiny areas of the picture called penstocks and computes several histograms, each of which corresponds to a different segment of the image. It then uses these histograms to redistribute the image's brightness values.

The input image is initialized by the picture shown below:

Fig. 9: Input image for CLAHE method

The input image has to undergo RGB to YCbCr or Gray level image.

IJFANS INTERNATIONAL JOURNAL OF FOOD AND NUTRITIONAL SCIENCES
ISSN PRINT 2319 1775 Online 2320 7876

  UGC CARE Listed (Group -I) Journal Volume 10, Iss 1, Jan 2021

Fig. 10: RGB to YCbCr converted image

The histogram of the above image is:

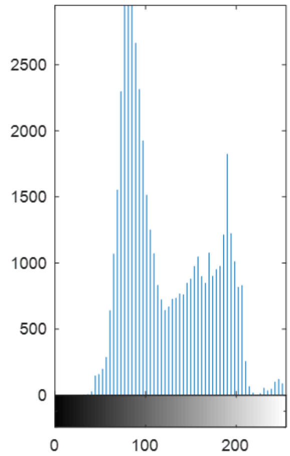

Fig. 11: Histogram of YCbCr converted image

On the YCbCr image, the adaptive histogram equalisation is carried out. By breaking the pictures into smaller data sections known as penstocks rather than the entire image and applying contrast enhancement, CLAHE eliminates over-amplification. Additionally, these penstocks are returned to obtain the final contrast-enhanced image.

In the generally homogeneous images, AHE has a tendency to over amplify noise. This issue is solved by CLAHE by restricting noise modification.

The "adapthisteq" MATLAB function is used to do the adaptive histogram equalisation on the YCbCr picture.

Fig. 12: Contrast Enhanced Image

The histogram of the above image is:

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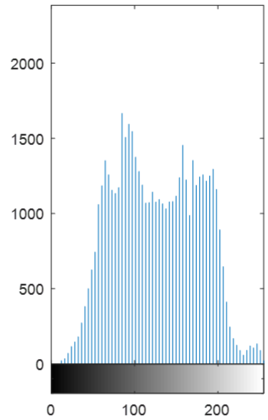

Fig. 13: Histogram of Contrast Enhanced Image

The PSNR, SNR, MSE, and SSIM values are calculated for input and output images.
The Peak-SNR value is 18.9768
The SNR value is 13.1329
The mean-squared error is 822.9966
The SSIM value is 0.7134.

CONCLUSION

BBHE and CLAHE, which boosted the brightness and contrast of the underwater picture, respectively. The image has been improved from poor contrast, low light, fuzzy, and foggy. The outcome is far superior to HE. The aforementioned issues with the conventional histogram equalisation are addressed by a novel extension of the histogram equalisation, known as the mean Brightness-preserving Bi-Histogram Equalisation (BBHE). The goal of the suggested approach is to preserve both contrast and the average brightness of the image. As a result of amplifying noise in relatively homogenous parts, the global histogram equalisation cannot solve the over-enhancement issue or alleviate the point loss issue in the dark portions of the picture. In order to overcome this problem, contrast limited adaptive histogram equalization (CLAHE) was proposed.

FUTURE WORK

Although we have improved the images, the outcome is still unclear. Although there is some noise, CLAHE does improve contrast. Future work will address this by adapting the methods.

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