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Image Reconstruction of Tumor Brain Cells

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Abstract:*Image reconstruction techniques are used to create 2-D and 3-D images from sets of 1-D projections. These reconstruction techniques form the basis for common imaging modalities such as CT, MRI, and PET, and they are useful in Medicine, Biology, Earth Science, Archaeology, Materials Science, and nondestructive testing. Image reconstruction is an MRI term for the mathematical process of converting the composite signals obtained during the data acquisition phase into an image. A real-world application that requires image reconstruction is X-ray absorption tomography where projections are formed by measuring the attenuation of radiation that passes through a physical specimen at different angles[1]. The original image can be thought of as a cross section through the specimen in which intensity values represent the density of the specimen.Projections are collected by special medical imaging devices and then an internal image of the specimen is reconstructedOur project mainly aims in reconstruction of the damaged cells in the neural system. The images collected will be converted into vectors using MATLAB and then the defect will be identified using any of the following methods i.e. by*

1. *Pixel method*
2. *Edge detection method*
3. *Color contrast method.*

The later part of the project would be writing an algorithm to reconstruct the image and compare it with the original picture. The reconstructed image will be analyzed and compared with the analysis of neurologist for the quality check.Output is analyzed by evaluating the tumor parameters such as RBF accuracy, linear accuracy, polygonal accuracy, quadratic accuracy. Two types of tumors are considered and evaluated using features like mean, standard deviation, IDM, contrast, correlation, entropy etc.

Keywords: *Image reconstruction, neural system, Vectors, MATLAB, Tumor.*

I. Introduction

In the last 20 years we have a number of useful algorithms developed for segmentation of medical image. Each method comes with its own set of features. Daily growth of medical data volume leads to raise human mistakes in their manual analysis and increase the requests to analyze automatically. Therefore applying some tools to collect, classify, and analyze the medical data automatically is necessary to decrease the human mistakes. The analysis and study of the brain is of great interest due to its potential for studying early growth patterns and morphologic changes in the tumor process[2]. Segmentation of anatomical regions of the brain is the fundamental problem in medical image analysis. In this paper brain tumor segmentation method has been developed and validated segmentation on 2D MRI Data.

A mass of tissue that does originate by a gradual growth of abnormal cells is called a tumor. Usually, in our body the cells get aged, dies and then they are replaced by newly born cells. But in the case of cancers and tumors, this cycle gets interrupt which leads to their formation. Tumor cells are those cells that grow, even though when the body does not requires them, and moreover as normal old cells, they do not expire. Now in the prolongation of this process, the tumor keeps on adding more and more tissues to the mass which grows up into a cyst. Tumors has been basically categorize into primary and secondary tumors. When the tumors emanate from the tissues of the brain itself are said to be primary tumors. Secondary brain tumors are those tumors that are caused from cancer that arises from another part of the body[3]. Brain tumors have been further categorized into benign primary tumors which are noncancerous and malignant primary brain tumors that are cancerous. Benign brain tumors could be easily recognizable as they have clear borders around them and are not intensely rooted into the brain tissue. A malignant brain tumor ordinarily grows faster than benign tumors and intrusively violates the enclosing tissues boundary. Our research paper "Brain Tumor Detection, Demarcation & Quantification via MRI" also discusses about the detection of tumor in human brain and the calculation of the area that tumor possesses but with a more capable technique. Brain tumor detection is really a burdensome assignment as it involves full automation in it. The machine has to identify, mark and quantify the tumor portion as canonical as a human vision can discern. The detection of benign brain tumor is an effortless task because it has a natural border around it and does not have deep intense roots as of malignant tumor. When MRI is done the system develops many image slices of a single brain, and if the tumor is benign in nature it will be seen through some of the slices only as benign tumors do not go to the deeper part of the brain. So, this would help us in discriminating the two types of brain tumors. Probably, to identify the tumor we even need to study some paramount properties of the MRI image which would help us in differentiating the abnormality from normal part in an MRI image of brain.

Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics[4].

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s).

In the study of image processing a watershed of a grayscale image is analogous to the notion of a catchment basin of a height map. In short, a drop of water following the gradient of an image flows along a path to finally reach a local minimum. Intuitively, the watershed of a relief corresponds to the limits of the adjacent catchment basins of the drops of water. There are different technical definitions of a watershed. In graphs, watershed lines may be defined on the nodes, on the edges, or hybrid lines on both nodes and edges. Watersheds may also be defined in the continuous domain[5]. There are also many different algorithms to compute watersheds. Watershed algorithm is used in image processing primarily for segmentation purposes.

II. Literature Survey

A. Tumor brain detection through MR Images

Today's modern medical imaging research faces the challenge of detecting brain tumor through Magnetic Resonance Images (MRI). Normally, to produce images of soft tissue of human body, MRI images are used by experts. It is used for analysis of human organs to replace surgery. For brain tumor detection, image segmentation is required. For this purpose, the brain is partitioned into two distinct regions. This is considered to be one of the most important but difficult part of the process of detecting brain tumor. Hence, it is highly necessary that segmentation of the MRI images must be done accurately before asking the computer to do the exact diagnosis. Earlier, a variety of algorithms were developed for segmentation of MRI images by using different tools and techniques. However, this paper presents a comprehensive review of the methods and techniques used to detect brain tumor through MRI image segmentation. Lastly, the paper concludes with a concise discussion and provides a direction toward the upcoming trend of more advanced research studies on brain image segmentation and Tumor detection.

B. Fast, iterative image reconstruction for MRI in the presence of field in homogeneities

In magnetic resonance imaging, magnetic field in homogeneities cause distortions in images that are reconstructed by conventional fast Fourier transform (FFT) methods. Several non-iterative image reconstruction methods are used currently to compensate for field in homogeneities, but these methods assume that the field map that characterizes the off-resonance frequencies is spatially smooth[6]. Recently, iterative methods have been proposed that can circumvent this assumption and provide improved compensation for off-resonance effects. However, straightforward implementations of such iterative methods suffer from inconveniently long computation times. This paper describes a tool for accelerating iterative reconstruction of field-corrected MR images: a novel time-segmented approximation to the MR signal equation. We use a min-max formulation to derive the temporal interpolator. Speedups of around 60 were achieved by combining this temporal interpolator with a non-uniform fast Fourier transform with normalized root mean squared approximation errors of 0.07%. The proposed method provides fast, accurate, field-corrected image reconstruction even when the field map is not smooth.

C. Review of MR image segmentation techniques using pattern recognition

This paper has reviewed, with somewhat variable coverage, the nine MR image segmentation techniques itemized in Table II. Wide arrays of approaches have been discussed; each has its merits and drawbacks. We have also given pointers to other approaches not discussed in depth in this review. The methods reviewed fall roughly into four model groups: c-means, maximum likelihood, neural networks, and k-nearest neighbor rules. Both supervised and unsupervised schemes require human intervention to obtain clinically useful results in MR segmentation. Unsupervised techniques require somewhat less interaction on a per patient/image basis. Maximum likelihood techniques have had some success, but are very susceptible to the choice of training region, which may need to be chosen slice by slice for even one patient. Generally, techniques that must assume an underlying statistical distribution of the data (such as LML and UML) do not appear promising, since tissue regions of interest do not usually obey the distributional tendencies of probability density functions. The most promising supervised techniques reviewed seem to be FF/NN methods that allow hidden layers to be configured as examples are presented to the system. An example of a self-configuring network, FF/CC, was also discussed. The relatively simple k-nearest neighbor rule algorithms (hard and fuzzy) have also shown promise in the supervised category. Unsupervised techniques based upon fuzzy c-means clustering algorithms have also shown great promise in MR image segmentation[7]. Several unsupervised connectionist techniques have recently been experimented with on MR images of the brain and have provided promising initial results. A pixel-intensity-based edge detection algorithm has recently been used to provide promising segmentations of the brain. This is also an unsupervised technique, older versions of which have been susceptible to over segmenting the image because of the lack of clear boundaries between tissue types or finding uninteresting boundaries between slightly different types of the same tissue. To conclude, we offer some remarks about improving MR segmentation techniques. The better unsupervised techniques are too slow. Improving speed via parallelization and optimization will improve their competitiveness with, e.g., the k-nn rule, which is the fastest technique covered in this review. Another area for development is dynamic cluster validity. Unsupervised methods need better ways to specify and adjust c, the number of tissue classes found by the algorithm. Initialization is a third important area of research. Many of the schemes listed in Table II are sensitive to good initialization, both in terms of the parameters of the design, as well as operator selection of training data.

D. A review on image segmentation techniques

Many image segmentation techniques are available in the literature. Some of these techniques use only the gray level histogram, some use spatial details while others use fuzzy set theoretic approaches. Most of these techniques are not suitable for noisy environments. Some works have been done using the Markov Random Field (MRF) model which is robust to noise, but is computationally involved. Neural network architectures which help to get the output in real time because of their parallel processing ability have also been used for segmentation and they work fine even when the noise level is very high. The literature on color image segmentation is not that rich as it is for gray tone images. This paper critically reviews and summarizes some of these techniques. Attempts have been made to cover both fuzzy and non-fuzzy techniques including color image segmentation and neural network based approaches. Adequate attention is paid to segmentation of range images and magnetic resonance images. It also addresses the issue of quantitative evaluation of segmentation results.

III. Existing System and Proposed System

E. Existing system

In the last 20 years we have a number of useful algorithms developed for enhancement, Denoising, segmentation and compression of medical image. Each method comes with its own set of features. Daily growth of medical data volume leads to raise human mistakes in their manual analysis and increase the requests to analyze automatically. Therefore applying some tools to collect, classify and analyze the medical data automatically is necessary to decrease the human mistakes. The analysis and study of the brain is of great interest due to its potential for studying early growth patterns and morphologic changes in the tumour process[8]. Segmentation of anatomical regions of the brain is the fundamental problem in the medical image analysis. In the existing paper, brain tumour segmentation method has been developed and validated segmentation on 2D MRI data.

F. Proposed system

1. Read and convert the input image from RGB to grey scale image.
2. Preprocessing steps.
3. Grayscale contrast enhancement.
4. Divide image into 4 equal quadrants and calculate max and min values of pixels in each quadrant.
5. Build matrix for intensity and entropy for analysis and pick the quadrant having max values of intensity and entropy.
6. Calculate temporal lower bound of threshold & using upper and lower bound threshold to the target quadrant.
7. Apply extended maxima transformation, regional maxima transformation.
8. Run region properties.
9. Mark the boundary around the area which matches to the max profile.
10. Count the pixels that lie within the boundary.

IV. Methodology

G. Steps
1. Perform image processing.
2. Analysis.
3. Algorithm Development.

H. Image Processing
Image Processing Toolbox provides a comprehensive set of reference-standard algorithms, functions, and apps for image processing, analysis, visualization, and algorithm development. You can perform image analysis, image segmentation, image enhancement, noise reduction, geometric transformations, and image registration. Many toolbox functions support multicore processors, GPUs, and C-code generation.

Image Processing Toolbox supports a diverse set of image types, including high dynamic range, giga pixel resolution, embedded ICC profile, and tomographic. Visualization functions and apps let you explore images and videos, examine a region of pixels, adjust color and contrast, create contours or histograms, and manipulate regions of interest (ROIs). The toolbox supports workflows for processing, displaying, and navigating large images.

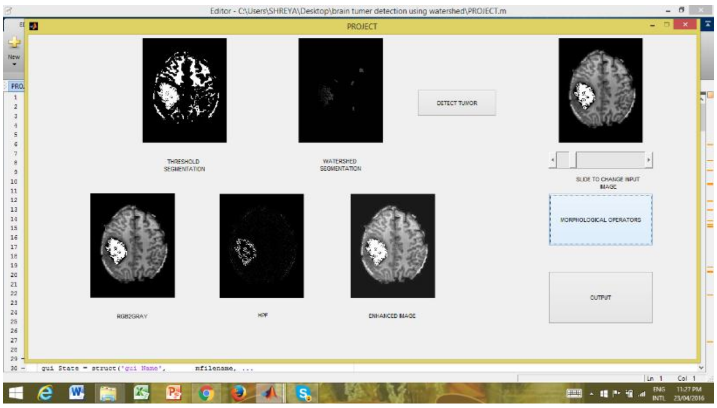
I. Image Enhancement
Image enhancement techniques bring out the detail in an image that is obscured or highlight certain features of interest in an image. Enhancement techniques include contrast adjustment, filtering, morphological filtering, and deblurring. Image enhancement operations typically return a modified version of the original image and are frequently used as a preprocessing step to improve the results of image analysis techniques.

J. Image Analysis
Image analysis is the process of extracting meaningful information from images such as finding shapes, counting objects, identifying colors, or measuring object properties. The toolbox provides a comprehensive suite of reference-standard algorithms and visualization functions for image analysis tasks such as statistical analysis and property measurement.

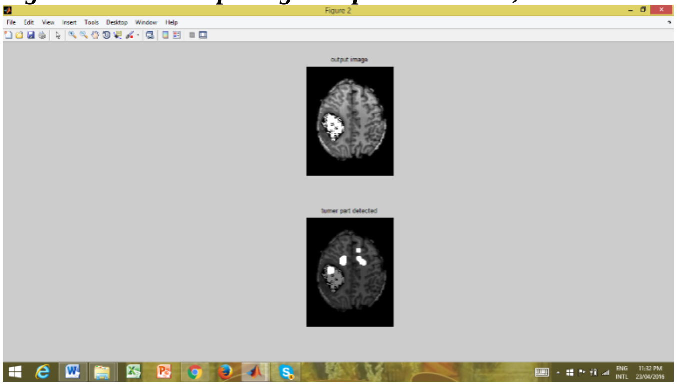
K. Creating a MATLAB GUI
For more control over design and development, you can also create MATLAB code that defines all component properties and behaviors. MATLAB contains built-in functionality to help you create the GUI for your app programmatically. You can add dialog boxes, user interface controls (such as push buttons and sliders), and containers (such as panels and button groups).

V. Results

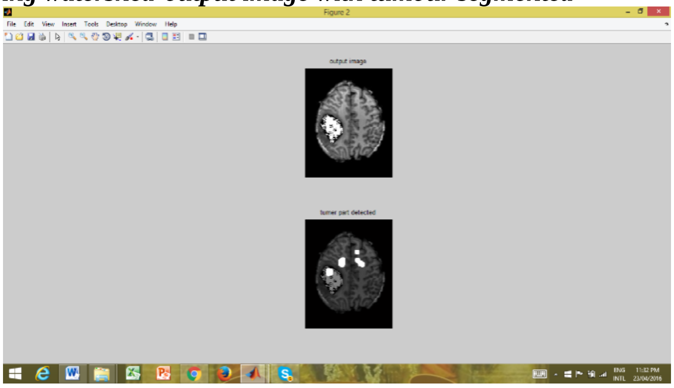
L. Tumor detection using watershed



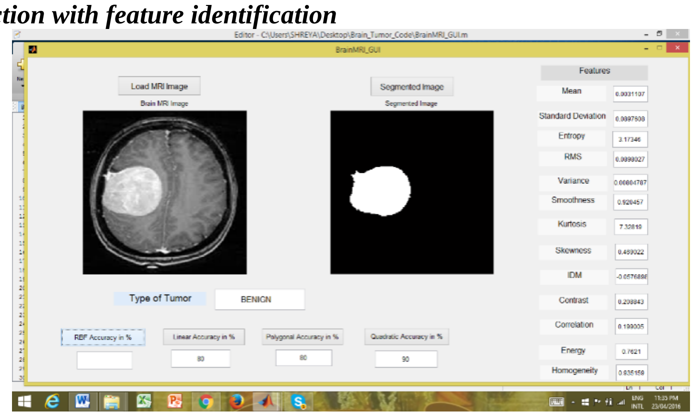
M. Tumour detection using watershed- morphological operators-erode, dilate



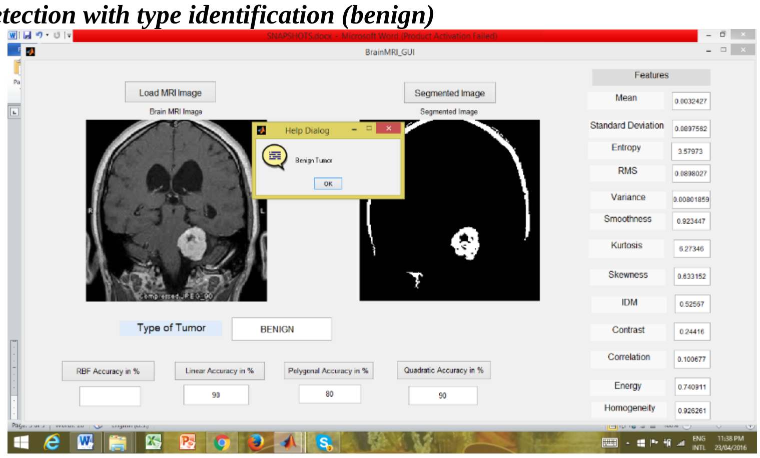
N. Tumour detection using watershed-output image with tumour segmented



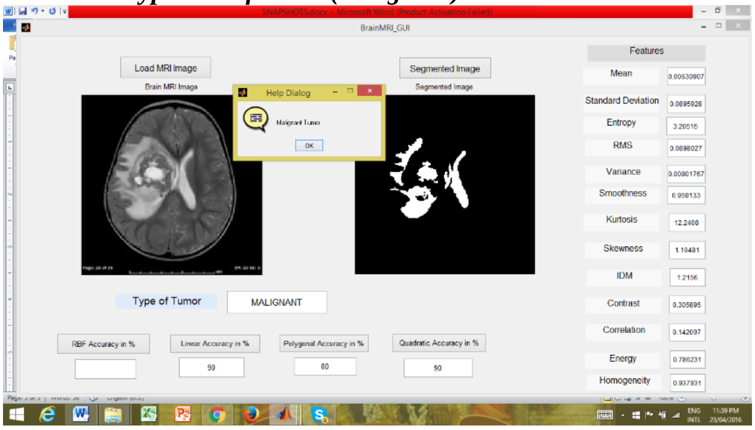
O. Brain tumour detection with feature identification



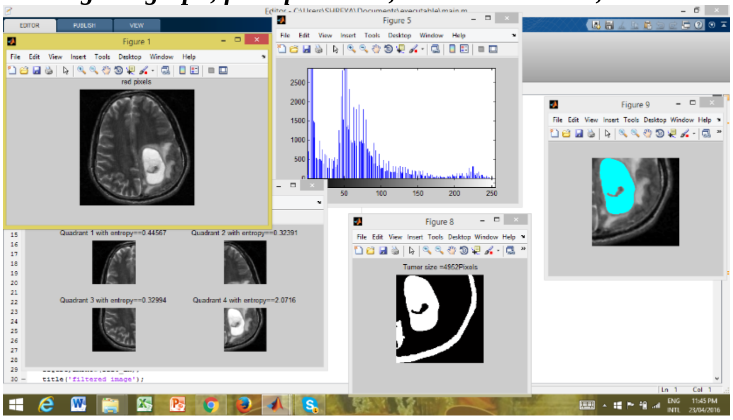
P. Brain tumour detection with type identification (benign)



Q. Brain tumour detection with type identification(malignant)



R. Entropy algorithm –histogram graph, four quadrants, tumour detection , tumour enhancement



VI. Conclusion

After looking into the results it could be said that the proposed method is better than the previous one as it has been found that the execution time has been reduced. Moreover rather than looking into the whole image for the pixels showing tumor the proposed algorithm is searching in just the quadrant where the possibility is highest by using entropy, intensity and solidity matrix and transforming the image. This way the computation also has been lessening up. For future scope, it could be suggested that one can take advantage of machine learning non-parameterized algorithms that uses regression decision tree to arrive at the classification of objects like tumor and non-tumor parts.

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