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Detection of an Inflammatory Disease Based on Classification of Tissues in Brain MRI

R.Vidhya[1], Mrs.P.Rajarajeswari[2], Mrs.S.Ellammal[3]

PG scholar, Sri Vidya College of Engineering and Technology, Tamilnadu, India[1]

Associate Professor, Sri Vidya College of Engineering and Technology, Tamilnadu, India[2, 3]

Abstract: Detection of the Multiple Sclerosis (MS) Lesions on magnetic resonance image (MRI) is most important as a disease activity and surgical purpose in medical field. We propose an approach to provide tissue segmentation while appearing an inflammatory disease. The two stage of classification process uses in this method 1)a Bayesian classifier that performs a brain tissue classification at each voxel of reference and follow-up scans using intensities and intensity differences, and 2) a random forest based lesion-level classifier provides a identification of an inflammatory diseases. The method is evaluated on sequential brain MRI of 160 subjects from a separate multi-center clinical trial. The proposed method is compared to the manual identification and gives better performance, sensitivity with fault detecting rate than manual identification. For new lesions greater than 0.15 cc in size, the classifier has near perfect performance (99% sensitivity, 2% false detection rate), as compared to ground truth. The proposed method was also shown to exceed the performance of any one of the nine expert manual identifications.

Key words: Bayesian classifier, Lesion level Random forest classifier, an inflammatory disease, Multiple Sclerosis (MS) Lesions, Magnetic Resonance Imaging (MRI).

I. INTRODUCTION

In medical image processing the detection of new Multiple Sclerosis (MS) lesions or an inflammatory diseases that is an inflammatory disease on Magnetic Resonance Imaging (MRI) is important as a disease activity and surgical purpose.Brain Magnetic Resonance Imaging (MRI) is widely used in surgical and diagnosis purpose in that the image processing is used to give the result. Brain tissues classified as three ways that is, White Matter(WM),Gray Matter(GM),Ceribrospial Fluid(CSF).Multiple sclerosis (MS) is a chronic autoimmune disorder affecting movement, ensation, and bodily functions. It is caused by destruction of the myelin insulation covering nerve fibers (neurons) in the central nervous system (brain and spinal cord). MS is a nerve disorder caused by destruction of the insulating layer surrounding neurons in the brain and spinal cord. This insulation, called myelin, helps electrical signals pass quickly and smoothly between the brain and the rest of the body. When the myelin is destroyed, nerve messages are sent more slowly and less efficiently. Patches of scar tissue, called plaques, form over the affected areas, further disrupting nerve communication.

II. RELATED WORK

Cohn Elliott, Dougles L.Arnold, D.LouisCollius,Tal Arbel gives brief information about Automated segmentation of multiple sclerosis lesions in brain MRI by using I)Shochastic model.(ii)Markov model to increase the load correlation but, less accuracy [1].Petronella Anbek, H.c.Bisschops and Jeroen Vander Grand suggested that the probabilistic segmentation of white matter lesions in MR imaging by using K-Nearest Neighbor method to increase the accuracy but, the computational time is increased[2].Baseem A.Abdullah, Mel-Ling Shyu, Terri A.Scanduna, Nigel John gives brief details about the segmentation of Multiple Sclerosis Lesions in brain MRI is used to provide accurate edges but, the design is complex[3].Anjum Hayet, Gandal, Ahmad Khan gives brief information about a review of automated techniques for

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brain tumor detection from MR images for an Identification of brain tissues and detect the diseases. It used to provide high sensitivity[4].M.Eifadal, J.Zhang, H.Denn suggested that the abnormality detection of brain MR image segmentation by using Iterative Conditional Mode Algorithm but,it gives less accuracy[5].Muhamad Abdel.Mottaleb, Baseem A.Scandura contributed that a topology-preserving approach to the segmentation of brain images with multiple sclerosis lesions by using T2-Weighted techniques but, it have computational complexity[6].V.B.Padole, D.S.Chaudhari, K.K.Mektha gives brief description about brain MAI Segmentation by using T1 and T2 weighted spatially constrained Fuzzy C-means clustering to provide Effective performance and robust to noise[7]. Michel J.Berg,Sken Ebholm,Edward A.Ashton suggested that the accuracy and reproducability of manual and semi automated quantification of Ms lesions by MRI Geometrically Constrained Region Growth Method. It required large time for computation[8].Mareel Bose,Fabrico Hertz, Jem-Paul gives brief idea about automated change detection in muiltimodal serial MRI: application to MS lesions evolution by using joint histogram equalization method. It used to reduce the fault but, sensitivity is less[9].Reza Forghanl, Alan C.Evans gives brief information about the automation "Pipeline" Analysis of 3-D MRI Data for clinical Trials: Application to MS is used enhance to detect small treatment effects[10].

III. PROPOSED SYSTEM

The histogram equalization is an approach to enhance a given image. The approach is to design a transformation T(.) such that the gray values in the output is uniformly distributed in [0, 1].Histogram equalization yields an image whose pixels are (in theory) uniformly distributed among all gray levels. Sometimes, this may not be desirable. Instead, we may want a transformation that yields an output image with a pre-specified histogram. This technique is called histogram specification.

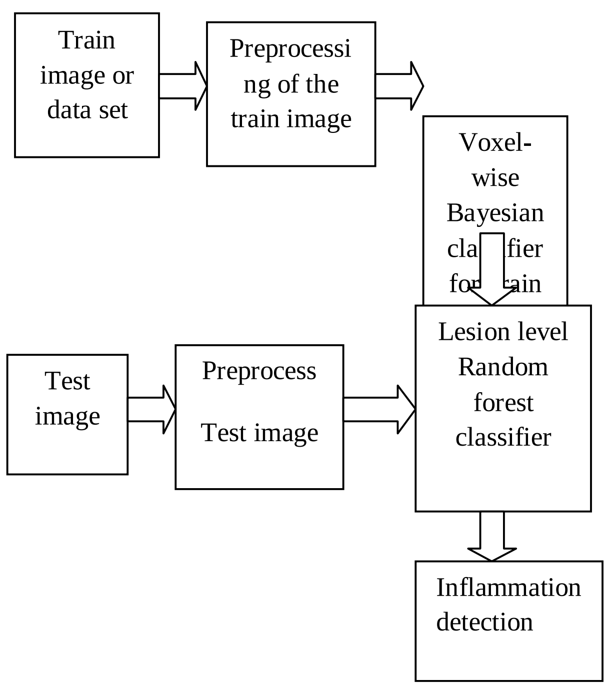

Figure 1: Block diagram

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The Sobel operator is used in image processing, particularly within edge detection algorithms. Technically, it is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function. At each point in the image, the result of the Sobel operator is either the corresponding gradient vector or the norm of this vector. The Sobel operator is based on convolving the image with a small, separable, and integer valued filter in horizontal and vertical direction and is therefore relatively i

3.1 preprocessing of the train image

Histogram equalization: Histogram provides a global description of the appearance of the image. If we consider the gray values in the image as realizations of a random variable R, with some probability density, histogram provides an approximation to this probability density.

3.2 Voxelwise bayesian classifier

The Bayesian Classification represents a supervised learning method as well as a statistical method for classification. Assumes an underlying probabilistic model and it allows us to capture uncertainty about the model in a principled way by determining probabilities of the outcomes

Bayes classifier employs single words and word pairs as features. It allocates user utterances into nice, nasty and neutral classes, labelled +1, -1 and 0 respectively.This numerical output drives a simple first-order dynamical system, whose state represents the simulated emotional state of the experiment's personification

3.3 Preprocessing or the test image

Median filtering: The median filter is a nonlinear digital filtering technique, often used to remove noise. Median filtering is very widely used in digital image processing because it preserves edges while removing noise. The median filter is a sliding-window spatial filter.

Edge detection using SOBEL: The Sobel operator performs a 2-D spatial gradient measurement on an image. Typically it is used to find the approximate absolute gradient magnitude at each point in an input grayscale image.

3.4 Train image/test image matching

The test image going to rotate by using geometrical rotated signals for match the position of both train and test image.Test and train image is compare to detect differences b/w that images.The convolution of two functions is an important concept in a number of areas of pure and applied mathematics such as Fourier Analysis, Differential Equations, Approximation Theory, and Image Processing.Nevertheless convolutions often seem unintuitive and difficult to grasp for beginners. This project explores the origins of the convolution concept as well as some computer graphic and physical interpretations of convolution which illustrate various ways the technique of smoothing can be used to solve some real world problems

3.5 Lesion level random forest classification

This section gives a brief overview of random forests and some comments about the features of the method.We assume that the user knows about the construction of single classification trees. Random Forests grows many classification trees. To classify a new object from an input vector, put the input vector down each of the trees in the forest. Each tree is grown as follows:

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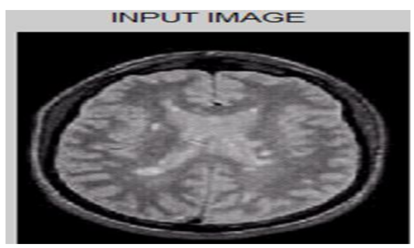
3.5 PRINCLPAL COMPONENT ANALYSIS

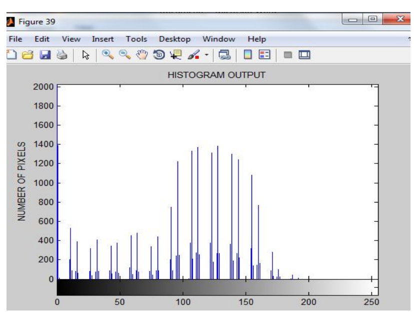
Principal Component Analysis (PCA) is the general name for a technique which uses sophisticated underlying mathematical principles to transforms a number of possibly correlated variables into a smaller number of variables called principal components.

1. Give the query image as the input.
2. Convert the input from BMP to data file.
3. Perform Discrete Cosine Transform on the dataset.
4. Extract 3X3 matrix based on subjective analysis.
5. Perform covariance on the 3X3 matrix.
6. Generate characteristic equation from the
covariance matrix and solve for maximum Eigen value.
7. Perform comparison of Eigen values by Least Mean Square Algorithm (LMS).
8 If LMS=0, recognize and display image; else no found match

IV. IMPLEMENTATION

Train image





Test image

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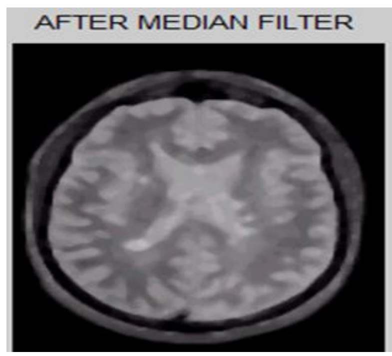

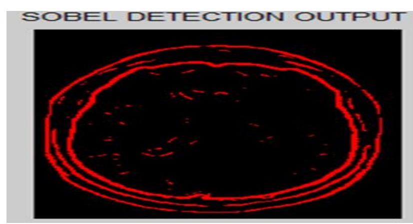

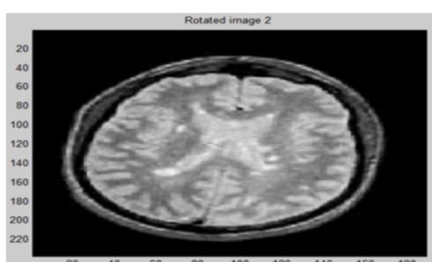

Less level Random Field

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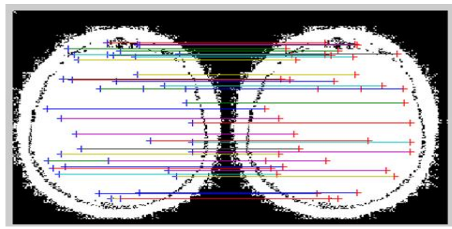

An inflammation detection

V. CONCLUSION AND FUTURE ENHANCEMENT

We haves presented a framework for automated detection of new MS lesions using a two-stage classifier that first performed a joint Bayesian classification of tissue classes at each voxel of reference and follow-up scans using intensities and intensity differences, and then performed a lesion-level classification using a random forest classifier. The new lesion classifier allows for trade-off of sensitivity and specificity through the use of a user-specified confidence threshold (or target sensitivity). Sample points of operation showed that our classifier is able to detect new lesions as small as three voxels with a sensitivity and false detection rate and a sensitivity with false detection rate as compared to a reference standard. Comparisons to manual identification of new lesions using only sequential FLAIR scans showed better performance than any individual expert rater and comparable performance to consensus segmentation combining manual identification of new lesion from nine independent raters. In future Classification of tissues and the Multiple Sclerosis(MS) Lesions will detect by using Principal Component Analysis. It provide less computational time and also give better performance.

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