

An Overview of Comparison between different Image Enhancement Techniques for Dental Radiographs

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Abstract

Image enhancement is a first step in digital image processing. As the name suggest, the original image is processed in such a manner that, the resultant image will be more suitable as compared to original image. Image enhancement is purely subjective processing technique. Enhancement basically improves the subjective quality of the images by processing the available data. This paper discusses the different point operating techniques, and analyse its performance based on HVS for dental images.

Key words - HVS, CVS, X-RAY, EM

1. Introduction

Image enhancement is process of improving the visual quality of an image which is more suitable for the HVS. Image enhancement aims to improve the quality of an image in order to extract the features and analyse it for both HVS and CVS. Intensity is the most important factor that affects the appearance of an image. At present many enhancement methods are used. Factors affecting in choosing suitable method from the existing methods are, the enhancement efficiency, computational requirements, Noise amplification, user intervention and application suitability. The choice varies with specific image processing application [1]

2. Literature review

X- Rays are the primogenital EM radiation used for imaging [2]. The X-rays used commonly in medical diagnostics. The x-rays are also used extensively in industry and other areas. The intensity of the x-rays is modified by absorption they pass through the patient and the resulting energy falls on the film. Dental X-ray image analysis is another major area of digital image processing. Image enhancement is the effective tool to analyse the x-ray image.

Image enhancement improves an image appearance by increasing dominance of some features or by decreasing ambiguity between different regions of an image [3]. Image enhancement process consists of a collection of techniques that improves the image to form a better image for analysis by human or machine.

3. Various image enhancement techniques:

All the enhancement techniques fall under the following categories.

I. Point operation :

Point operations are applied to individual pixel only therefore interaction dependencies between neighbouring pixels are not considered. Point operation includes creating negative image, contrast stretching, histogram equalization etc.

An input image is $I(x, y)$ and its output image is $o(x, y)$ the value of $o(x, y)$ depends only on the intensity of I at that particular point the simplest form of transformation T when the neighbourhood is of size 1×1 i.e. single pixel. Suppose the intensity of I image is s which is not depend on neighbourhood pixels, the transformation function is written as:

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

Where s denotes the intensity of Input Image, r denotes the intensity of Output Image both at the same point.

Creating Negative Image : The most basic and simple operation digital image processing is to compute the negative image of an image [4]. The pixel grey values are inverted to compute the negative of an image. The grey values of an image are in the range of 0 to 255. Every pixel values of an original image are subtracted from 255. The resultant image is the negative of an original image [2] for example if an image of size is $R \times C$ where R represents number of rows and C represents number of columns. The original image is represented by $I(r, c)$. The negative image represented by $N(r, c)$ and can be computed as

$$N(r, c) = 255 - I(r, c) \dots\dots\dots (2)$$

Where, $0 < r \leq R$ and $0 < c \leq C$

It can be seen that every pixel value from the original image is subtracted from 255. The resultant image becomes negative of the original image Fig. 1(a) shows the Original image and 1(b) shows the negative of original image

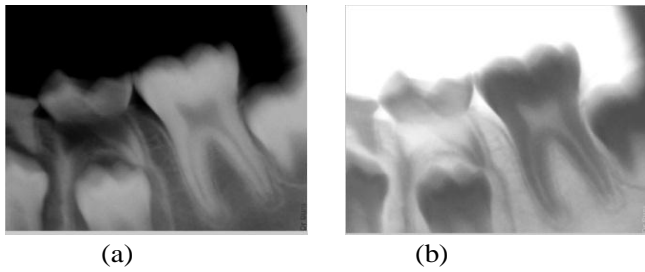


Fig.1 Figure shows the original image and negative image

Contrast stretching or Logarithmic Transformation

Contrast defines the difference between lowest and highest intensity level. Higher the value of contrast means more difference between lowest and highest intensity level this is the basic tools for dynamic range manipulation [5]. Logarithmic transformations are implemented using the expression

$$g = c \times \text{Log} (1 + f) \dots \dots \dots (3)$$

Where c is a constant and f is floating point. In this technique the low values set at 0 and high values set to 1 on both scales. There are two types of contrast stretching
 Linear Contrast Stretching: - This type of contrast stretch enhances the contrast in the image with light toned areas appearing lighter and dark areas appearing darker, making visual interpretation much easier.

Equalized Contrast Stretch:- This stretch assigns more range of values to the frequently occurring portions of the histogram. Fig.2(a) shows original image and 2(b) shows the contrast image.

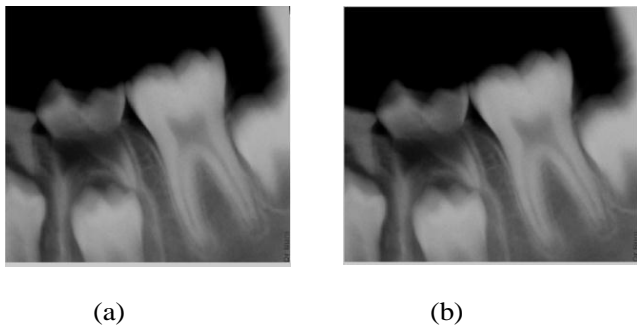


Fig.2 shows the Logarithmic Transformation

Histogram Processing : Histogram is a graph showing the number of pixels in an image at each different intensity found in that image .The histogram of a digital image with intensity levels in the range [0, L-1] is a discrete function as-

$$h (rk) = (nk) \dots \dots \dots (4)$$

Where rk is the kth grey level and nk is the number of pixels in an image having grey level rk. Histogram frequently normalised by the total number of pixels in the image. Assume that M X N is an image, a normalised histogram will be

$$P(rk) = \frac{nk}{MN} \dots \dots \dots (5)$$

Where, k = 0, 1 L-1

Is related to probability of occurrence of rk in the image. Histogram equalization is a common technique for enhancing the appearance of an image. Consider for continuous function and let the variable r represents the grey levels of the image to be enhanced. To be assume that r has been normalised to the interval [0, 1]; with r = 0 representing black and r=1 representing white. Figure 3(a) shows the original image and fig. (b) Shows the histogram equalize image.

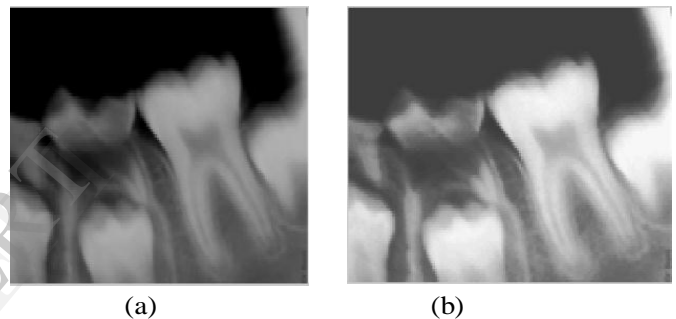


Fig.3 Shows the Histogram Processing

II. Spatial domain

Most of the spatial operations can be implemented by convolution. Spatial filters are designed to highlight or suppress features in an image based on their special frequency; the spatial frequency is related to the textural characteristics of an image [2] special filters are used to suppress the noise in an image. It includes low pass filters unsharped mask, high pass filters.

III. Transform operation

The transform operation includes linear filtering, route filtering and homomorphic filtering. All the enhancement operations are performed on Fourier transform of the image and then the inverse Fourier transform is performed to get the resultant image. These enhancement operations are performed in order to modify image brightness contrast or the distribution of the grey levels.

IV. Pseudo Colouring Method

Assign colours to grey values based on specified criterion the pseudo colouring is done by the false colouring, pseudo colouring.

4. Conclusion

This paper discussed about different enhancement techniques of point operation using MATLAB tool with relevant outputs. Point operations which includes negative image contrast stretching, histogram processing are zero memory operations that remap a given input grey level according to a global transformation. The point processing methods are most primitive and used primarily for contrast enhancement image. Negative image is suited for enhancing white details embedded in dark regions and has applications in medical imaging. These methods have the disadvantage of treating the image globally, not being able to differentiate between several areas of the image that requires different levels of contrast enhancement of these techniques, linear contrast stretching and histogram equalisation are the most widely used.

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