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A Review on Multi Focal Image Fusion Techniques and Approaches

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Abstract: Image fusion is a process of merging two or more images of same scene to generate single fused image which provide vital information in the fused image. Image fusion method is used for removing noise from the images. Noise is an unwanted material which decreases the quality of an image and affecting the clarity of fused image. Noise can be of different types such as impulse noise, Gaussian noise, uniform noise etc. Images distort some times during transmission or acquisition or due to fault memory locations in hardware. Image fusion can be occurring at three levels such as pixel level fusion, feature level and decision level fusion. A lot of research is being done in the field of multi focal image fusion and encompassing areas of Computer Vision, Image processing, parallel and distributed processing, Automatic object detection, Robotics and remote sensing. This paper is a detailed study performed over a sequence of image fusion methods and algorithms regarding their implementation. Research issues in Image Fusion techniques are to increase efficiency in term API, Standard deviation, PSNR, and try to generate more informative fused images.

Keywords: Image fusion, multi focal image, PSNR, Entropy.

I. INTRODUCTION

In applications of digital cameras, when a lens focuses on a object at a given distance, all objects at same distance are sharply focused. Objects are not at the same distance out of focus and given objects are not sharp. It is generally not possible to capture an image that contains all relevant objects in focus. One way to overcome this problem is combining multiple image of same scene that is image fusion; in which one can capture a series of pictures with different focus settings and combine them to produce an image with sharply focus on each object. During fusion process, all the important visual information occurs in the input images must be transferred into fused image without introduction of distortion.

In this field the fusion algorithm should be reliable and robust to distortion such as noise or mis-registration. Image fusion is a branch of data fusion where data occurs in the form of arrays of numbers that represent brightness, distance, color, temperature, and other important properties. Such data can be two-dimensional (multi focus images), three-dimensional (audio, video sequences or volumetric images), or higher dimensions. Last decades, multi variance imaging techniques have become an important source of information to aid diagnosis in many medical fields.

Image Fusion is such a technique to provide a superior quality image from a set of given images. It is the process of merging relevant information of two or more images into a single image wherein the resulting image will be more informative and qualitative than any of the input images.

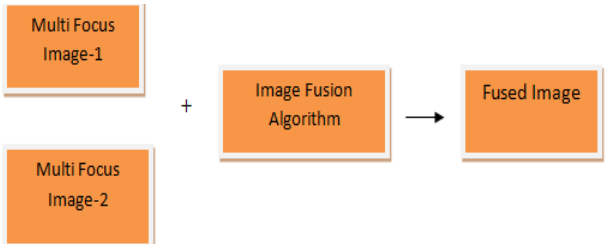

Fig 1.1 Flow Diagram of image fusion

Any piece of information is meaningful only when it is able to convey the content about it. The clarity and quality of information is important. Image Fusion is a technique to improve the quality and quantity of information from a set of images. By the process of image fusion the more information from each of the given images is combining together to generate a resultant image whose quality is maximum to any of the input images. This is achieved by implementing a sequence of process on the images that would generate the good information in every image prominent. The fused image is formed by merging such meaningful information from the input images into a single fused image.

2. EVOLUTION OF IMAGE FUSION

In 2003, image fusion process use method of registering and pixel level fusion techniques. All the set of images have different features, different intensities and different resolution at different time and developed global point mapping then search for control point matches of retinal images. In this technique fourteen pixel level fusion

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methods used to classified according qualitative and quantitative performance.

In 2006, IHS image fusion technique introduces. This is applying in applications of remote sensing in multispectral and panchromatic images. Through this technique it distorts the colour from input image as in same way it applied in after image fusion. This technique has tradeoffs parameters with its new approach and fast or easy implementation.

In 2007, A panchromatic image is merged and gives the desired output with improved quality and efficient resolution. In this wavelet based method image fusion are compared on the base of their spatial frequencies. All the wavelet transforms technique always gives better result than simple wavelet transform methods alone. The wavelet based methods, particularly in terms of reducing color distortions in images.

In 2008, Image fusion techniques used wavelet and PCA algorithm for image fusion. Fused image can be avoided using wavelets with shift invariant property. It has been concluded that image fusion using wavelet decomposition with higher level shows better result of performance in some metrics.

In 2009, Combination of pixel level and region based method with enhancement of edges and structure fusion applies for image fusion. These techniques are applicable for pixel level and energy based algorithms occur by analysing the data of images.

In 2010, Multiple techniques of fusion in RGB images, Gray Scale images occur. User interactive with DCT approach which is discrete cosine transformation generally for the better efficiency and information in fused image.

In 2011, Image fusion occurs by different methods or techniques and applying 2D-DWT algorithm on input images. Both Wavelet- DWT and SF is used for efficient output in fused image. Coefficients of input image at lower approximations are used in laplacian algorithm. Where SF and Wavelet combined together give better result and they are working for high approximation. Finally DWT technique gives the desired results through desired new fused coefficients.

3. LEVELS OF IMAGE FUSION

Image fusion can be categorized into different levels: low level, middle level, and high level; or pixel level, feature level, and Block Levels.

3.1 Pixel Level Fusion

This is simplest technique in image fusion done at pixel level. In this technique combine the values and intensities of two input images of same scene based on its average and give the single resultant fused image. The pixel-level mechanism works either in the spatial domain or in transform domain.

The prerequisite for such a process is that the images have been captured by homogeneous sensors, such that the images reproduce comparable or similar physical properties of the scene. The fusion technique, such as averaging, DCT method, principle component analysis (PCA), DCT and IHS based methods fall under the spatial domain approaches.

3.2 Feature Level

It work with the features of input image like if one image has its distorted eye and other have distorted any feature like nose, ear, head. In this level of technique fuse image easily extract the features of both similar images individually, then fusion mechanism gives the enhanced image after feature extraction.

The feature-level algorithms firstly segment the image into contiguous regions and then fuse the regions together using their appropriate properties. The features used for this technique may be calculated separately from each image or may be obtained by the simultaneous process of all the images.

3.3 Block level

In block level based fusion occurs according to the pixel blocks of the image. Blocks level technique is highest level technique comparative to above method. It is multistage measurements and representation is calculated according to the regions of input image.

4. APPROACHES OF FUSION TECHNIQUES

Term fusion means to combine the information acquire in several domains. Fusion is a process which can be used to improve excellence of descriptive from a set of images. The research issues of image fusion are to improve visible quality of fused image by reducing the noise. The continuous growth in data transmission through internet and also the methods which is been developed by the hackers in recent years forced developers to developed more reliable techniques of fusion

1. Spatial Domain Techniques
2. Transform Domain Techniques

4.1 Spatial Domain Techniques

In Spatial domain techniques we mainly deal with pixels of input image plane itself and all the operations done on pixel value of the input images. We know that the image is collection of pixels having (x,y) domain, Here x denotes the pixel position at X axis and y denotes the pixel position at Y axis. The Fusion techniques of spatial domain method are less complex and high payload. This method cannot even withstand at low pass filtering and common image processing attacks.

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Simple Maximum Method
In this method, we take two input images. And calculate their maximum pixels corresponding to input images. The resultant fused image is generating by selecting the maximum intensity of corresponding pixels from both the input images

Simple Minimum Method
In this method, we take two input images. and calculate their minimum pixels for the resultant fused image is obtained by selecting the minimum intensity of corresponding pixels from both the input image.

Simple Average Method
In this method, we take two input images. And calculate their average pixels corresponding to input images. The resultant fused image is generating by selecting the average intensity of corresponding pixels from both the input images

4.2 Transform Domain Techniques
Transformed domain based fusion are more robust and reliable as compared to simple spatial domain fusion. Such algorithms are robust against simple image processing operations like low pass filtering, adjustment (brightness and contrast) blurring, etc. On the basis of transforms of images from spatial domain to frequency domain, these techniques are classified as following.

1 Image fusion using Discrete Cosine transform.
2 Image fusion using Discrete Wavelet transform.

Discrete Cosine transforms.
DCT cosine transform is a transformation technique in this an image from space domain to transfer into frequency domain. In DCT method the generation of an even symmetric periodic sequence of frequency removes the discontinuity as the symmetric signal moves from one period to the next period smoothly.

As a result, like the DFT, the DCT does not suffer from leakage effects image pixels. Further, symmetric extension of the signal makes its length double from the original signal, and hence, its frequency resolution is better by a factor of two. Also, due to other properties like energy compaction, the computational advantage of image fusion being real rather than complex method makes it desirable for signal processing applications like image coding, speech coding, adaptive algorithms, and for many other coding methods.

Principal Component Analysis (PCA) method
Principal Component Analysis technique is a sub space method, which minimize the multidimensional data sets into lower dimensions for analysis. This method calculates the weights for each source image. This method uses the eigenvector corresponding to the largest Eigen value of the covariance matrix of each source image for further processing of image fusion.

Discrete wavelet transform
The Discrete Wavelet Transform (DWT) also converts the image from the spatial domain to frequency domain. The image is divided by vertical and horizontal lines and represents the first-order of DWT, and the image can be separated with four parts those are LL1, LH1, HL1 and HH1. In additional, those four parts are represented four frequency areas in the image. For the low- frequency domain LL1 is sensitively with human eyes. In the frequency domains LH1, HL1 and HH1 have more detail Information more than frequency domain LL1.

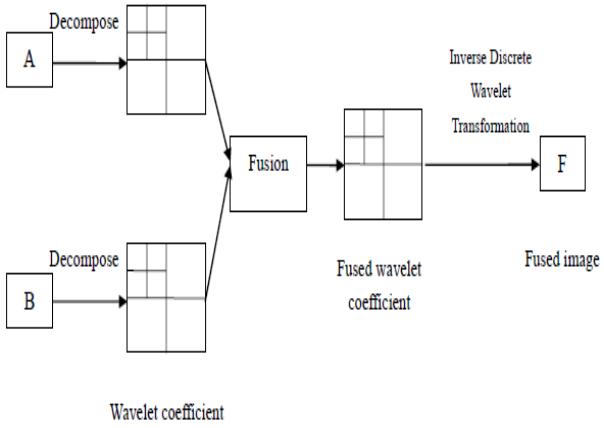

Fig 1.2 discrete wavelet transform (DWT) decomposition

(A) (B) (C)

Fig 1.3 A, B- Input Images, C– Fused image using DWT+DCT

TABLE 1 Result of image fusion using DWT-DCT

Measure	API	SD	PSNR	Entropy
Pepsi	97.8065	42.6922	36.6325	13.9461
leena	99.1347	46.7739	36.2360	4.8076
MRI Image	34.6227	44.0227	36.4992	12.1652

TABLE 2 Compared Result of image fusion using DWT-DCT

Measures	Existing PSNR [10] [12]	Proposed PSNR DCT-DWT
Pepsi	36.4166	36.6325
MRI image	25.64	36.4992

And we conclude that Proposed Method gives Better result as compare to Existing Technique

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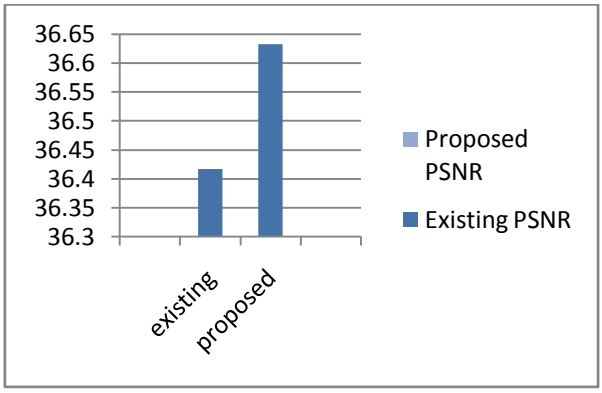

Fig 1.4 Analysis Graph of image Pepsi with Existing Technique [6] And Proposed Technique

5. CONCLUSION

The Proposed algorithm presents Hybrid DWT-DCT Digital image fusion algorithm. Proposed method exploits strength of two combined transform domain techniques DCT & DWT to obtain better image quality of fused image. The idea of inserting embedding image in combined transform is based on fact that joint transform eliminates drawback of each other and thus an effective embedding image method can be obtained.

From the results achieved by different technique mentioned in above it is observed that proposed image fusion techniques provide higher PSNR compared to individual DWT, DCT based existing image fusion technique so proposed work is better for image quality than existing image fusion technique. Proposed technique has lower standard deviation and higher PSNR compared to existing DWT and DCT technique so proposed technique provide more quality image compared to existing technique.

6. FUTURE WORK

Proposed technique can be modified for further enhancement of image quality parameter of fused image and performances are calculated against different attacks. Till now, we have worked upon grey scale and coloured image but we can perform fusion on animated image and video as well in future.

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BIOGRAPHIES

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