A Survey of Image Enhancement Techniques with its Applications and Problems

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Abstract— Image Enhancement is one of the predominant and problematic strategies in Image research. The intention of image enhancement is to reinforce the visible appearance of an image, or to provide a "better turn into illustration for future automated image processing. Many images like medical images, satellite image, aerial images and even real existence portraits endure from poor contrast and noise. It is necessary to enhance the contrast and dispose of the noise to expand imageo pleasant. Image Enhancement techniques which improves the first-rate (readability) of images for human viewing, casting off blurring and noise, growing distinction, and revealing important points are examples of enhancement operations. The enhancement technique differs from one discipline to yet another in keeping with its objective. The prevailing procedures of image enhancement can be classified into three classes: wavelength compensation and image dehazing (WCID), Contrast Limited Adaptive Histogram Equalization (Clahe)and blend-CLAHE. In this paper, the present an outline of image enhancement processing methods in spatial domain. Additional exceptionally, the categorise processing approaches established representative strategies of image enhancement.

Key words: Image Processing; WCID, CLAHE, MIX CLAHE; Image Enhancement

I. INTRODUCTION

Image processing is an evergreen research area where the outcomes are vast and progressive till date. It is a technique that deals with processing of a digitally obtained image and aims to improve the characteristics of it in terms of pixels, brightness, and contrast etc.. In general, images are classified into binary, Gray scale, true color, infrared that undergoes different levels of digital image processing such as Low level (noise removal, image sharpening, contrast Enhancement), Mid level (segmentation), High level (analysis based on output of segmentation) Infrared images are captured using an IR device which can be a day or night vision camera which operates by an electromagnetic spectrum with longer wavelength. The image is visualized based on the heat or infrared radiation produced by the object, just like heat produced in human body. There have been enormous studies drilled about the domains of medical research on measuring skin temperature, mass fever screening, etc.,[1] and environmental research focus on studying global warming and solar radiation, astronomy, etc., Moreover,research on tracking objects like human or animal and vehicles are the hotcakes in recent research studies To obtain a better result, an IR image should be enhanced with some techniques to kind it extra appropriate for the applications.

II. IMAGE ENHANCEMENT

Image enhancement is in actual fact bettering the interpretability or belief of expertise in portraits for human viewers and delivering `better' enter for other automated snapshot processing tactics. The principal purpose of image enhancement is to modify attributes of an image to make it extra compatible for a given undertaking and a specified observer. During this process, one or more attributes of the image are modified. The choice of attributes and the way they are modified are specific to a given task. furthermore, observer-exact factors, such as the human visible approach and the observer's expertise, will introduce a great deal of subjectivity into the choice of image enhancement methods. Enhancement may also be done in the following ways: smoothing, noise removal, edge detection and more. Basically, image Enhancement is an initial step of processing an image to improve Visual best of it by using reinforcing edges and smoothing the flat areas of an enter image. Image Enhancement can be labeled into the next approaches,

1) Spatial domain method
2) Frequency domain method
3) Hybrid Method

In spatial domain, image enhancement is achieved by manipulating each pixel values of the image, also known as point processing. Due to the evaluation of night vision cameras, Infrared image enhancement have become more challenging as it offers an image with the properties of low visibility and less contrast. The resulting image of this technique is more similar to how a human perceive the scene. In frequency domain, various techniques are applied on the Fourier transformed image to modify its brightness, contrast, distribution of gray levels and removes the impulse noise. The high frequency contents are eliminated to achieve a more.

Fig 1: Image Enhancement

III. APPLICATION

Image enhancement is used for reinforcing a best of images. The applications of image enhancement are Aerial imaging, satellite imaging, medical imaging, Digital camera utility, far remote sensing, image Enhancement methods utilized in many areas corresponding to forensics, Astrophotography, Fingerprint matching, and so forth. The easier influence for image enhancement has also used in real time enhancement of neuro evolution of augmenting. IE techniques when utilized to images and movies support the visually impaired in studying small print, making use of computer systems and tv, and face recognition. Color contrast enhancement, sharpening and brightening are just one of the systems used to make the images vivid. In the area of e-finding out,IE is used to clarify the contents of chalkboard as viewed on streamed video; it improves the content readability medical imaging utilizes this for lessening commotion and sharpening little print to toughen the visual representation of the image. This makes IE a vital supporting device for checking on anatomic ranges in MRI, ultrasound and x-rays to call only a couple.In forensics IE is used for identification, evidence gathering and surveillance. Images acquired from fingerprint detection, protection videos evaluation and crime scene investigations are better to support in identification of culprits and safety of victims.[2]

IV. NEED OF IMAGE ENHANCEMENT

- To enhance the visual perception of a handled image
- To build the abundancy and steepness of image fined etails: See what couldn't be seen with the X-rays investigation arrangement that extends capacities.
- To strengthen image exceptional in poor visibility conditions
- To support the interpretation and diagnostic imaging capabilities.
- To expand side steepness and preserve part important points at the same time enhancing distinction in image with varying illumination. Enhance the sides of an object to facilitate steerage of a robotic gripper
- For broad use and reception low computational cost; suitability for constant application[3]

V. PROBLEM FORMULATION

- Our aim is to enhance the quality of the recorded image as to how a man or women would have perceived the scene.
- To look at the particular parameters like PSNR, MSE, SD on the basis of image upgrade.
- To study the editions in enter and derived output image of precept and unbiased side components.
- image fusion on the bases of facet add-ons to examine the parameters of image.[3]

VI. IMAGE ENHANCEMENT TECHNIQUES

A. Wavelength Compensation and Dehazing

The algorithm for wavelength compensation and image dehazing combines strategies of WCID to do away with distortions because of light scattering and colour change The WCID algorithm can effectively restore image color balance and remove haze. To the most strong of our data, no existing procedures are designed for mild scattering and color change distortions suffered through underwater image simultaneously. The experimental outcome show sophisticated haze getting rid of and colour balancing capabilities of WCID over typical dehazing and histogram equalization ways. Nevertheless, the salinity and the complete quantity of suspended particles in ocean water range with time, place, and season, making accurate size of the cost of sunshine vigour loss Nrer elaborate. Blunders in the price of light vigour loss will impact the precision of thewater depth and the underwater propagation distance derived. Constant monitoring and long-term tabulation of the rate of light energy loss based on time, location, and season might provide a fair estimate of the actual value. Furthermore, a calibration procedure might be performed first by drivers before an image-capturing session by having a test image at known water depth and underwater propagation distance to fine-tune the rate of light energy loss. Additionally, the artificial lighting is assumed to be a point source emitting uniform Omni-directional light beams across all wavelength spectrums. This is distinctive from the linear or surface source of light with strong beam directionality and no uniform color characteristic commonly encountered in underwater photography. The precise estimation of the luminance distribution of the light source is also demanding. If the geographic place in taking the underwater images and the traits of the light source employed are known a priori, even better outcome in haze removing and colour balance can be reached.

Fig. 2: (a) Input image (b) Haze image

B. Contrast Limited Adaptive Histogram Equalization (Clahe)

CLAHE was once initially developed for medical imaging and has which can be positive for enhancement of low distinction images similar to for instance portal movies. The CLAHE calculation [4] segments the image into logical districts and applies the histogram balance to each one This evens out the distribution of used grey values and for this reason makes hidden prime facets of the picture more seen. The whole grey spectrum is employed to state the image. CLAHE is a superior adaptation of AHE, or Adaptive Histogram Equalization. Both overcome the limitations of standard histogram equalization. A number of adaptive contrast limited histogram equalization techniques

(CLAHE) are provided. Sharp field edges could be kept up by Selective upgrade inside the subject limits. Specific upgrade is proficient by first recognizing the subject edge in an entrance image after which just preparing those segments of the image that exist in the territory aspect.Noise could be diminished while keeping the high spatial frequency content of the image by means of the use of a form of CLAHE, median filtration and aspect sharpening. An alternative of the distinction constrained technique known as adaptive histogram clip (AHC) may also be utilized. AHC mechanically adjusts clipping level and moderates over enhancement of historical past parts of portal images. CLAHE on RGB colour mannequin: The RGB color model is undoubtedly an additive colour mannequin. Right here red, inexperienced and blue gentle are brought together in a type of methods to copy a broad kind of colours. The value of R, G, and B segments could be the measure of the separate affectability capacities and the approaching light. In RGB shading space, CLAHE is connected on the majority of the three segments exclusively and the outcome of full-combining so as to shade RGB might be acquired them.CLAHE on HSV color model: HSV is really a cylindrical-coordinate illustration of elements inside an RGB colour model. In color house it describes colors in the case of the Hue (H), Saturation (S), and value (V). Regardless of the valued at staying at both min or max depth degree, hue and saturation phases won't fluctuate. CLAHE can simply simplest be applied on V and S accessories.
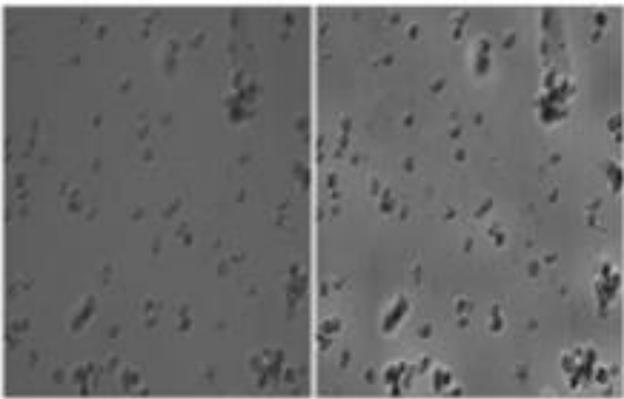

Fig. 2: (a) Original image (b)CLAHE Image

C. Mix-Clahe

When making use of a combination algorithm the major element to accumulate just right visibility of the perfect effect is represented by using the good tailored inputs and weights. Distinct of the entire current fusion approaches (nevertheless, don't require designed to cope with underwater scenes), this fusion manner approaches only a single degraded image.The general idea of image combination is that the handled result, consolidates a few information images by saving just likely the most noteworthy top components of them. For that reason, outcome received by way of a fusion-founded process fulfill the depiction expectation when each and every area of the outcome grants a compatible appearance in a number of of the enter images. Within single-situated image approach two inputs of the fusion system are founded on the first degraded image. Bettering answer doesn't search to derive the inputs on the groundwork of the physical variety of the scene, for the reason that the present units are very complicated to be

tackled. Instead, we strive for a quick and simple technique that works generally. The very first derived input is represented through the colour corrected variation of the image whilst the second motive is computed as a distinction improved variation of the submerged image in the wake of having a clamor decrease operation is performed.This strategy was tested for sure underwater videos and images obtained from different available amateur photographer collections. Consequently, images and videos have now been captured using various cameras and setups. However, an important remark is that individual's process handiest 8-bit information format although many respectable cameras have the option to shoot in the raw mode that typically stores the unprocessed data of the camera's sensor in 12-bit format. This technique is computationally strong taking roughly 2 seconds in mat lab code for a 800×600 frame but we consider that the optimized implementation could run real-time on common hardware. By way of a normal visual inspection it usually is observed this technique has the capacity to yield accurate results with enhanced global contrast, color and fine details as the temporal coherence of the videos is well preserved.

VII. LITERATURE SURVEY

Yuan Yao,et.al (2015) [5] Space object image enhancement is an most important problem in pc imaginative and prescient, which can also be a essential difficulty for area remark. As an alternative of single image enhancement ways, we introduce a approach established on intrinsic image decomposition by making use of an image sequence to solve the obstacle of space object image enhancement. Experimental results on our dataset exhibit that the enhanced image are higher than the enter sequences both in qualitative visual effects and quantitative standards,e.g. image entropy.

Manasvi Kalra,et.al (2015)[6] This paper aims to identify efficient image enhancement techniques in order to detect the preliminary effect of skin cancer. We present results using these techniques on color and grey scale images in order to develop mobile application which patients can use to send such images to a medical practitioner. The application is linked to an electronic Health Information System, whose functionality is augmented by the use of this simple and efficient mobile image enhancement application. Here, the results that showed up have been discussed below.

Yuan Hai,et.al (2015)[7] In order to solve those problems, we proposed a novel image enhancement algorithm which consists of three steps: adjusting image by contrast limited adaptive histogram equalization method, choosing the reference image and color matching. The experimental results show that the proposed algorithm produces high quality 3D images by improving image contrast, enhancing the details of the image obviously, removing the color cast and improving consistency of two stereo views. Therefore, the proposed method can obtain high quality 3D images under stressful conditions and be easily applied to stereoscopic endoscopy.

Rajlaxmi Chouhan,et.al (2014)[8] This paper presents a noise-aided image enhancement algorithm focussed on addressing images that have a large dynamic range, i.e., images with both dim and brilliant locales. The

use of another numerical model, In a moved double-well framework showing stochastic reverberation, is explored for such representations. The brand new mathematical model addresses the shortcomings of prior SRbased enhancement mannequin by means of deriving parameters simply from enter values (as a substitute of input information).

V.Janani,et.al (2014)[9] Image has to be enhanced prior to any mentioned processing. An optimal Enhancement technique should enhance both high quality and low quality images, and should highlight even small details hidden in the image. Infrared image enhancement refines the subtle elements immerged out of sight and give a commotion free image as yield. This paper was aimed to talk about and analyze about more than a few image enhancement strategies and filters which might be used to enhance the best of the given input image.

Yaqiu Sun,et.al (2013)[10] In this paper, a novel optical switch operate-founded micro image enhancement algorithm is put ahead. On this algorithm, the factor spread function used to be received according the incoherent illuminate within the optical approach to begin with. Secondly, the optical transfer function(OTF) was obtained and the high-pass filter based on optical property was constructed through the microscopic OTF. Finally, micro image would be processed by using the compensating filter. As a result, the clear and non-obvious Ringing effect micro image was gained.

VIII. COMPARISON TABLE

Authors	Techniques	Features	Limitations
Cao, Gang, Yao Zhao, Rongrong Ni, and Xuelong Li[12] (2014)	global contrast enhancement	consistency between regional artifacts is checked	Lead to degraded edges
Celik, Turgay[13] (2014)	Spatial Entropy-Based Global And Local Image Contrast Enhancement	achieves contrast improvement in the case of low-contrast images	Used k adjustment factor statically i.e. 128
Huang, S., and W. Chen[14] (2014)	hardware-oriented contrast enhancement algorithm	decrease hardware cost and improve hardware utilization for real-time performance	Used k adjustment factor statically i.e. 128
Chen, Xiaoming, and Lili Lv[15] (2013)	histogram equalization based methods (HEBM) and an multi-scales unsharp masking based methods (UMBM)	good performance in global contrast and local contrast enhancement with noise and artifact suppression	Lead to degraded edges

Kil, Tae Ho, Sang Hwa Lee, and Nam Ik Cho[16] (2013)	Channel Prior And Contrast Enhancement	enhances contrast with less color distortion	Lead to degraded edges
Madhu S. Nair. And G. Raju[17] (2013)	fuzzy logic and histogram based algorithm	well suited for contrast enhancement of low contrast color images	Used k adjustment factor statically i.e. 128
Cheng, H. D., and Yingtao Zhang (2012)	contrast enhancement	useful for dynamically monitoring the quality of the enhanced image	Imbalance the color of the output image
Jha, Rajib Kumar, Rajlaxmi Chouhan, Prabir Kumar Biswas, and Kiyoharu Aizawa. (2012)	discrete cosine transform (DCT) domain	remarkable performance in terms of relative contrast enhancement, colorfulness and visual quality of enhanced image	Imbalance the color of the output image

Table 1: Shows comparison of various Techniques[11]

IX. CONCLUSION

Customary process in image enhancement that's as a rule use is histogram equalization, as a result of this system is modest and has low computation load. In this study, we utilize contrast Limited Adaptive Histogram Equalization (CLAHE) to improve the color retinal image, The calculation for wavelength pay and image dehazing (WCID) and MIX-CLAHE. Are to cut back this noise outcomes in colour retinal image due to the acquisition procedure, we have to increase this image. Image enhancement is to procedure an image in order that influence is extra suitable than normal image for certain application image enhancement procedures provide a mess of alternatives for making improvements to the visible best of images.

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