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A Survey of image enhancement with Local Tone mapping for HDR Images

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***Abstract*:** Contrast enhancements improve the perceptibility of objects in the scene by enhancing the brightness difference between objects and their backgrounds. Contrast Enhancement is a technique of improving the quality of image so that the brightness of the image is preserved. There are number of techniques are used for enhancing contrast quality of image but contrast enhancement of HDR images is difficult to achieve. Here in this paper a survey of all the techniques for the improvement of the brightness of the image is given. Also the techniques implemented for the tone mapping is given in the paper, so that by analyzing the related work an efficient technique is proposed in the future for the image brightness or contrast enhancement.

Keywords: Tone mapping, HDR images, Exposure value, LDR, soft thresholding, hard thresholding.

I. INTRODUCTION

Image processing techniques are now becoming indispensable in applications such as entertainment, healthcare, surveillance, and security. Their use scan be found in cephalic radiography in medical imaging [1], human identification [2], indoor security surveillance [3], and crowd monitoring in outdoor environments [4]. These application paradigms encompass a wide domain of the types of features contained in the captured images and a diversity of image processing techniques are anticipated to be employed for satisfactory performances in different situations.

Contrast enhancement for gray-level images, implemented in the form of histogram transformations [5] is considered one of the fundamental processes that facilitate subsequent higher level operations such as detection and identification. Color images can be enhanced by separating the image into the chromaticity and intensity components [6]. The contrast enhancement can be performed by hardware devices [7] or software algorithms. The majority of the work for the latter category usually manipulates a histogram of pixel gray-levels in an image by some transformation functions to obtain the required contrast enhancement. Therefore, this operation also delivers the maximum information contained in the image which is the result obtained from an efficient use of the available gray-levels.

A. Contrast Enhancement:

The conventional approach to enhance the image contrast is to manipulate the gray-level of individual pixels to the required value by constructing and transforming an intensity histogram. However, the maximization of the information content carried in the image should be taken into account when constructing the histogram. In the following, benchmark images will be used as examples to illustrate the effects of employing different strategies for histogram transformation and a definition of entropy as a measure of information will also be given. Then, a continuous distribution transformation is proposed for maximizing the information content.

Figure 1. a) Normal Input Image Containing Low Contrast or brightness b) Enhanced Image

B. Tone Mapping:

Tone mapping (TM) is a method that maps high dynamic range (HDR) image to low dynamic range (LDR) image for display devices with limited dynamic range (DR). Recently TM algorithms have been developed for reproducing the tone mapped colour image, in which color, contrast, and detail components are enhanced using luminance compression and colour reproduction by considering the human visual system or the local statistical characteristic. Various TM algorithms are classify into global and local [2] algorithms in view of luminance compression. iCAM algorithm is a new image appearance model.

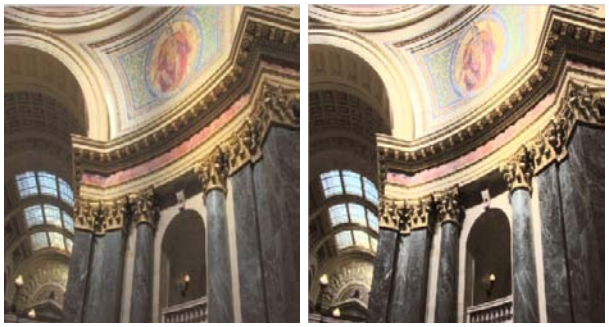

Figure 2. a) Input HDR Image b) Linear Toned Mapped Image

C. HDR Images:

HDR image, called radiance map, is generated by combining LDR images, which are captured with changeable exposure setting using auto exposure bracketing in a digital camera. Sometimes HDR camera captured HDR image, which has high and low sensitivity sensors per pixel to increase DR. Noise is enclosed in HDR images, which are captured with high international organization for standardization (ISO) setting under the low light condition such as dim interior and night scene [3]. Also the dark region of HDR image has a low signal to noise ratio (SNR). Most conventional TM algorithms do not consider noise. HDR image contains both coarse grain (low-frequency) and fine grain (high frequency) noise. Fine-grain noise is easy to decrease, whereas coarse-grain noise is relatively hard to smooth because it is difficult to distinguish between signal and noise. The bigger number of LDR images we use, the extra the noise in HDR image is reduced. Though, the number of LDR images used in HDR image generation is limited in consumer products due to the processing time. This paper, HDR image is assumed to be generated by combining three LDR images with –1, 0, and 1 exposure value (EV) using auto exposure bracketing in a digital camera.

Figure 3. Sample HDR Images

D. Bilateral Filtering:

Filtering is perhaps the most fundamental process of image processing and computer vision. In the broadest sense of the term "filtering", the value of the filtered image at a given location is a function of the values of the input image in a small region of the same location. For example, Gaussian low pass filter computes a subjective average of pixel values in the neighborhood, in which the weights decline with distance from the neighborhood center. Although proper and quantitative explanations of this weight fall-off can be given, the intuition is that images typically fluctuate slowly over space, so near pixels are likely to have similar values, and it is therefore proper to normal them together. The noise values that corrupt these nearby pixels are mutually less correlated than the signal values, so noise is averaged away while signal is preserved.

Figure 4. a) Input Image b) Bilateral Filtering

E. Subband Decomposition Using Dwt:

The DWT of images is a transform based on the tree structure with D levels that can be implemented by using an appropriate bank of filters. Essentially it is possible to follow two strategies that differ from each other basically because of the criterion used to extract strings of image samples to be elaborate by the bank of filters. The first solution, definitely not very used, in queuing consists of generating the string image lines and then executing decomposition on D levels; after this operation, we generate D strings by queue the columns from the found sub-images and decomposition for each string is applied. The resultant decomposition, in the simplify version extensive up to the third level, is shown in figure 5.

llllll	**llhlll**	**lhlll**	**hlll**
llllh	**llhlh**	**lhlh**	**hlh**
llh	**llhh**	**lhh**	**hh**

Figure 5.Non-standard 2D-DWT decomposition

The standard solution consists of alternating one decomposition by rows and another one by columns, iterating only on the low-pass sub-image.

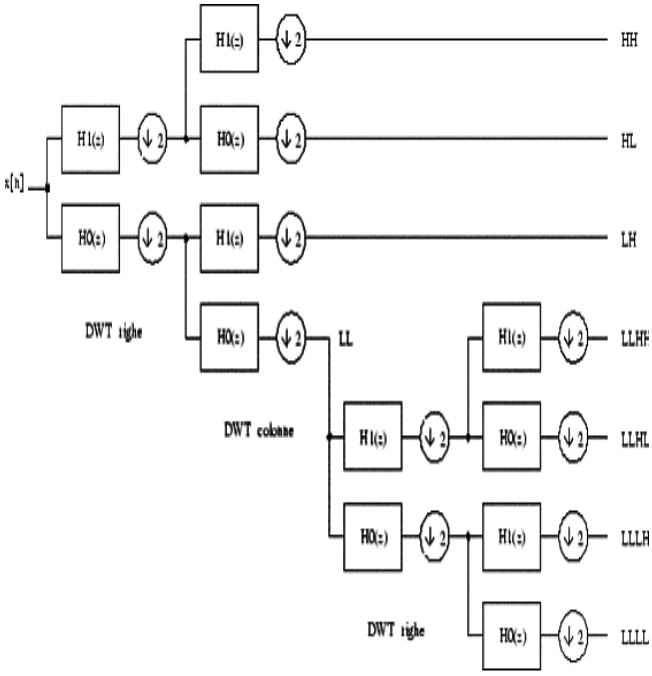

Figure 6.Bank of filters iterated for the 2D-DWT standard

The resulting decomposition is visible in the figure 7.

<table>
<tr><td>llllll</td><td>llll hl</td><td rowspan="2">ll hl</td><td rowspan="2">Hl</td></tr>
<tr><td>llllh</td><td>lllhh</td></tr>
<tr><td colspan="2">llh</td><td>llhh</td></tr>
<tr><td colspan="2">lh</td><td>Hh</td></tr>
</table>

Figure 7.Standard 2D-DWT decomposition

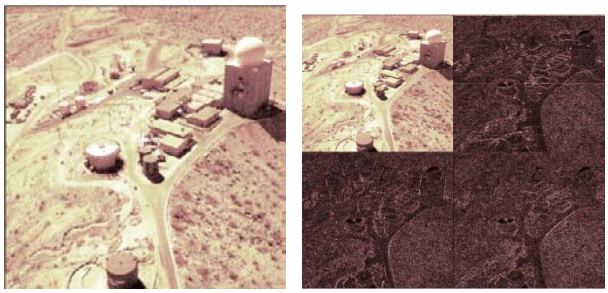

Figure 8. a) Input Image b) 2 level subband decomposition using DWT

II. RELATED WORK

In 2012 by Ji Won Lee et. al propose a noise reduction method and an adaptive distinguish enhancement for local tone mapping (TM). The proposed local TM algorithm compresses the luminance of high dynamic range (HDR) image and decomposes the compressed luminance of HDR image into multi-scale sub bands using the discrete wavelet transform. In case of noise reduction, the stale images are filtered using a bilateral filter and soft-thresholding then, the active ranges of the clean sub bands are enhanced by considering local contrast using the modified luminance compression function. At the color tone-mapped image is reproduced using an adaptive saturation control parameter and generate the tone-mapped image using the projected local TM. Computer imitation by noisy HDR images shows the effectiveness of the proposed local TM algorithm in terms of visual quality as well as the local distinguishes. It can be used in various displays with noise reduction and contrast enhancement**1**. The tone-mapped image of the planned local TM algorithm gives better image quality than those of the conventional TM algorithms. That is, the proposed local TM algorithm effectively reduces coarse-grain noise and enhances the local contrast [8].

In these case author using different types of techniques they are:

A. Subband Decomposition:

In the local TM algorithm, the luminance of the HDR image is compressed using a simple luminance compression function, a logarithmic function. And then, decompose the initial compressed luminance using the discrete Haar wavelet transform, which is applied separately in the *x* and *y* directions and is iterated upto level *K*. The Haar wavelet consists of a low-pass filter [1 1] and a high pass filter [1 – 1], which are the simplest filters to implement. The filter outputs are sub sampled by a factor of two in each direction

B. Denoising Using A Bilateral Filter And Soft Threshold:

In the local TM algorithm, the decomposed subbands are filtered using a denoising filter, which consists of bilateral filtering and soft-threshold. The *LL* subband (low-frequency subband) is filtered using the bilateral filter, whereas *LH*, *HL*, and *HH* subbands (high-frequency subbands) are smoothed using soft threshold for effective noise reduction.

C. Color Reproduction:

In order to assign the color of the tone-mapped image, we use an adaptive color saturation control factor. In the over-exposed region such as reflect area, bright sky, street lights, and outside of the window in a sunny day, the color saturation control factor *s* is set to a small value to reproduce natural color. In the under-exposed area such as shaded area and inside of the building, the color and detail are rendered well in the tone-mapped image with a large color saturation control parameter *s*. The color saturation control parameter *s* is limited to a fixed maximum value smax.

By ZeevFarbmanet. al present a new way to construct edge-preserving multi-scale image decompositions and show that current base detail decomposition procedures, based on the joint filter, are limited in their ability to excerpt detail at random scales. As a replacement for, sponsor the use of a different edge-preserving smoothing machinist, based on the weighted least squares optimization creation, which is mainly well appropriate for progressive coarsening of images and for multi-scale feature extraction. After describing this operator, then show how to use it to construct edge-preserving multi-scale decompositions, and compare it to the mutual filter, as well as to other schemes. Finally show the usefulness of edge preserving decompositions in the context of HDR and LDR mapping of tone, enhancement detail, and other applications. Which may be viewed as raising the local contrast of the finest scale information, as well as to change the global distinguish [9].

In 2004 by Shenghe Sun et.al give a completely unique algorithmic program supported Super-Resolution Image Reconstruction (SRIR) and have a tendency to use pattern recognition methodology to optimize the performance of digital watermarking. First, the binary watermarking is scanned to one dimension sequence before embedding, at an equivalent time ,we selected a mixed error-correcting code—(3,1,2)convolution code and (3,1) repetition code to encrypt the first watermarking, and therefore the sequence is inputted into the (3,1,2) convolution encoder and (3,1) repetition encoder frame by frame. results show that our image watermarking theme with SRIR is best than the standard one that is while not SRIR, not solely invisible, however additionally sturdy against numerous common signal process (such as salt and pepper noise, JPEG compression, median filtering and Gaussian low-pass filtering) [10].

In 2010 by Haiyan Zhao offers the thought regarding article combines with human visual feature to check digital watermarking technique, utilizes watermarking redundant technique to insert watermarking, extracts watermarking in line with the harm state of affairs of watermarking, and combines with visual redundancy feature to attain a image scrambling algorithmic program that's simple to recover and a recovery theme for broken scrambling image. Abstract-HVS theory plays necessary role within the application of digital image watermarking technique. Once inserting watermarking, the visual masking feature of HVS can betotallywont to style digital watermarking algorithmic program with smart perceived performance. Once extracting watermarking from the broken image, human's visual feature can be combined to recover the broken image thus on acquire higher result. This rule might be applied in digital

image watermarking rule to strengthen the hardiness of watermarking rule [11].

In 2011 by Keqiang Ren and Huihuan Li given an oversized capability digital audio watermarking algorithmic program victimization twenty four bit true colour image as watermarking, compared with algorithms victimization pseudorandom sequence, binary image or grey image as watermarking, the watermarking info capability was accrued considerably. The watermarking info was embedded into the moving ridge low frequency elements; the embedding strength was dynamically determined by the values of low frequency coefficients and might effectively resist the common attacks like resembling, low-pass filtering, median filtering, noise officious, denoising, and lossy compression, and so on. The algorithmic program has provided one quite answer for the big capability digital often ness watermarking algorithmic program [12].

III. CONCLUSION

Here in this paper a survey of contrast enhancement of HDR images using different techniques is given. The paper also includes some of the methodology adopted for the enhancement of images specially HDR images. The basic idea of enhancement of HDR is difficult to achieve, since HDR images contains pixels of very high intensity and decomposition of HDR is difficult. Hence these HDR images should be converted to Low Dynamic Range images so that the enhancement can be done using any technique.

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