ejpmr, 2018,5(5), 266-269

SJIF Impact Factor 4.897

EUROPEAN JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH

www.ejpmr.com

Research Article

ISSN 2394-3211

EJPMR

DETECTION OF MULTIPLE SCLEROSIS- A PROPOSED METHOD

Sudipta Roy[1] and Prof. Samir Kumar Bandyopadhyay*[2]

[1]Department of Computer Science and Engineering, Institute of Computer Technology (UVPCE), Ganpat University, Ahmadabad 380060, India.

[2]Advisor to Chancellor, JIS University, India.

***Corresponding Author: Prof. Samir Kumar Bandyopadhyay**

Department of Computer Science and Engineering, Institute of Computer Technology (UVPCE), Ganpat University, Ahmadabad 380060, India.

Article Received on 24/02/2018 **Article Revised on 17/03/2018** **Article Accepted on 06/04/2018**

ABSTRACT

Multiple sclerosis (MS) is one of the major diseases, and the progressive MS lesion formation often leads to cognitive decline and physical disability. In this paper, a method has been discussed where background generation and binarization using global threshold are the key steps for MS lesions detection and segmentation. After performing three phase level set, we add third phase segmented region with a contour of the brain to connect the normal tissues near the boundary. Then remove all lesions except largest connected area and corpus callosum of the brain to generate adaptive background. The binarization method is used to select the threshold based on entropy and standard deviation preceded by non-gamut image enhancement. Proposed method accurately identifies the size and number of lesions as well as location of lesions detection as a radiologist performs. The adaptability of the proposed method creates a number of potential opportunities for use in clinical practice for the detection of MS lesions in MRI. Proposed method gives an improved accuracy, and low error compares to existing recent methods.

KEYWORDS: MS lesion, Binarization, Multiple sclerosis.

INTRODUCTION

A quick and perfect method for estimating the number and size of MS lesions in the brain for Multiple sclerosis (MS) is crucial in determining the progress of the disease and effectiveness of treatment. But, the accurate identification, characterization, and quantification of MS lesions in brain MRI are extremely difficult due to the frequent change in location, size, morphology variation, intensity similarity with normal brain tissues, and inter-subject anatomical variation of brain images. MS is a central nervous system (CNS) disease that damages to the insulating myelin sheaths around the axons in the brain. MS causes the immune system to attack these nerve fibers. The rate of progress of MS varies from person to person and can have periodic remission and relapse. The healthy brain contains WM, GM, and CSF.[1]

Automatic segmentation offers an attractive alternative to manual segmentation which remains a time-consuming task and suffers from intra-expert and inter-expert variability. However, the progression of the MS lesions shows considerable variability and MS lesions present temporal changes in shape, location, and the area between patients and even for the same patient. Many segmentation techniques in the literature suffer from high false positives due to the similarity between MS lesions and the normal tissue and also due to basing the learning on pixels while the lesions form regions.

A comprehensive study of false positive and negative in MS segmentation is needed with proposed segmentation technique or any other technique to provide more accurate and clinical friendly results. The proposed technique is designed mainly for MS lesions detection, and the different tissues of the brain are not segmented. We have proposed a method that will generate the background for each image. Three phase level set is the key idea to generate backgrounds for each image. Contour detection performed after artifact and skull removal image. Then the level set image and the contour image to generate adaptive background has been performed. To detect MS lesion, a global threshold selection methodology has been performed by the combination of entropy and standard deviation. Then the binary threshold generated image is subtracted from the background image, and finally, the MS lesion is obtained. This approach captures the neighboring lesion properties and produces encouraging results, with a general improvement in the detection rate of lesions.

Review Works

Conventional methods are limited by lack of pathological specificity and lack of sensitivity to gray matter lesions and to microscopic damage in the normal-appearing white matter, which can also be associated with other chronic inflammatory diseases of the CNS.[2] Focal cortical lesions are typically not seen on some conventional method as they are smaller in size and have poor contrast with the surrounding normal gray matter, in addition to partial volume effects from the CSF.

An automatic multimodal graph[3] cuts to automatically segment MS lesions in MRI which replace the manual interaction to discriminate between MS lesions and the normal appearing brain tissues. It is observed with an example of semi-automatic edition of our automatic segmentation. When a lesion is missed, a user can add a seed, in this case, a source seed, and the graph cuts are recomputed in few seconds.

A semi-automatic segmentation[4] based active contour model and statistic prior knowledge of MS Lesions that can find in regions of interest within brain MRI. But it is useful for interactive segmentation due to its high performance and the facility to add or remove training prototypes to improve the results.

An augmented multi-sequence hidden Markov model[5] includes additional weight variables to account for the relative importance and control the impact of each sequence. The model, applied to the detection of multiple sclerosis and stroke lesions shows promising results. But investigating other settings, particularly in relation to targeting specific lesion types is a limitation of that method.

A new method[6] was used method based on Active Contours (AC) model incorporating tissue knowledge issued from T1-weighted and tissues distribution on FLAIR image. The GM and WM, as well as CSF tissue classes issued from T1-weighted and the tissues intensities issued, is used to determine an automatic outlier of each tissue class is used to detect outliers. Neither training nor thresholding is needed to performed the fully automatic segmentation based AC and outlier. Another advantage of our approach lies in the fact that it involves no thresholding step. Without explicit modeling, either soft or hard rejection, a predetermined threshold has to be used to decide the separation between the normal tissue and the outlier pixels. Since the thresholds are often data-dependent, manually chosen values tend to not work consistently across different data sets.

Proposed Methodology

Proposed Methodology MS lesions do not appear within skull portion of the human head. Skull removal methodology used to improve the MS lesion segmentation on input image $I_N(x, y)$ and skull removed image is stored in $I(x, y)$. Then decompose our method in two key steps as background generation and binarization. The final step for MS lesions detection and segmentation is used after background and binarization. A flowchart of proposed methodology has been shown Figure 1.

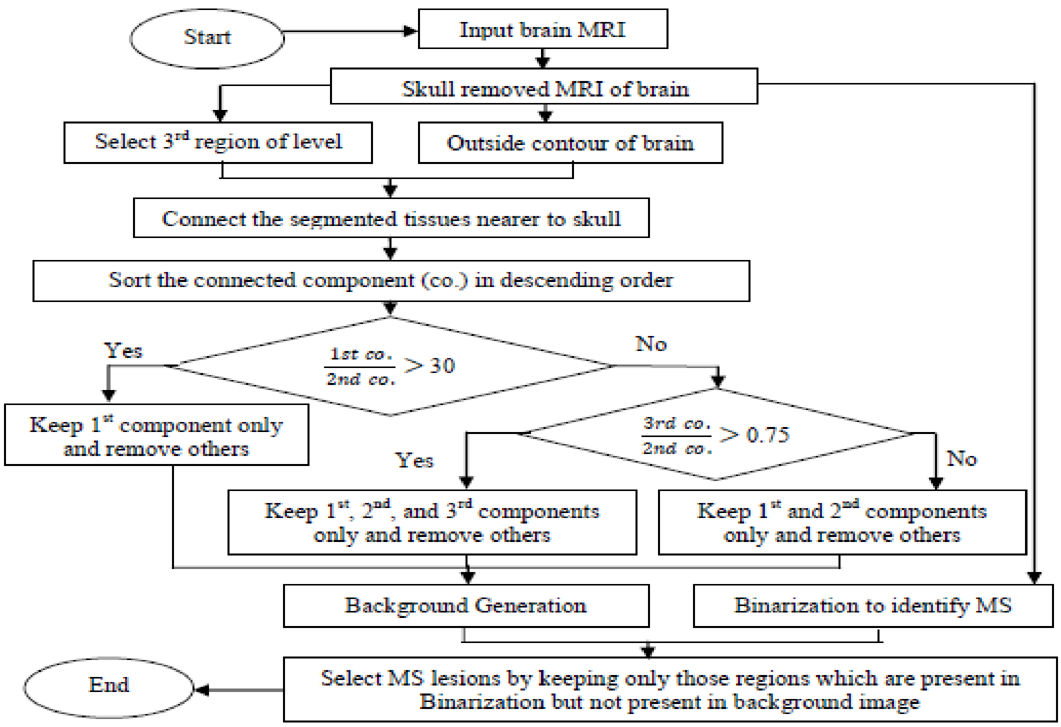


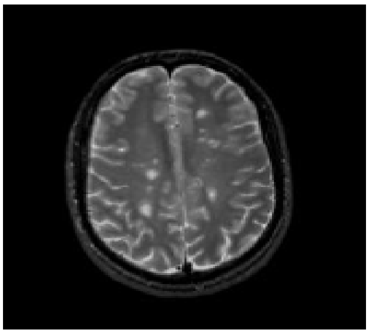
Figure 1: Flowchart of proposed methodology.

RESULTS AND DISCUSSION

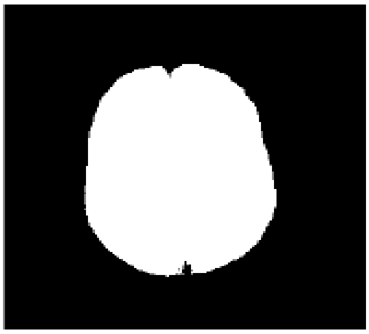
Proposed method tested on data set of "Whole Brain Atlas" image database[7], which consists of T1 weighted, T2 weighted, and PD MRI images. The method is implemented on Intel core2duo@ 2.13GHz processor and 2 GB RAM with Windows seven home basic 32-bit operating system. The support analysis software is used as MATLAB R2009a version.

Automated MS lesions detection and segmentation is complex and challenging. The progression of the MS lesions shows considerable variability and it present temporal changes in shape, location, and the area between patients and even for the same patient. So correct segmentation with its localization is very important, and the results of our method have been shown in Figure 2. Figure 2(b) is the binary output of Figure 2 (a) after skull removal. Skull removal is used because MS lesions do not contain in the skull. Skull removal makes post processing easier and we generate Figure 2(d) as the contour of Figure 2(b). The level set segmentation of region three has been shown in Figure 2(c). Figure 2(c) contains normal tissues as well as some abnormal tissues. It is also very clear from Figure 2(c) that normal tissues nearer to the skull are not connected. But it requires for background generation. To make normal tissues connected nearer to skull tissues we combine it with Figure 2(d) and generate Figure 2(e). Keeping one those maximum areas described in methodology are shown in Figure 2(e).

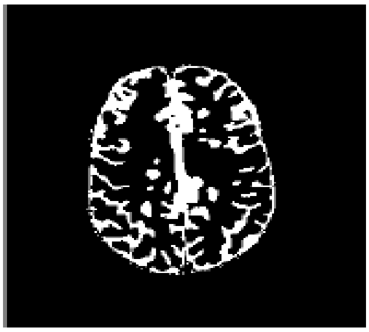
Now Figure 2(e) does not contain any MS lesions. Figure 2(f) is the binarized output generated using entropy-standard deviation method. Figure 2(f) contains MS lesions and some other normal tissues.



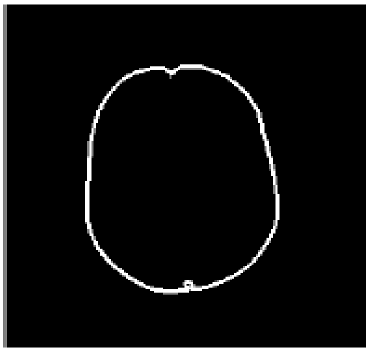
(a) Input brain image



(b) After skull removal

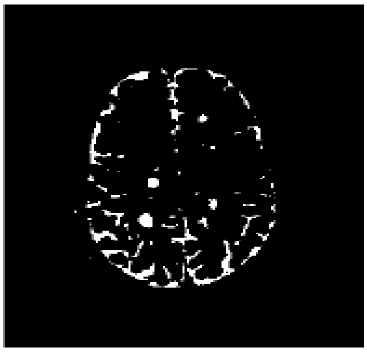


(c) CSF segmentation.



(d) Contour combination of

(e) Background



(f) Binarized result horizontal and vertical

Figure 2: Result of MS lesions segmentation. a) input brain image, b) Binary image after skull removal from (a), c) CSF segmentation from without skull image, d) combination of horizontal and vertical contour from (b), e) background generation from (c) and (d), f) output after binarization.

CONCLUSIONS

Proposed method provides a better segmentation on brain MRI with defined data sets both visually as well as metrically. Two different strategies are used to improve the lesion detection and segmentation. The use of skull removal and background subtraction concept deals with the higher level of MS lesion segmentation which does not generate any spurious lesions.

REFERENCES

1. Q. Mahmood, A. Chodorowski, M. Persson, "Automated MRI brain tissue segmentation based on mean shift and fuzzy c-means using a priori tissue probability maps," ELSEVIER, IRBM, 2001; 36: 185–196.
2. M Inglese, “MRI measures of neuroprotection and repair in multiple sclerosis,” Journal Neurological Science, 2016; 311(1): 16–23.
3. D. Garc´ıa-Lorenzo, J. Lecoeur, D.L. Arnold, D.L. Collins, C. Barillot, “Multiple Sclerosis lesion segmentation using an automatic multimodal Graph Cuts,” 12th International Conference on Medical Image Computing and Computer Assisted Intervention, MICCAI, Lecture Notes in Computer Science, 2009; 5762.
4. F Derraz, L Peyrodie, A Pinti, A Taleb, A Chikh, “Semi-automatic Segmentation of Multiple Sclerosis Lesion Based Active Contours Model and Variational Dirichlet Process,” Computer Modeling in Engineering and Sciences, Tech Science Press, 2010; 67(2): 95-117.

5. F. Forbes, S. Doyle D. Garcia-Lorenzo, C. Barillot M. Dojat, “A Weighted Multi-Sequence Markov Model for Brain Lesion Segmentation,” Proc. AISTATS, Chia Laguna Resort, Sardinia, Italy, 2010; 1-9.
6. F Derraz, Antonio Pinti, Laurent Peyrodie, Miloud Boussahla, Hechmi Toumi and Patrick Hautecoeur, "Multiple Sclerosis lesion segmentation using Active Contours model and adaptive outlier detection method," Proceedings IWBBIO 2014. Granada, April 2014; 7-9, 878-889.
7. Whole Brain Atlas: MR brain image [online (2013): http://www.med.harvad.edu/AANLIB/home.html].