

## Review of Various Image Enhancement Techniques''

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### Abstract

Image enhancement is a technique which involves, applying certain changes or modification to some input image so as to make it more pleasing (visually), a satisfying image or which is clearer to the human eye. Image enhancement helps us in quality improvement of the image so that resulting image is more satisfactory than the original. This paper presents a review on the spatial domain techniques used for improving the quality of the desired image. Various algorithms have been applied on the original images to make the alterations that are desired. This paper puts analysis on image enhancement through intensity transformations like image negative, gamma transformation and logarithmic transformation, which have their own application areas. We have found out that image negativity causes least distortion. It's also been found out that in image negativity, intensity of pixel increases as the intensity level increases, whereas in case of gamma and logarithmic transformations, as the value of  $v$  and  $c$  increases respectively, brightness of image increases.

**Keywords:** Image enhancement, spatial domain technique, logarithmic transformations.

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### I. INTRODUCTION

Processing of an image is a wide subject that consists of the various alterations. Some of them may be very complex. But general purpose of the digital image processing is very easy and uncomplicated. The final intention of altering an image is to take the data hidden in the image, so that the system understands, identifies and explains the information, processed from the pattern of image. The main purpose in enhancement is to search out the hidden details contained in an image and to improve the image contrast [1]. It is very simple and most interesting areas of digital image processing. It is widely used in computer graphics. It is subarea of image processing. One or more characteristics of an image are modified in the image enhancement process. The attributes can be selected and can be modified according to the specific or the required task. For image enhancement we have two types of methods-spatial domain methods and frequency domain methods. In this paper we have put a special analysis on spatial domain methods.

#### A. Frequency Domain Methods

Frequency domain techniques [2] make changes to the orthogonal transform of the image rather than that of the image. In frequency domain techniques, the enhancement of the image is done according to the frequency content in the image. In image enhancement using frequency domain methods, the basic principle is to compute a single transform of an image and then to operate the transform coefficients, and then to perform the inverse transform at the end. The orthogonal transform of the image consists of the magnitude and phase components. The magnitude deals with the frequency content of the image, whereas the phase component deals with restoring back the image to the spatial domain. Operation on the content of frequency of the image is possible using the transform domain, and also

the content such as edges and other delicate information can be easily enhanced. Frequency domain method generally operates on the Fourier transformation of the image itself.

#### B. Spatial Domain Methods

Spatial domain can be explained as a plane containing the pixel values of an image. Spatial domain image enhancement techniques are generally based on the gray level mappings, where the type of mapping we use depends on the criteria we chose for the enhancement. This technique works by the operation on the pixels of an image, as compared to the frequency domain where the operation is carried out on the Fourier transform of an image, instead on the image itself. In spatial domain techniques [3], we generally deal with the pixels of an image. The values of the pixels are controlled to get the enhancement which is required. Image enhancement can be applied in wide number of fields where the images are needed to be viewed in a certain desired way or according to the need of the viewer.

The processes that occur in spatial domain can be denoted as:

$$g(x, y) = T[f(x, y)] \quad (1)$$

Here,  $f(x, y)$  is the input image,  $g(x, y)$  is the output image and  $T$  is an operator on  $f$  defined over a neighbourhood of point  $(x, y)$ . The operations can be applied to a single image or to a number of images, or according to our requirements.

#### C. Intensity Transformation Techniques

All the image processing techniques discussed under the intensity transformation techniques are implemented in spatial domain method which is simply the plane

containing the pixels of the image. The Spatial domain method operates directly on the pixels of the image.

**D. Image negative**

In this technique [1] the inversion of the gray level value of the pixels is done so as to get the negative of the image. Negative transformation can be found by using the following expression:

$$S=L-1-R \tag{2}$$

Here, S is the value of gray level after transformation, R is the value of gray level before transformation and L is the intensity levels. If an 8 bit image with size P\*Q is considered, then pixel value from the original image is subtracted from 255 i.e. S=255-R. This technique gives the advantage to the photographers, that they can enjoy the ease of shooting, using the digital camera and digitally edit the image while working with the traditional processes of photography. A negative image is a total inversion, in which the bright areas appear to be darker and the dark areas become bright or else we can also say vice versa.

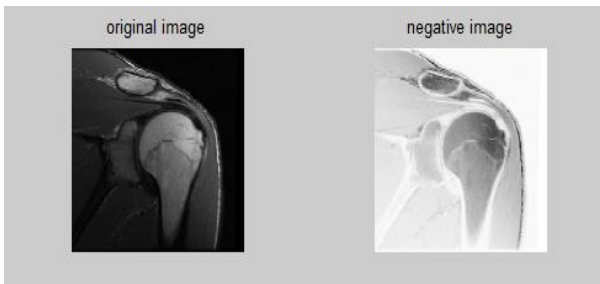


Figure 1 .Original image and the negative image



Figure 2 .Original image and its negative image

**E. Gamma transformation**

Gamma transformation is another available technique which can be used to enhance an original image as per the requirement. It is of the form basically:

$$S=c*r ^ v \tag{3}$$

Where, c and v are positive constants here, we keep on changing value of v. As the value of v increases, white part becomes dark and dark part becomes white. The generation of the curves with values v>1 are exactly opposite to curves generated with that of v<1 [5].

For example: with v=2 .We get the following result;

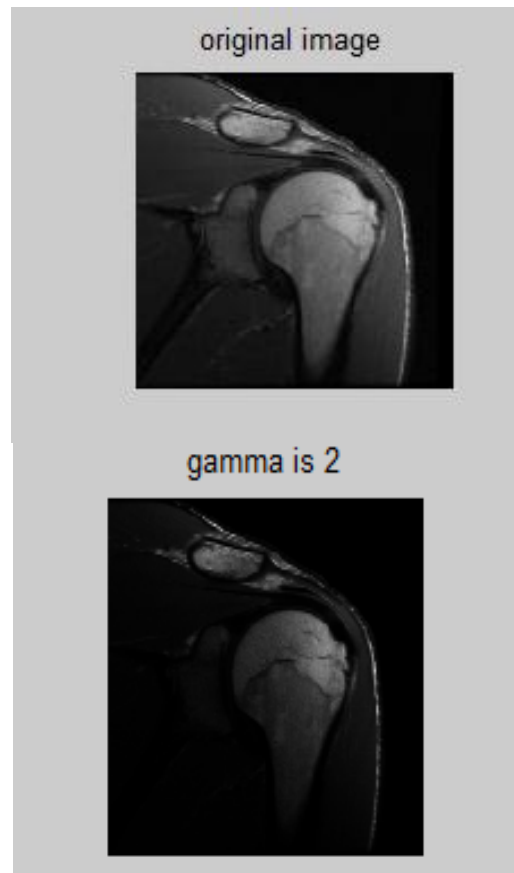


Figure 3.Gamma algorithm applied to original image

**F. Logarithmic transformation**

This technique [5] is basically used to enhance the brightness of the image. The general formula for this technique is:

$$S=c* \log (1+r) \tag{4}$$

Here, c is equal to constant and the value r>=0 is being supposed. One of the most important characteristic of the log function or the log transformation is that it compresses the dynamic range of images with variations in pixel values that are very large. Low input grey values with a narrow range can be mapped into the output values with wider range by using Logarithmic transformation techniques.

Here, by taking value of  $c=1$  and  $c=2$ , we have found the results as shown in figure 6.

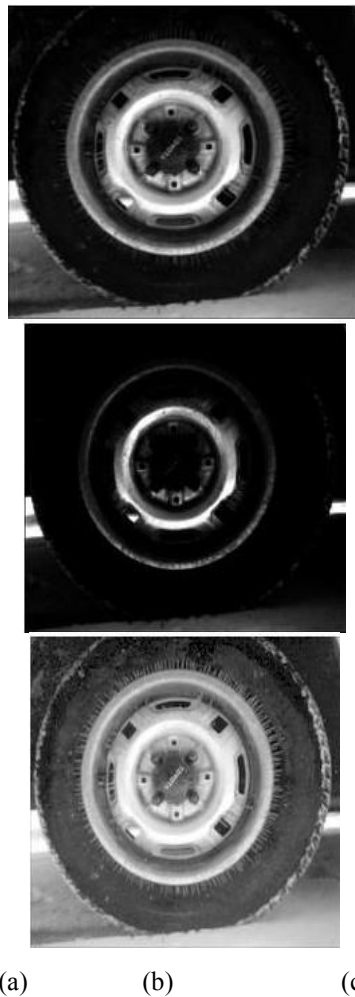


Figure 4. (a) Original image (b) Gamma= 3 (c) Gamma = 4



(a) Original (b)  $c=1$  (c)  $c=2$   
Figure 6: Logarithmic transformation of original image



Figure 5

## II. RESULTS AND DISCUSSIONS

Various image enhancement algorithms are available for the improvement of the quality of the original image so as to increase its visual clarity. In this paper we have applied three methods or algorithms for making the original image more visually acceptable which are image negatives, logarithmic transformations and gamma transformation. These 3 algorithms were used for the image enhancement, where the experiments were performed on about 25 images thereby changing the values of the algorithms (for example  $c=1, 2$  and  $3$ ). The image processing was carried out using MATLAB software. A few resulting enhanced images produced after applying the various enhancement techniques are shown in this paper. Two images after applying image negative algorithms are shown in figure (1) and figure (2). Negative images of two original images are shown which show that dark part of the picture becomes white. In gamma transformation again, the value of gamma is changed for enhancing the image intensity. The original image is being enhanced by taking the value of gamma is equal to 2, as shown in figure (3). Value of gamma is taken as 3 and 4 as shown in figure (4). Similarly under the logarithmic transformation, two images have been enhanced by changing the values of  $c$ , which is shown in figure (6). Here images are enhanced by taking the value of

$c=2$  and  $c=3$ . So we can transform the intensity of the images using these 3 methods.

### III. CONCLUSIONS

Image enhancement algorithm provides us with the wide range of applications to modify the images so as to get clearer and visually satisfying images. We choose such techniques according to the specific task we have to perform, content of image and viewing modes. It is important component of Digital Image Processing. Image negative is used to optimize the white detail which is hidden in the dark regions and is used in medical applications. Logarithmic Transformations are useful for enhancing details in darker region of the image at expense of detail in the brighter regions. These techniques can be used in real world applications also. The future scope is to develop the techniques using neural networks and fuzzy logic.

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