# MRI and CT Images Integration using DWT and Fusion Enhancement

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***Abstract-*** Now a days ,with the fast development in the technology and the modern instruments ,Medical imaging has become an essential parameters which includes different applications like diagnosis. Medical Image Fusion is the best idea to combine multiple images into a single image from different imaging tools like Computer Tomography(CT),Magnetic Resonance Imaging (MRI) renewing the most important and required features from the original images.The main idea is to enhance the image content by fusing images with high accuracy compared to existing one using Preprocessing Techniques and Discrete Wavelet Transform(DWT),so as to provide efficient information for the treatment purpose.

## I. INTRODUCTION

Image fusion is a process of combining information that are relevant in two or more images into a single image.With the advent of many imaging modalities which assess different parameters of any disease process, fusion of these data has become inevitable for the best understanding of the concerned physiology. Positron Emission Tomography (PET) assess the functional aspects of the organ is being studied by the Nuclear Medicine. Although conventional computed tomography (CT scan) and magnetic resonance imaging (MRI) are considered best in delineating the morphological information about the human body and various disease processes but the new technical improvements have expanded their scope due to innovations in functional imaging including perfusion, diffusion, spectroscopy, etc. Hence, Integration of the functional and structural information would probably give us the best information. Though, the major impact of these fusion imaging techniques is on oncology patient management yet multiple oncological applications that have e recently come up are also discussed in the article.CT image provides hard tissue information such as bone structure, where asMRI image provides soft substance information such as flesh. However a radiologist needs both CT and MRI information in a single image for better diagnosis and treatment. The outline of this paper is as follows:Section 2 deals with the related work of this paper.section 3 deals with the Proposed algorithm.Section 4 describes the fusion metrics .Section 5 experimental setup is discussed.Section 6 presents the results and the analysis.Section7concludesthearticle.

## II. RELATED WORK

The contrast enhancement techniques are commonly used in various applications where subjective quality of image is very important. The objective of image enhancement is to improve visual quality of image depending on the application importance. Enhancement is an important factor for any individual estimation of image quality. It can be used as controlling tool for documenting and presenting information collection during examination. The images having a higher contrast level usually display a larger degree of color or gray scale difference as compared to lower contrast level. The contrast enhancement is a process that allows image features to show up more visibly by making best use of the color presented on the display devices. During last decade a number of contrast enhancement algorithms have been developed for contrast enhancement of images for various applications. These are histogram equalization,global histogram equalization, local histogram equalization, adaptive histogram equalization and Contrast Limited Adaptive histogram equalization , other histogram equalization based algorithms and other contrast enhancement methods have been proposed by various researchers. One of the most widely used algorithms is global histogram equalization, the basic idea of which is to adjust the intensity histogram to approximate a uniform distribution. It treats all regions of the image equally and, thus often yields poor local performance in terms of detail preservation of image. Succeeding fusion schemes in this category of multiresolution category uses discrete wavelet transform (DWT) decompositions.DWT has more advantages over pyramid. It provides compact representation and directional information of a given image. These qualities of DWT make it suitable for the purpose of fusion. Wavelet fused image contains less blocking effects than pyramid fused image. DWT is shift variant because of its multirate operations. This shift variant property may introduce some artifacts in the fused image. To avoid these problems of DWT, stationary wavelet transform (SWT) has been introduced. Image fusion is also carried out using recent techniques such as singular value decomposition (SVD), high order singular value decomposition,and two-scale fusion (TIF).

## III. EXISTING METHOD

An efficient pixel-level image fusion8 algorithm should satisfy the following three requirements:

1.Itshould preserve the necessary information from input imagery. 2. It should not produce artifacts. 3. It should not depend on location and orientation of the objects present in the source imagery.

In this context, for the past few decades, several pixel-level image fusion algorithms have been developed for spatially register images. Pixel-level image fusion can be classified in a generic way based on the methods used, namely, nonlinear operator, optimization, artificial neural network, multiresolution decomposition, and edge preserving-based methods. In nonlinear methods, min, max, and morphological nonlinear operators are used for the purpose of fusion. Successful fusion methods based on morphological operators are discussed in .Even though these methods are simple, fused image may not look good. In optimization-based approaches,12,13 fusion process. But in general, this problem is difficult to solve. Markov random field and generalized random walk methods solve this problem by computing edge aligned weights. Fused image is as shown in the figure 3.1. Furthermore, artificial neural networks have gained a lot of interest in the area of imagefusion by the inspiration of biological signal fusion. Successful methods in this class are discussed in . In addition to the above fusion schemes, multiresolution schemes have played a great role in image fusion. These schemes are motivated by the fact that human visual system (HVS) is sensitive to the edge information. That is, HVS can perceive even small changes in edge information. Both image pyramid and wavelet decomposition belong to multiresolution methods. These approaches require transform domain analysis. Image pyramid decomposes each given image into set of low-pass filtered images. Each filtered image represents the information of the given image in different scales. Gradient pyramid (Grad),laplacian pyramid, ratio of low-pass pyramid (Ratio),Gaussian pyramid, contrast pyramid, filter-subtract-decimate pyramid, and morphological pyramid methods are used for the purpose of fusion.

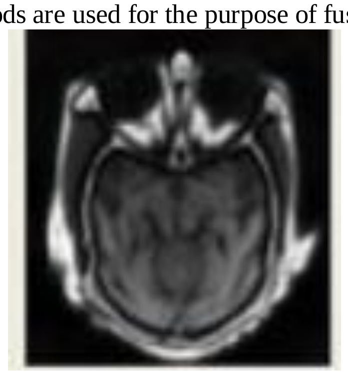

Fig.1: Fusion of CT and MRI Images

## IV. PROPOSED METHOD

The key idea in our proposed method is blur the source images using GF, then subtract these blurred images from corresponding source images to get sharpen images. Use details of sharpened images to calculate weights for the purpose of fusion. The proposed method is illustrated in.For better understanding, we have explained this method Proposed method with the help of images by detailing the changes in each and every step. This algorithm consists of two major steps. (A) First step: obtain the detail layer images using GF. (B) Second step: fuse the detail images using a fusion rule based on image statistics. The proposed method is explained as follows.

### A. IMAGE ACQUISITION

Image acquisition stage is the first stage for any image vision system.After the image has been obtained, various methods of processing can be applied to the image to perform the many differentvision tasks required today.However, if the image has not been acquired satisfactorily then the intended tasks may not be achievable, even the aid of some form of image enhancement. The general aim of Image Acquisition is totransform an optical image (Real World Data) intoan array of numerical data which could be latermanipulated on a computer, before any video orimage processing can commence an image mustbe captured by camera and converted into amanageable entity.

The Image Acquisitionprocess consists of three steps and is shown in figure 4.1.1 and 4.1.2:

1. Optical system which focuses the energy
2. Energy reflected from the object of interest
3. Measuring the amount of energy by the sensor.

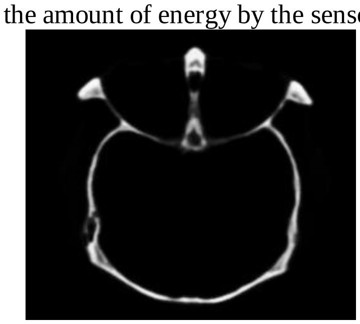

Fig.2:CT Image

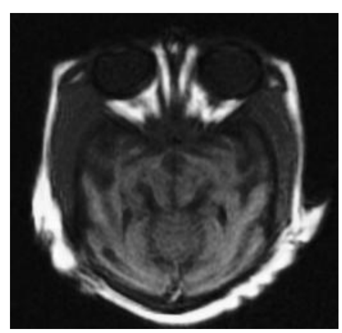

Fig.3:MRI Image

**B. PREPROCESSING**

Values and scales of different variables may vary greatly. For example, the values of a variable can be from [0,1], {0,1,..,6}, [0,100] or [0,106 ]. Thus, some scaling or normalization is often, but not always, needed. Some machine learning algorithms are sensitive to number intervals or scales used. On the other hand, the other methods are insensitive. Nearest neighbor searching is often sensitive to those different intervals which can be understood easily according to when we run the nearest neighbor searching algorithm that employs such distance measures as Euclidean distance. Consequently, the normalization of variable values is here useful.

**C. GUIDED IMAGE FILTER:**

Guided image filter (GF) is an explicit image filter. This filter computes the output of a pixel in an image by taking the statistics of the neighborhood around that pixel into the account. It is a local linear model between output and guidance image. GF computes the output like other linear transform invariant (LTI) filters but it uses a second image to filter the input image for guidance purpose. Second image may be the same input image or a translated version of it or a totally a different image. This filter is an edge preserving smoothing filterwhich not only smooths the input image but also preserves the edge information as shown in the figure 4.3.1 and 4.3.2. If G is a guidance image centered at a pixel l in a local square window wl, then the filtered output O at a pixel j is given by where ml and nl are the linear coefficients which are constant in window wl. To determine linear coefficients (ml, nl), constraints have to be derived.

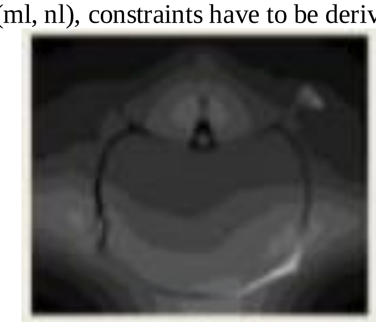

Fig.4: CT Image

Fig.5: MRI Image

**D. DISCRETEWAVELETTRANSFORM**

Wavelets are often used as the two dimensional signals, such as images. The following example provides three steps to remove unwanted white Gaussian noise from the noisy image shown. The important tool used to import and filter the image is MATLAB. The first step is to choose a wavelet type, and a level N of decomposition.Inthiscase biorthogonal wavelets were chosen with a level N of 10. Biorthogonal wavelets are commonly used in image processing to detect and filter white Gaussian noise, due to their high contrast of neighboring pixel intensity values as shown in figure 4.4.1 and 4.4.2. Using this wavelets a wavelet transformation is performed on the two dimensional image. Following the decomposition of the image file, the next step is to determine threshold values for each level from 1 to N. Birgé-Massart strategy is a fairly common method for selecting these thresholds. Applying these thresholds are the majority of the actual filtering of the signal. The final step is to reconstruct the image from the modified levels. This is accomplished using an inverse wavelet transform. The resulting image, with white Gaussian noise removed is shown below the original image. When filtering any form of data it is important to quantify the signal-to-noise-ratio of the result.In this case, the SNR of the noisy image in comparison to the original was 30.4958%, and the SNR of the denoised image is 32.5525%. The resulting improvement of the wavelet filtering is a SNR gain of 2.0567%. It is important to note that choosing other wavelets, levels, and thresholding strategies can result in different types of filtering. In this example, white Gaussian noise was chosen to be removed. Although, with different thresholding, it could just as easily have been amplified.

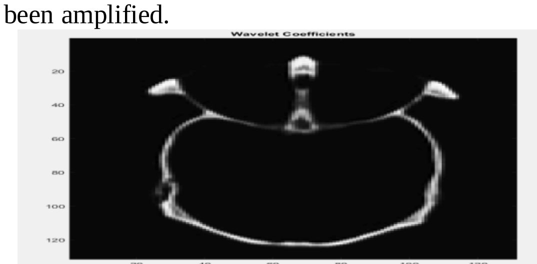


Fig.5: CT Image Coefficients

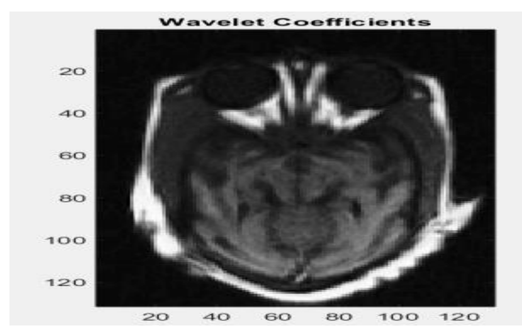


Fig.6: MRI Image Coefficients

**E. FUSION**

The image fusion process is defined as gathering all the important information from multiple images, and their inclusion into fewer images, usually a single one. This single image is more informative and accurate than any single source image, and it consists of all the necessary information. The purpose of image fusion is not only to reduce the amount of data but also to construct images that are more appropriate and understandable for the human and machine perception.In computer vision, Multisensor image fusion is the process of combining relevant information from two or more images into a single image.The resulting image will be more informative than any of the input images.

## V. RESULTS

The aimed result of this work is tointegrate the CT and the MRI images to get the efficient output image,there by in increasing the efficiency of 1.2120% when compared to existing technique Guided Filter Transform(GFT) efficiency is 0.9073%, for the better Medical Diagnosis as shown in following figure 5.3 after execution of modified techniques:

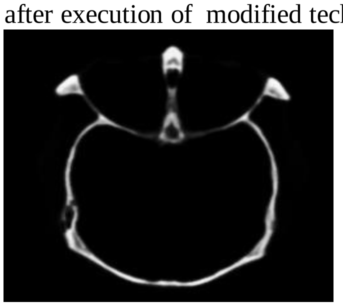

Fig.7: Input CT IMAGE

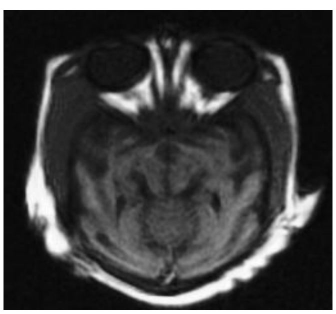

Fig.8: Input MRI Image

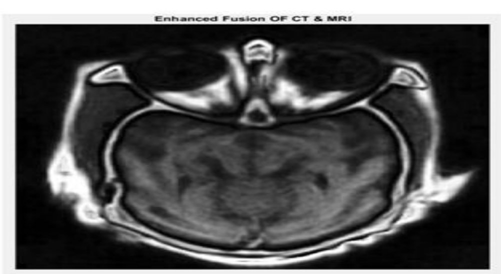


Fig.9: Integrated Image of CT and MRI Images.

## VI. CONCLUSION

This study is mainly adequate for treatment planning.In this project the results are developed by modified DWT algorithm by using FusionEnhancement.This work produces 3%accuracy of images and high quality MRI and CT images for medical diagnosis.

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