IJEIT
ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 3, Issue 7, January 2014

An Intelligent Approach for Automatic Brain Tumor Detection

Manojkumar Kathane, Vilas Thakare
Department of Electronics & Telecommunication Engineering, Department of Computer Science & Engineering
J.J.T.University, Sant Gadge Baba Amravati University
Chudela, Rajasthan, Amravati, Maharashtra

Abstract*—In this paper we are comparing our proposed intelligent approach using Genetic Algorithm (GA) for automatic brain tumor detection in MRI brain images with the existing intelligent approaches. This uses "Relative Localization Weighted F-measure" (RLWF) [2], which attempts to acknowledge the worth of individual localizations made by the genetic program. The fitness function is based on precision and recall which always guaranty the best results. We use the images in the MICCAI BRAT 2012 database [3], a well-known and recent public dataset, to do our experiments. In this database, there are 30 subjects MRI brain images with T1, T1 contrast, T2 and FLAIR parameters. On observing results, it can be seen that GA based tumor segmentation algorithm is capable of detecting the tumor points.

***Keywords*—Genetic Programming, Tumor Detection, Fitness function, Image filtering.**

I. INTRODUCTION

A brain tumor is any intracranial tumor created by abnormal and uncontrolled cell division, normally found anywhere in the brain. Benign brain tumors have clearly defined edges and contain cells that look healthy, just like normal cells [1] [2]. They tend to grow slowly, are not likely to spread, although these tumors may cause harm if they start to interfere with normal brain function. On the contrary, malignant brain tumors have irregular borders, multiple protrusions and made up of abnormally shaped cells [1] [2]. The MR brain image segmentation is an important and challenging problem confronting grain mapping [1]. Accurate classification of magnetic resonance images according to tissue types of grey matter (GM), white matter (WM), cerebrospinal fluid (CSF)[7] at voxel level provides a means to assess brain structure. Lachmann et al. have proposed brain tissue classification from MRI data by means of texture analysis [4]. Xuan *et al.* suggested statistical structure analysis for MRI brain tumor segmentation [5]. Kupinski *et al.* [6] developed two seeded lesion segmentation techniques. Li *et al.* [7] have developed a segmentation method that uses probability to determine segmented contours. The present work is continuation of our earlier work based on theory of shape [8]-[9] related to gradation of benignancy of tumor in tissue region.

II. PROPOSED METHOD

The GP system described above is used for the problem of tumor detection from MRI brain images. The two main features used here are mean and standard deviation. Figure 1 shows the work flow of our system. The fitness function, was used for object localization using GP. We used the "Relative Localization Weighted F-measure" (RLWF) [2], which attempts to acknowledge the worth of individual localizations made by the genetic program. Precision refers to the number of objects correctly detected by a GP system as a percentage of the total number of object detected by the system. Recall refers to the number of objects correctly detected by a system as a percentage of total number of target objects in a data set.

$$Fitness = \frac{2X\ Precision X\ Recall}{Precision + Recall}$$

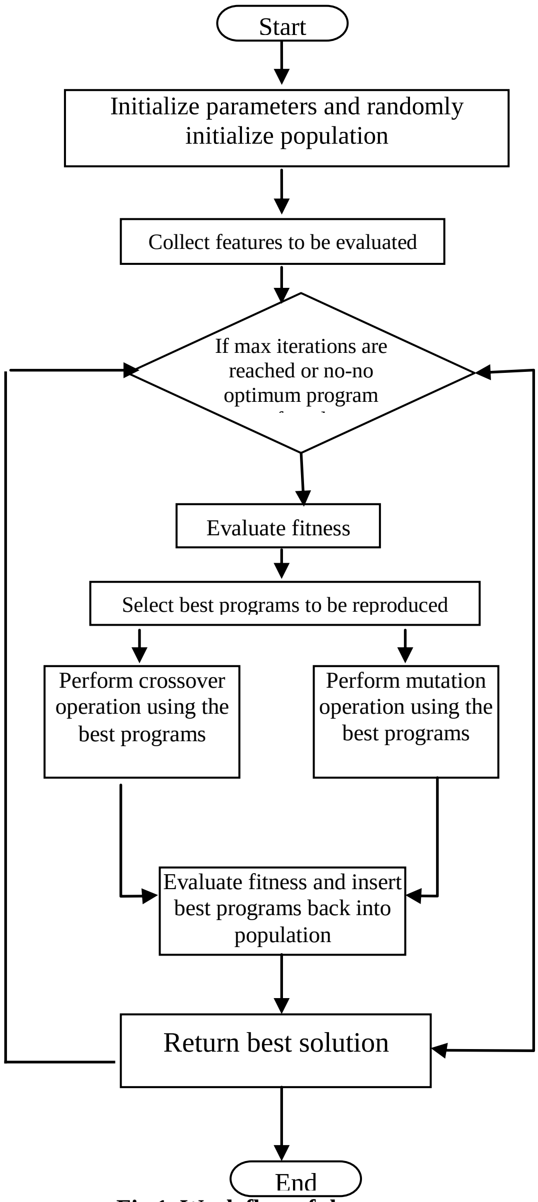

Fig 1. Work flow of the system

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 3, Issue 7, January 2014

In this approach, the learning/evolutionary process is terminated when one of the following conditions is met:

1) The detection problem has been solved on the training set, that is, all objects in each class of interest in the training set have been correctly detected with no false alarms. In this case, the fitness of the best individual program is zero.

2) The number of generations reaches the pre-defined number, max-generations. We use the images in the MICCAI BRAT 2012 database [9], a well-known and recent public dataset, to do our experiments. In this database, there are 30 subjects MRI brain images with T1, T1 contrast, T2 and FLAIR parameters. The dataset also has tumor annotation images. First, we read these images with toolkit available and converted those images in "PNG" format. Then, they were used in the experiments of tumor detection. On observing results, it can be seen that GP based tumor segmentation algorithm [10] is capable of detecting the tumor points.

III. COMPARATIVE STUDY

We have compared the experimental results of our system with other intelligent techniques. Following are the details of the same. In [6] Arpita Das et.al., present an attempt taken to determine the degree of malignancy of brain tumors using artificial intelligence. The suspicious regions in brain as suggested by the radiologists have been segmented using fuzzy c-means clustering technique. Fourier descriptors are utilized for precise extraction of boundary features of the tumor region. As Fourier Descriptors introduce a large number of feature vectors that may invite the problem of over learning and chance of misclassifications, the proposed diagnosis system efficiently search the significant boundary features by genetic algorithm and feed them to the adaptive neuro-fuzzy based classifier. In addition to shape based features, textural compositions are also incorporated to achieve high level of accuracy in diagnosis of tumors. The study involves 100 brain images and has shown 86% correct classification rate. In [5], Myung-Eun Lee et.al. described a segmentation method for brain MR images using an ant colony optimization (ACO) algorithm. This is a relatively new meta-heuristic algorithm and a successful paradigm of all the algorithms which take advantage of the insect's behavior. It has been applied to solve many optimization problems with good discretion, parallel, robustness and positive feedback. As an advanced optimization algorithm, only recently, researchers began to apply ACO to image processing tasks. Hence, we segment the MR brain image using ant colony optimization algorithm. Compared to traditional metaheuristic segmentation methods, the proposed method has advantages that it can effectively segment the fine details. In [4], in order to segment and register multimodality rigid medical images, they have proposed both Bayes theory and a maximum likelihood framework with a DAEM algorithm. First, they have performed segmentation using fast matching and the geometric deformable model and extracted the surface of the object from a segmented volume data. Then, the likelihood function for the intensity of the transformed node was obtained with the Gaussian mixture distribution. Second, they performed the DAEM algorithm to estimate optimal parameters of the transformation. We defined a Qfunction computed from the parameters of GMM for intensities of object regions of two given images. Then, they have used the Q-function as the criterion for the final registration. Experimental results showed that the proposed method had great potential of segmenting and registering rigid volume images given by multimodality instruments.

IV. EXPERIMENTAL RESULTS

It is observed that in the case of Ant colony method [5], the results are highly dependent on the number of iterations performed. According to the iteration times, the white matter is segmented well after two hundred iterations for T1-weighted image. And also, the gray matter is segmented well after two hundred iterations for T2-weighted image. Hence the segmentation result using the proposed ant colony optimization algorithm is more robust than the other method. In the case of fuzzy logic applied with GA in [6], the introduced a computer-based robust procedure to detect and classify lesions in MRI (both T1 & T2 weighted) and CT brain images. This classification technique concerns about the prediction of the disease either towards benignancy or malignancy using machine intelligence. The proposed method introduces GA for searching four significant Fourier shape descriptors that are able to represent the particular class/group of the tumors. Combination of both shape based and texture based classification also improves the decision accuracy on benignancy/malignancy gradation of the tumors. This study involves 100 brain images and has shown 86% correct classification rate. As compared to theses techniques our technique, we have used the images in the MICCAI BRAT 2012 database [2], a well-known and recent public dataset, to do our experiments. In this database, there are 30 subjects MRI brain images with T1, T1 contrast, T2 and FLAIR parameters. The dataset also has tumor annotation images. First, we read these images with toolkit available and converted those images in "PNG" format. Then, they were used in the experiments of tumor detection. On observing results, it can be seen that GP based tumor segmentation algorithm is capable of detecting the tumor points. There may be requirements of some post processing for the segmentation of tumor around the detected tumor points. This shows the appropriateness of the evolutionary algorithm in the segmentation of MRI images for the tumor localization.

V. CONCLUSION

We have presented a novel segmentation system of tumor detection using genetic programming. This is an approach that has not been used before. It has used a very powerful tool which has recently emerged to solve difficult

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 3, Issue 7, January 2014

classification problems, namely, Genetic Programming. This approach has proved to work sufficiently well with different types of tumors of against contrasting and uncluttered backgrounds. We have used publicly available dataset of brain tumor MRI image for studying the effect of the new algorithm. The results obtained for tumor localization proves the appropriateness of this approach. There may be requirements of some post processing for the segmentation of tumor around the detected tumor points.

REFERENCES

[1] Jonghyun Park1, Wanhyun Cho, Soonyoung Pak, Junsik Lim1, Soohyung Kim, Gueesang Lee, "A Generic Framework of Integrating Segmentation and Registration", 2009 Ninth IEEE International Conference on Bioinformatics and Bioengineering, 978-0-7695-3656-9/09 $25.00 © 2009 IEEE, DOI 10.1109/BIBE.2009.30

[2] Mengjie Zhang, Malcolm Lett, "Genetic Programming for Object Detection: Improving Fitness Functions and Optimizing Training Data", Feature Article in IEEE Intelligent Informatics Bulletin, Dec 2006, vol 7, No 1

[3] Challenge on Multimodal Brain Tumor Segmentation http://www.imm.dtu.dk/projects/BRATS2012) organized by B. Menze, A. Jakab, S. Bauer, M. Reyes, M. Prastawa, and K. Van Leemput. The challenge database contains fully anonym zed Images from the following institutions: ETH Zurich, University of Bern, University of Debrecen, and University of Utah.

[4] Sina Zarei Mahmoodabadi, Javad Alirezaie, Paul Babyn "A Novel Diffusion-weighted Image Analysis System for Pediatric Metabolic Brain Diseases", Proceedings of the 4th International SaD1.43 IEEE EMBS Conference on Neural Engineering Antalya, Turkey, April 29 - May 2, 2009

[5] Myung-Eun Lee, Soo-Hyung Kim, Wan-Hyun Cho, Soon-Young Park, and Jun-Sik Lim, "Segmentation of Brain MR Images using an Ant Colony Optimization Algorithm", 2009 Ninth IEEE International Conference on Bioinformatics and Bioengineering

[6] Arpita Das, Mahua Bhattacharya, A Study on Prognosis of Brain Tumors Using Fuzzy Logic and Genetic Algorithm Based Techniques, 2009 International Joint Conference on Bioinformatics, Systems Biology and Intelligent Computing.

[7] Manojkumar Kathane, Vilas Thakare, "Brain Segmentation using support vector machine: diagnostic intelligence approach" International conference on benchmarks in engineering science and technology 2012 proceeding published by IJCA pp:12-14 ,oct 2012

[8] Manojkumar Kathane, Vilas Thakare,"MRI Image Processing with Intelligence: step toward CAD in Healthcare system" International conference on Software and Computer Applications 2012 IPCSIT vol 41(2012), IACSIT Press, Singapore, pp: 230-237.

[9] Manojkumar Kathane, Vilas Thakare ,"Fusion at Features Level for MRI Image Segmentation", Published in International Journal of Electronics Communication And Computer Engineering Vol 3, Issue 6 ,ISSN(online): 2249-071X ,ISSN (print): 2278-4209 pp: 1087-1091

[10] Manojkumar Kathane, Vilas Thakare,"A Survey of Comparative Segmentation Analysis for MRI"UACEE International Journal of Computer Science and its Application – vol 3 issue1 [ISSN: 2250-3765], pp 75-79, Feb 2013.