Brain Tumor Segmentation Using Genetic Algorithm

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Abstract

Detection of brain tumour is very common fatality in current scenario of health care society. Image segmentation is used to extract the abnormal tumour portion in brain. Brain tumor is an abnormal mass of tissue in which cells grow and multiply uncontrollably, apparently unregulated by mechanisms that control cells. Several techniques have been developed for detection of tumor in brain. Our main concentration is on the techniques which use image segmentation to detect brain tumor. Tumor classification and segmentation from brain computed tomography image data is an important but time consuming task performed by medical experts.

Keywords: Brain Tumor, GA, Image Segmentation

1. Introduction

Brain is a soft, non-replaceable and spongy mass of tissue which is stable place for patterns to enter and stabilize among each other. A tumor is a mass of tissue that grows out of control of normal forces that regulates growth .Brain tumor is intra-cranial lump formed by uncontrolled cell division. Tumors can destroy brain cells indirectly by inflammation, compressing parts of the brain, inducing cerebral edema or by exerting internal pressure as they evolve. Brain tumors spread to other parts of the body outside of the central nervous system (CNS). Brain tumors are categorized into:

1. Primary brain tumor.

2. Secondary brain tumor.

Identifying a brain tumor usually involves a neurological examination or brain scan. A neurological examination is series of tests to measure the function of the patient is nervous system and physical and mental alertness.

1.1. Image Segmentation

Image segmentation is the procedure of dividing a digital image into several regions or set of pixels. This splitting can be done by various image segmentation techniques. To be useful, these techniques must typically be combined with a domain's specific knowledge in order to effectively solve the domain's segmentation problems. This is usually used to identify objects or other relevant information in digital images. In other words the aim of image segmentation is to group pixels into prominent image regions, i.e., regions analogous to individual surfaces, objects, or natural parts of objects. The result of image segmentation consists of a set of regions whose merger forms the intact image.

1.2. Brain tumor Segmentation

Brain tumor is a serious and life-threatening disease because of its invasive and infiltrative character in the limited space of the intracranial cavity. Brain tumor is curable and treatable if it is diagnosed in earliest stages of disease. Diagnosis of brain tumor is done by specialist called neurologist.

Brain tumor segmentation partitions a portion into mutually special and pooped regions such that each region of interest is spatially contiguous and the pixels within the region are homogeneous with respect to a predefined criterion. Mostly, homogeneity conditions include values of concentration, texture, color, range, surface normal and surface curvatures.

The automatic segmentation has great potential in clinical medicine by freeing physicians from the burden of manual labelling; whereas only a quantitative measurement allows to track and modelling precisely the disease. MR is generally more sensitive in detecting brain abnormalities during the early stages of disease, and is excellent in early detection of cases of cerebral infarction, brain tumors, or infections [8].

1.3. Genetic Algorithm

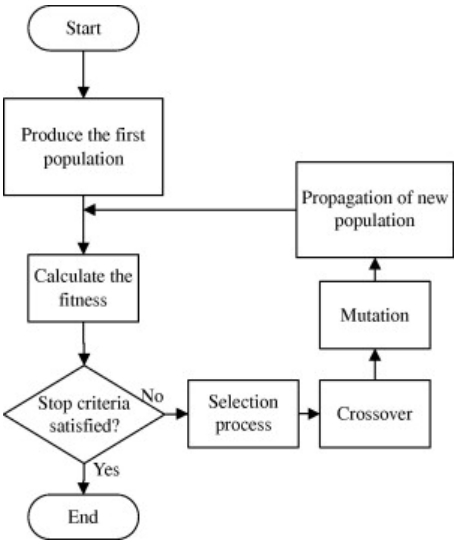
Genetic algorithm is a natural inspired Meta heuristic algorithm. In GA each solution is represented as chromosome and each chromosome is built up from genes. . The best generated solutions will be added to the next iteration while the bad solutions will be rejected. While the algorithm iterates its solutions, these solutions are improved up to a point where a converge to near optimal solution is achieved [12][11][3].

In general, a GA has five stages: initialization of population, evaluation of fitness function, selection, crossover, mutation and termination. Initial population is created randomly, which can be done by setting genes to random values. After the initialization process, fitness function of each chromosome is evaluated.

• In the selection process, the fittest members in the current population are selected for reproducing the new solutions in crossover process two is chromosomes are selected and exchange genes by some point. In mutation process a gene is selected randomly and its value is changed.In last Termination of the iteration is done when

a certain criteria is met. Generally termination is done by number of iterations.

Flowchart for Genetic Algorithm



2. Literature Review

Priyanka and Balwinder Singh focused on survey of well-known brain tumor detection algorithms that have been proposed so far to detect the location of the tumor [8].

T.Logeswari and M.Karnan proposed a clustering based approach using a Self Organizing Map (SOM) algorithm for medical image segmentation. They presented a new unsupervised MR image segmentation method based on fuzzy C-Means clustering algorithm for the Segmentation [13].

Sudipta Roy, Atanu Saha and Prof. Samir K. Bandyopadhyay showed that Watershed Segmentation can successfully segment a tumor provided the parameters are set properly in MATLAB environment. Their paper explores a method to identify tumor in brain disorder diagnosis in MR images [10].

. M. N. R. Gajanayake, R. D. Yapa and B. Hewawithana segmented a set of MR images using standard image segmentation techniques to isolate a brain tumor from the other regions of the brain. Subsequently the resultant images from the different segmentation techniques were compared with each other and analyzed by professional radiologists to find the segmentation technique which is the most accurate. Experimental results showed that the Otsu's thresholding method is the most suitable image segmentation method to segment a brain tumor from a Magnetic Resonance Image [5].

A. Padma and R. Sukanesh inferred that the brain tumor classification and segmentation is best done using SVM with dominant run length feature extraction method than SVM with wavelet based texture feature extraction method and SVM with SGLDM method. In their work, they attempted to improve the computing efficiency as it selects the most suitable feature extraction method that can use for classification and segmentation of brain tumor in CT images efficiently and accurately [9].

Minakshi Sharma and Dr. Sourabh Mukherjee proposed Grey level Co-occurrence Matrix(GLCM) for texture feature extraction, ANFIS(Adaptive Network Fuzzy inference System) plus Genetic Algorithm for feature selection and FCM(Fuzzy C-Means) for segmentation of Astrocytoma (Brain Tumor) with all four Grades. The comparative study between FCM, FCM plus K-mean, Genetic Algorithm, ANFIS and proposed technique showed improved Accuracy, Sensitivity and Specificity [6].

Akabar Shahrzad Khashandarag, Mirkamal Mirnia and Aidin Sakhavati proposed a new method combining genetic algorithm and K-Means algorithm for clustering medical images. In this combined technique, variable string length genetic algorithm (VGA) is used for the determination of the optimal cluster centres [1].

Baladhandapani Arunadevi and Subramaniam N. Deepa explored Extreme Learning Machine Classifier algorithm for implementing genetic algorithm. This method is modeled for automatic brain tissue and pathological tumor classification and segmentation of 3D MRI tumor images [2].

Payel Ghosh and Melanie Mitchell proposed a genetic algorithm for automating the segmentation of the prostate on two-dimensional slices of pelvic computed tomography (CT) images. In this approach they represented segmenting curve using a level set function, which is evolved using a genetic algorithm (GA) [7].

R. Ganesan and S. Radhakrishnan proposed a novel method for automatic segmentation of Computed Tomography (CT) brain images. Their method consists of two major phases. In the 1st phase, the original images are enhanced by using Selective Median Filter (SMF) and in the 2nd phase the GA is used to segment the image. They applied their proposed method to real patient CT images [14].

Tianzi Jiang, Faguo Yang, Yong Fan, and David J. Evans proposed a parallel genetic algorithm for cell image segmentation under severe noise. A priori knowledge about cell shape is incorporated in their method. The segmentation results of noisy human thyroid and small intestine cell images demonstrate that the proposed method is very successful in segmenting images of elliptically shaped cells [9].

Author(s)	Year	Paper	Technique	Results
T.Logeswari and M.Karnan	2010	[13]	Self Organizing Map (SOM) algorithm	new unsupervised MR image segmentation
G.M.N.R. Gajanayake, R. D. Yapa and B. Hewawithana	2009	[5]	using standard image segmentation techniques to isolate a brain tumor from the other regions of the brain	Otsu's thresholding method is the most suitable image segmentation method to segment a brain tumor from a Magnetic

				Resonance Image
A. Padma and R. Sukanesh	2013	[9]	SVM with dominant run length feature extraction method	improve the computing efficiency
R. Ganesan and S. Radhakrishnan	2001	[14]	using Selective Median Filter (SMF) and in the GA is used to segment the image	automatic segmentation of Computed Tomography (CT) brain images
Minakshi Sharma and Dr. Sourabh Mukherjee	2013	[6]	Grey level Co-occurrence Matrix for texture feature extraction, ANFIS and Genetic Algorithm for feature selection and FCMfor segmentation of Astrocytoma	improved Accuracy, Sensitivity and Specificity

3. Conclusion

We study various methods and techniques for detecting and segmenting the brain tumor from scanned MRI images. After review of various methods and techniques it is clearly shown the various methods which can detect the brain tumor with improved Accuracy, Sensitivity and Specificity. Image segmentation has a promising future as the universal segmentation algorithm. Due to all review factors, image segmentation remains a challenging problem in image processing and computer vision and is still a pending problem in the world. Plans for future work include the specific annotation of the abnormal regions such as haemorrhage, calcification and lesion. With a well-known artificial intelligence called genetic algorithm, the output brain tumor region is extracted well from corners as well, and we get sharp results from our simulation instruction set.

4. References

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