Image fusion using the discrete wavelet transform method

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***Abstract*: Image processing can be defined as analysis of picture using techniques that can basically identify region of interest from all those images in bitmapped graphic format that have been scanned or captured with digital camera. Image enhancement techniques aims at realizing the improvement in the quality of a given image. An image can be enhanced by changing any attribute of the image. There exist many techniques that can enhance an image without spoiling it. Enhancement methods can be broadly divided into two categories i.e. spatial domain technique and frequency domain technique.**

***Index Terms*: Dwt, Fusion.**

I. INTRODUCTION

Image processing can be defined as analysis of picture using techniques that can basically identify region of interest from all those images in bitmapped graphic format that have been scanned or captured with digital camera. Image enhancement techniques aims at realizing the improvement in the quality of a given image. An image can be enhanced by changing any attribute of the image. There exist many techniques that can enhance an image without spoiling it. Enhancement methods can be broadly divided into two categories i.e. spatial domain technique and frequency domain technique.

Spatial domain deals with direct manipulation of pixels of an image whereas the frequency domain filters the image by modifying the Fourier Transform of an image. In this paper, main focus is laid on enhancing an image using frequency domain technique. The objective to show how a digital image is being processed generates a better -quality image.

Image Analysis

An image is an array, or a matrix, of square pixels (picture elements) arranged in columns and rows.

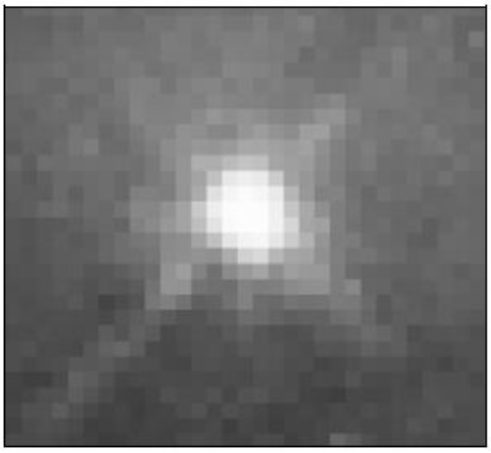


Fig 1.1: An image — an array or a matrix of pixels arranged in columns and rows

An image is defined in the "real world" is considered to be a function of two real variables, for example, a (x, y) with a as the amplitude of the image at the real coordinate position (x, y).Modern digital technology has made it possible to manipulate multi-dimensional signals with systems that range from simple digital circuits to advanced parallel computers. The goal of this manipulation can be divided into three categories:

- Image Processing (image in -> image out)
- Image Analysis (image in -> measurements out)
- Image Understanding (image in -> high-level description out)

An image may be considered to contain sub-images sometimes referred to as regions-of-interest, ROIs, or simply regions. This concept reflects the fact that images frequently contain collections of objects each of which can be the basis for a region. In a sophisticated image processing system it should be possible to apply specific image processing operations to selected regions. Thus

one part of an image (region) might be processed to suppress motion blur while another part might be processed to improve color rendition.

Sequence of image processing: Most usually, image processing systems require that the images be available in digitized form, that is, arrays of finite length binary words. For digitization, the given Image is sampled on a discrete grid and each sample or pixel is quantized using a finite number of bits. The digitized image is processed by a computer. To display a digital image, it is first converted into analog signal, which is scanned onto a display

Closely related to image processing are computer graphics and computer vision. In computer graphics, images are manually made from physical models of objects, environments, and lighting, instead of being acquired (via imaging devices such as cameras) from natural scenes, as in most animated movies. Computer vision, on the other hand, is often considered high-level image processing out of which a machine/computer/software intends to decipher the physical contents of an image or a sequence of images (e.g., videos or 3D full-body magnetic resonance scans).

In modern sciences and technologies, images also gain much broader scopes due to the ever growing importance of scientific visualization (of often large-scale complex scientific/experimental data). Examples include microarray data in genetic research, or real-time multi-asset portfolio trading in finance.

Before going to processing an image, it is converted into a digital form. Digitization includes sampling of image and quantization of sampled values. After converting the image into bit information, processing is performed. This processing technique may be, Image enhancement, Image restoration, and Image compression.

DWT (Discrete Wavelet Transform):

DWT is any wavelet transform for which the wavelets are discretely sampled. It captures both frequency and location information

DWT based image fusion:

Discrete wavelet transforms (DWT) based image fusion is one of the most simplest kind of image fusion. The major step in image fusion is the multi scale decomposition of source images. The source images are divided into lower and higher sub bands. The pixel having largest wavelet coefficients are selected for operation. DWT performs a transformation of image in spatial domain to image in frequency domain. The fusion operators used in this method vary for different decomposition levels. The major advantage by using DWT is that it preserves coefficient information since it uses different fusion rules so it provides better SNR. The final step in DWT based technique is the application of inverse discrete wavelet transform to the
processed image. The basic steps in image fusion process using discrete wavelet transforms is shown in Figure.

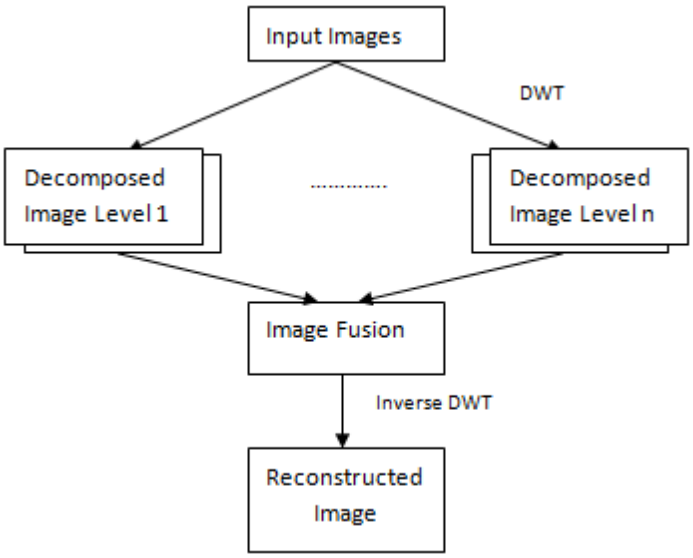


Figure 1.2: DWT Based Image Fusion Basic steps

Image histogram:

A good histogram is that which covers all the possible values in the gray scale used. This type of histogram suggests that the image has good contrast and that details in the image may be observed more easily.

Image 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, Multisensory 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.

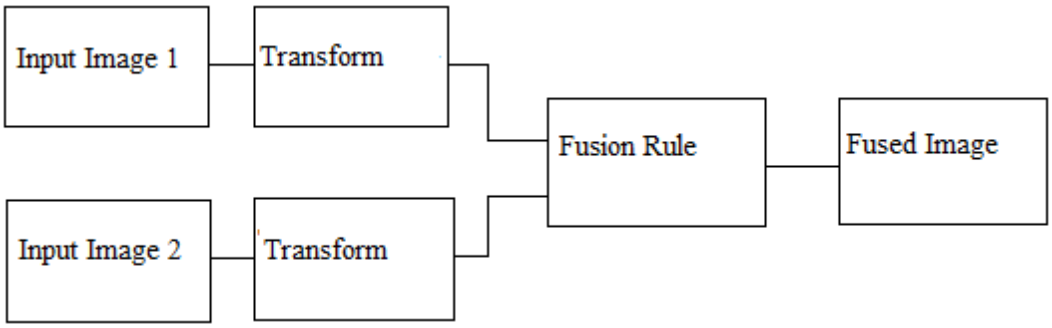


Figure 1.4: Basic Image Fusion Block Diagram

Above figure shows the generalized block diagram of image fusion technique. Image fusion is a process of extracting the information from two images into a single image. As shown in above block diagram the first step is to take input image first and input image second then apply wavelet transform to those images. After that wavelet coefficient are generated. The next step is to apply fusion rule to those images after applying the fusion rule fused image is extracted. The proposed work is given below.

1. To study the different techniques for image fusion.

2. To study different transforms with respect to image fusion in digital image processing.

3. To design image fusion techniques using transform method.

4. Verification of results based on design

II.LITERATURE SURVEY

S.M Mukane [12] represents the study of wavelet transform method and laplacian pyramid using image fusion. The performance of these techniques are measured by using mean square error, peak signal to noise ratio(PSNR) or normalized absolute error (NAE). It concludes that the mean square error decreased in both cases and PSNR increased in both cases, In case of laplacian pyramid NAE decreased and constant in case of wavelet transform.

Tianji o Zeng [14] adopted laplacian pyramid because it is based on pixel level. In this the single image is obtained from multi-focused images is implement into the real application i.e. Android application.

Pavithra C[13] presents a method of wavelet transform using image fusion via combine gradient and smoothness criteria. The result of this method compared with widely used wavelet transform. The result shows that this method produces better fusion.

Kusam Rani [11] represents the study of discrete wavelet and Discrete Multi wavelet. For multi-resolution fusion, the technique used is DWT. Multi-wavelet has many advantages over the scalar wavelet, multi-wavelets are extension over the scalar wavelet. Multi-wavelet can provide more absolute image. Multi-wavelet can also provide fine edges and boundary details.

III.METHODOLOGY

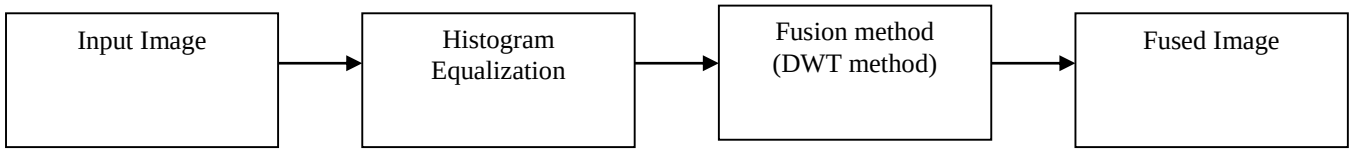


Figure 3.1: Block diagram for proposed fusion method

- The above figure denotes that how the fusion of the image will be done after applying the histogram equalization method.
- In this process first the input image will be loaded and then histogram equalization function will be applied to get the more contrasted image.
- After the getting of the contrasted image the fusion will be done for given input image and the resulted image.

- Hence by applying the fusion function to these two images we get the more clear image which is more improved version of the input image. In the system implementation we mainly have given the flow diagram of the following
- Image Fusion Flowchart
- Image fusion using DWT flowchart.

3.1.1 Image Fusion Flowchart

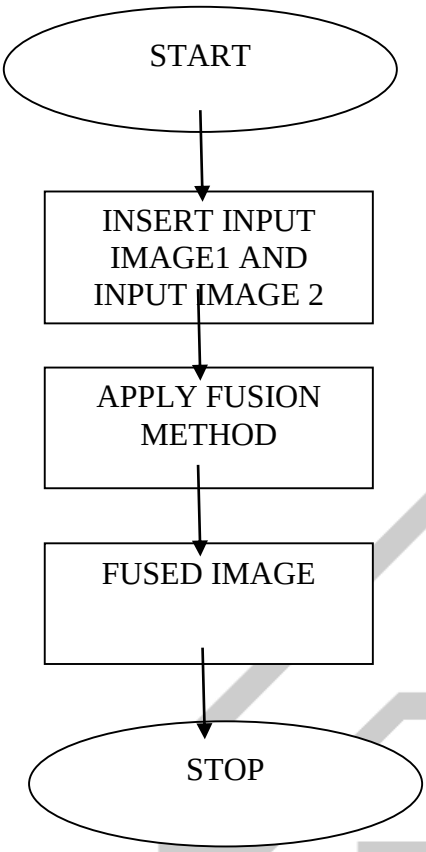


Figure 3.1.1 Image Fusion Flowchart

- As shown in above flow chart the first step is to take the first two images from the image database.
- The next step is to apply the fusion technique to those images.
- At last the fused image is obtained.

3.1.2 Image fusion using DWT flowchart:

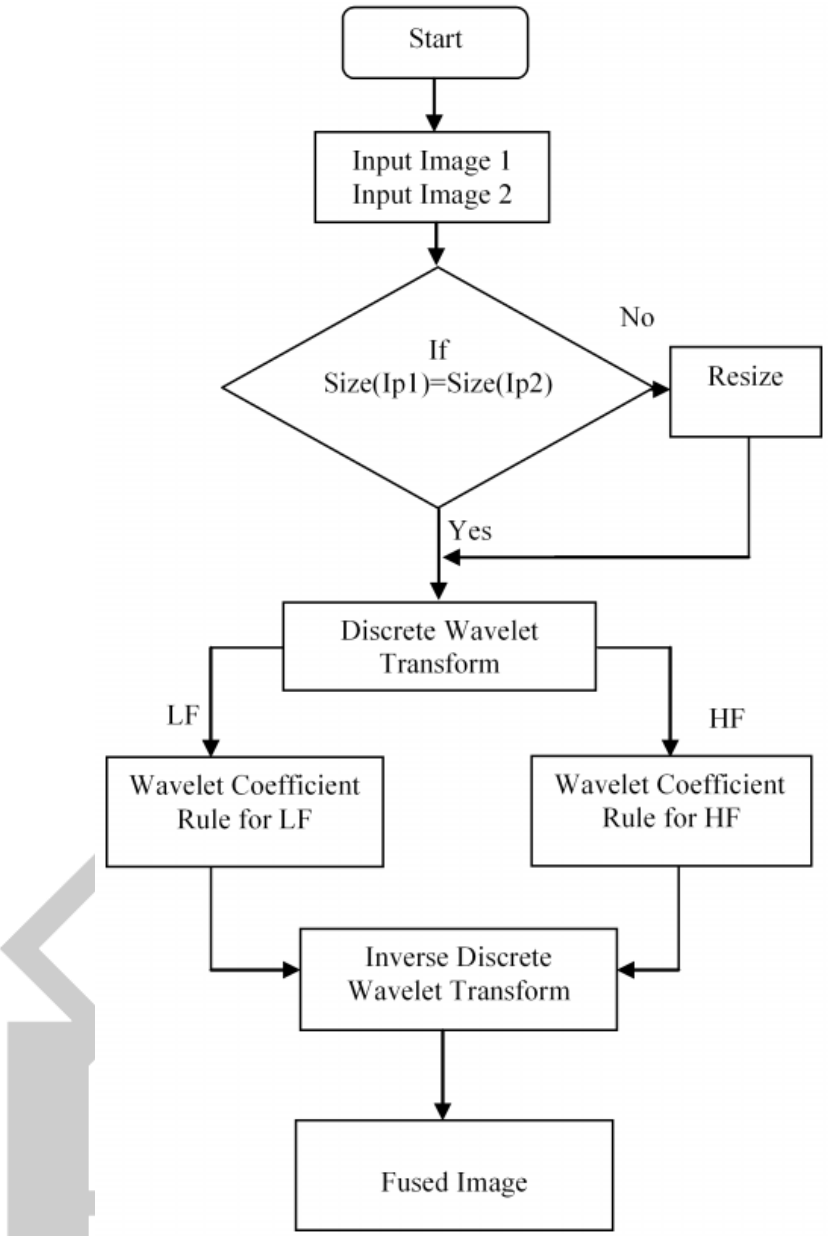


Figure 3.1.2: Image fusion using DWT flowchart

- Read two source images and resize both to same size.
- Apply Mallet algorithm to decompose source images into low pass and high pass sub images.
- At each level, we get four sub images.
- One low pass sub image, three high pass sub images (Horizontal, Vertical, Diagonal).
- Apply max wavelet coefficients rule to find fused coefficients.
- Apply Mallet reconstruction algorithm for construction from fused low pass and high pass coefficients. The fused image is obtained.
- Calculate Entropy, Correlation Coefficient, Mean values and Root Mean Square (RMS).
- Compare with other existing wavelets.

RESULT

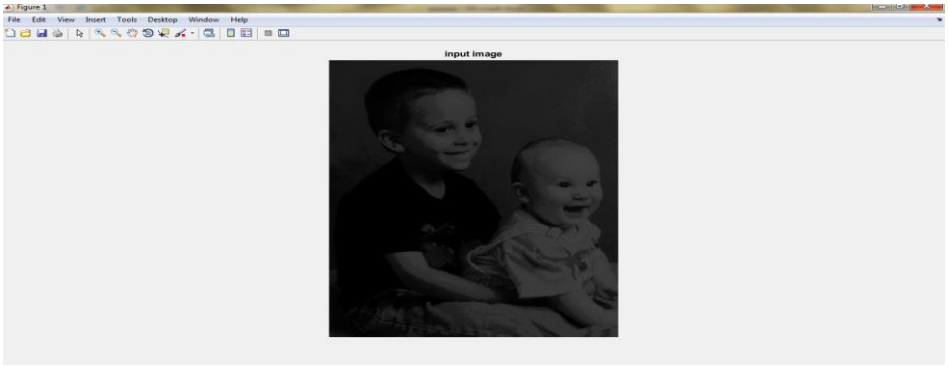
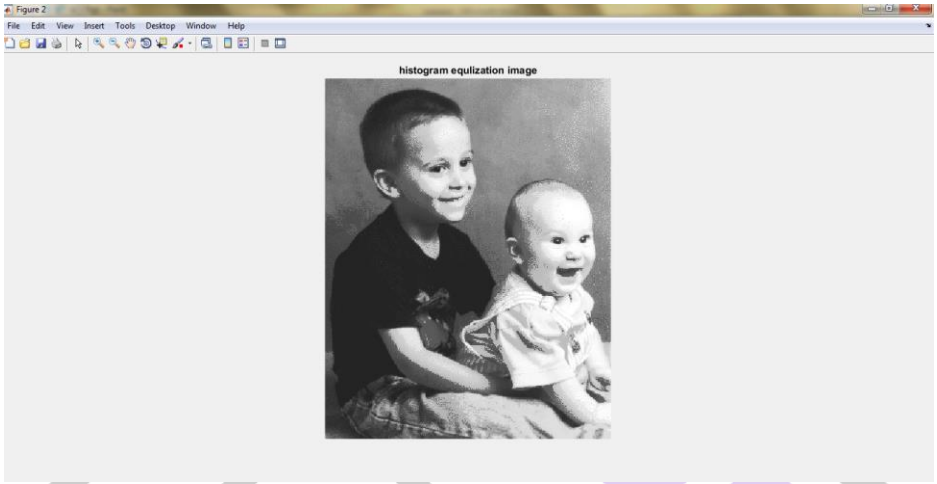


Figure: input image



Figur:histogram equalized image

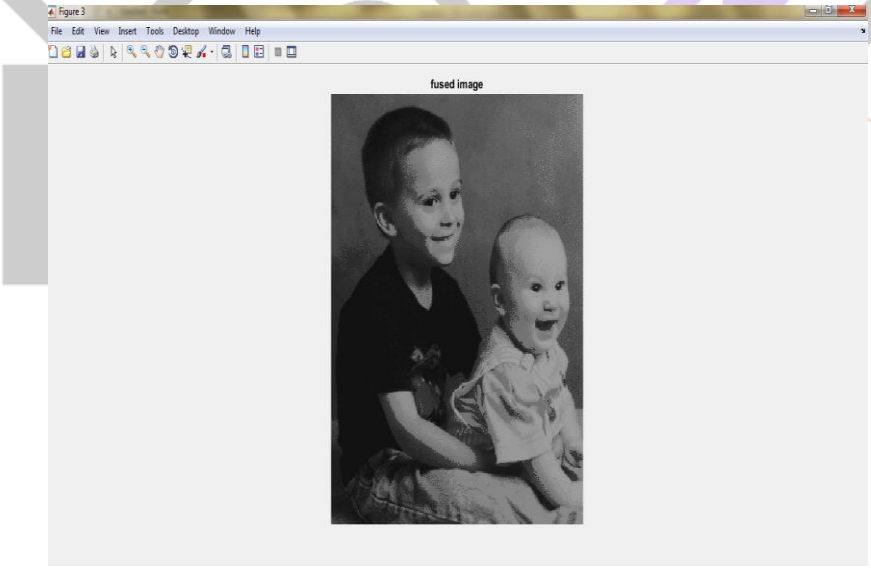


Figure: fused image

CONCLUSTION

A technique of mixing the multiple images into one is called image fusion. This project presents the image fusion technique applying Histogram Equalization process. In this advantages, disadvantages and applications of the image fusion technique is discussed. This method will improve the performance.

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