ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Detection of Brain Tumor by Image Fusion Using Genetic Algorithm.

SL Jany Shabu[1]*, and C Jayakumar[2].

[1]Faculty of Computing, Sathyabama University, Chennai, India
[2]Computer Science & Engineering, Sri Venketeswara College of Engineering, Sriperumbudur, India.

ABSTRACT

Random and rapid of abnormal cells in and around the brain area leads to the death of healthy brain cells. The statistics of 2011 reports that “The number of new cases of brain and other nervous system cancer was 6.4 per 100,000 men and women per year. The number of deaths was 4.3 per 100,000 men and women per year”. Hence the major challenge in medical image processing is to detect the brain tumor at the very early stage in order to reduce death rates. In this paper, a novel approach has been used to detect the brain tumor using Genetic Algorithm. Initially two input images are preprocessed and enhanced. The enhanced images are fused using Genetic Algorithm and extract the features for fused image. The extracted features are used to detect the Tumor Region. The quality and accuracy of the fused images are compared to the conventional methods. The efficiency of the proposed algorithm is compared with existing wavelet based fusion method and it is validated that brain tumor detection by Genetic Algorithm works well with 40.66 (Peak Signal to Noise Ratio) PSNR.
Keywords: Brain Tumor; Genetic Algorithm; Feature Extraction; Image Fusion.

Corresponding author

INTRODUCTION

The diagnosis of brain tumor by imaging technique is a boon to brain tumor patients. The process of medical image fusion involves combining multiple images from single or several imaging modalities refine and augment the imaging quality thus by reducing randomness and redundancy. This is a user friendly approach for the clinical applicability of medical images for diagnosis and assessment of medical problems. Image Fusion is one of the efficient techniques adopted to solve the problem that produces a single image which retains all the required significant information from a set of different sensors. Fusion of two images produces a clearer image than the input images. For example, Brain tumor may be obviously noticeable in SPECT image, but not in the MRI image. Structure of the brain can be observed in MRI, but not in SPECT image, Multimodal fused image shows the anatomy of brain with tumor. Many creative and user friendly algorithms have been developed recently for image fusion and optimization. Genetic Algorithms are progressively being explored in image analysis to decipher complex optimization problems. In this research paper, we introduced a new approach that includes image fusion using Genetic Algorithm to detect brain tumor at the early stage.

Related Work

V. Jyothi et al. (2011) have compared the regular image fusion techniques with the Genetic Algorithm based techniques. They introduced Pixel level weighted average method using GA and weighted average DWT based image fusion using GA and they found that GA based techniques gains much better results when compared with the predictable techniques.

Tanish et al. (2009) have proposed Region based image fusion method on two types of MR sequence images to dig out useful information which is then compared with different pixel based algorithms. The act of these fusion schemes is evaluated using standard quality assessment parameters. From the analysis they found that their scheme provides a better result compared to pixel based fusion scheme.

Vivek et al. (2013) have developed a novel method for Wavelet Based Image Fusion to detect brain tumor. Image fusion is performed by performing multimodality scanning images such as CT, MRI, PET, and SPECT images. Image segmentation algorithm results are better than Gradient Vector Flow Algorithm. Since non-stationary signal fails to be analyzed by Fourier Transform, a novel wavelet based image fusion was developed and wavelet transforms are performed by analyzing the components of a non-stationary signal. They have implemented wavelet transform, for the decomposition and fusion of image. A wavelet based fusion algorithm for image fusion is more efficient than segmentation. It achieved a better result when the algorithm is decomposed with fourth level decomposition.

Chetan et al. (2011) have developed Pixel based and wavelet Based Image fusion method for fusing two medical images. Pixel level image fusion methods affect the contrast of the image and this problem was resolved by wavelet based fusion approach. Wavelet based image fusion decomposes the input image into various decomposition levels of discrete wavelet transform and then the decomposed images are fused by wavelet fusion algorithm. They obtained the original image by performing the inverse wavelet transform. Also, it removes the limitation of pixel based image fusion method.

Anjali et al. (2013) have developed an image Fusion Method based on incorporation of Wavelet and Fast Discrete Curvelet Transform. They recognized that the wavelet transformation does not present clear information about edges. So they implemented the integration of wavelet and fast discrete curvelet transform which analyses feature of images in a better way and also gave clear edge information. Incorporation of both methods preserves both high spatial and high spectral quality contents of an image.

PROPOSED METHODOLOGY

The proposed image fusion algorithm detects the brain tumor at the very early stage. The image fusion algorithm is used to obtain an image with different modalities of images; a multimodal image fusion is required to fuse the images, giving a better view of human or machine perception.

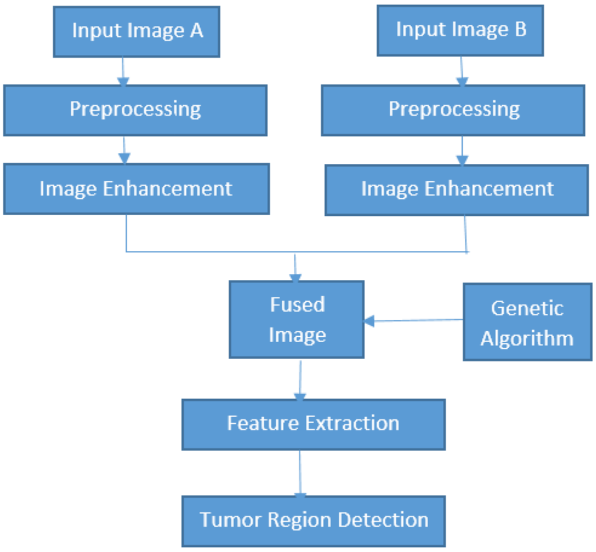


Fig 1: Block diagram of proposed methodology

The block diagram of the proposed method is illustrated in Fig1. The Major steps of this approach are Preprocessing, & Image Fusion and Feature Extraction. Initially two input images are preprocessed to remove unwanted artifacts and noise and then the image is enhanced to improve the quality of the image. Finally the enhanced images are fused by the genetic algorithm and the extracted features are used to detect the brain tumor.

Preprocessing

The input images are pre-processed by median filter to remove or suppress the noise in the image. The median filter is normally used to reduce noise in an image. Consider the following 6*6 matrix. The median value of any pixel is derived by calculating the nearby neighbourhood pixel values.

Steps:
1) Take the pixel for which median to be generated.
2) Find the neighbour pixels.
3) Write the neighbour pixel values in ascending order.
4) Take the median of the pixel if odd numbered pixels.
5)If even numbered pixels, take the median of the two middle pixels.

For example, take pixel 142.The neighbourhood values are 125,131,140,139,116,135,149,117.After arranging it in ascending order,116,117,125,131,135,139,140,142,149.so the median value here is 135.

Table I: Calculation of Median value neighbourhood pixel

122	115	112	113	140	128
111	116	151	155	141	138
113	121	119	114	116	133
125	139	135	153	117	114
131	142	149	138	127	118
140	116	117	136	114	124

In Table I.
Neighborhood values:116,117,125,131,135 139,140,142,149
Median value :135

Image Fusion By Genetic Algorithm

Genetic Algorithm is used to fuse MRI and CT images. The best population is selected for the operation. Crossover selects two best chromosome, crossover that and produce new offspring. Finally, mutation randomly changes the population and produce new population.

1) Algorithm for image fusion using genetic algorithm

a). Get the two enhanced images as the input.
b). Generate random population of n chromosomes.
c). Calculate the fitness of each chromosome in the population.
d).Generate a new population by repeating the following steps until the new population is complete,
i.Choose two parent chromosomes from a population according to their fitness.
ii.Apply crossover probability forms a new offspring. If no crossover was performed, the offspring is an exact copy of parents.
iii.With a mutation probability, mutated new offspring.
iv.Consign new offspring in a new population.
e). Use new generated population for a further run of the algorithm.
f). If the end condition is satisfied, stop, and return the best solution in current population
g).Go to step b).

C. Feature Extraction

The features are extracted and input type is based on the appropriate properties of the image into a feature vector. The image content is mainly built with color, texture and shape soon. The color, texture and shape feature describes the image content from different angles. In this proposed system, Texture feature is extracted based on GLCM (Gray Level Co-Occurrence Matrix) is being used. GLCM produces a matrix table having directions and distances between pixels, and then extracts meaningful statistics from the matrix as texture features. GLCM is defined by P(i, j d,θ)) which expresses the possibility of the couple pixels at θ direction and d interval. When θ and d is resolute (i, j d,θ) is shown by Pi, j . Conspicuously GLCM is asymmetry matrix; its level is firm by the image gray-level. Elements in the matrix are calculated by the equation mentioned below,

$$P(i,j|d,\theta)=\frac{P(i,j|d,\theta)}{\sum_i\sum_j P(i,j|d,\theta)} \quad (1)$$

To get more accurate, precise results the following parameters, namely contrast, Homogeneity, correlation, Entropy and Energy are considered.

Measurement of Texture Parameters

The following are the parameters for measuring the texture,

i) CONTRAST**-** is derived as the separation between the darkest and brightest area. It is represented by the following formula,

$$\sum_{i,j=0}^{n-1} P_{i,j}\,(i-j)^2 \quad (2)$$

ii) CORRELATION**-** is derived into what is known as the correlation coefficient, which ranges between -1 and +1. It is denoted by,

$$\sum_{i,j=0}^{n-1} P_{i,j}\,\frac{(i-\mu)(j-\mu)}{\sigma^2} \quad (3)$$

iii) HOMOGENEITY- is defined as the quality or state of being homogeneous. The formula for homogeneity is,

$$\sum_{i,j=0}^{n-1} \frac{P_{i,j}}{1+(i-j)^2} \quad (4)$$

iv) ENERGY- gives the sum of squared elements in the GLCM .Also known as the uniformity or the angular second moment. Energy is given by,

$$\sum_{i,j=0}^{N-1} (P_{i,j})^2 \quad (5)$$

v) ENTROPY- Entropy is computed as the uncertainty in a random variable.

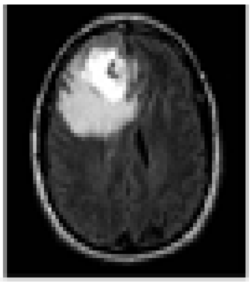
$$\sum_{i,j=0}^{N-1} -\ln(P_{i,j})\, P_{i,j} \quad (6)$$

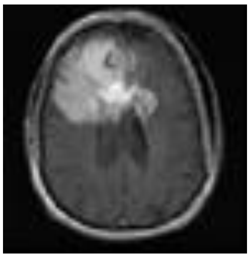
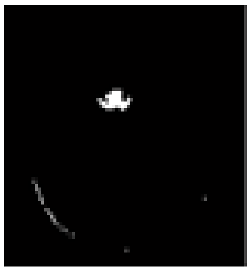
Table 2. Texture Feature Values For Input Images

	Contrast		Correlation		Energy		Homogeneity		Entropy
Images	Value 1	Value 2	Value 1	Value 2	Value 1	Value 2	Value 1	Value 2	Values
MRI Image	0.2991	0.4625	0.9512	0.9241	0.1798	0.1672	0.9306	0.9045	0.9984
CT Image	0.9422	1.0840	0.9304	0.9199	0.2378	0.2355	0.8644	0.8525	0.7856

Brain Tumor Detection

The extracted features are used to detect tumor region. Peak signal to noise ratio and mean square error are used to compare the quality, and accuracy of the fused images.



MRI Image; CT Image; Fused Image; Detected Tumor Region Efficiency of Algorithm

So far many algorithms have been evolved for brain tumor detection. GA makes use of the simplest representation, reproduction and diversity mechanism. Optimization with GA is performed through the natural exchange of genetic material between parents. The performance of the algorithm is evaluated by PSNR (Peak Signal to noise ratio).

$$PSNR = 20 * \log(256/E) \quad (7)$$

here E is root mean square error and is given by equation,

$$E = \left[\frac{\sum_i (r_i - d)^2}{m * n} \right]^{\frac{1}{2}} \quad (8)$$

mn is the number of pixels in the image and r,d denotes the original and fused images respectively.

The proposed approach produces a highly reliable fused image for detection of tumor. The efficiency of the proposed algorithm is compared with existing wavelet based fusion method and it is found that brain tumor detection by genetic algorithm gives better results with 40.66 PSNR.

Table3. Performance Comparison

Comparison of performance	
	PSNR
Genetic Algorithm	40.66
Wavelet based fusion	34.61

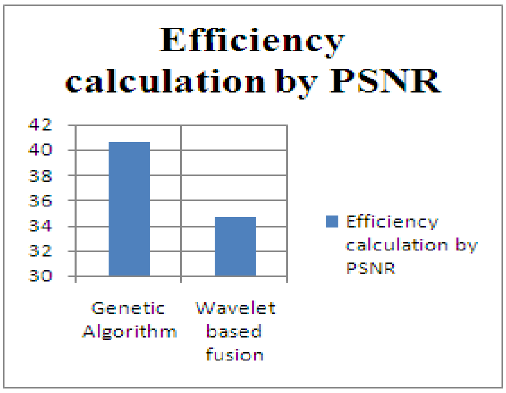


Fig 2. Comparison of Efficiency

CONCLUSION

Accurate detection of size and location of brain tumor plays a vital role in the diagnosis of tumors. Brain tumor is detected based on the extracted features from images. The proposed method removes the limitations of existing fusion methods. The proposed algorithm for the image fusion provides high quality fused image. It is found from the results that Genetic Algorithm is an efficient method compared to the existing image fusion methods. Proposed algorithm shows more accurate results in the fusion of two images after comparing it to wavelet based image fusion. This can be detected by other evolutionary algorithms like Fuzzy Logic and Neural Network with other parameters.

REFERENCES

[1] LakhwinderSingh,Dr.Sunil Agrawal,Mrs.Preeti Gupta.I J of Sci Research Engg & Techno 2015; (7).

[2] Manoj Kumar Kathane,Vilas Thakare ,I J of Engg and innovative Techno 2014;3(7).

[3] K. Kannan, S. Arumuga Perumal and K. Arulmozhi. Recent Patents on Signal Processing 2010; 2: 28-38.
[4] Vivek Angoth, CYN Dwith, Amarjot Singh.I J of computer vision and signal processing 2013;2(1):1-7.
[5] V. Jyothi, B. Rajesh Kumar, D. V. Rama Reddy,IJ of Computer Tech & Applications 2011;2: 322-326.
[6] SusmithaVekkot, and Pancham Shukla,World Academy of Science, Engineering and Technology57;372-377.
[7] Sapthagiri. K, Manickam. L ,I J of Merging Tech and Advanced Research Computing; ISSN: 2320-1363.
[8] B.K Saptalakar, et al,IJ of Computer and Electronics Research2013;2: 1.
[9] Pareshrawat, et al,IJ of Computer Tech and Electronics Engineering2011;1.
[10] V.P.S. Naidu and J.R. Raol, Defense Science Journal 2008;58:3.