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Automatic Detection Of Brain Tumor Through Magnetic Resonance Image

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Abstract: Magnetic Resonance Imaging (MRI) plays an important role in Brain Tumor diagnisation in advanced stages. It is a form of medical imaging using nuclear magnetic resonance of protons in the body. Segmentation process to extract suspicious region from complex medical images is very important. Brain image segmentation is a complex and challenging part in the Medical Image Processing.This research deals with new approaches for brain Tumor detection using Meta Heuristic Algorithm. It aims to develop and effective algorithm for the segmentation of Brain MRI images.Pre-processing, Enhancement and Segmentation are deeply analyzed in this work. In the Pre-processing system film artifacts and unwanted portions of MRI brain image are removed. In the Enhancement process the noise and high frequency components are removed using median filters.The Segmentation process it has three different approaches like block based (non algorithmic), PSO and HPACO algorithm segmentation. MRI helps to diagnose accurate condition of the Brain Tumor and to give necessary proper treatment.

Keywords - MRI Brain Image segmentation, Particle Swarm Optimization, Hybrid Parallel Ant Colony Optimization, FCM Algorithm

I. INTRODUCTION

Brain is the most fascinating and the least understood organ in human body. For centuries, scientists and philosophers have pondered over the relationship among behaviour, emotion, memory, thought, consciousness, and the physical body. The study of brain function progressed in the late 19^{th} century through work involving the stimulation of the cortex of animal brains using electrical currents. This leads to the mapping of motor function in animals and later in humans. It results however contained many inconsistencies.

More reliable work was carried out in the mid 20^{th} century by Penfield, who managed to map the motor and somatosensory cortex using cortical stimulation of patients undergoing neurosurgery. In the later half of this century, most progress in the study of brain function has come from patients with neurological disorders or from electrode measurements on animals. It has only been in the last decade or so that brain imaging techniques have allowed the study of healthy human subjects.

The field known as biomedical analysis has evolved considerably over the last couple of decades. The extraordinary growth experimented by the medical image processing field in the last years has motivated the development of many algorithms and software packages for image processing. The widespread availability of suitable detectors has aided the rapid development of new technologies for monitoring, diagnosis and treatment of patients. Over the last century technology has advanced from the discovery of x-rays to a variety of imaging tools such as magnetic resonance imaging,

computer tomography, positron emission tomography and ultrasonography. The recent revolution in medical imaging results from techniques such as Computer Tomography (CT) and Magnetic Resonance Imaging (MRI) can provide detailed information about disease and can identify many pathologic conditions giving an accurate diagnosis. Furthermore, the new techniques are helping to advance fundamental biomedical research. Medical imaging is an essential tool for improving the diagnoses, understanding and treatment of a large variety of diseases.

There are also some efforts to develop software that could be easy to modify by other researchers. For example the Medical Imaging Interaction Toolkit is intended to fill the gap between algorithms and the final user to provide interaction capabilities to construct clinical applications. Therefore, many software packages for visualization and analysis of medical data are available for the research community.

Magnetic Resonance Imaging of the brain is a powerful technique for diagnosis used by physician to detect structural abnormalities responsible for neurological disorder pathology. Few years ago, most neurologists only had pictures of several cross sections of a brain on a light board using their knowledge to make a diagnosis or determine the course of a therapy based on these images. With an increasing interest in the field of medical image processing, semi-automatic and automatic tools have appeared to assist medical diagnosis. For instance brain segmentation allows now not only to visualize a volume of functional cortical structures but also to quantify it.

II.PREPROCESSING AND ENHANCEMENT

Image processing and enhancement stage is the simplest categories of medical image processing. This stage is used for reducing image noise, highlighting edges, or displaying digital images. Some more techniques can employ medical image processing of coherent echo signals prior to image generation. The enhancement stage includes resolution enhancement and contrast enhancement. These are used to suppress noise and imaging of spectral parameters. After this stage the medical image is converted into standard image without noise, film artifacts and labels.

Image enhancement methods inquire about how to improve the visual appearance of images from Magnetic Resonance Image (MRI), Computer Tomography (CT) scan; Positron Emission Tomography (PET) and the contrast enhancing brain volumes are linearly aligned. The enhancement activities are removal of film artifacts and labels, filtering the images. This part is use to enhances the smoothness towards piecewise-homogeneous region and reduces the edge-blurring effect. Conventional Enhancement techniques such as Low pass filter, Median filter, Gabor Filter, Gaussian Filter and Prewitt edge-finding filter.The Preprocessing aspects are surveyed and analyzed in this section. The Preprocessing techniques such as Content Based model, Fiber tracking Method, Wavelets , Wavelet Packets, and Fourier transform technique.

III. SEGMENTATION

Segmentation is needed to determine areas of interest in the image and in many cases accurate demarcation of objects yields valuable information. Segmentation is an important process to extract information from complex medical images. Segmentation has wide application in medical field. The main objective of the image segmentation is the partition of an image into mutually exclusive and exhausted region such that each region of interest is spatially contiguous and the pixels within the regions are homogeneous with respect to a predefined criterion. The objective of this chapter is to provide a framework for image registration tasks for segmenting MRI brain tumor image and to survey the classical approaches.

Rigid body registration is one of the simplest forms of image registration. The shape of a human brain changes very little with head movement, so rigid body registrations can be used to segment tumor image. Registration methods described in this section is within the same modality of MRI. Matching of two images within single modality registration generally involves matching the images by minimizing the sum of squared difference between them. Multimodality registrations, the matching criterion needs to be more complex. In this research work, registration by single modality is implemented for segmenting the ROI.

Segmentation by proposed non rigid registration is block based and also referred as area based approach. In this technique normal image and the target image are divided into block of size 64 ×64 and compared. The area-based method usually adopts a window of points to determine a matched location using the correlation technique. The most commonly used measure is normalized cross-correlation. This method is more robust than the feature-based method.

This chapter mainly focuses with the population based optimization PSO with FCM. It is implemented to detect the brain tumor region. PSO produce optimum threshold value is used to select the initial cluster point for FCM implementation. Medical image Segmentation is the partitioning of image data into related sections or regions. This thesis has led to the development of a wide range of segmentation methods addressing specific problems in medical applications. Some methods proposed in the literature are extensions of methods originally proposed for generic image segmentation.

Particle Swarm Optimization algorithm is a kind of evolutionary computation technique developed by Kennedy and Eberhart in 1995. It is similar to other population-based evolutionary algorithms in that the algorithm is initialized with a population of random solutions. Unlike most of the other population- based evolutionary algorithms, however, each candidate solution called particle is associated with a velocity and „flies‟ through search space. PSO algorithm rapidly attracted researchers attention and has been applied in neural network optimization, data clustering, engineering design.

The Fuzzy C-means (FCM) seems to be the most popular algorithm in the field of fuzzy clustering. Many researchers have attempted modifications of the classical FCM and applications to image segmentation in the past few years.

IV. EXPERIMENTS AND RESULTS

Segmentation is the second stage where Optimization forms an important part of our day to day life. Many scientific, social, economic and engineering problems have parameter that can be adjusted to produce a more desirable outcome. Over the years, numerous techniques have been developed to solve such optimization. This

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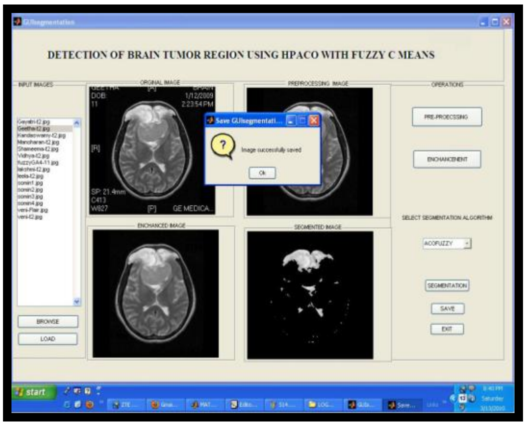
study investigates the most effective optimization method, known as Hybrid Parallel Ant Colony Optimization (HPACO) is introduced in the field of Medical Image Processing. Hybrid Parallel Ant Colony Optimization (HPACO) algorithm is a recent population-based approach inspired by the observation of real Ant's Colony and based upon their collective behaviour.

In this work, a novel approach was applied to MRI Brain Image segmentation based on the Hybrid Parallel Ant Colony Optimization (HPACO) with Fuzzy Algorithm have been used to find out the optimum label that minimizes the Maximizing a Posterior estimate to segment the image. The HPACO search is inspired by the foraging behaviour of real ants. Each ant constructs a solution using the pheromone information accumulated by the other ants. In each iteration, local minimum value is selected from the ants' solution and the pheromones are updated locally. The pheromone of the ant that generates the global minimum is updated. At the final iteration global minimum returns the optimum label for image segmentation. In the above 3×3, 5×5, 7×7, 9×9, 11×11 windows are analyzed the HPACO with Fuzzy of 3×3 window is chosen based on the high contrast than 5×5, 7×7, 9×9, and 11×11.



(Fig.1.*Confirmation of HPACO with FCM Saved to Output Folder)*

The detection of brain tumor region using Hybrid Parallel Ant Colony Optimization with Fuzzy C Means is investigated. A New CAD System is developed for verification and comparison of brain tumor detection algorithm. HPACO with FCM automatically determines the adaptive threshold for the brain tumor segmentation.

V. CLASSIFICATION

This Chapter deals with similarity between proposed segmented algorithms and Radiologist report. In this thesis, the proposed techniques block based non rigid registration, PSO with FCM, HPACO with FCM are used to detect the tumor region. The tumor Spatial Similarity Measure and Gray Level Similarity Measure similarity of the above techniques is measured with Radiologist report. The major objective of this thesis is to extract suspicious region from back ground tissue from MRI.

In the thesis, the lowest error Rate is 20%. The PSO with FCM configuration is compared with HPACO with FCM. The Lowest Error Rate in the accuracy percentage and the error rate of different algorithms are calculated and shown above. HPACO gives the best accuracy comparing with other optimization techniques. Overall accuracy of tumor Gray Level Similarity Measure using HPACO is 95.16%.

VI. PERFORMANCE ANALYSIS

Performance evaluations determine how well a system performs relative to some requirement the results of the implementation of the hybrid fuzzy segmentation process are discussed in this chapter. Any computer aided analysis, the execution time is one of the important parameters for analyzing medical images.

The Free Receiver Operating Characteristics Curve (FROC) is a popular tool in Medical and Image processing research to analyze the rate of classification. ROC Analysis is based on statistical decision theory developed in the context of electronic signal detection and has been applied extensively to diagnostic systems in Clinical medicine. The FROC curve is a plot of the classifier's true positive detection rate and its false positive rate. True positive (TP) detection rate is the probability of correctly classifying a target object and False positive (FP) detection rate is the probability of incorrectly classifying a target object.

VII. COMPARISON OF TECHNIQUE

The execution time for different segmentation techniques, HYBRID MRF-PSO with Fuzzy C Means and HYBRID MRF-HPACO with Fuzzy C Means require more time than the proposed HPACO with Fuzzy C Means. The weight vector value obtained for the proposed method is less compared to the existing results.

This is due to the clustering process and abstraction level technique. The weight vector for the REGISTRATION is 8x8. The weight vector for the HYBRID MRF-PSO with FCM is about 3x3. This weight vector value for the REGISTRATION is higher but it is less in our proposed method.

The value of the tumor cells detected with our proposed implementation is about 795 for the HYBRID MRF-PSO with FCM but the value of the tumor pixel detected for the HPACO with FCM is only 2772.The increase in the value of the detected tumor cells is due to the abstraction level and FCM clustering process.

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Algorithm	Accuracy (%)	Error Rate (%)	Detection Rate(%)
Block based technique	68.6	0.4273	92
PSO with FCM	74.6	0.3919	94.8
HPACO with FCM	95.16	0.008	99.87

(Table 1. ***Performance Analysis of the Algorithm)***

Performance evaluations determine how well a system performs relative to some Requirement the results of the implementation of the hybrid fuzzy segmentation process are discussed in this section. Any computer aided analysis; the execution time is one of the important parameters for analyzing medical images.

The execution time for the HYBRID MRF-PSO with FCM is 93.39 seconds and HPACO with FCM is 90.03 seconds. The increase in the execution time for the proposed implementation is due to the layer by layer abstraction level and FCM clustering techniques.

VIII.CONCLUSION

In this thesis, novel approaches to brain MRI image segmentation and classification based on the combination of Markov Random Field-Particle swarm optimization with fuzzy c means and Markov Random Field -Hybrid Parallel Ant Colony Optimization with fuzzy c means, are implemented.

In Preprocessing and enhancement the proposed method has been used to remove the film artifacts using tracking algorithm. In the enhancement stage to remove high frequency components, the Median, Weighted Median and Adaptive Median Filter is used to enhance the image and the performance of the system, was investigated

Ii is implemented a hybrid model for MR brain image registration using transform model like rigid method (linear Transformation) and non-rigid method (non-linear transformation). The images are entered into registration. Here, the reference (tumor) and normal image (patient) are involved in non- rigid method. In non rigid method the block based technique is implemented. The reference image and normal images are split into several blocks of size 64 ×64. Intensity of each block of those images is compared, if any changes occur in those blocks then it will be assigned as a new image and it is given the next stage.

Segmentation is done by Fuzzy C Means along with metaheuristic algorithms such as Registration Technique, PSO and HPACO. In the process of the detection of brain tumor, in terms of weight vector, execution time and tumor pixels detected using the PSO. The optimum value is considered to select the initial cluster point to find the adaptive value (the out put of the FCM) for tumor detection. The average classification error is reduced when the number of sample is increased. The results have provided substantial evidence to prove that algorithm performs well in the area of brain tumor segmentation of HPACO algorithm performed well. The similarity between segmented results using various segmented algorithm with the Radiologist tumor identification report as per the hospital database is used to classify the images. The Registration Technique, PSO with Fuzzy and HPACO with Fuzzy algorithms are used to identify tumor position and pixel similarities are measured with Radiologist report.

The true positive detection rate and the number of false positive detection rate at various thresholds of the images are used to measure the algorithm's performance. These rates are represented using Free-Response Receiver Operating Characteristic (FROC) curve. The experimental results shows that the registration approach produces the detection rate at 92% and the MRF- PSO with fuzzy approach produces around 94.8% and the MRF-HPACO with fuzzy method produces at 99.87% as Az value. It is observed that the metahuristic MRF-HPACO hybrid with FCM performed well.

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BIOGRAPHY

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