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Underwater Image Enhancement

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Abstract

Underwater images suffer from color casts and low contrast due to wavelength and distance-dependent attenuation and scattering. To solve these two degradation issues, an underwater image enhancement network is presented by using MATLAB. It is used to enhance the image using image processing techniques. To solve the color cast and low contrast of underwater images caused by the effects of light absorption and scattering, a novel underwater image enhancement technique is used. Color correction, contrast enhancement and multiscale fusion are the three primary aspects of the suggested technique. First, the color cast is eliminated by imcomplement. Then, Laplacian filtering is used which enhances the contrast and details of the image and the low-frequency information is disposed via gamma correction for adjusting the exposure. Multiscale fusion fuses the low frequency information after gamma correction for adjusting the exposure with the high-frequency information after Laplacian which enhances the contrast and details of the image. As a result, this method can effectively improve the visual quality of underwater images.

Keywords: Color correction, contrast enhancement, multiscale fusion, imcomplement, Laplacian filtering.

1. INTRODUCTION

Underwater images exhibit serious weakening such as color deviation, low contrast, and blurry details due to the absorption and scattering effect on light when traveling in water. Typically, when the light propagates through water, it suffers from selective attenuation which results in various degrees of color deviations. Furthermore, suspended particles in water, such as micro phytoplankton and non-algal particulate, scatter the light, resulting in low contrast. In ocean engineering, obtaining quality photographs in underwater conditions is critical. Underwater image quality is critical for scientific purposes including monitoring sea life, collecting population censuses and assessing geological or biological settings. Capturing images underwater is challenging, mostly due to haze caused by light that is reflected from a surface and is deflected and scattered by water particles and color change due to varying degrees of light attenuation for different wavelengths. In photographs taken underwater, light scattering and colour alteration cause contrast loss and colour variation. This is an effective approach for improving the quality of underwater images.

2. LITERATURE REVIEW

Berman et al.[1] have proposed in their work by estimating two additional global parameters, the attenuation ratios of the blue-red and blue-green color channels. This method takes into account multiple spectral profiles of different water types and is reduced to single image dehazing. Here all color channels have the same attenuation coefficients. Since the water type is unknown, different parameters out of an existing library of water types is evaluated. In each kind, a unique image is restored, with the best outcome determined automatically based on colour distribution.

Cai et al.[2] have proposed a multi-step and all-round underwater image processing system to improve the image quality, the dynamic interference is removed and the image is reconstructed. Image contrast and colour are increased by using a dark channel prior and an upgraded grey world algorithm. Concerning image enhancement, firstly, the dynamic interference is recognized and removed. Secondly, upgraded total variation model is applied to patch the blank at the cost of resolution. Finally, super-resolution of the details is realized by applying improved BP network. After simulation and experiments, this system proved to achieve ideal results of image enhancement and reconstruction.

Cecilia et al.[3] have proposed dehazing model-based algorithms to overcome hazy effect of the underwater images due to the presence of sediments, lighting inconsistencies, color variations and dissolved particles. The effectiveness and limitations of various algorithms are analyzed both in terms of subjective and objective measures. The Underwater Hazeline Prior (UHP) algorithm is contrast adjusted to form the Modified Color Restoration (ColR). The ColR achieves a metric improvement of 2.5% in Underwater Color Image Quality Enhancement (UCIQE) than the UHP algorithm. Further contrast improvement strategies for underwater images are also discussed.

Dixit et al.[7] have proposed an underwater image enhancement using dark channel prior (DCP) with adaptively clipped contrast limited histogram equalization (ACCLAHE) and homomorphism filtering (HF). The blur zone is estimated and it is eliminated with DCP. The maximum bin height in the local histogram of the sub picture was taken and redistributed the clipped pixels evenly to each gray-level with the help of ACCLAHE.

Iqbal et al.[4] in their work have proposed an approach based on slide stretching in order to improve the perception of underwater images. The objective of this approach is twofold. To begin, the RGB algorithm's contrast stretching has used to equalize color contrast in photographs. HSI has used to boost the true colour and alleviate the lighting problem by stretching the saturation and intensity.

Li et al.[5] have proposed a method which relaxes the need for paired underwater images for training and allows the underwater images being taken in unknown locations. Inspired by cycle-consistent adversarial networks, a multiterm loss function including adversarial loss, cycle consistency loss and structural similarity index measure loss which made the content and structure of the outputs are identical to the inputs, while the color is similar to the photographs taken without water. Experiments on underwater images captured under diverse scenes show that the method produces visually pleasing results, even outperforms the state-of-the-art methods. Besides, this method can improve the performance of vision tasks.

Liu et al.[6] have proposed an undersea image capturing system and a large-scale Realworld Underwater Image Enhancement (RUIE) data set which is divided into three subsets. The three subgroups are focused on three difficult things to improve: image visibility quality, colour casts and higher-level detection/classification. Extensive and systematic experiments were conducted on RUIE to evaluate the effectiveness and limitations of various algorithms to enhance visibility and correct color casts on images with hierarchical categories of degradation.

Using the outcomes and results obtained from these papers, the proposed system with multiscale fusion image processing technique is used to achieve better enhancement results.

3. PROPOSED SYSTEM

In the proposed system, the quality of the underwater images is improved by using multiscale fusion image processing techniques. The steps involved in the proposed method of the system are collection of images, preprocessing, extracting the images based on the RGB model and multiscale fusion image enhancement technique. The results are shown based on the measurement of the performance of the system. The proposed method's efficiency is demonstrated by experimental data. In a binary image's complement, zeros become ones and ones become zeros. Black and white are reversed. The Laplacian of an image is widely used for edge identification since it indicates regions of fast intensity change. Although multiscale fusion with low-frequency information can effectively minimise overexposure, it can also cause overcompensation, resulting in some areas being too dark and black spots are produced compared to the surrounding areas.. Multiscale fusion fuses the low-frequency information after gamma correction for adjusting the exposure with the high-frequency information after Laplacian which enhances the contrast and details of the image. The process of enhancing the quality of datasets is through filtering the noise by preprocessing, color correction using imcomplemnt, contrast enhancement through Laplacian of gaussian. Finally multiscale fusion is applied to get the enhanced output image. The framework of the system is shown in the Fig.1.

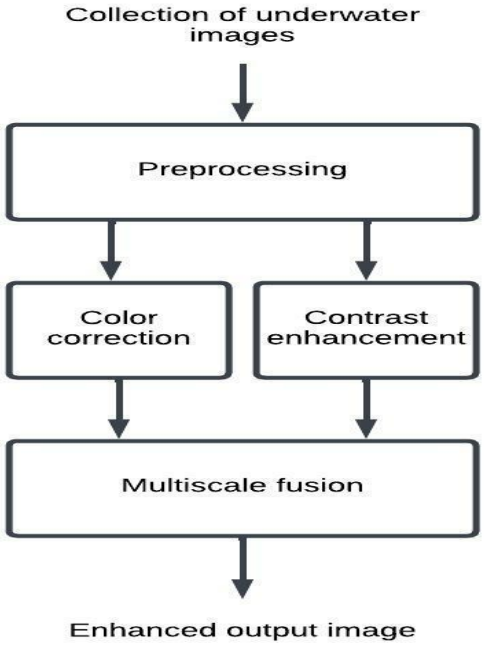

Fig.1. Workflow of the system

Collection of Input Image

The collection of input data is called the image dataset. An input data can be obtained in image format to enhance the quality of the underwater image.

Preprocessing

To ensure accurate, efficient, or relevant analysis, data may require preprocessing techniques.Data cleaning refers to methods for finding, removing and replacing bad or missing data. The Gaussian method is used in the Preprocessing techniques. A Gaussian filter is used to reduce the noise in the input image of the system.

Conversion of RGB

The main purpose of the RGB color model is for the sensing, representation and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography. An RGB image, sometimes referred to as a true color image, is stored as an m-by-n-by-i data array that defines red, green and blue color components for each individual pixel. RGB stands for red, green and blue. The RGB color model is additive, meaning that red, green and blue light are mixed in various proportions to create a wide range of colours. In MATLAB, an RGB picture is a M*N*I array of colour pixels, with each color pixel having three values that correspond to red, blue and green colour components at a given spatial location.

Color correction and contrast enhancement

Color correction is the practise of altering each clip of footage to reflect a consistent look standard. Basically, levelling out the colours, making the whites appear white, the blacks appear black and making sure everything is even to fix faults with the underlying image. To improve visibility, contrast enhancement procedures modify the relative brightness and darkness of items in the scene. The contrast and tone of the image can be changed by mapping the gray levels in the image to new values through a graylevel transform.

Image Enhancement

Image enhancement is the process of improving the quality and information content of raw data prior to processing. Common practices include contrast enhancement, spatial filtering, density slicing etc. The quality of an image as perceived by a person is improved using image enhancement techniques. These techniques are quite useful

because many satellite photographs on a color display provide insufficient information for image interpretation. The goal of image enhancement is to make an image more helpful for a certain task, such as making it more appealing to human eyes.

Multiscale Fusion

Multiscale fusion is the process of integrating two or more images into a single composite image that combines the information from the separate enhanced images. In comparison to any of the input images, the outcome is an image with more information content. Image fusion provides image sharpening, feature augmentation, enhanced categorization and the production of stereo data sets, among other benefits. Multisensory image fusion has advantages in terms of operational range, spatial and temporal properties, system performance, reduced ambiguity and increased dependability.

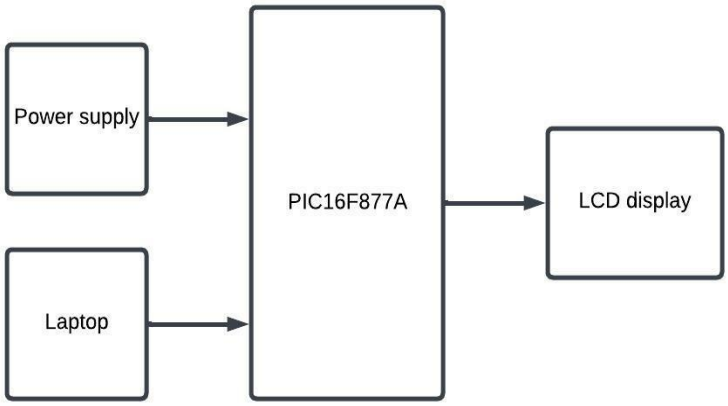

Fig.2. Block diagram of the hardware unit

The enhanced pixel value of the output image is displayed through LCD screen using PIC microcontroller as shown in Fig.2.

4. RESULTS AND DISCUSSION

The hardware setup consists of a Pic controller and LCD screen, PIC controllers are reliable. The performance of the PIC is very fast as it uses RISC architecture. When compared to other microcontrollers, the power consumption is likewise relatively low. The output of the enhanced pixel values is displayed on the LCD screen as shown in Fig.3. and the enhanced image output is shown in Fig.4.

Fig.3. Hardware setup

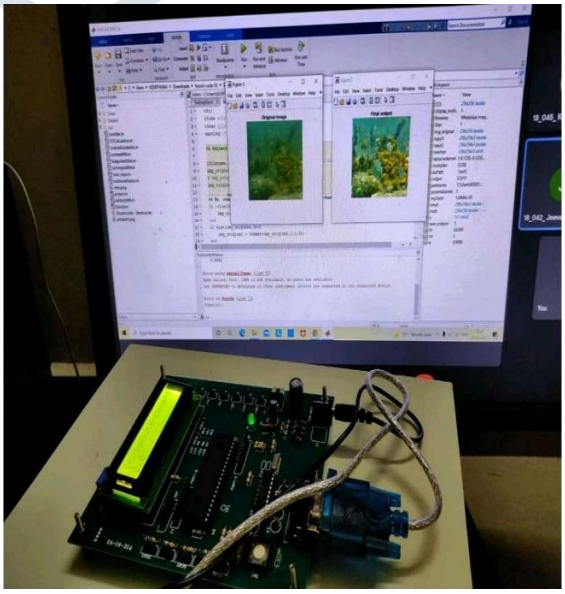

Fig.4. Image enhancement output

OUTPUT

The Laplacian of an image highlights regions of rapid intensity change and is therefore often used for edge detection as shown in Fig.5.

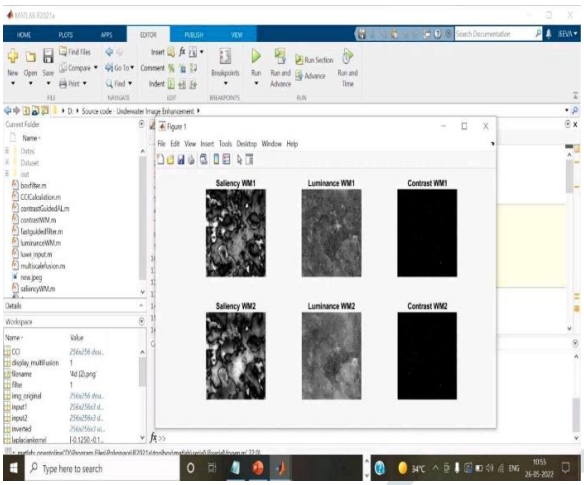

Fig.5. Contrast Enhancement

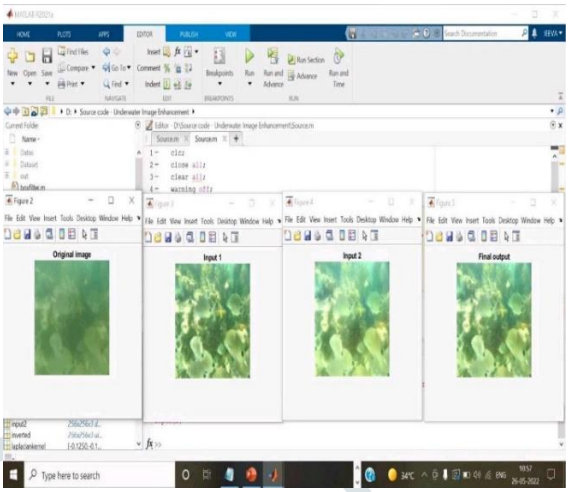

Fig.6. Fusion of images after color correction and contrast enhancement

When the complement of the binary image is taken, zeros become ones and ones become zeros. Black and white is reversed.

In the complement of a grayscale or color image, each pixel value is subtracted from the maximum pixel value supported by the class (or 1.0 for double-precision images). In the output image, the difference is used as the pixel value.

The multiscale fusion shown in Fig.6. with low-frequency information can effectively avoid overexposure, but overcompensation phenomenon is generated, which results in the fact that some areas are too dark, and dark spots are generated compared with the surrounding areas. The final output is shown below in Fig.7.

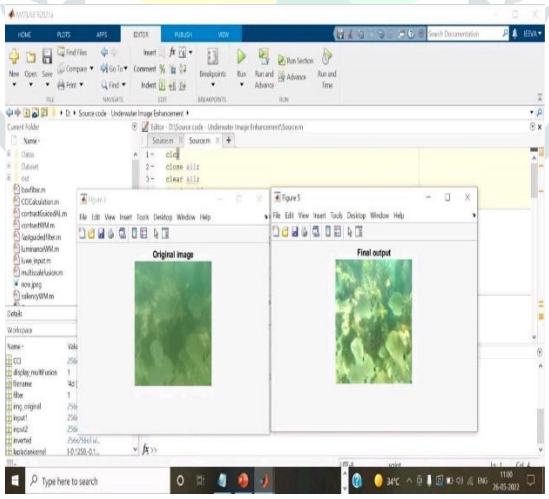

Fig.7. Final output

The contrast and texture of the image have been greatly improved when compared to the original image.

5. CONCLUSION AND FUTURE SCOPE

The main aim of the system is to enhance the quality of underwater images getting them rid of quality degradation issues caused by wavelength and distance-dependent attenuation and scattering. Laplacian of Gaussian for contrast enhancement, imcomplement for color correction, and multiscale fusion has been checked for best accuracy for image enhancement. These Machine Learning algorithms have been deployed in PIC16F877. The enhanced image output is

obtained through MATLAB functions and displayed in the system and the enhanced image pixel values are shown in the hardware using LCD screen. Underwater image enhancement process finds use in inspection of underwater infrastructure and detection of any man-made objects. It can be used for marine biology research, for environmental evaluation, for the research of monuments submerged in water and for underwater navigational monitoring in submarines. Underwater image enhancement is the field of image processing and it is considered as a dynamic sector. It's tough to see items in underwater scenes from afar, whether at a short or long distance. As a result, image processing techniques are used to enhance the underwater photographs. The machine learning algorithms are used for the process of image enhancement.

REFERENCES

[1] Dana Berman, Deborah Levy, Shai Avidan, Tali Treibitz, "Underwater single image color restoration using haze-lines and a new quantitative dataset", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 43, pp. 2822 - 2837, Mar. 2020.

[2] Chengyi Cai, Yiheng Zhang, Ting Liu, "Underwater image processing system for image enhancement and restoration", IEEE 11th International Conference on Communication Software and Networks , Nov. 2019.

[3] S. Mary Cecilia, S. Sakthivel Murugan, N. Padmapriya, "Analysis of various dehazing algorithms for underwater images", International Symposium on Ocean Technology, Feb. 2020.

[4] Kashif Iqbal, Rosalina Abdul Salam, Azam Osman and Abdullah Zawawi Talib, "Underwater image enhancement using an integrated color model", International Journal of Computer Science, vol. 34, Nov. 2007.

[5] C. Li, J. Guo and C. Guo, "Emerging from water: underwater image color correction based on weakly supervised color transfer", IEEE Signal Processing Letters, vol. 25, pp. 323 - 327, Jan. 2018.

[6] R. Liu, X. Fan, M. Zhu, Minjun Hou and Zhongxuan Luo, "Real-world underwater enhancement: challenges, benchmarks, and solutions under natural light", IEEE Transactions on Circuits and Systems for Video Technology, vol. 30, pp. 4861 - 4875, Jan. 2020.

[7] Sonal Dixit, Sandeep Kumar Tiwari, Pankaj Sharma, "Underwater image enhancement using DCP with ACCLAHE and homomorphism filtering," International Conference on Signal Processing, Communication, Power and Embedded System, Jun. 2017.