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Image Fusion Using Stationary Wavelet Transform and Particle Swarm Optimization

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ABSTRACT

The complementary idea of imaging sensors of various modalities all brought an incredible need of image fusion to separate applicable data images. Image fusion utilizing Stationary wavelet change (SWT) and improve parameter utilizing particle swarm optimization (PSO) has been executed and shown in PC MATLAB. In this paper chose images are melded and comes about got are arranged. The target of proposed algorithm was to augment the aggregate number of pixel in the edges to enhance the determination of edges points of interest, in this way having the capacity to envision more subtle elements in the images. In proposed algorithm, entropy is taken as determination criteria in stationary wavelet decay and PSNR is connected as the wellness work on particle swarm optimization to the informational collection The execution of proposed algorithm is estimated by top flag to commotion proportion (PSNR), entropy, mean square mistake (MSE), standard deviation, (STD) and so on.

Keywords:- Image fusion, Particle Swarm optimization, peak signal to noise ratio, entropy, Stationary Wavelet Transform

I. INTRODUCTION

In PC vision, multisensory image fusion is method to extricate applicable data from at least two source images into single melded image that contains awesome quality element frequently implies most elevated spatial or higher ghastly determination and also more solid and exact instructive when contrasted with any of the source image. For the most part, Image fusion strategies can be grouped into two classifications - Direct image fusion and Multi - determination image fusion that depends on pixel level fusion technique [1]. It is regularly partitioned into three levels relying upon the phase at which fusion happens, to be specific: pixel level, include level and choice level of portrayal. Pixel fusion is the most reduced – level fusion, which breaks down and coordinates the data previously the first data is evaluated and perceived. Highlight fusion is done in the center level, which breaks down and manages the component data, for example, edge, form, course acquired by pretreatment and highlight extraction. Choice fusion is the most noteworthy – level fusion, which focuses to the genuine target. Before fusion, the information ought to be obtained to pick up the autonomous choice outcome, so the data lose can't be stayed away from and in the meantime the cost is high [3]. Image fusion is essential systems now and again where it isn't conceivable to acquire an image that contain extremely critical protests in center because of restricted concentration profundity of optical focal points in CCD gadgets. Therefore, resultant image won't be in concentrate all around. Image fusion process is required to accomplish all articles in concentrate with the goal that every single centered protest are chosen. As of late, image fusion has been broadly utilized as a part of medicinal field, military task, in satellite and so on. [5].In expansion, an expanding number of uses, for example, highlight recognition, change observing and arrive cover order; regularly request the most elevated spatial and phantom determination for the best achievement of their goals. Because of those requirements, image fusion has turned into an intense arrangement furnishing a solitary image with all the while the multispectral substance of the source image and an upgraded spatial determination [6]. The complementary idea of imaging sensors of various modalities, all brought an awesome need of image fusion to remove important data from therapeutic images. The essentialness of fusion process is critical for multisensory images as single sensor images gives just particular data; in this manner it isn't doable to get all the imperative data from image created by single sensor in imaging [8].This paper uses stationary wavelet change (SWT) to meld the diverse multisensory general images and streamline the outcomes utilizing Particle Swarm Optimization (PSO).The proposed algorithm is tried on number of chose images and results got are organized. Richa gupta et.al melded the multisensory images by wavelet parcel based strategy with hereditary algorithm as an optimization algorithm [5]. Be that as it may, the discrete wavelet change (DWT) is absence of interpretation variation property. S.S Bedi et.al intertwined the images by utilizing half breed of wavelet and curvelet fusion lead [4] where the image experiences fusion twice utilizing productive fusion system give enhanced outcome. This strategy is intricate and required great fusion procedure for better outcomes.

II. PROPOSED FUSION APPROACHES

A.Stationary Wavelet Transform (SWT)

Wavelet Transform is basically used in feature detection of MRI, signal de-noising, pattern recognition and brain image classification. Richa gupta et.al fused the multisensory images by wavelet packet based method with genetic algorithm as optimization algorithm [5]. However, the discrete wavelet transform (DWT) is lack of translation variant property which can be nullified by using stationary wavelet transform (SWT). In SWT, even if the signal is shifted, the transformed coefficient will not change and also performs better in de-noising and edge detecting. In contrast to DWT, SWT can be applied to any arbitrary size of images rather than size of power of two and has shown better fusion performance in medical and other images. SWT is similar to DWT is more commonly known as "algorithm a trous" [9] in French meaning "with holes" which refers to inserts zeros in the filter for up sampling the filter and suppressing the down sampling step of the DWT [7].As with DWT, First the filters is applied to the rows and then the columns asresults four images are produced (one approximation and three horizontal, vertical and diagonal detail images.

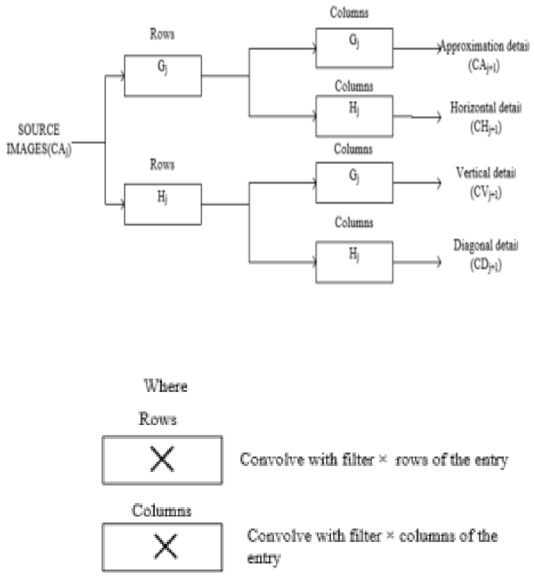


Figure 1 Decomposition steps for two dimensional SWT

Translation invariance of is achieved by removing the down samples and up samples in the DWT and up sampling the coefficients by the factor of 2j-1 in the jth level of the algorithm. Therefore, The SWT is redundant technique as the output of each level of SWT contains the same number of samples as input and improves the resolution of edges details with three groups of wavelet coefficients [7].

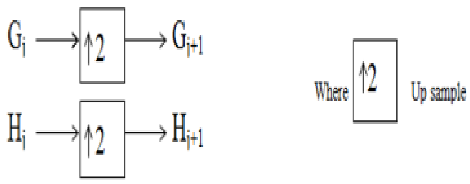


Figure 2 Final Computation

B.Particle Swarm Optimization

Particle Swarm Optimization is population based stochastic optimization algorithm, introduced by Dr. James Kennedy and Dr. Russell Eberhart in 1995.Particle swarm optimization is inspired by social behavior of bird flocking and school of fish and swarming theory in particle [10] and used to solve various problems in telecommunication, robotic, military and medical application [11]. In computer language, the swarm is similar to a population (set of particles) while each particle represents a potential solution [12].Unlike other approaches of evolutionary algorithms, the particle Swarm Optimization uses neither mutation nor crossover. To find the best solution PSO uses local and global information [13-14]. In PSO process, initially a group of random particles are considered and particle's fitness function is evaluated .Each particle moves with a adaptive velocity as given in equation (1) in search space and update its position by keep track of previous best position called pbest (position best) based on best experience of the particle itself and its neighbors or globally the whole swarm called gbest (globally best).

$$Vi = wVi-1 + C1 * rand . * pbest - Xi + C2 * rand . gbest - Xi \quad (1)$$

$$Xi = X_{i-1} + V_i \quad (2)$$

$$w = 1 \text{ gen .Num} \quad (3)$$

Where Vi-1, Vi , Xi are previous velocity, modified velocity and position of particle i respectively.C1 and C2 are cognitive and stochastic coefficients that influence particle velocity. rand is a random number ranges between 0 &1.gen. Num is current generation number. This algorithm then searches for optimum results through a series of generation. The location of best position of search space it has ever visited is stored in pbest and the best fitness function achieved during any generation is stored in gbest. The update process is repeated until the maximum number of generation is reached or specified fitness function is achieved as shown in Fig 3.

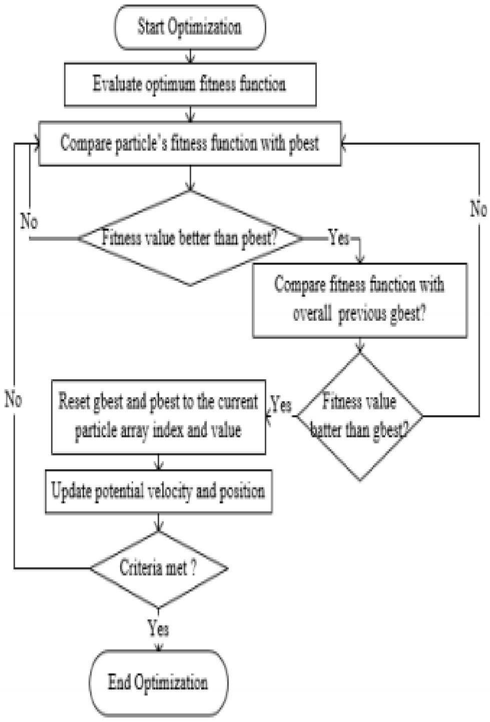


Figure 3 Flow diagram of particle swarm optimization

III. PROPOSED ALGORITHM

In our proposed algorithm we have first register source images to assure that the corresponding pixels are aligned. After that SWT is applied to decompose images into wavelet transformed images. The transform coefficients of different portions are performed with a certain fused rule. Apply optimization on transformed images by using particle swarm optimization (PSO).The fused image is constructed by performing an inverse stationary wavelet transform (SWT). The whole process is shown in Fig. 4

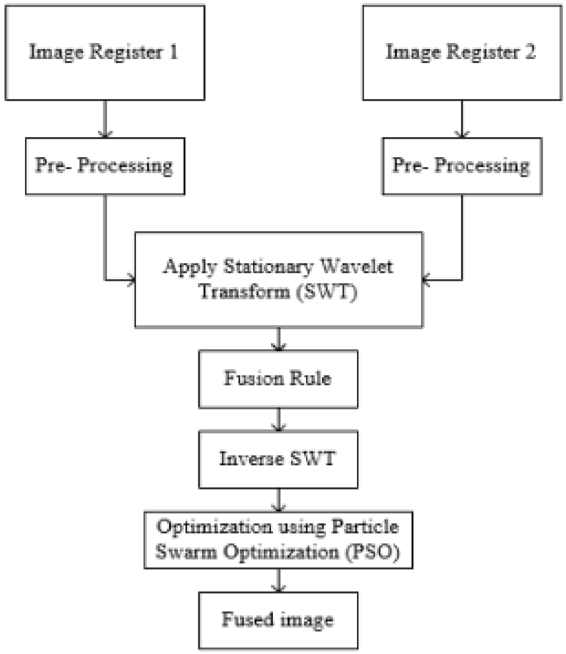


Figure 4: Proposed algorithm

IV. OBJECTIVE EVALUATION FOR IMAGE FUSION

The quantitative evaluation parameters are as follow [5]. The parameter evaluated mainly peak signal to noise ratio, mean square error, mutual information etc.

A.Peak Signal to Noise Ratio PSNR will be high when the fused and source images are alike. Higher value means better fusion. It is computed as: PSNR=10 log $(\frac{L^2}{RMSE})$ (4)

Where L is the number of gray level in the image Where Ix i, =source image If (i,)=fused image.

B.Standard Deviation It is known that standard deviation is composed of the signal and noise parts and it is more efficient in the absence of noise. It measures the contrast in the fused image. An image with high contrast would have a high standard deviation.

$$\sigma^2 = \frac{1}{N-1}\sum_i^n (x-\mu)^2 \quad (5)$$

Where μ= number of pixels.

C.Entropy Entropy is defined as amount of information contained in an image. Shanon was the first person to introduce entropy to quantify the information. Entropy is sensitive to noise and other unwanted rapid fluctuation. If entropy of the fused image is higher than parent image then it indicates that the fused image contains more information. Using the entropy, the information content of a fused image If is

$$H_e = -\sum_{i=0}^{l} h_{I_f}(l)\log_2 h_{I_f}(l) \quad (6)$$

D.Variance Variance filter is basically used to determine the edge detection and to find how each pixel varies from the neighboring pixel. It is computed as:

$$\sigma^2 = \frac{\sum(x-\mu)^2}{N} \quad (7)$$

Variance= 6.7811e+06

X=Source image, μ= mean of the population and N=number of source images.

V. RESULTS AND DISCUSSION

This section contains the qualitative and quantitative analysis of the fused images taken from the proposed algorithms.

Data Set The proposed algorithm is tested on three multisensory general images. All the images are of same size i.e. 256*256.Evaluation parameter play vital role in measuring the qu ality of image obtained from proposed fusion algorithm. The objective of proposed algorithm was to maximize the total number of pixel in the edges thus being able to visualize more details in the images. The parameter evaluated mainly entropy, peak signal to noise ratio (PSNR), mean square error (MSE), mutual information (MI), standard deviation (STD) and variance etc.

Qualitative and quantitative analysis Source images and qualitative analysis results for data set using SWT-PSO is shown in fig 5, while the quantitative results are outlined in table 1. In proposed algorithm, entropy is taken as selection criteria in stationary wavelet decomposition and

PSNR is applied as the fitness function on particle swarm optimization to the data set.

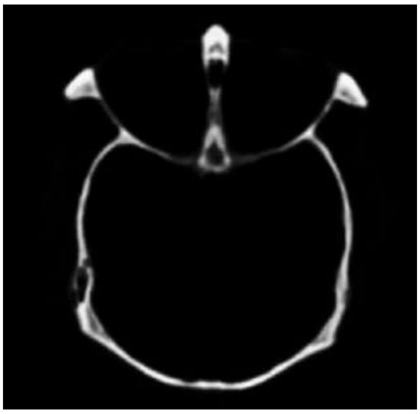


Fig 5 Input image1

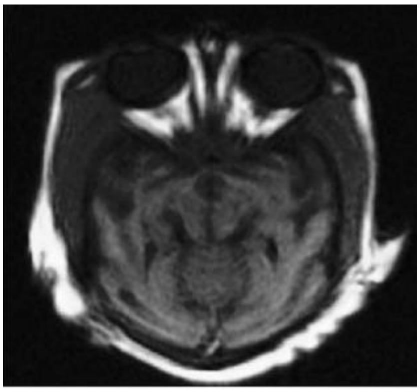
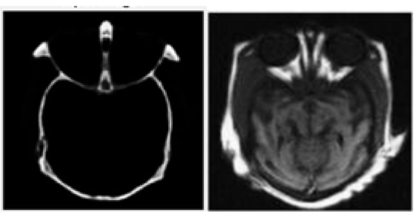
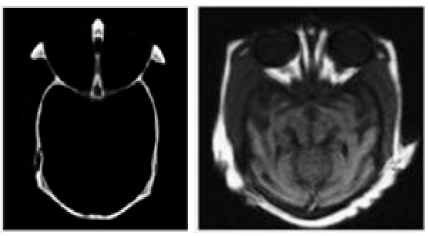


Fig 6 Input Image2



(i) (ii)



(iii) (iv)

Fig 7 fig (i) & (ii) are representation of input images and Fig (iii) & (iv) are representing their gray level images

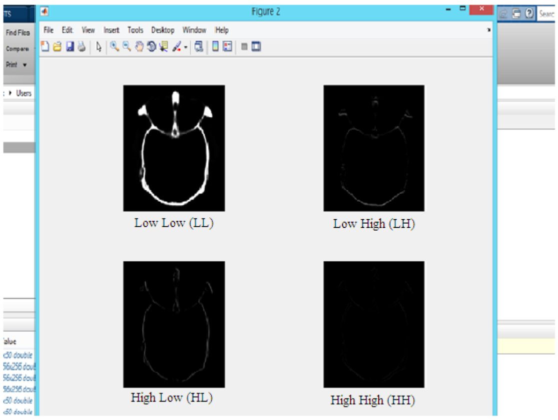


Fig 8 Representation of sub-bands of Input Image1

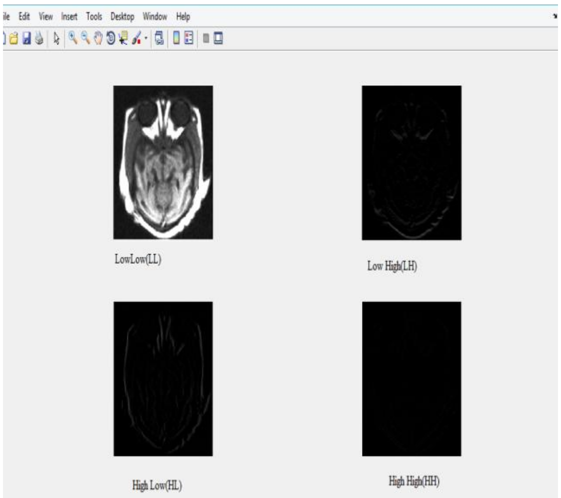


Fig 9 Representation of sub-bands in Input Image2

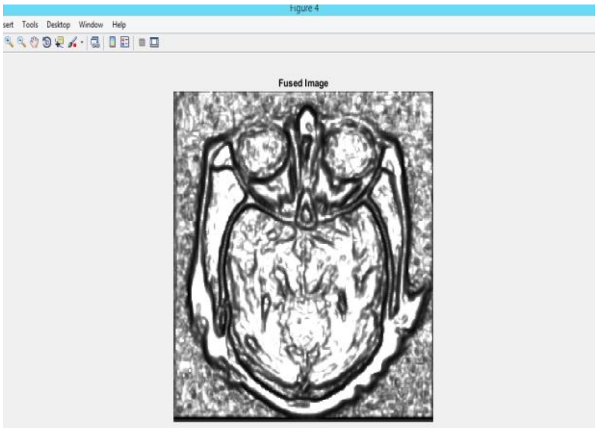


Fig 10 Fused Image

Table I

Quantitative Analysis

Comparison Table		
Parameters	**Existing system values**	**Proposed system values**
PSNR	47.8	51.67
Entropy	67	73.55
Standard Deviation	4	6.94
Variance	3	6.78

VI. CONCLUSION

The target of image fusion is to keep most extreme ghastly data from the first multispectral image while expanding the spatial determination. Image fusion is a critical issue for remote detecting and restorative field. Numerous algorithms were created in these regions for better execution of the melded images. Image quality evaluation of intertwined images may give examination between the distinctive fusion strategies, yet the conclusion isn't so broad on the grounds that diverse test images would prompt distinctive appraisal comes about. To address this issue the present proposition proposed different coordinated methodologies for image fusion for upgrading the perceivability of the image and enhancing the spatial determination and the otherworldly data of the first images.

In this paper, two multisensory images are intertwined utilizing stationary wavelet change and genuine coded particle swarm optimization (PSO) is connected for image improvement. In proposed algorithm, entropy is taken as determination criteria in stationary wavelet disintegration, comparing estimation of entropy found is 6.944and PSNR is connected as the wellness work on particle swarm optimization to the informational index, found that estimations of PSNR are 51.6784 for image 1, image 2 individually. By applying PSNR as the wellness capacity to the informational index, it is watched that PSNR has high an incentive by de-noising the images inferring that present work is equipped for giving great quality combined image with more useful substance. Henceforth, this proposed work is particularly helpful for number of images.

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