Multimodal Medical Image Fusion using Grey World Algorithm and Deep Learning

Mrs.D.Vasanthi¹, Dr.U.Palani², Ms.S.Soundarya³, Mrs.T.Sivasakthi⁴

¹Associate Professor, Department of Electronics and Communication Engineering, IFET College of Engineering, Villupuram.
²Professor, Department of Electronics and Communication Engineering, IFET College of Engineering, Villupuram.
³UG Scholar, Department of Electronics and Communication Engineering, IFET College of Engineering, Villupuram.
⁴Assistant Professor, Department of Electronics and Communication Engineering, IFET College of Engineering, Villupuram.

¹dvasanthime@gmail.com, ²palani_uin@yahoo.com, ³soundaryasenthal712@gmail.com, ⁴sakthi15ifet@gmail.com

Abstract. Medical image fusion strategy assumes an undeniably basic job in numerous clinical applications by getting the corresponding data from clinical pictures with various modalities. The combination of these pictures assists doctors with giving dependable and exact clinical finding to their patients, and explores in any case outlandish medical procedures. The segmentation by ANN for these sub-pictures are utilized to get the areas of each level. So as to lessen the computational multifaceted nature, the proposed calculation is utilized to accomplish image segmentation.

Keywords: MRI, CT, Feature Extraction, ANN, Grey-world based algorithm.

1. Introduction

Image fusion is the process where a single image is formed by the combination of pertinent information from two or more images. When compared to the input image, the resulting output image will be more informative. A motivation for different image fusion algorithms is given by the increasing availability of space borne sensors in remote sensing applications. A single image requires high spatial and high spectral resolution in several situations in image processing. Such convincing data cannot be provided by most of the available equipments. The different information sources are being integrated by the image fusion technique. Complementary spatial and spectral resolution characteristics are obtained by the fused image. The medical issues that are mirrored through images of human body, cells and organs were addressed by medical image fusion which enclosed a broad range of techniques from image fusion and general information fusion. The imaging technologies in the areas of medical diagnostics, analysis and historical documentation have growing interest and application. A quantitative assessment of the images under evaluation is enabled by the computer aided imaging techniques, where an unbiased and objective decision is arrived in a short span of time and efficiency of the medical practitioners is improved. In addition, greater diversity in the features used for the medical analysis applications is offered by the use of multi-sensor and multi-source image fusion methods; information that is invisible to human eye is revealed in robust information processing. The fused image gives additional information which can be well utilized for more precise localization of abnormalities.

Image processing with ANN is used in various domains, such as:
- Industrial examination (quality control) so as to distinguish the imperfect items in the creation of steel, materials, natural products, vegetables, plants and food;
- Medicine for identification of tumors and the foundation of a clinical conclusion;
- Safeguard framework to recognize focuses for different route frameworks, direction, acknowledgment;

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d. Service of archives, in particular programmed handling of structures, arranging messages, the 
chance of learning a transcribed book, and so forth;
e. Identification and confirmation for enrolment number acknowledgment, unique finger 
impression examination so as to distinguish people;
f. Optimization issues;
g. Geotechnical building, so as to order the perilous zones with potential avalanches, to decide 
the qualities of the dirt;
h. Civil building, for the investigation of the rubber treated solid's homogeneity, to distinguish 
the gaps/breaks in various structures.

2. Related works
The gathering of various imaging modalities has become a typical clinical practice in joint 
examination of clinical information. Along these lines, an effective method of upgrading and joining 
data is given by the image fusion method, and expanding consideration is drawn from the clinical 
network. A novel cross-scale combination rule for multiscale-disintegration based combination of 
volumetric clinical pictures is proposed where both intrascale and interscale textures is considered. 
The coefficients are ideally arranged from the multiscale portrayals of the source pictures and 
compelling misuse of neighborhood data is dictated. A proficient shading combination conspire is 
likewise proposed [1]. The procurement of different cerebrum imaging types for a given report is a 
typical practice. There have been various methodologies proposed for joining or intertwining performs 
multiple tasks or multimodal data. These can be generally isolated into those that endeavor to examine 
intermingling of multimodal imaging, for instance, how capacity and structure are connected in a 
similar locale of the mind, and those that endeavor to consider the corresponding idea of modalities, 
for instance, using fleeting EEG data and spatial utilitarian attractive reverberation imaging data. 
Inside every one of these classifications, one can endeavor information incorporation (the utilization of 
one imaging methodology to improve the consequences of another) or genuine information 
combination (in which numerous modalities are used to illuminate each other). We audit the two 
methodologies and present an ongoing computational methodology that first preprocesses the 
information to register highlights of intrigue. The highlights are then broke down in a multivariate way 
utilizing free part examination [2].

In this paper, the proposed work is an Internal Generative Mechanism (IGM) based combination 
calculation. In the calculation, disintegration of source picture into a detail and course layer by 
mimicking the human visual framework instrument seeing pictures; at that point, the detail layer is 
intertwined by the calculation utilizing Pulse Coupled Neural Network (PCNN), and the coarse layer 
is circuited by the ghastly leftover based saliency strategy utilization; at long last, all the melded 
layers coefficients are consolidated so that the last combined picture is obtained. The calculation 
interest lie in the way that the essential standards of human visual framework seeing pictures is agreed 
and detail data is protected that exists in source images[3]. The separation of both auxiliary and 
utilitarian data from input grey magnetic resonance imaging (MRI) and Computer Tomography (CT) 
images is difficult where a similar decay conspire in multi-scale change combination strategies is 
utilized. Here two calculations dependent on inherent picture deterioration is utilized to break down 
MRI and CT pictures into its two separate parts in the spatial area. Retinex-based Methods could 
extricate auxiliary data while lessening the clamor from the MRI picture. Grey-world-based Methods 
is for averaging the shading data from the CT picture. Concerning the rule of image fusion, the 
characterized picture coefficients significance is utilized for the deteriorated two-scale segments 
joining and the last intertwined picture is delivered, where more spatial goal with replacement systems 
is kept. Utilization Retinex based strategy examines the solitary picture decomposition. The human 
visual framework is reenacted by Retinex strategy and the shading consistency marvel is clarified. To 
break down one picture into a reflectance picture and a illumination picture is the essential objective of 
Retinex-based strategies.
3. Grey world based method

For addressing of the issue of shading consistency grey world strategy is created. In human visual framework, the eyes get light where signs are imparted by the visual cortex. What's more, shading steadiness is a procedure portrayed as the technique of permitting the human cerebrum to see a conspicuous article simply like solid concealing paying little regard to the proportion of light reflecting from it at a given second. The info RGB (red, green, blue) shading picture pixel estimation is reliant on the light source, the surface reflectance and the camera sensitivity work. The brightening segment by the normal shade of the chose picture came about because of the shading steadiness is gauged by the Grey – World Technique. As per the norm of imaging framework, clinical imaging information can be partitioned into basic and practical picture. X-ray, basic picture, gives tissue kind of the human brain data. PET, useful picture gives the blood stream movement with low space goal data in a better way when all is said in done. For PET picture, helpful information is most likely going to realize changes perfectly healthy during acquirement as the tracer redistributes. The converging of MRI and CT pictures means to secure both the ordered image of anatomical structures of the human cerebrum and picture wide assessment of physiological and biochemical techniques inside the body. The information source pictures are thought to be co-enrolled.

In clinical pictures, for instance, MRI, the automated banners now and again are polluted by inclination field. It is a savvy thought to apply Retinex methodology for recovering the reflectance picture from the primary signs. Along these lines, the reflectance picture is recovered by removing the light of the smoothed picture from the principal clinical MRI picture. The critical subtleties of the injury district in human mind is given by pseudo-shading PET picture, the objective is to isolate the first PET clinical picture into reflectance picture containing the ordinary locales and brightening pictures containing the sore areas. On the supposition of shading steadiness, apply of gray-world calculation to the pseudo-shading PET picture for the injury area identification. In light of the information PET picture pulverized by the commotion, the information PET picture is right off the bat smoothed utilizing Gaussian channel initially to get great inborn pictures. At that point, The characterization of shading consistency as the as the diminish an impetus by averaging of R, G and B channels. The brightening picture is surveying by the extent of diminish a motivation to the ordinary estimation of the image framework with the disconnected concealing channel. Finally, the reflectance picture is gotten by the qualification between the data picture and the brightening picture. The decayed reflectance picture means the framework data of the information dark MRI and pseudo-shading PET
pictures. Also, the deteriorated light picture means the high-force data of the information pictures. At that point, the joining of disintegrated layers into a solitary picture utilizing PCA, IIC, and IHS based rules of combination for saving substantially more spatial data, separately.

4. Proposed method
Here, ANN is used in clinical images as a prediction method to out write the missing data in MRI and CT images. The MRI and input CT are fused together by segmentation using Artificial Neural Network algorithm. The proposed algorithm is used to design robust and efficient fusion rules for multiple fusion tasks.

![](image)

Fig. 2 Flow chart

The proposed method comprises three stages: preprocessing, feature extraction and back-propagation as classifier. In multi focus image fusion, the feature selection procedure is the important key role. A nonlinear response function is employed by ANN based methods where a special network structure is iterated many times in order to learn the complex functional relationship between input and output training data. ANN based fusion method exploits the pattern recognition capabilities of ANN. The ANN-based fusion methods indicate many applications that have more advantages than traditional statistical methods, especially when several input sensor data were inadequate or with much noise. The neural system will comprises of three layers – input layer, hidden layer and output layer. The input layer has a few neurons, which speak to the component factors separated and standardized from the source images. The hidden layer has a few neurons and the output layer can have at least one neurons.

4.1 Preprocessing
Image preprocessing alludes to the raw image preparation to address numerical twisting, adjust data radio metrically and take out the uproar and fogs in the data. In order to improve the nature of the pictures and make the component extraction stage more dependable, a preprocessing period of the pictures is important. Preprocessing is a consistent need at whatever point the data to be mined are boisterous, clashing or divided. The utilization of image enhancement methods which improve the quality (clearness) of pictures for human review is one of the most significant stages in medical images location and examination. Evacuating obscurity, clamor, expanding complexity and uncovering subtleties are occurrences of upgrade action

4.2 Feature Extraction
One of the most significant strides for perceiving strange areas from the clinical picture is feature extraction and a significant advance in clinical pictures arrangement. These highlights are separated utilizing picture handling procedures. The surface component was utilized in different regions including face discovery, face acknowledgment, clinical examination and satellite picture
investigation. Surface highlights have been used for some clinical picture applications. The combined picture should save all significant data contained in the info pictures and it ought not present any relics or irregularities.

4.3 Training stage
1. The stage of training mainly consist of five steps:
2. From the database, an image is loaded.
3. By the selected features as discussed earlier the image is Pre-processed and feature extracted
4. Features (feature vector) applied as input.
5. The back propagation neural network is trained
6. Save as .mat file.

4.4 Testing stage
1. From the database, an image to be tested is loaded.
2. By the feature extraction techniques, the image is Pre-processed and feature extracted.
3. Features extracted (feature vector) are applied as input to a trained neural network.
4. According to value of features, the decision is taken by it.
5. The output generated from neural network is checked.

5. Artificial neural network
Artificial neural networks are made up of interconnecting artificial neurons (programming built that copy the properties of natural neurons). May either be utilized to increase a comprehension of natural neural systems; or for overcoming artificial intelligence issues without forming a model of a real biological framework.

![Fig.3 Architecture](image.png)

As needs be in feed-forward systems; the sign stream is from commitment to yield units; cautiously in a feed-forward course. By then data dealing can connect over various layers of units; anyway no information affiliations are accessible. Feed-forward ANNs grant signs to travel one way just; from commitment to yield. There is no analysis (hovers) for instance the yield of any layer doesn't impact that comparable layer. The Feed-forward ANNs will all in all be straightforward frameworks that accomplice commitments with yields. Moreover, they are broadly used in structure affirmation

6. Implementation
In this paper, the tests are conveyed utilizing MATLAB coding. We have arranged a GUI design with a rundown of menus. Tapping on every menu will play out an autonomous capacity.
7. Conclusion

In this paper, the proposed fusion procedure can create a superior visual quality fused images and a list of capabilities including contrast perceivability, spatial recurrence, vitality of inclination, edges and change is utilized which improves the lucidity of the image block. Counterfeit Neural system is
prepared to recognize the unmistakable squares and wire the pair of images. A feed forward backspread neural system is actualized for the arrangement reason, which can be additionally stretched out to utilize different calculations of neural system. As just MRI and CT pictures are utilized to test the proposed strategy, however it very well may be additionally stretched out on different sorts of clinical images.

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