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# A Hybrid Enhancement Technique of Medical Images

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**ABSTRACT:**

Medical images are used by the doctors which helps in diagnosis of diseases. The common format of medical image is DICOM. DICOM stands for Digital Imaging and Communications in Medicine. They are required for the diagnosis of diseases but often these images are corrupted by noises and the images are of low quality. The diagnose of disease will become more difficultfor the low quality DICOM images which is corrupted by noise sources. So the medical image quality has to be increased and the noises are to be removed without increasing its cost of construction. The medical image quality can be improved by enhancement techniques. Histogram equalization and contrast enhancement are the most common and low cost method of enhancement of these medical images. Filters are used to decorrelate the effects of noise which affects those images by inverse model of the noise function. There are various types of filters available to reduce the noise of the image. When the image is subjected to enhancement technique, the noises present in the image are also enhanced and so it is vital to reduce those noises before enhancement process. The medical image's quality can be improved by the concept of super resolution. It involves using multiple low resolution images to form a single super resolution image. The cost for constructing the super resolution image is lower than that of constructing a high resolution image.

**Keywords:** DICOM, medical image enhancement, Noise reduction, hybrid approach.

## INTRODUCTION

An image is represented by a 2-D matrix of pixels. Each cell has some value which corresponds to the intensity of the pixel. For a binary image, the value of pixels will be 0 or 1 and for the grayscale image, each pixel is represented by a particular value from 0 to 255. Pixels in a color image can be decomposed into three bit planes namely Red, Green and Blue. Each decomposed images has its own representation

corresponding to the intensity of the images. Every pixel of any type of images can be represented in 8 bit representations. The images can be collected by various methods which is generally called as image acquisition. Once the images are captured or collected they can be processed to make it useful for many applications. Common applications include satellite imaging, medical imaging, radar imaging, etc. The MRI or CT scanned images have low value of signal to noise ratio (SNR) and Contrast to noise ratio (CNR). These images need to have sufficient value of SNR so that it yields necessary details for the process of diagnosis.

## THEORY

### Analysis of medical images:

Now-a-days medical images have attracted much attention in the field of diagnosis of diseases by collecting image from various acquisition techniques such as Computer Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear medicine imaging, Ultrasound imaging etc. But these medical images are of low quality and may contains noises making it difficult for the diagnostician to diagnose the disease hence it is much essential to remove those noises present in the image and also to improve the quality. Noises can be eliminated by the use of filters. There are various types of filters available to remove distinct noises. Most common noise that affects the medical image is the speckle noise. The medical image's quality can be improved by number of available techniques such as contrast enhancement, histogram equalization and modification etc. The low quality of the medical image causes difficulty in diagnosis process which may results in false interpretation of disease and hence the medical images plays a vital role in the diagnosis of diseases. These medical images we capture now-a-days usually have the extension of .dcm and these can be read out in the system with the help of dicom viewers available. There are also other formats available like NCR/NEMA 1.0 and 2.0 but the use of dcm format is more applicable as it can contains much information about the image also more slices can be produced making perception of every minute details possible. SNR of these medical images are generally low which is difficult for the surgeon to analyze and hence it is necessary to have high value of SNR. Capturing the medical DICOM image with high SNR increases the cost of construction.

### Image Enhancement:

Enhancement of an image is the second step in image processing which involves improving the quality of an image. The quality of an image is characterized by brightness, contrast, luminance, chrominance and the noise levels. It is generally necessary to reduce the noise contents of the image. This can be done by image enhancement technique. They improve the quality by changing the brightness or sharpness characteristics and also they reduces the noise contents present in the image. The quality of an image is identified from the resolution and dynamic range. Dynamic range is the range of values used to represent every pixel in an image. The size of an images is identified from resolution on an image.

The resolution of an image source can be pinned down in terms of three quantities, namely

- Spatial resolution
- Temporal resolution
- Bit resolution

The terms spatial resolution can be conveniently represented by the number of columns (C) by the number of rows available which generally covers the area that are visible to us in the image. The term temporal resolution is usually related to continuous images (videos) which is the number of images captured within a specific time period in which each image that we capture is referred as frames and the continuous or motion pictures can be represented in terms of frames per second (fps). Television broadcast channels uses 25fps for its transmission and reception.
Image enhancement can be done in two domains,

- Spatial domain enhancement
- Frequency domain enhancement

Spatial domain enhancement involves direct manipulations of pixels present in the image whereas the frequency domain techniques involves conversion of image from domain into another domain like frequency domain using various types of transform techniques where the individual element are altered and they are again converted back to its original domain by inverse transformation functions. Generally the transformation is represented by the following equation.

$$\boldsymbol{g(x,y) = T\big(F(x,y)\big)}$$

Where,

f(x,y) is the input image
g(x,y) is the processed image
T is the transformation function.

There are two approaches of image enhancement

- Subjective enhancement
- Objective enhancement

Subjective enhancement involves enriching the quality until the spectator identifies that the image yields sufficient details for the diagnosis but in case of objective enhancement, the techniques is applied in order to correct for knows abjections.

**Noise Filtering:**
The important barrier in the digital image processing or digital signal processing is the noise present in it. Noise is the source that degrades the quality of the image making it unsuitable for diagnosis by the surgeon. Hence it is obvious that the noises has to be removed from the image to make it suitable for processing. There are various types of

noises and to remove them there exists number of filters and with the help of these filters the noises can be removed or minimized to make it suitable for further processing. While performing the process of image enhancement, image enhancement is done prior to noise removal. If noise filtering is done first to remove the noises present in the image, image enhancement does not yields necessary details for analysis. Some types of filters are kalman filters, anisotropic diffusion filters, Lee filter, adaptive filters etc.

## PROPOSED WORK

The proposed work involves the following steps,

1. Capturing the dicom image using the medical instruments available
2. Enhancement of the captured image
3. The noises present in the image has to be removed with the help of filters
4. Obtain the enhanced image as output and can be used for diagnosis

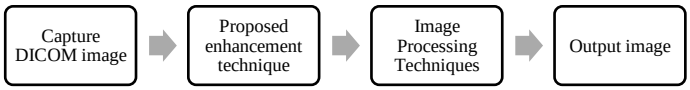


**Fig.1 Proposed Technique**

The DICOM images can be captured from USB imaging devices, Endoscope, microscope or any other imaging devices and can be converted into DCM format with the help of dicomizer which can be used for both imaging as well as report making tool.

**Algorithm:**

This whole algorithm is tested in MATLAB and the steps in processing the image is given below.

- Read the DICOM image
- Apply filter to compute the gradient magnitude of the read image
- Go for preprocessing and perform segmentation
- The segmented image and the original image are found
- Filtering operation is done in order to remove the unnecessary details
- The metrics are calculated to determine whether the image is suitable for diagnosis

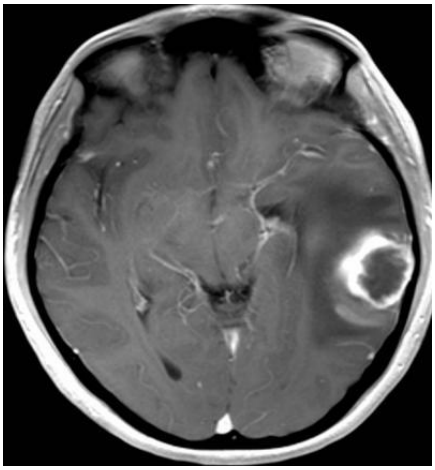

**Fig.2 original image**

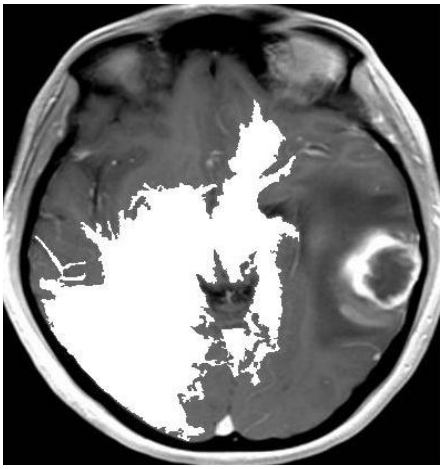

**Fig. 3 Enhanced image**

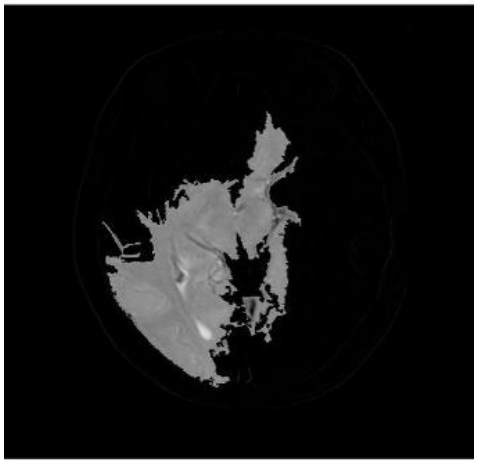

**Fig.4 Segmented image**

**METRICS**

**Mean Square Error (MSE):**

Mean square error is the metrics used to determine the quality of image after it has been processed for enhancement and noise removal. Calculated by the square of the difference between the original and the enhanced image. The enhancement and filtering operation is done till the value of MSE is kept as small as possible. Consider the image of size mxn. Let $a(x,y)$and $a'(x,y)$ be the original and the processed image, the MSE can be calculated using the formula,

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}\left|a(x,y) - a'(x,y)^2\right| \quad (1)$$

**Peak Signal to Noise Ratio (PSNR):**

Peak Signal to noise ratio of the image is specified in terms of decibels in logarithmic scale used to indicate the quality of reconstruction of the image. If the value of PSNR is higher, it indicates that the reconstruction quality of image is higher. It can be analyzed with the help of MSE as,

$$PSNR = 10\log_{10}\left(\frac{MAX^2}{MSE}\right) \quad (2)$$

**Root Mean Square Deviation (RMSD):**

It is calculated by the square root of the difference between the original and the outcomes of the proposed technique. It can be written as,

$$RMSE(x) = \sqrt{MSE(x)} \quad (3)$$

**Universal Quality Index (UQI):**

It is used to measure the image similarity across distortion types. It is designed by modeling the image distortion as a combination of three factors: loss of correlation, luminance distortion and contrast distortion and can be represented by the equation,

$$UQI = \frac{4\sigma_{xy}\overline{xy}}{[\sigma_x^2 + \sigma_y^2][(\bar{x})^2 + (\bar{y})^2]} \quad (4)$$

**Evaluation Time (ET):**

It is defined as the amount of time the algorithm take to complete the process of enhancement and filtering. The value of ET must be low as possible. It cannot be calculated with the help of equation but can be computed by calculating the time the algorithm takes to complete the entire process.

## CONCLUSION

This method of enhancement and image processing technique deals with improving the quality of the medical image. Medical images plays a crucial role for the surgeon in diagnosing the disease of the patients by giving better perception about every details of the organs and tissues present inside the human body but often the medical images are degraded by the existence of noise source. Speckle noise, salt and pepper noise, granular noise are some examples of noises that affects the image's quality. These noises has to be removed to increase the SNR of the image. This method employs both image enhancement and noise removal techniques which can be called as hybrid technique.

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