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A Survey on the Implementation of Image Enhancement

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Abstract

Image enhancement is a common thing we use to get better results from previous imagery. This image enhancement is not only used by us, but it is implemented in many fields. Such as implementation in the military field, medical field, legal field, industry field, entertainment field and much more. The primary use of image enhancement in each field is to obtain clear information. Because this information is something that is very important in everyday life. This is also to minimize misunderstanding of the information we receive. In this paper, we will discuss surveys on the implementation of image enhancements in specific areas, such as satellite images, infrared images, medical images and images for digital entertainment along with information from the image enhancement method used.

Keywords: usability, implementation field, survey, image enhancement methods, everyday life.

INTRODUCTION

The picture is an important role in this life. Without pictures, we can not recognize anything that exists in our environment. Images are objects that can have many concepts, colors, details, even the information contained therein. Even so the picture is not completely perfect, but still, has a disability that not everyone can understand it. Like less detail, less lighting, noise in the picture, so we can not understand what the intent of the picture. Therefore, image improvement is necessary, especially at this time, the image is a very important object in the field of geographical, industry, medical, and as entertainment.

Digital image processing is a field that is generally used by experiments on a large scale. Digital image processing has many algorithms and methods for the process. Implementation of the algorithm can be done on the input image to be processed further. With this digital image processing, an image with bad information would be great if used in digital image enhancement. Through this digital image enhancement, the quality of the digital image will be better than the previous image. The basic idea of this image enhancement is to change the contrast and detail better.

This image enhancement has many methods, ranging from filtering methods, histogram methods, methods with multiple algorithms to even the incorporation of several methods to produce excellent image repairs. To use the image enhancement, we must understand what is contained in the image or the problem in terms of what underlies us to use the image repair method, whether from detail, color, lighting, and others. Because in image enhancement, not all methods will produce a good image after being processed. Sometimes we initially want to improve the image but instead aggravate the image. With this, we must estimate what image improvement method is needed.

With the current technological development of image enhancement can be done easily according to our own desires. For example, if we want to improve our pictures or photos, we can fix them with the app on your laptop or smartphone without having to fiddle with the inside of the image. Apart from that, the image repair app was originally a collection of some of the image repair methods implemented in the app. In this paper, will discuss the implementation of some image improvements for everyday life.

Basically, image improvement is the first step to image processing to improve the visual quality by strengthening the edges and smoothing the input image area. Image improvements are categorized as follows [1]:

1. Spatial Domain Method

   In this method, image improvement can be achieved by manipulating each pixel value, also called a point treatment.

2. Frequency Domain Method

   In this method, there are two frequencies that influence, namely high frequency and low frequency. To produce

smoother images can eliminate high frequencies and to produce sharper images can eliminate low frequencies. This method can also be called a High-pass filter and Low-pass filter using Fourier transform.

3. Hybrid Method

   This method is a combination method of spatial domain method and frequency domain that can enhance the infrared image by adjusting the contrast by smoothing outline. This approach uses algorithms such as the Gaussian function to improve the detail, top edge, and bottom edge to smooth the content of the image.

LITERATURE REVIEW

Satellite Image

Satellite imagery is generally used by geographic and geological fields for survey purposes and such. Improved satellite imagery is used to eliminate the rough effects or obscurity of the satellite imagery, so that satellite imagery can be seen clearly. Image enhancement is divided into two domains, the spatial domain, and the frequency domain. In the spatial domain, the increase is done by changing or modifying the pixel value of the image, while the frequency domain of image enhancement can be done by using Fourier transformation. Increases in the frequency domain and on spatial domains will result in significantly improved image improvement compared to image enhancements on a single domain only. This increase can also produce images with better detail and contrast.

Satellite images play a vital role in modern computer-aided applications like geographical information systems. Highresolution satellite images are mostly acquired with Synthetic Aperture Radar (SAR) imaging and are widely used in various research disciplines of remote sensing, ecology, oceanography, geology, and interferometery. But the efficient use of these satellite images is possible only if the captured images are of high quality with high-resolution pixels and free from external factors like noise, default of capturing devices, discrete sources of radiation etc [3].

While discussing the subparts of the main composed work which is such as, resolution and contrast of an image these two factors are always important issues in many image processing applications, such as satellite image resolution enhancement, feature extraction, video resolution enhancement. Due to interpolation of an image, the number of pixels in digital image increases and its applications are widely used in many image processing applications, such as image resolution enhancement, multiple description coding, and facial reconstruction. Many techniques have been developed to increases the resolution image enhancement by interpolation [4].

Figure 1: Example of Satellite Image [4]

Infrared Image

Based on previous research, explained that the quality of infrared camera images has poor quality. Starting from contrast, detail, and poor lighting. Therefore, image enhancement is needed to improve image quality. Improved image is a process of image processing that has the ability to change the original image to be more appropriate. In Image Improvement Technique, can be divided into two types, namely spatial domain, and frequency domain.

The use of infrared technology has been widely applied to the military and civilian fields. Implementation in military fields for example for night vision with night vision camera, target detection, for more accurate precision and so on, while in the civil field applied to many CCTV cameras for the store or house security purposes. On the contrary, the result of the infrared image has low contrast, detail, and signal-to-noise ratio (SNR), so we will be difficult to translate the information contained in the infrared image. Therefore, we before we identify the infrared image, we must further process the infrared image in order to contrast, detail, SNR, visual effects and information contained to be better than before.

As a product of the combination of infrared technology and imaging technology, the application of infrared technology is becoming more and more widely. However, limited by the performance of infrared detectors, the infrared image has low spatial resolution, poor visual effect, no obvious details and low contrast. Therefore, the contrast enhancement and detail enhancement of infrared image received widespread attention [6].

Figure 2: Example of Infrared Image [6]

Medical Image

Many factors cause the result of the X-ray image to be bad, because of the outside factor and factor in, for example for the external factor that is not enough equipment, mistake of the operator, abnormal of the patient, and others. This can cause X-ray images to have insufficient detail, low contrast and brightness and the other. So, we need to improve the X-ray image so that the quality is better than the previous image. X-ray image improvements can be performed for example by means of histogram equalization to allow for uniform illumination, changing gray levels for reduced noise, using High-pass filters to clarify details and more.

The X-ray has been widely used in the biomedical and medical fields since it was born. At present, X-ray images have become important basis in the process of medical diagnosis. Medical X-ray image contains a large amount of information, but the details are fuzzy and the contrast is low, which makes adverse effects on the doctor's judgment. Thus, improving the image contrast and enhancing the details sharpness while suppressing the noises are the key points of this kind of image enhancement [9].

X-rays can penetrate objects including the human body, meanwhile, the X-ray transmittance of different tissues or organs inside the human body are different. Thus, when the uniform intensity x-rays pass through the body, the rest of the X-ray energy reaching to the film is varied at each position, finally, the film presents an image with the changes in brightness of light and shade. Therefore, we can observe different tissues and organs, the technique is known as X-ray imaging [9].

Figure 3: Example of X-ray Image [25]

Digital Image

The purpose of digital imagery is to provide an idea of an object digitally displayed through the computer or other viewer media as the introduction of the object. High-quality digital images have information or components that can express how the shape of the object is in detail. So that we can understand or explore the object. The color image basically has three main color bands namely Red, Green, and Blue (RGB). Whereas humans have perceptions of hue, saturation, and intensity to color images. Therefore, the image is processed in such a way as to change the color of the RGB in order to be understood by human perception.

In general, media viewer and printing machine using input in the form of RGB format so that the image will be processed several times. Therefore, digital image enhancement is necessary to see the difference from everyone's perception. By using some image improvement method we can generate images with significant color change, because, the main color used is the RGB color tape. Not only color change, detail, lighting, and contrast are the main thing in image improvement process, so we need some more process to get a more optimal result.

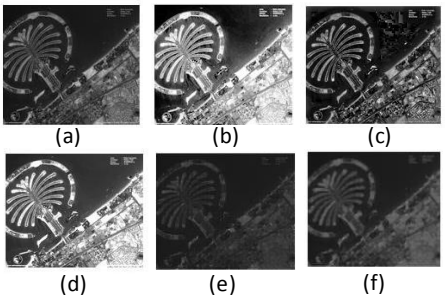
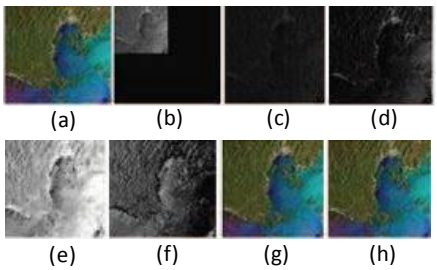
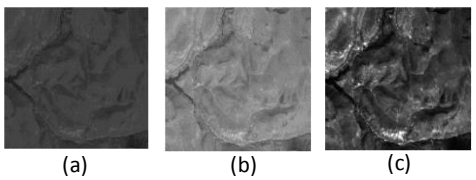
Improvement of a digital image is very influential in the field of entertainment, for example at a photo exhibition. The better the detail and the coloring it will attract more audiences to see it, as well as entertaining videos such as animation. In addition, the image with good quality is usually applied in the field of the industry by way of the use of banners, billboards, and others - so that consumers will be interested in advertising from a product. Imagine if the advert is a gray or even black-and-white image, then consumers will not be interested in the advertisement of the product.

Figure 4: Example of Digital Image [23]

REVIEW AND DISCUSSIONS

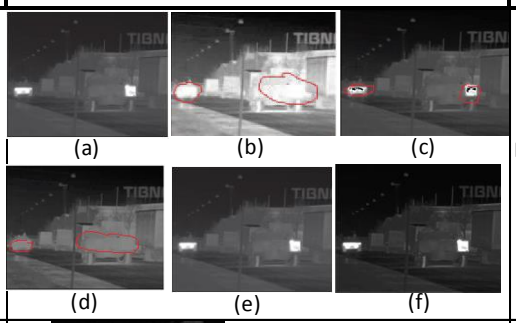
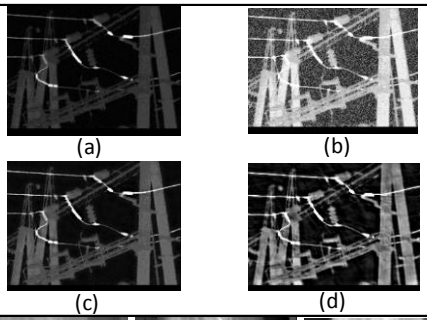
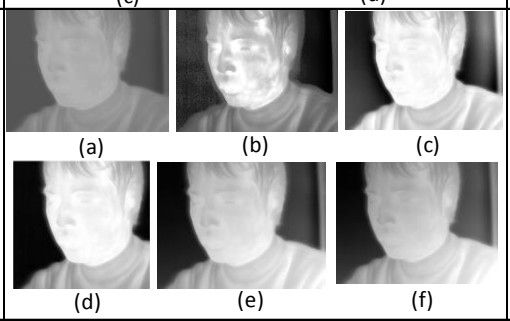
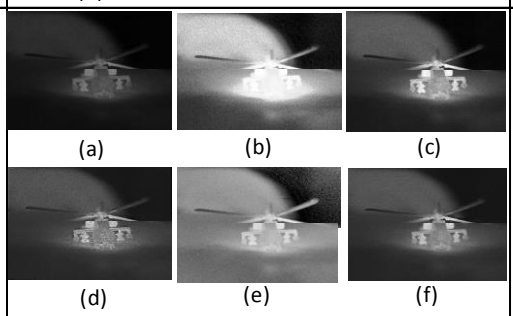
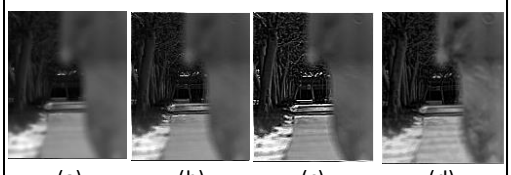
Satellite Image

Table 1: Implementation of Satelite Image Enhancement

Image Improvement Field	Author's Name	Methodology Used	Result of Image Enhancement	Information
Satellite Image	Aditi Sharma and Ajay Khunteta [4]	Singular Value Decomposition (SVD), Discrete Wavelet Transform (DWT)	 (a) (b) (c) (d) (e) (f)	(a) Input Image; (b) GHE Image; (c) LHE Image; (d) SVE Image; (e) DWT Image; (f) Proposed Method Image
	H. Singh and A. Kumar [2]	Beta Wavelet, Gamma Correction, Knee Transfer Function	 (a) (b) (c)	(a) Input Image; (b) GHE Image; (c) Beta-wavelet Image
	S. Oudaya Coumar and et.al [12]	Discrete Wavelet Transform (DWT), Prevalent Glaze Level, Image Decomposition, Adaptive Intensity Transfer Function Estimation, Contrast Enhancement, Boundary Smoothing, Priority Map Estimation, Image Fusion	 (a) (b) (c) (d) (e) (f) (g) (h)	(a) Low contrast satellite image; (b) LL, LH, HL&HH Subband of DWT; (c) Segmentation of Blocks; (d) Low radiant zone; (e) High radiant zone; (f) Medium radiant zone; (g) Comparison of Existing Method
	B. D. Jadhav and P. M. Patil [13]	Discrete Wavelet Transform (DWT), Interpolation, Interpolation Discrete Wavelet Transform (IDWT)	 (a) (b) (c)	(a) Original Image; (b) DWT; (c) IDWT
	Nitin Sharma and Om Prakash Verma [14]	Gamma Correction, Singular Value Decomposition (SVD), Discrete Wavelet Transform (DWT)	 (a) (b) (c)	(a) Low contrast satellite image; (b) Demirel's based enhanced satellite image; (c) Proposed method based enhanced satellite image

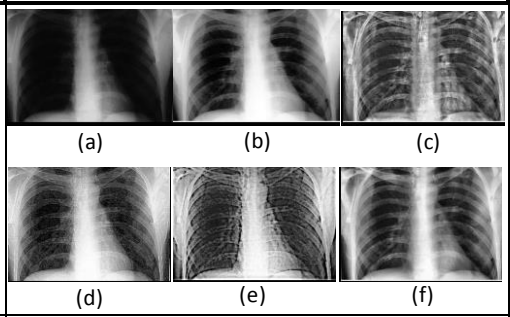
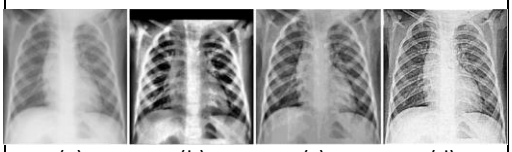
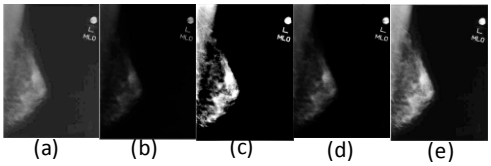
Infrared Image

Table 2: Implementation of Infrared Image Enhancement

Image Improvement Field	Author's Name	Methodology Used	Result of Image Enhancement	Information
Infrared Image	Liming Sun and et.al [6]	Bilateral Fitering, Most Value Normalizing, S-curve Transform, Gray scale compression	 (a) (b) (c) (d) (e) (f)	(a) Original infrared image; (b) Histogram equalization; (c) Fungsi Gaussian; (d) Gray level; (e) S-curve Transformation; (f) Result of Proposed Method
	Yan Zhou and et.al [15]	Curvelet Transform, Threshold Function, Nonlinear mapping function,	 (a) (b) (c) (d)	(a) Original infrared image; (b) Histogram equalization; (c) AIE-NSCT; (d) Result of Proposed Method
	Ying Li and et.al [16]	Retinex Algorithm, SSR Algorithm, MSR Algorithm	 (a) (b) (c) (d) (e) (f)	(a) Original infrared image; (b) Histogram equalization; (c) Frankle-McCann Retinex Algorithm; (d) McCann99 Retinex Algorithm; (e) SSR Algorithm; (f) MSR Algorithm
	Bichao Zhan and Yiquan Wu [17]	Wavelet Transformation,	 (a) (b) (c) (d) (e) (f)	(a) Original Image; (b) Histogram Equalization; (c) Unsharp Masking; (d) DSWT Enhancement; (e) Multiscale Retinex; (f) Proposed Method
	Zhiqiang Guan and et.al [18]	Wavelet Transformation, Morphological Filter, Gaussian Function, Image Fusion,	 (a) (b) (c) (d)	(a) Original Image; (b) Laplacian Filter; (c) Morphological Sharpening Filter; (d) Fuzzy-set and Multi-scale Wavelet

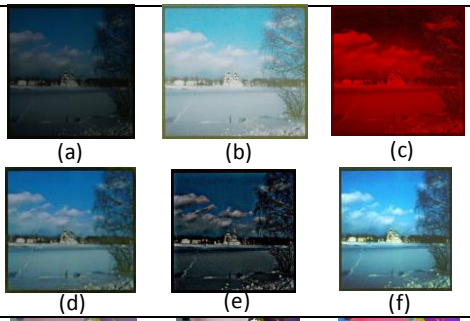
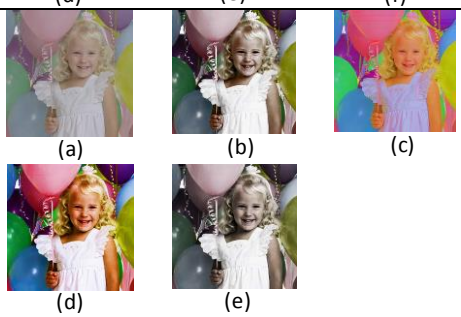
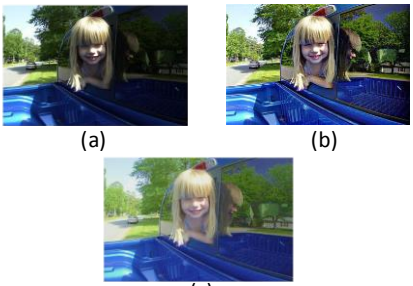
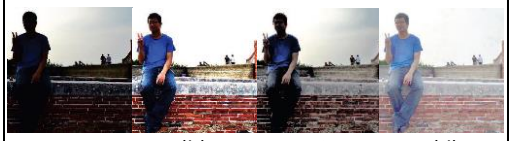
Medical Image

Table 3: Implementation of Medical Image Enhancement

Image Improvement Field	Author's Name	Methodology Used	Result of Image Enhancement	Information
Medical Image	He Wen and et.al [25]	Discrete Wavelet Transform (DWT), Homomorphic Filtering, IDWT, CLAHE	 (a) (b) (c) (d) (e) (f)	(a) Original Image; (b) Histogram Equalization; (c) CLAHE; (d) Unsharp Masking; (e) High Frequency Emphasis Filter; (f) Proposed Method
	Wang Rui and Wang Guoyu [26]	Homomorphic Filter, Total Variation	 (a) (b) (c) (d)	(a) Original Image; (b) CLAHE; (c) Multi-scale Retinex; (d) TV-Homomorphic Filter
	Liu Jing and Xiong Jie [27]	Context and Gradient Nonlinear Function, Context and Gradient Smoothing	 (a) (b) (c) (d) (e)	(a) Original Image; (b) Homomorphic Filtering; (c) Multi-scale Retinex; (d) Photoshop Histogram Equalization; (e) Proposed Method
	Ili Ayuni Mohd Ikhsan and et.al [28]	Histogram Equalization, Gamma Correction, Contrast Limited Adaptive Histogram Equalization (CLAHE)	 (a) (b) (c) (d)	(a) Original Image; (b) Histogram Equalization; (c) Gamma Correction; (d) CLAHE
	Lina Septiana and Kang-Ping Lin [29]	Histogram Equalization, Anisotropic Diffusion with Weighted K-Means Clustering	 (a) (b) (c) (d)	(a) Original Image; (b) Cropped X-ray Image; (c) Histogram Equalization; (d) Proposed Method X-ray Image

Digital Image

Table 4: Implementation of Digital Image Enhancement for Entertainment

Image Improvement Field	Author's Name	Methodology Used	Result of Image Enhancement	Information
Digital Image for Entertainment	Heungsoo Kim and et.al [19]	SSR Algorithm, MSR Algorithm, Threshold Function	 (a) (b) (c)	(a) MSR Algorithm; (b) Reference Algorithm; (c) Proposed Algorithm
	Huijie Liu and et.al [20]	MSR Algorithm, Guided Filter, Saturation Enhancement	 (a) (b) (c) (d) (e) (f)	(a) Original Image; (b) MSR Algorithm; (c) MSRCR Algorithm; (d) Hao's Algorithm; (e) He's Algorithm; (f) Proposed Alorithm
	Minako Kamiyama and Akira Taguchi [21]	Preserving Hue, Preserving Saturation, Preserving Intensity	 (a) (b) (c) (d) (e)	(a) Original Image; (b) Preserving Hue & Saturation; (c) Preserving Hue & Intensity; (d) Combination (b) and (c) ; (e) Result of [22]
	Xiong Jie and et.al [23]	Butterworth Homomorphic Filter, Multi-scale Gaussian Homomorphic Filter, Combination of Butterwoth and Multi-scale Gaussian	 (a) (b) (c)	(a) Original Image; (b) NASA Technology; (c) Proposed Algorithm
	Su-Ling Lee and Chien-Cheng Tseng [24]	Homomorphic Filtering Method, Discrete Consine Transform (DCT)	 (a) (b) (c) (d)	(a) Original Backlight Image; (b) Enhanced Color Image; (c) Histogram Equalization; (d) Multi-scale Retinex

In table 1, we can conclude with the most widely used form of improvement is the Discrete Wavelet Transform method (DWT), because basically, this DWT is Wavelets. Wavelet is a small wave which has varying frequency and limited duration. Using Discrete Wavelet Transform, it can map continuous variable functions because Discrete Wavelet Transform is based on Wavelets that can check signals on the frequency domain and on spatial domains simultaneously.

In table 2, there are many methods for improving infrared imagery, from filters, retinex algorithms, Gaussian functions and more. Each method has advantages and disadvantages. Many experiments basically use this method but they modify it from existing methods by adding a method or combining it so that it can produce improved images than ever before.

In Table 3, we know that x-ray images in the medical field are very important in diagnosing a disease. So, we need to improve the x-ray image so that the diagnosed disease can be seen clearly. This can benefit the patient, so the patient can do what the doctor ordered so that the illness healed quickly recovered. And of course, this can also reduce misunderstanding of information between doctors and patients.

In table 4, image enhancement is a common thing to do if we are not satisfied with the photo shoot. With this image enhancement, we do not need to re-take the photo until it gets the most out. From the above results, we can see that each method has advantages and disadvantages. So, we need to estimate which method can produce a good image. It does not need all the methods, just the methods we need only. Basically, the most common method is improving contrast, color level, and detail.

CONTRIBUTION

The advantage of this paper from other papers in this paper is a survey of the implementation of image enhancement quality of everyday life. In this paper, all of these image enhancement methods are grouped from areas that require enhanced images to deliver positive results to relevant users as well as to communities that need them.

CONCLUSION

From this survey, we can learn the usefulness of image improvement methods for everyday life. Starting from the field of industry, medical, legal purposes, and us as ordinary people. We can conclude that image enhancement in each field is indispensable for the smoothness of information. So that misunderstanding of information can be minimized. Especially at this time, information is very important for life. With this survey, we hope to implement improving the image for other things on daily life

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