Modified Panel Splitting Naturalness Preservation For Non-Uniform Illumination Images

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Abstract—Image enhancement is an important tool for processing image. There exits many enhancement algorithms, in which Retinex algorithm enhance details of an image and is widely used. Retinex algorithm can remove illumination but cannot maintain the range of reflectance, hence it is not essential for non-uniform illumination images. So to preserve naturalness along with enhancing the details we propose an algorithm named naturalness preserved enhancement panel splitting algorithm. This paper mainly contributes three main issues. First, splitting a non-uniform illumination image into three coloured panels. Secondly, decomposing each and every image in the panel for brightness. Third, applying a bilog transformation to have a balance between the details and naturalness of an image. Experimental results for the proposed algorithm gives more enhanced naturalness preserved image.

Keywords—FFT-transformation, NTSC, Restoration factor, Bi-log transformation, synthesis, MSR.

I. INTRODUCTION

The main objective of enhancing an image is to process an image so that the resulting output is more apt for the specific application. There exists many algorithms for enhancing an image such as Retinex algorithm, the unsharped masking algorithm, histogram equalization (HE) algorithm. Many of these algorithms concentrate on details enhancing, but the naturality cannot be preserved, so that there is a light source confusion, and in some other cases there is an attempt of over enhancement.

Retinex theory assume that the colour sensations is having a strong correlation with reflectance. Most of the Retinex algorithms extract the reflectance and remove the illumination as a result image. But it is not possible to exactly remove the illumination for unsmooth depth of an image. And the reflectance should be with in 0 and 1.

The algorithms based on unsharped masking decompose an image into two terms which are high frequency and low frequency components. In these algorithms it is useful to restrain over enhancement by taking low frequency information into account.

However these unsharped masking algorithms integrate the high and low frequency information in which there is no balance between details and naturalness of an image. These algorithms need a rescaling process which is performed carefully for an image to get the good result.

HE algorithm result in over enhancement, and many algorithms with many restrictions for brightness preservation and contrast limitation have been proposed. But brightness preservation leads to get a disadvantage in detail enhancement in dark areas.

Naturalness preserved image enhancement for non-uniform illumination images result in more enhanced image but it cannot be implemented in videos and for images it cant consider high resolution with maximum size.

Panel splitting image enhancement for preservation of naturalness has been applied to varied areas of science and engineering, such as atmospheric sciences, astrophotography, biomedicine, computer vision, biometrics etc. The image Enhancement tries to improve the visibility of one component of an image, but this is usually at the expense of the rest of the image whose visibility decreases. For many applications (including this visual tagging project) that look for image enhancement this is not really a problem. Most techniques fall under the spatial domain of image processing.

![Fig. 1. The relationship between naturalness and details.](image-url)
The goals of image enhancement can be differently stated depending on the particular application. For natural color image, very often, human visual system gives the final evaluation of the processed image. There are two major problems should be solved for natural color image enhancement: 1) for more detailed texture, and 2) color and brightness of the processed splitted images are perceptually better.

II. OBSERVATION

In this section, we present the observation mainly on the details enhancement and naturalness preservation.

In Retinex based algorithms an image is decompose into illumination and reflectance. illumination represents naturalness and reflectance represent details of an image, but the resolution of an image is limited so there should be a balance between details of different images.

Fig.2 represents an image processed by generalized unsharp masking(GUM) and single scale Retinex(SSR) where SSR simply removes the illumination without considering reflectance range into account. The effect of illumination of ID signal is as shown in the fig 3. In naturalness preserved enhancement algorithm the image is decomposed and then applied a bilog transformation as shown in fig:4, but the basic disadvantage is during processing there is a missing of pixel details.

As shown in figure 5 an image can be decomposed into different frequency domains. For example, the FFT transform, the curvelet based algorithms etc., then these zero frequency term is shifted to center of the spectrum which means after applying FFT transform the adjacent pixel of each coloured image in each panel is substituted in an zero matrix having size same as the coloured image. For this image then apply bi-log transformation and then add an restoration factor then synthesis this image to get an enhanced image as a result for an non-uniform illuminated image which is taken as input.

![Fig. IV flowchart for naturalness preserved enhancement algorithm](image-url)
Therefore in the proposed algorithm it aims to maintain the image clarity with better resolution than the naturalness preserved enhancement algorithm taking bi-log transformation into account.

In this section, we present the details of panel splitted proposed algorithm which explains mainly three parts as shown in Fig. V. firstly, the original image is decomposed by means of FFT transform. secondly, the decomposed images is processed using bilog-transformation. finally, for that image restoration factor is applied and then enhanced image is obtained by synthesizing it.

### A. Definition of FFT transform

Firstly, the original images are saved in database such that, the image is read by means of specific variables which is converted into unsigned integer and then it is again converted into double datatype and then the original image is splitted into panels which are red, green and blue respectively. for each and every panel an FFT transform is applied for which the values in spatial domain is converted into frequency domain.

\[
\text{r}_\text{ftt}1 = \text{transform(r)};
\]

Where \( r_{ftt1} \) represents FFT transform of a red panel and similarly for green and blue panels.

Generally, after applying an FFT transform for each and every panel an empty zero matrix of same size as original image is created and then the adjacent pixels of each panel is taken and replaced in zero matrix in same position as on original image. similarly, for each panel it is necessary to replace and then apply an inverse transform to get illumination free image as a result.

Here \( (n,m) \) represents row and column of a pixel.

\[
\begin{align*}
    a1 &= r_{ftt1}(1,1); \\
    a2 &= r_{ftt1}(1,m); \\
    a3 &= r_{ftt1}(n,1); \\
    a4 &= r_{ftt1}(n,m);
\end{align*}
\]

\[
\begin{align*}
    &\% \text{ Shift zero frequency component to center of spectrum} \\
    r_{ftt1} &= \text{zeros(n,m)}; \\
    r_{ftt1}(1,1) &= a1; \\
    r_{ftt1}(1,m) &= a2; \\
    r_{ftt1}(n,1) &= a3; \\
    r_{ftt1}(n,m) &= a4;
\end{align*}
\]

\[
\begin{align*}
    \text{r}_\text{fft} &= \text{r}_\text{fft1};
\end{align*}
\]

III. THE PROPOSED ALGORITHM

Image quality assessment is related to human vision and therefore there is no prefect image enhancement exists for preserving naturalness.
B. Bilog-transformation

In bilog-transformation after applying an inverse transformation to an image after doing FFT transform then logarithm is applied to inverse transformed image then difference of both the logarithmic of inverse image and original red panel image values is calculated to get the bilog-transformation of an original image which preserves the lightness and enhances the details and preserves the naturalness of an image respectively.
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REFERENCES

D. Synthesis of an image
As mentioned the sudden change in illumination is a disadvantage for details, but preserving naturalness it is necessary. We synthesize r(m,n)*G to get the final enhanced image.

MSRCR1(:,1)=mat2gray(0.6543*(cired.*((R(:,1))))+bvalue);

Where MSR represents multiscale Retinex and G represents gamma value and bvalue represents beta value respectively.

IV. EXPERIMENTS AND DISCUSSION
The propose algorithm has been tested on our database of more than 200 images, and compared with many algorithms. The database consists of: 100 images captured using the digital camera, and 150 images downloaded from NASA and Google. All the images taken are having more illumination.

V. CONCLUSION
This paper proposes an algorithm of panel splitting naturalness preserved enhancement algorithm for non-uniform illumination images, which enhances both details and preserves naturalness. Experimental results demonstrate the images enhanced by the proposed algorithm is perceptually better when compared to remaining algorithms. This algorithm can also be implemented in flickering videos in which we cannot take any type of videos respectively. This will be our future work.

