Deep Learning Technique for Brain Tumor Detection using Medical Image Fusion

M.Suganya, R.Sabitha, J.Aruna Jasmine

Abstract—Brain Tumor detection using Medical image fusion plays an important role in medical field .Using Fusion technique, The medical image can be enhanced to detect the tumor. It is a mechanism of combining various images of same scene into a single fused image to reduce uncertainty and redundancy, also extracting vital information from the source images. The applications used here to detect Brain Tumor are DBN and CNN techniques. This paper emerges a new process of fusing the images to produce efficient and reliable result for detecting the cancerous tissue and early detection of Brain Tumor.

Index Terms—MRI Image, PET Image, Image Fusion, DBN Network, CNN

1. INTRODUCTION

Medical image Processing is a new innovation used in medical field for disease diagnosis purpose. Due to poor quality of images, accuracy of the diagnosis is not satisfactory. To avoid such conditions, the images are enhanced by fusion method for better results.For that, denoising methods like median filter is introduced.Similarly further enhancement is achieved by converting information from multimodal images into single fused images.

Fusion image from various imaging systems like computed tomography (CT), MRI, and PET are used for medical diagnosis. The imaging technique provides different level of information for making diagnosis method easier. For example, CT images are commonly used for visualizing structures in dense and CT images are not appropriate for soft tissues and physiological analysis. Whereas, MRI imaging system provides good visualization of soft tissues and most commonly used for detection of tumors and any other tissue related abnormalities. PET technique involves in providing blood flow information but at the same time it suffers from low resolution in contrast to CT and MRI. So fusion of images extracted from different methods is useful for extraction of information necessary in clinical diagnosis and treatment.

Deep learning is one of the new technique in machine learning. Every lower dimensional projection corresponds to a higher perceptual level provided that the network is optimally weighted it result in a top level abstraction of the raw data or images

Magnetic Resonance Imaging (MRI)

An MRI (or magnetic resonance imaging) is a scanning technique in radiology that uses the magnetism principle, radio wave propagation and computer to produce body structure in the image format. The MRI scanning machine is a tube like structure surrounded by a huge circular magnet. The object is scanned by placing them on a moveable bed assembler called Ganter. The magnetic assembly creates a strong magnetic field which brings together the hydrogen atom, later that is changed as radio wave beams. These beams are then detected by the receiver part of the MRI scanner.

The received information is processed by a computer, and as a resultant image is produced. The image and its clarity produced by MRI is detailed portions of the image and it can detect abnormal changes within the body. For some specific testing, contrast agents, such as gadolinium, are introduced to improve the accuracy of the scanned images. MRI scan can be very much preferred for applications where a high accuracy output is needed like abnormalities in human brain include injuries and tumors.

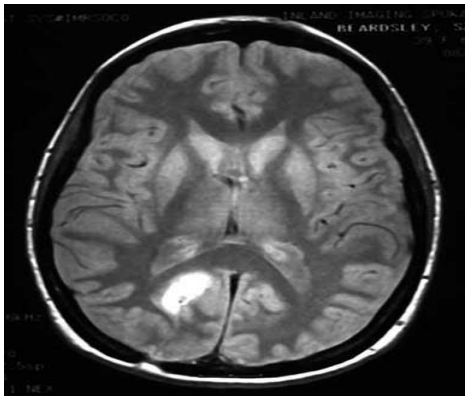

Figure 1: MRI Image

Positron Emission Tomography (PET)

A very specialized technique in imaging that uses radioactive substances to produce images with 3D objects that function within the body. The output of these scanning machine is called as PET scan.PET scan also gives details about the complete chemistry or metabolic activity of the human body, which is not easily available from any other image modalities. Other imaging systems like CT and MRI are used to cover the anatomy of the body, and thus they differ from PET in this way. The main application domain of PET scanning is in Cardiology, Neurology and Oncology. PET scan technique is adopted in estimating the level and requirement of bypass surgery earlier detection of micro calcifications and it is mainly used to detect the tumors growth rate.

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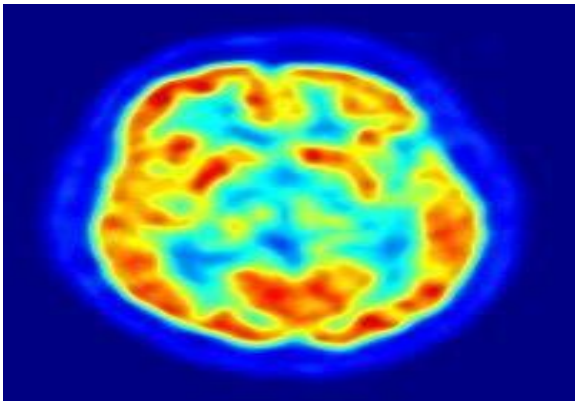

Figure 2: PET Image

2. ARCHITECTURE

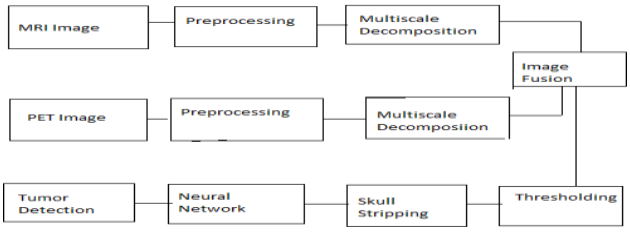

Figure 3: Workflow

3. PREPROCESSING

Preprocessing of MR images is the initial step of brain tumor detection. Various preprocessing methods exist which are categorized into intensity normalization, filtering, histogram equalization etc. Preprocessing of images is implemented to remove the noise and improvise the MR images. The ultimate target of these above methods is primarily to improve the quality of image , improvise image to get surety and ease in detecting the tumor.

In the proposed technique intensity normalization is applied on every sequence to bring the comparison and range of intensity among similar over patients. Calculation of the mean intensity and standard deviation to normalize the MRI images over all training sets is obtained for each sequences. On each sequence, normalization on the patches to measurable unit variance and mean as zero.

4. MULTISCALE DECOMPOSITION

Multiscale transform separates a given input signal into a set of signals which comprises information at different scales. The algorithm is used on multiscale images by decomposition to capture fine level details.

Image fusion:

The MRI image, PET image are preprocessed and moved to one step ahead for decomposition process which is then fused together to form a fused image. The combination of two or more images to form single image is called image fusion.This CT, MRI and PET image plays a significant role in detecting the brain tumor at early stage which is useful for disease diagnosis in medical field. So, fusion of images got from different modalities is reliable to extract required information for clinical process in diagnosis and treatment. It not only provides accurate description of the same object but also helps in required memory reduction by storing fused images instead of multiple source images. Different techniques are developed for medical image fusion which can be generally grouped into pixel, feature, and decision level fusion. Compared to feature and decision, pixel level methods are more suited for medical imaging as they can preserve spatial details in fused images

Restricted Boltzmann Machines

RBM is a pattern of neural network pattern involves binary units and undirected edges between units. The RBM has a major scalability issue. So learning for machine is not practical. The RBM has one hidden units. And RBM restricts connections between various hidden units. Therefore RBM allows effective and efficient learning algorithms.

Contrastive divergence algorithm is helpful to fasten the learning RBM. In parallel hidden units is updated starting with visible unit and reconstructing visible from units that are hidden, and updation of the those again finally, is the good idea.

Deep Belief Networks (DBN) is a multi-layer network, In this network each layer is RBM (Restricted Boltzmann Machine). To construct DBN each one is stacked to each other. To train DBN, CD algorithm is performed. Learning the final layer which is hidden if achieved the whole DBN is trained.

EXISTING METHOD

In Existing method, the brain tumor detection using medical images is through automatic segmentation method based on CNN. It also posses positive effect on giving weightage to the network. A new techniques of intensity normalization is carried out in preprocessing in the initial stage.The methodology used performs low in detection of brain tumor in early stage. The sata augmentation is not fully explored in deep learning technique and produce very less accuracy rate.

PROPOSED METHOD

Deep Belief Network technique is used in proposed methodology to overcome the limitations of neural networks A deep belief network is a graphic model, or even a network of neurons deep in machine learning type, consist of variables, interconnections within the layers, but not connected with the units. DBN is a model integrated with multiple layers. By using this algorithm it can reconstructs its input. Layers can act as a feature detectors further supervised to perform classification. It is a composition of unsupervised network.

A DBN can be trained to learn ,to probabilistically check its inputs on a sample dataset in unsupervised way. The layers is featured to detect on inputs. DBN is then practiced in an supervised manner. Another algorithm used is Convolution Neural Network to detect the brain tumor. The composite image is formed to improve image content and make easier for the user to detect tumor The main advantage of this methodology is it improves reliability in tumor detection and also improvises the capability with low noise and produce results with high accuracy rate.

Convolution Neural Networks

Convolution neural network is one of the method of ML(Machine Learning) technique.CNN is artificial neural network technique that is successfully applied to analyze visual image.CNN uses multiple layer preceptors which is designed to require minimal pre-processing method. It is otherwise called as shift invariant or space.

CNN is involved in pre processing method in contrast to other image classification methods. Convolution neural network consist of input and output layer and multiple hidden layer.

Pooling:

Convolution networks includes both local or global pooling layers. The average pooling is a process of combining the outputs of neuron clusters. For example, max pooling uses the maximum value from each of a cluster of neurons at the previous layer.

Median Filter:

The median filter is a feasible technique to get rid of pulse or spike noise where the central pixel takes place by median value. The results show median filter is more effective and efficient than the mean filter though it has few restrictions. Sorting all the pixels in numerical order and placing the pixel with considered pixel value is evaluated to obtain the value. Median filters are found to be efficient for both bipolar and unipolar impulse noise.

Fully connected:

Fully connected layers neuron on different layers are interconnected by various means. The principle is the same way followed by intraditional neural network(multi-layer perceptron).

Weights:

Convolution Neural Network share the weights shown in convolution layers,The same filter is used for receptive layers in the field; this weights plays a role in reduction of memory footprint and performance enhancements.

5. RELATED WORK& RESULTS

Magnetic resonance imaging (MRI) images through scanning is a most commonly used technique to detect tumors. The large amount of data produced by MRI limits the use of precise quantitative measurements in the field of medical . To avoid this situation, automatic and reliable method of finding the solution is required . Even then brain tumor detection using automatic segmentation was a difficult problem when considering the spatial and structural part in terms of variability . In this work, we present an segmentation method depending on Convolutional Neural Networks (CNN), involving 3 kernels. The application of provides a deeper architecture, begets a positive effect against over fitting, provided the lesser number of weights in network. In this paper Brain tumor segmentation is the primary task in medical image processing.. Manual segmentation of brain tumors for cancer diagnosis, from huge amount of MRI images is a hard and time consuming work in medical routine. There is a great necessity for automatic brain tumor image segmentation. The aim of this paper is to deliver a study of MRI-based brain tumor segmentation techniques.

CONCLUSION

A DBN can be trained to recreate its initial given inputs when data set is trained in an unsupervised way. The layers will act as feature detectors on inputs. Following this learning step, in order to perform classification, a DBN can also be trained in supervised way in other hand for enhancement. The DBN based brain tumor detection algorithm is successfully implemented and applied on medical images collected from various hospitals. Since DBN is a type and it is comparatively more accurate when compared to other techniques.

SCREEN SHOTS

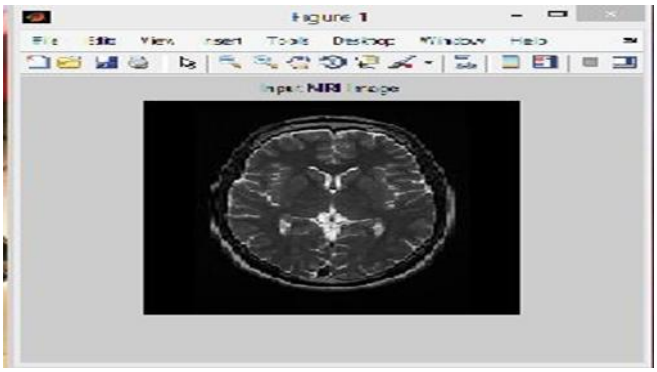

Figure 4: Input-MRI Image

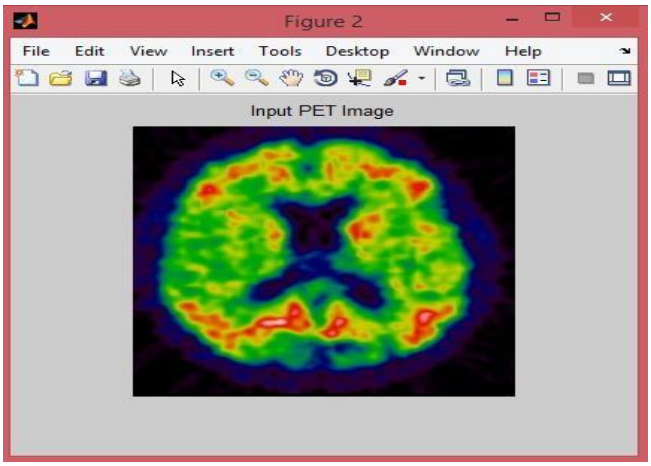

Figure 5: Input-PET Image

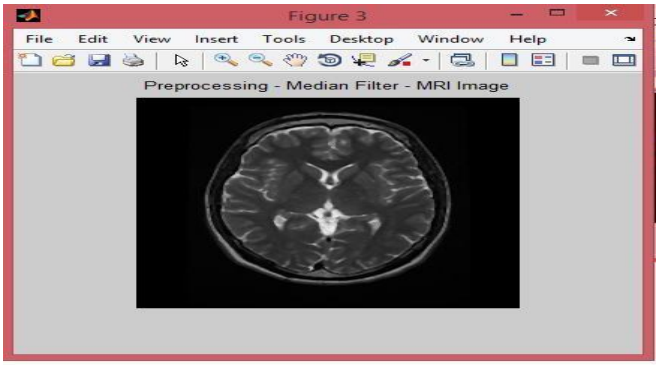

Figure 6: Preprocessing- MRI Image

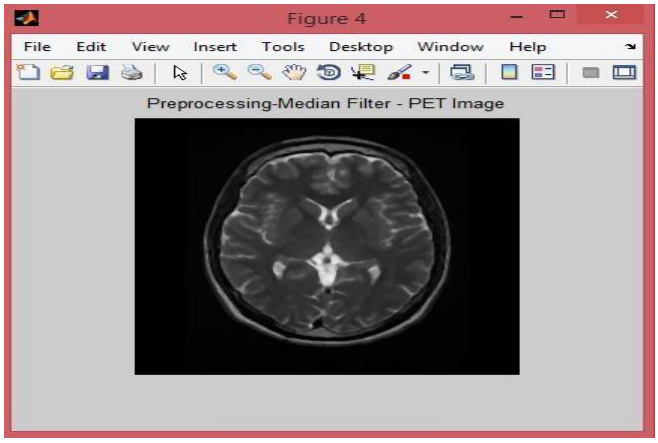

Figure 7: Preprocessing- PET Image

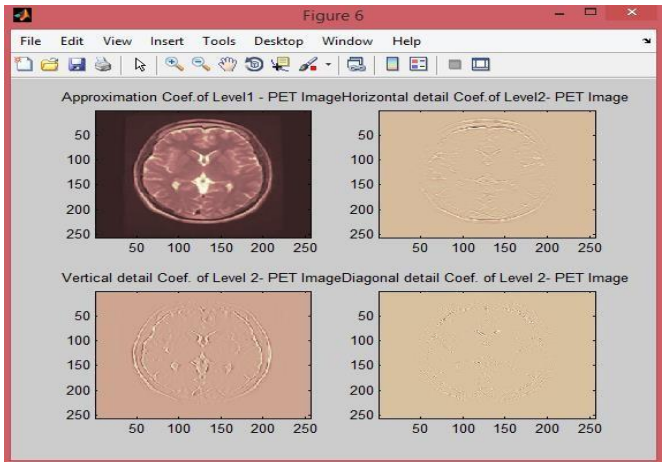

Figure 8: Output Image

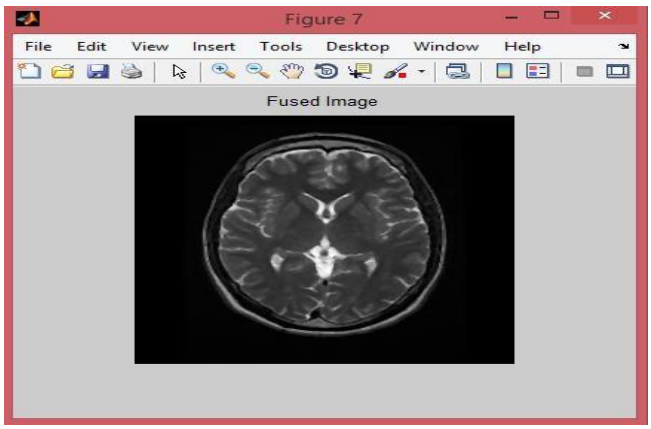

Figure 9: Fused Image

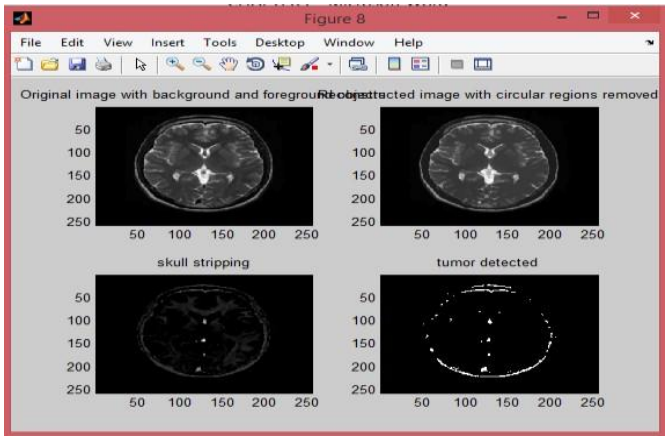

Figure 10: Original Output Image

Ethical Clearance: Taken from Jeppiaar Institute of Technology

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Conflict of Interest: NIL

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