# A REVIEW OF ENHANCEMENT TECHNIQUES ON MEDICAL IMAGES

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**Abstract**

**Image enhancement is the process of dealing out with an image to make the resulting image more appropriate with respect to the original image for some certain application. For making better, the observable appearance of images in the digital image enhancing techniques, it provides number of choices. Relevant options of such techniques are highly determined by imaging method, task on hand and visualizing conditions. The paper will be providing an outline of below approaches, generally used for image enhancement. This paper is given on the spatial domain methods for medical image enhancement, with appropriate implication to the point processing techniques and also the histogram processing. The results conferred in the paper determine that the use of spatial domain techniques on the dark medical images will be producing a good quality image, which makes relevant for pre-processing the medical image applications.**

**Keywords: Medical image enhancement, contrast stretching, Power law transformation, Histogram equalization.**

## I.INTRODUCTION

Image enhancement process resides a number of techniques which are used to develop the visual presentation of an image. Image enhancement is one of the method by which the pictorial quality and the overview of an image are ameliorated so as to extract the spatial features within an image. The first purpose of the image enhancement technique is to alter the traits of an image and to produce it so that it is further appropriate for a particular given job and viewer. This method provides better performance as it directly depends on image pixels. One or many attributes of an image are altered meanwhile in this process. The choosing of the features and the manner they are been altered are particular to a specific task. Moreover, for a greater agreement of the prejudice into the choosing of the image enhancement methods we have the viewer-distinguishing factors, like the human visual structure and the viewer's opinion will contribute. We have many methods that will be enhancing a digital image outside spoiling it. Low contrast images are generally due to photographs taken using cellular phones and smart phones. So, to improve the contrast we need to enhance such type of images.

Removal of noise from the image determines the standard enhancement operation. To simplify the vision it is used to pre-process the step in multiple computer visual applications. To develop the interpretability and the viewing information containing in image meant for human viewers is the main function of image enhancement. It brings about a restored image which inherently looks superior to the original input image by the change in pixels and intensity level of the original input image. Image enhancement, being the utmost significant technique in digital image processing, shows significant character in many areas, such as medical image processing, remote sensing application, speech detection, high definition television (HDTV), X-ray imaging, microscopic image processing and many other image or video processing applications. Most of these techniques require inter mutual steps to obtain satisfactory outputs, and that is why these are not acceptable for everyday applications.

Digital image processing is very important in health care because of the increase use of digital imaging schemes in medical diagnostics. In accession to basically digital applications, such as Computed Tomography (CT) or Magnetic Resonance Imaging (MRI), initially equivalent imaging methods such as endoscopy and radiography are outfitted with the digital sensors. Discrete illumination or contrast values are given as the digital images are collection of many single pixels. By the means of some particular communication linking networks and some of the protocols at the same time they can be competently treated, accurately intended. For detecting and examining functions of human body portion enhancement of Bio-medical images is of great importance. By improving the visual effects of an image, enhancement of such images is a significant technique which theatres a vigorous role in the image processing. Boosting the definite traits of the image by decreasing the noise, fine-tuning the image contrast and rising the brightness level for analysis is the main purpose of this technique.

## II.POINT PROCESSING OPERATIONS

The modest spatial domain processes occur when the neighborhood is pixel only and In this example, *T* is referred by way of point processing operation given as:

$$s=T(r) \qquad (1)$$

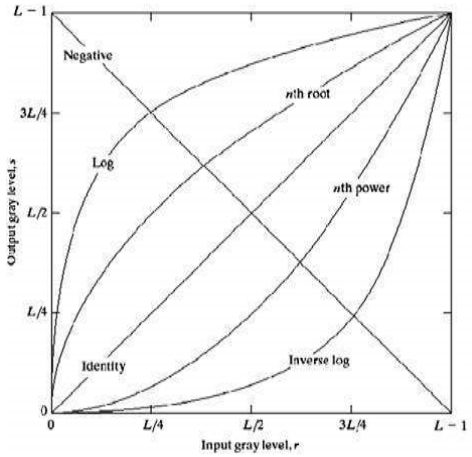



Figure 1.Shows basic grey level transformations.

### A. *Negative Image*

The basic primitive process of this technique is to calculate the negative of an image [1]. To calculate the negativity of an image the pixel intensity standards are inverted. For sample, if an image is of dimensions R x C, where R belongs to the count of rows and C will represent the count of columns, and then it is denoted using I(r, c). The negative given as N(r, c) of the image given as I(r, c) can be figured as in equation [2]:

$$N(r, c) = 255 – I(r, c), \qquad (2)$$

Where, $0 \le r \le R$ and $0 \le c \le C$. Here, from the value 255 each pixel value is deducted from the original input image. Then we develop restored image negative. Meant for enhancing the white or grey details confined in the dusky areas of the image the negative images are useful.

**Original Image** **Negative Image**

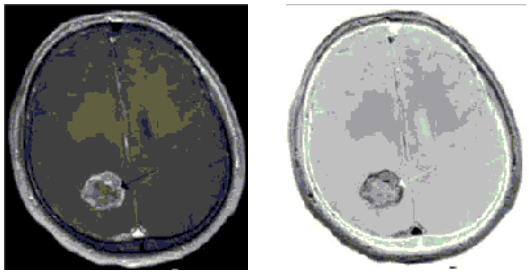


Figure 2. Negative of Brain tumor image**.**

### B. *Contrast stretching*

Insufficient illumination, such as the wrong setting of the lens aperture during an image acquisition phase or absence of dynamic series in the image sensor cause minimal contrast images. Contrast stretching [3] is a procedure that enlarges the series of grey points in the image and therefore it extents the full grey level series of the presentation device or recording medium. The notion behind this is to upsurge the contrast of the images by creating the dark sections darker and the bright sections brighter. Equation [3] and figure [3] shows the transformation purpose used to attain contrast stretching technique in an image.

$$s = \begin{cases} l * r & 0 \le r < a \\ m * (r - a) + v & a \le r < b \\ n * (r - b) + w & b \le r < L - 1 \end{cases} \qquad (3)$$

Where I, m and n represents the slopes. As it is obvious from the chart of figure [3]. In equation [3] above, the dark gray levels are made darker by allocating a slope of less than one (between (0, 0) and ( $r_1$ $s_1$ ) and between ( $r_2$ $s_2$ ) and (L-l, L-l)) and create the bright intensity stages more brighter by allocating a slope larger than one

(between ( $r_1$ $s_1$ ) and ($r_2$ $s_2$)) i.e., the slopes 'l'and 'n' are fewer than one while 'm' is larger than one. The contrast stretching [10] transformation will upsurge the dynamic range of the improved image.

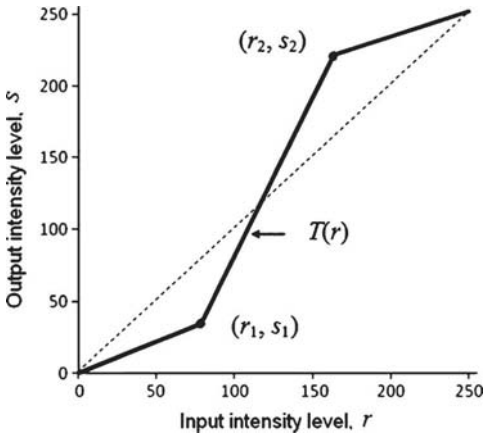



Figure 3. Graph of Contrast Stretching

**Original Image** **Enhanced Image**

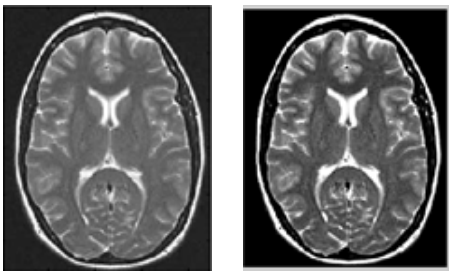


Figure 4. Enhancement of Brain tumor image after
Contrast stretching.

Liable on the input original image and depending on the application intended for which it is to be used, different slopes can be applied. No set of slope values that would yield the pleased output, meanwhile we identify that the image enhancement is an idiosyncratic processing technique. The rise in the dynamic series of the reformed image is performed by the contrast stretching transformation. From the given graph as in figure [3] we can realize that the area of the points ( $r_1$ $s_1$ ) and ( $r_2$ $s_2$ ) manages the outline of the transformation function. If ( $r_1 = s_1$ ) and ( $r_2 = s_2$ ) , the transformation is a straight function and there is no changes in the grey levels.

*C. Thresholding*

If ( $r_1 = r_2$ ) , $s_1 = 0$ and $s_2 = L - 1$ , as discussed above, the transformation develops a threshold function. The threshold function produces a dualistic image as revealed in below figure [5]. Generally, the equation for the threshold image is given as:

$$s = \begin{cases} 0 & r \le a \\ L-1 & r > a \end{cases} \quad (4)$$

Thresholding function [2] diagram and output image is as shown below in figure [5] respectively. The result will always be using only two colors, black that is pixel value 0 and white that will be pixel value 255 for a thresholding image.

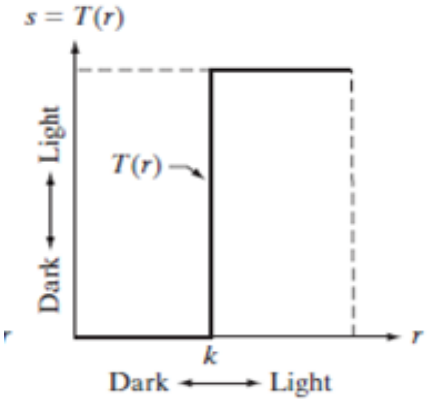



Figure 5. Thresholding function

**Original Image Threshold Image**

Figure 6.Thresholding function applied on brain image.

*D. Log transformation*

The log transformation in general form is given as :

$$s = c * log (1 + r) \quad (5)$$

The log transformation draws a partial array of small input intensity level assessments to a broader array of output assessments. The opposite transformation of log transformation is the inverse log transformation [2]. When the input grey level assessments may have enormously high range of assessments at that point the Log functions becomes useful. Here, to affirm more details in the image Fourier

transform is carried through a log transform. We set *c* as 1 and grey levels should be in the array of [0.0, 1.0].

**Original Image** **Transformed Image**

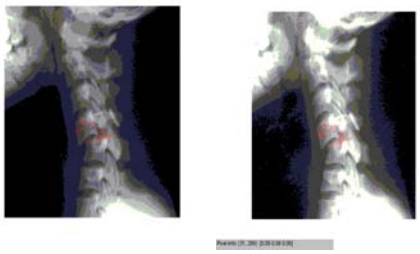


Figure 7.Log transformation function applied on to the cervical spine fractured image.

*E. Power law transformation*

In the power law transformation [5] not to degrade the quality of the image we need to select the exponent seeming in the transformation function. Figure [8] shows the nth power and the nth root curves that is expressed as in equation [6]:

$$s = cr^{\gamma} \qquad (6)$$

Where, s and r are given as the intensity points of pixels in the input and output images, respectively and c stays as constant. Different stages of enhancements can be attained for distinct values of gamma. Below figure[8] displays the scheme of power law transformation curves, with the input intensity level 'r' along the x axis and the output intensity level 's' along the y axis for numerous values of s besides constant as c = 1 .

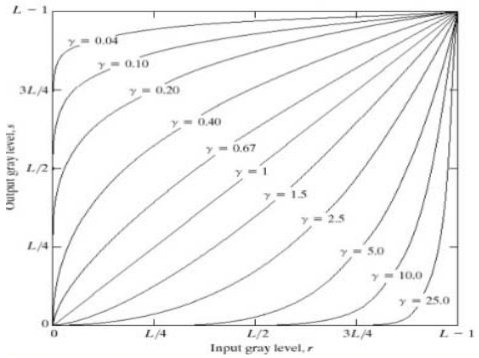



Figure 8. The plot of Power law transformation.

Many likely transformation curves can be attained by fluctuating the gamma.

**Original Image** **Enhanced Image**

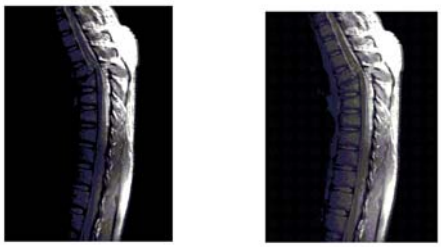


Figure 9. Enhancement of MRI of fractured human Spine by power law transformation by varying Gamma.

*F. Histogram Equalization*

Histogram Equalization (HE) [4], [9] is a method which equalizes the histogram in such a way that the image contrast enhancement is achieved. The digital image histogram with intensity points are given in the range [0, L-1] which is a discrete task given as:

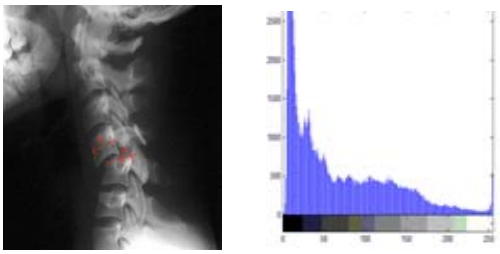
$$h(r_k) = n_k. \qquad (7)$$

The overall amount of pixels present in an image is repeatedly normalized in histogram. Considering M x N as an image, a stabilized histogram is allied to the likelihood of happening of $r_k$ in the image.

$$p(r_k) = \frac{n_k}{MN}, \qquad k=0,1,2\ldots..L\text{-}1 \qquad (8)$$

For enhancing the external look of the images histogram equalization is also called as collective technique. If we have an image that is mostly dark, then the histogram is to be biased to the inferior finish of the grey scale. All the image details will be flattened into the dimmer edge of the histogram. If we spread the intensities at the darker edge to yield a more evenly dispersed histogram then our image will develop much flawlessly.

**Original Image** **Histogram**



**Equalized Image** **Equalized Histogram**

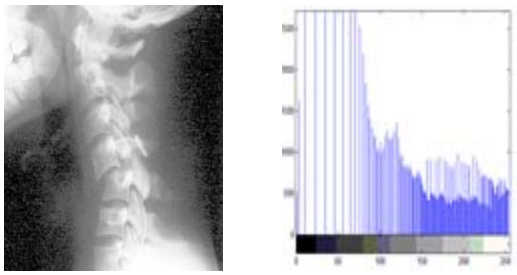


Figure 10. The original image with its histogram, the equalized versions by histogram equalization.

## CONCLUSION

Image enhancement deals with advanced variety of methodologies for adjusting the images to bring about visually agreeable images. The option of the techniques is a function of some certain task, such as image composition, observer attributes, and observing conditions. For contrast enhancement of the images the point processing procedures are most simple, still necessary image processing operations. Image Negative here is responsible for enhancing the white details confined in dark regions. It also has applications in the medical imaging. For the general purpose contrast manipulation, Power-law transformations are useful. By means of a power-law transformation with fractional exponent for dark images, spreading of intensity levels is proficient. For enhancing the data in the darker parts of the image at the cost of fine points in the brighter areas log transformation become useful.

Using a power-law transformation for any image which is having a drained look, a firmness of gray levels is achieved when γ will be greater than 1. Regarding the contrast of an image the histogram of an image provides the important information. Stretching out of the contrast by reorganizing the intensity-level values consistently is performed by Histogram equalization.

Although, In selecting a procedure for real-time uses the computational cost of enhancement procedures plays a critical role. Instead of the performance of every procedures independently, in training one has to develop a mixture of such approaches to attain additional effectiveness in the medical image enhancement.

## REFERENCES


[1] Rafael.C.Gonzalez and Richard.E.Woods "Digital image processing" Third edition.

[2] Raman Maini and Himanshu Agarwal "Comprehensive review on enhancement techniques" Journal of Computing, Volume 2, issue 3, march 2010, ISSN 2151-9617.

[3] Godwin D and Krishna kumar S "Contrast enhancement technique of medical X-ray images". ISSN : 2248-9622, Volume.4, Issue 4(Version 6), April 2014, pp.19-24.

[4] Nithyananda C R and Ramachandra A C "Histogram equalization method based image enhancement techniques" Departmentof ECE, 978-1-4673-9939-5/16/$31.00 ©2016.

[5] Om Prakash Verma and Pooja Gupta "A simple approach for image enhancement using Power law transformation" Department of IT,Delhi University, 978-1 - 4799-1 607-8/1 3/$31 .00©2013 IEEE .

[6] Sargun and Sashi Rana "Medical Image enhancement techniques for Image Processing" Dept of E&T, International journal of current engineering and technology,Volume.5, No.2(April 2015).

[7] S.E.Umbaugh , "Computer Vision & Image Processing," Prentice Hall PTR, 1998.

[8] Kushhal Jindal and Kirti Gupta "Bio-medical Image Enhancement In Spatial domain" 978-1-4799-6393-5/14/ $31.00 2014 IEEE.

[9] R Hummel, "Histogram modification techniques", Computer Graphics and Image Processing, Volume.4, pp. 209-224, 1975.

[10] N.Mohanapriya and Kalaavati, "Image enhancement using multilevel contrast stretching and noise smoothning technique for CT images" IJSER Volume 5, Issue 5, May-2014 ISSN 2229-5518.