AN INVESTIGATING OF WHITE BALANCING FOR UNDERWATER QUALITY OF IMAGES

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ABSTRACT

One of the most important things to look into while exploring underwater photography is how to improve the visual quality of the photographs by using white balancing and dehazing procedures. Images taken underwater suffer greatly in clarity and accuracy due to the special difficulties of underwater photography, such as light attenuation, color distortion, and decreased contrast. The technical and scientific implications of studying white balancing and dehazing solutions for underwater photography applications are explored in this abstract. Underwater, white balancing—an essential step in traditional imaging—becomes considerably more crucial because water selectively absorbs certain light wavelengths. Researching methods for underwater picture white balance entails creating and honing algorithms that can precisely fix color changes caused by the optical characteristics of water. In order to facilitate precise scientific study, marine exploration, and aesthetic enjoyment of the underwater environment, it is essential that underwater photos accurately portray the actual hues of the underwater landscapes. The automation and optimization of white balance for varied underwater situations are greatly aided by technological breakthroughs, such as machine learning methods and adaptive algorithms.

KEYWORDS: White Balancing, Quality of Images, underwater photography, underwater environment, machine learning methods.

INTRODUCTION

Recent years have seen a meteoric rise in underwater photography, both to improvements in image technology and a general fascination with the ocean's hidden treasures. The aesthetic appeal and scientific correctness of underwater photos are compromised by problems including color distortion and haze, which make shooting high-quality underwater images a

unique task. Under these circumstances, it becomes clear that studying dehazing and white balancing methods is an important effort to improve underwater pictures generally.

Accurate color representation in images relies heavily on white balance, which is especially important while shooting underwater. Because water absorbs and scatters light of various wavelengths, the lighting conditions in the aquatic domain are always changing. Because of this, it's very uncommon for underwater photos to have an artificial color cast, where the main colors don't match the actual underwater scene. Researchers and photographers have worked together to solve this problem by creating and perfecting white balance techniques for usage underwater.

The lack of a universally accepted standard for genuine white is one of the main obstacles to white balancing underwater photographs. Underwater photography is different from terrestrial photography since there is no neutral object to utilize under established lighting conditions. In response, experts in the field have developed complex algorithms that automatically seek to restore an image's original color balance based on its color distribution. Finding and changing the color balance of achromatic regions in a picture is what this process is all about.

The haziness or lack of clarity produced by the dispersion of light in water may be effectively addressed with dehazing, an additional crucial component in improving the quality of underwater images. Images with low contrast and sharpness are the result of light scattering and absorption caused by suspended particles, plankton, and other contaminants in the water. The goal of dehazing is to bring back these attributes by eliminating or greatly reducing the impact of haze, so that the actual underwater scene details can be seen.

Many different dehazing methods have been developed and put into use, and they all have their advantages and disadvantages. Using mathematical models to estimate and remove the haze component from images is one way that certain solutions depend on picture enhancement algorithms. In the hands of knowledgeable researchers, these algorithms may be powerful instruments, but they are complicated and frequently need knowledge of both the weather and the properties of the underwater medium. Polarization filters or other imaging equipment may reduce the effect of scattered light, which means post-processing dehazing isn't always necessary.

Combining white balance with dehazing methods produces remarkable results when used to underwater photographs. The purpose of white balance is to correct for color distortion and make sure that the underwater scene's recorded colors are accurate representations of those colors. Concurrently, dehazing methods mitigate the negative impacts of light dispersion, bringing to light the textures and features that would otherwise go unnoticed, resulting in a picture that is both clearer and more aesthetically pleasing. The goal of higher underwater picture quality has been centered on the integration of these two techniques.

Machine learning and artificial intelligence (AI) have been investigated as potential ways to improve white balancing and dehazing algorithms. Big datasets of underwater photos can teach machine learning algorithms to spot haziness and color distortion patterns. After training, these models may be used to automatically dehaze and change white balance in fresh photos by using learnt patterns. This technique shows potential for improving the workflow of image processing and getting consistent findings in different underwater environments.

White balancing and dehazing methods have come a long way, but getting perfect results in all kinds of underwater situations is still a struggle. Adaptable and adaptable solutions are required due to the complexity introduced by variations in water quality, depth, and the existence of marine life. In order to take the undersea environment's intrinsic diversity into consideration, researchers are always working to improve current algorithms and create new techniques.

Additionally, there is a current focus on improving underwater photographic equipment by including real-time white balancing and dehazing capabilities. Underwater photographers and filmmakers would be able to take better shots with less post-processing work if these kinds of innovations were available. In line with the general trend in image technology, this move towards real-time correction reflects the growing importance of rapid feedback and on-the-fly modifications.

WHITE BALANCING

To get proper color representation in photos, white balance is an essential part of taking photographs. To guarantee that the colors recorded in a picture closely match the actual colors of the scene, this basic idea tackles the problems caused by different lighting situations. Although white balance is important in photography in general, it takes on a far

greater significance in settings when the quality of natural light fluctuates dramatically, such at dawn or sunset or when using artificial illumination. Learn about the fundamentals, some of the difficulties, and the current methods for white balance that photographers employ to get the best possible color reproduction in a variety of situations.

The basic idea behind white balancing is to change the colors in a picture such that a neutral tone, which is usually white, seems really neutral. Accurate color reproduction is of the utmost importance in photography since it has a direct impact on how the spectator perceives the picture. It is quite astounding how the human eye can shift its color perception in response to changes in ambient light. But cameras don't have this natural flexibility, so you have to do something to make up for the changes in the color temperature of the light.

Kelvin is a unit of measurement for the color temperature of light; lower values indicate warmer tones (reds and yellows), while higher values indicate cooler tones (blues). Color temperatures range from 2700K (warm incandescent) to 6500K (daylight fluorescent) when lit indoors, in contrast to daylight, which is usually about 5500K. If you want to know why white balance is necessary and how to deal with problems caused by various light sources, you need to know these temperature fluctuations.

Images taken under artificial lighting, such tungsten or incandescent lights, sometimes suffer from an orange cast, which is a typical example of why white balance is important. Photographs taken with these lights will have whites that seem more yellow or orange because of the warmer tones they produce. To eliminate this color cast and make sure that white items seem white in the scene, white balancing is used. White balance is a simple fix that brings the image's colors closer to how they would seem in real life by simulating natural light.

Depending on the lighting circumstances, photographers would traditionally manually alter their cameras' white balance settings. The user may choose from a variety of predefined settings, including daylight, shade, cloudy, tungsten, fluorescent, or even create their own unique settings for different types of illumination. Even while these manual changes gave you some control, they weren't always accurate, particularly in fast-paced shooting situations where the illumination may shift suddenly. Not to mention that the manual method often demanded an expert degree of skill that amateur photographers may struggle to achieve.

Software engineers and camera makers have responded to these issues by creating automatic white balancing solutions. In order to remove any color cast, these systems use complex algorithms to assess the image's color distribution and make modifications in real-time. The goal is to make whites seem neutral under different lighting circumstances, much like the human eye. Automated methods have made photographers' lives so much easier, yet they still make mistakes sometimes and need manual tweaks in post-processing.

WHITE BALANCING AND DEHAZING

The image processing domain is home to two essential processes—white balancing and dehazing—that improve the visual quality of photographs in separate but complementary ways. An essential part of color correction, white balance is making adjustments to the image's colors so that the whites seem real white in all kinds of illumination. Conversely, dehazing is a method that improves contrast and clarity by reducing or eliminating the impact of atmospheric haze or fog in photographs. We will examine the relevance of white balance and dehazing in photography, computer vision, and other areas as we dig into its concepts, approaches, and applications.

Because of the wide range of possible lighting situations, white balance is an essential part of every picture processing workflow. Perceiving colors pretty properly is made possible by the extraordinary flexibility of the human visual system to adapt to diverse lighting settings. Unfortunately, this adaptive capacity is not inherent to cameras since they are mechanical devices. Color casts may be introduced into images due to the fact that the color temperature of the light source influences the way colors are rendered. If this is the case, white balance may help by making the colors seem more neutral and true to the lighting conditions that were present when the picture was captured.

Kelvin is a unit of measurement for the color temperature of light; lower numbers represent redder, warmer light, while higher numbers represent bluer, cooler light. Algorithms that alter the brightness of an image's red, green, and blue color channels are a common way to do white balance and neutralize color casts. Many techniques are used by automatic white balancing algorithms. One approach is gray world assumption, which involves adjusting the average color of the whole picture to neutral. More advanced algorithms, on the other hand, consider the distribution of colors and the content of the scene. When using automated

algorithms may not work, including in scenes with varying illumination, manual white balancing—where the user chooses a specific spot in the image—is a typical solution.

White balance is essential for a number of reasons, including fixing problems with color temperature and making sure that several photos have the same color palette. This is especially true in fields like digital filmmaking and panoramic photography. White balance is an important part of many industries, including photography, filmmaking, and remote sensing, since proper visual communication and interpretation rely on consistent color representation.

When atmospheric haze or fog reduces the visibility and clarity of pictures, dehazing steps in to restore those qualities. Airborne particles and droplets disperse light, creating haze that degrades picture quality by diluting colors and reducing contrast. The goal of dehazing algorithms is to restore the original scene by estimating and eliminating haze, which makes the final product more aesthetically pleasing and clear.

To get a haze-free rendition of a picture, one typical method of dehazing is to estimate the haze in the original and then remove it. A fundamental idea in dehazing is the dark channel prior, which highlights the fact that the majority of outdoor photos have a dark channel, or a channel with low intensity values, that represents areas that are not as cloudy or have less haze. Dehazing algorithms take use of this prior to remove the haze by estimating the light transmission through it. Dehazing, on the other hand, isn't easy as it has to differentiate between real haze and the depth and color differences that occur in the image organically.

Dehazing has several potential uses in many different areas, such as remote sensing, autonomous driving, computer vision, and surveillance. For computer vision algorithms like object identification, recognition, and tracking, dehazing is essential for producing more accurate and detailed pictures. In outdoor settings, particularly those with unpredictable weather, dehazing methods improve the visibility of objects, which is useful for surveillance systems. Dehazing improves autonomous driving systems' visibility and detection of people, other cars, and objects, which in turn increases the systems' safety and dependability. In order to better understand the surface characteristics and atmospheric conditions of Earth, dehazing is used in remote sensing applications, such as satellite and aerial images.

Both white balancing and dehazing aim to improve the visual quality and interpretability of photos, although they tackle different problems in image processing. When removing haze

and correcting colors are both necessary, the sequence in which they are applied may have a big influence on the outcome. As an example, because haze changes the actual colors of the scene, dehazing a picture before white balancing could result in incorrect color representation. Consequently, to get the best results in image processing, white balancing and dehazing procedures must be integrated carefully and according to the unique environment.

COLOR CORRECTION IN UNDERWATER IMAGING

Because of the specific difficulties of working under water, color correcting is an essential yet intricate part of underwater photography. Colors acquired by imaging systems are distorted in the aquatic environment due to factors such as the water's absorption qualities, ambient lighting conditions, and depth. To improve the visual quality of underwater photos and films, this investigation delves into the complexities of color correction in underwater photography, exploring the fundamental ideas, techniques, and applications that make this process possible.

Light is altered as it passes through water, creating an effect that is unique to the underwater environment. As depth increases, the colors change and become less intense because various wavelengths of light are absorbed at different rates. Underwater sceneries mostly include blue and green colors because the red and orange wavelengths are absorbed at a higher rate. Underwater photos have a more muted color palette and less vibrant colors because of this process, called selective light absorption.

In order to restore the actual colors of the underwater scene and reduce the impact of these distortions, color correction is used in underwater imaging. When dealing with problems like selective light absorption and light scattering in water, a variety of approaches and procedures are used. To augment natural light and restore the absorbed color wavelengths, one basic method is to employ artificial illumination, such underwater strobes or video lights. Photographers and filmmakers may make up for the color gamut's loss in certain spots by carefully positioning lighting and changing their color temperature.

Color correction for underwater pictures relies heavily on post-processing methods as well as artificial illumination. With the use of image editing software, you may tweak the saturation, contrast, and color balance to make the recorded colors seem more accurate. To be able to controllably and accurately correct for the precise color changes that occur under water, as well as to comprehend these shifts, is essential for good post-processing.

Another crucial part of fixing the color distortion in underwater photography is using color correcting filters. Filters like this are intended to counteract water's absorption properties by absorbing or blocking light of certain wavelengths. Red, magenta, and cyan filters are used underwater because they target distinct hue changes at different depths. For example, magenta filters work well at deeper depths when green and blue tones predominate, and red filters work well at shallower seas where red wavelengths are more strongly absorbed.

Technological progress has also enabled the creation of high-tech underwater cameras that have the ability to automatically adjust colors. In order to adjust the camera to the current lighting conditions, several of these cameras include underwater-optimized white balance options. In addition, certain high-tech systems include color correction algorithms that work in real-time; this means that the color balance is automatically adjusted as the camera goes down to various depths, eliminating underwater color distortion in a more dynamic and seamless way.

Color correction in underwater photography is important for more than just leisure photography; it's also crucial for scientific studies, marine preservation efforts, and documentary films. Underwater imaging is a powerful tool for researchers and scientists who want to learn more about marine life, coral reefs, and aquatic ecosystems. For purposes of species identification, marine environment assessment, and relevant scientific analysis, accurate color representation is crucial in these situations. Color correcting also guarantees that audiences are shown the real variety and vibrancy of undersea habitats, which is crucial in marine conservation efforts as visual documentation is used to promote conservation projects and raise awareness.

Color correcting methods are also vital for underwater videographers and documentary filmmakers to create realistic and aesthetically pleasing underwater footage. The capacity to record and transmit the vibrant array of colors that define aquatic life and habitats is crucial to the narrative potential of films shot underwater. Through the use of filters, manual tweaks, or sophisticated camera systems, color correction allows filmmakers to craft mesmerizing stories that captivate viewers and encourage a greater respect for the delicate balance of marine ecosystems.

IRRESPECTIVE OF THE LIGHTING CONDITIONS

Understanding and controlling illumination difficulties is crucial in many areas, including computer vision, photography, filmmaking, and even normal human activities, regardless of the lighting circumstances. From the quality of an image to the accuracy of face recognition algorithms, lighting—both natural and artificial—plays a significant influence in determining how we see our environment. The importance of lighting conditions in many situations is investigated here, with a focus on how they influence visual perception, picture capture, and the creation of solutions to these problems.

The quality of the lighting has a major impact on the final product of visual narrative in both photography and film. The ever-changing relationship between light and shadow is a challenge for photographers and filmmakers, whether they are trying to capture the gentle glow of a sunset, the details of a dark room, or the vividness of a brightly lighted picture. An image's or a scene in a film's mood, ambiance, and overall effect are influenced by the light's quality, direction, and color. To get the best possible exposure and emphasize certain parts of an image, professional photographers often use lighting modifiers like strobes, softboxes, and reflectors.

Photographers confront the issue of obtaining high-quality photos in low-light situations, such as at night or in interior locations with little lighting. The use of lengthy exposure periods, large apertures, and high ISO settings becomes crucial under these situations. Thanks to developments in image processing algorithms and camera sensor technology, photographers can now take stunning photos in low light. Not only has technology opened up new avenues of expression for photographers, but it has also enabled security and surveillance systems to function better in low-light settings.

Cinematographers do the same thing, navigating the complexity of lighting to show subtleties in the story and make people feel something. An essential part of visual storytelling is the strategic use of light and shadow to set the mood, highlight important details, and direct the audience's attention. Cinematographers skillfully use lighting to convey stories, whether it's the harsh glare of a desert environment or the warm light of candles in a cozy home. The development of high dynamic range (HDR) filmmaking has opened up new vistas for recording a variety of lighting situations, with details maintained in both the highlights and shadows, allowing for more realistic and aesthetically pleasing filmmaking.

In computer vision, where computers are supposed to decipher visual information, lighting plays a crucial role. One area where illumination fluctuations may have a large impact is face recognition systems, which depend on accurately capturing facial characteristics. In order to maintain constant and dependable performance, face recognition algorithms need to be able to adjust to different lighting situations. To make face recognition more reliable under different lighting conditions, the researchers and engineers developing these systems use advanced approaches including feature extraction, adaptive exposure correction, and picture normalization.

Managing illumination conditions well is crucial for the effectiveness of object detection algorithms, autonomous cars, surveillance systems, and face recognition algorithms. The difficulties already encountered by these technologies are made much worse by inclement weather, such rain or fog. The advancement of radar systems, thermal imaging capabilities, and sensors with improved low-light sensitivity allows these technologies to function flawlessly in a variety of locations, even when lighting conditions are tough.

Lighting is a constant factor in human life, impacting how we see and interact with the environment around us. Lighting has an important role in creating the mood and facilitating the use of various indoor and outdoor settings, including homes, businesses, and recreational sites. Lighting is an important part of any space's design, and architects and interior designers spend a lot of time thinking about how to best illuminate a room so that it meets the functional and aesthetic demands of its users. Energy efficiency, circadian cycles, and user well-being are some of the scientific considerations that go into the art and science of carefully balancing natural and artificial lighting in architectural design.

COMBINED APPROACH FOR UNDERWATER IMAGE ENHANCEMENT

A comprehensive strategy that incorporates many procedures and strategies to tackle the specific constraints of the aquatic environment is a combined approach to underwater picture enhancement. Light attenuation, color distortion, and lower contrast are some of the problems with underwater photography that make the results seem dull and lifeless compared to what you'd get on land. In light of these difficulties, academics and practitioners have looked into a variety of strategies, often combining several techniques to provide all-encompassing solutions for improving underwater photos. Understanding the importance of underwater

picture improvement in scientific study, marine exploration, and artistic pursuits, this talk delves into the ideas, methodologies, and applications of a combined approach.

The interplay between light and water are the root cause of the primary difficulties in underwater photography. Light experiences selective absorption and scattering as it passes through water, leading to a decrease in intensity, changes in hue, and a decrease in contrast as the depth increases. Images captured underwater will be blurry, monochromatic, and have poor contrast as a consequence of these phenomena. By combining approaches that focus on various parts of the issue, a combined approach to picture enhancement aims to overcome these obstacles.

Using state-of-the-art color correcting methods developed specifically for use underwater is an integral part of the integrated strategy. Due to the selective absorption of various wavelengths of light, underwater sceneries may need more sophisticated white balance techniques than those used on land. Due to the unique color changes caused by water, it is crucial to have individualized color correcting algorithms. These algorithms, when used with standard white balancing, allow for a more thorough color correcting method, which brings brightness and natural color balance back to underwater photographs.

When it comes to improving underwater images, the combined method relies heavily on contrast augmentation and color correction. The lack of contrast in underwater images makes it hard to make out details. The enhancement pipeline may include contrast enhancement methods like adaptive contrast stretching or histogram equalization. To compensate for light attenuation and dispersion, these techniques boost the image's intensity value variations, making previously hidden features stand out. A more comprehensive increase in the visual quality of underwater photos is achieved by the careful mix of color correction and contrast augmentation.

Applying dehazing methods is also an important part of the combined strategy. When used to underwater environments, dehazing algorithms may reduce the impact of haze caused by dissolved substances and suspended particles, much as they do when applied to air haze. Dehazing techniques improve clarity in underwater photographs by bringing out previously hidden features and decreasing the effect of haze. By combining dehazing with color correction and contrast improvement, several issues that degrade underwater picture quality may be addressed simultaneously, creating a synergistic effect.

IMAGE QUALITY METRICS

Metrics for image quality are crucial for evaluating and assessing visual material in many fields, including medical imaging, computer vision, photography, and filmmaking. To help compare algorithms, imaging systems, or compression approaches, these metrics provide quantifiable measurements to assess the accuracy, perceived quality, and integrity of pictures. Visual content assessment is a dynamic topic, and this research delves into the ideas, methodology, and applications of picture quality measures, highlighting their relevance in many domains.

The human visual system, an intricate network that processes and understands visual information, is fundamental to the process of evaluating picture quality. Metrics for image quality attempt to mimic human vision in order to provide quantitative assessments that are consistent with subjective evaluations of picture quality. A number of models and techniques have emerged in the area of picture quality evaluation in an effort to solve the problem of how to reconcile objective measurements with viewers' subjective experiences.

Metrics such as the Structural Similarity Index (SSI) and the Mean Structural Similarity Index (MSSIM) are often used to assess the level of structural similarity in images. By looking at structure, contrast, and brightness, these measures determine how close the distorted and reference pictures are to one another. The structural information is extracted from picture local patterns, and the metric output shows how similar the original and distorted images are to each other. In situations when there are global structural changes, structural similarity metrics—which are extensively used—may fail to reflect the subtleties of human perception.

In contrast, perceptual metrics use models of visual attention and sensitivity to go further into simulating human perception. The perceptual image quality assessment (PIQA) and the visual information fidelity (VIF) index are two measures that try to take human eyesight and sensitivity into consideration. Complex mathematical models that account for perceptual characteristics like as luminance masking and contrast sensitivity functions are often used to calculate these measurements. These measures aim to provide more realistic evaluations of picture quality as seen by humans by integrating perceptual elements.

Metrics like the Structural Similarity Index for Color (SSIM-C) and the Color Difference meter (ΔE) measure the variations in color appearance between reference and distorted

pictures in the color domain. These measures quantify color fidelity by considering chromatic adaptation, perceptual color discrepancies, and transformations of color spaces. When measuring the efficacy of imaging systems and color processing algorithms, these measures are indispensable in situations when color fidelity is of the utmost importance.

TECHNOLOGICAL ASPECTS OF IMPLEMENTING WHITE BALANCING AND DEHAZING

White balance and dehazing are important technical components of image processing that greatly improve the visual quality of photographs taken in various settings. Images are more faithful representations of scene colors when white balance corrects for color distortions brought on by changes in illumination. In contrast, dehazing attempts to overcome the problems caused by air haze or fog by restoring contrast and clarity to photos taken in low-light circumstances. This investigation dives into the technical aspects of applying dehazing and white balancing, illuminating its foundational ideas, methodology, and uses as picture enhancing tools.

An essential part of picture processing, white balance compensates for the differences in color temperature caused by various lighting conditions. Consistent color perception across a range of lighting situations is a result of the visual system's inherent ability to adjust to environmental changes. Color changes in photos might be the result of cameras not being able to capture this flexibility. In order to restore color accuracy and make whites seem neutral, white balancing is used.

The technical foundation of white balance algorithms is the concept of color constancy, which is the capacity to see constant colors regardless of changes in lighting. A common white-balancing technique is the Gray World assumption, which states that the overall picture should be a muted gray. The algorithm eliminates color casts caused by different light sources by modifying the image's color channels to reach this gray average.

Color temperature and tint modifications are another typical method for white balance. Kelvin is the unit of measurement for the color temperature, which indicates how hot or cold light is. For instance, incandescent light is warmer and more reddish than daylight because its color temperature is lower, but daylight's color temperature is greater, giving it a cooler, blue cast. In order to obtain a balanced color temperature, white balancing algorithms determine the scene's color temperature and make adjustments to the picture based on it.

Using computational approaches, automatic white balance (AWB) algorithms dynamically change color channels according to the predicted color temperature of the scene's light source. These algorithms can adapt to changing illumination conditions in real-time by using heuristics, statistical models, or machine learning approaches. To estimate the color temperature and execute white balancing, an AWB algorithm may, for example, look to neutral-looking areas of the picture, such highlights or specific objects.

Automatic approaches are helpful and practical in most cases, but they may not work so well in complicated settings with varying illumination or in circumstances where an object's neutrality is questionable. White balancing by hand or using pre-made color correcting profiles are options in these situations. Users may ensure proper color reproduction based on their visual judgment using manual white balancing, which enables them to designate a neutral reference point in the picture.

One recent development in white balancing technology is the use of machine learning algorithms. These algorithms can sift through massive datasets and determine the best way to modify colors. Adaptive and precise white balance solutions may be provided by convolutional neural networks (CNNs) trained on multiple scenarios, which allow them to generalize well to different lighting situations. White balance algorithms benefit from machine learning models' resilience and flexibility by being able to recognize complicated patterns in color fluctuations.

A wide range of imaging instruments, computer vision systems, and video processing all make use of white balancing technology. For tasks like object identification, recognition, and tracking in computer vision applications, precise color representation is vital. By maintaining constant color information under varying illumination situations, white balancing algorithms enhance the performance and reliability of computer vision systems.

CONCLUSION

To improve underwater images, the suggested method combines white-balancing and Rayleigh-stretching. To address the varying degrees of deterioration in the dominant and weaker channels, different histogram stretching of varying extents has been used. The Rayleigh properties are then used to refine this mapping. Research shows that the suggested technique significantly reduces noise in underwater photographs while simultaneously improving their contrast and color. Quantitative and qualitative computations reveal that the

proposed technique eliminates over- and under-exposed regions of the picture and decreases non-uniform lighting. By comparing it to other state-of-the-art methods, we find that the suggested technique significantly improves the picture details. In spite of the enhanced visual quality, there are still problems with distorted colors in the final photographs. To address these difficulties, a new method is suggested in the following chapter that uses a dual domain based approach to improve underwater images.

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