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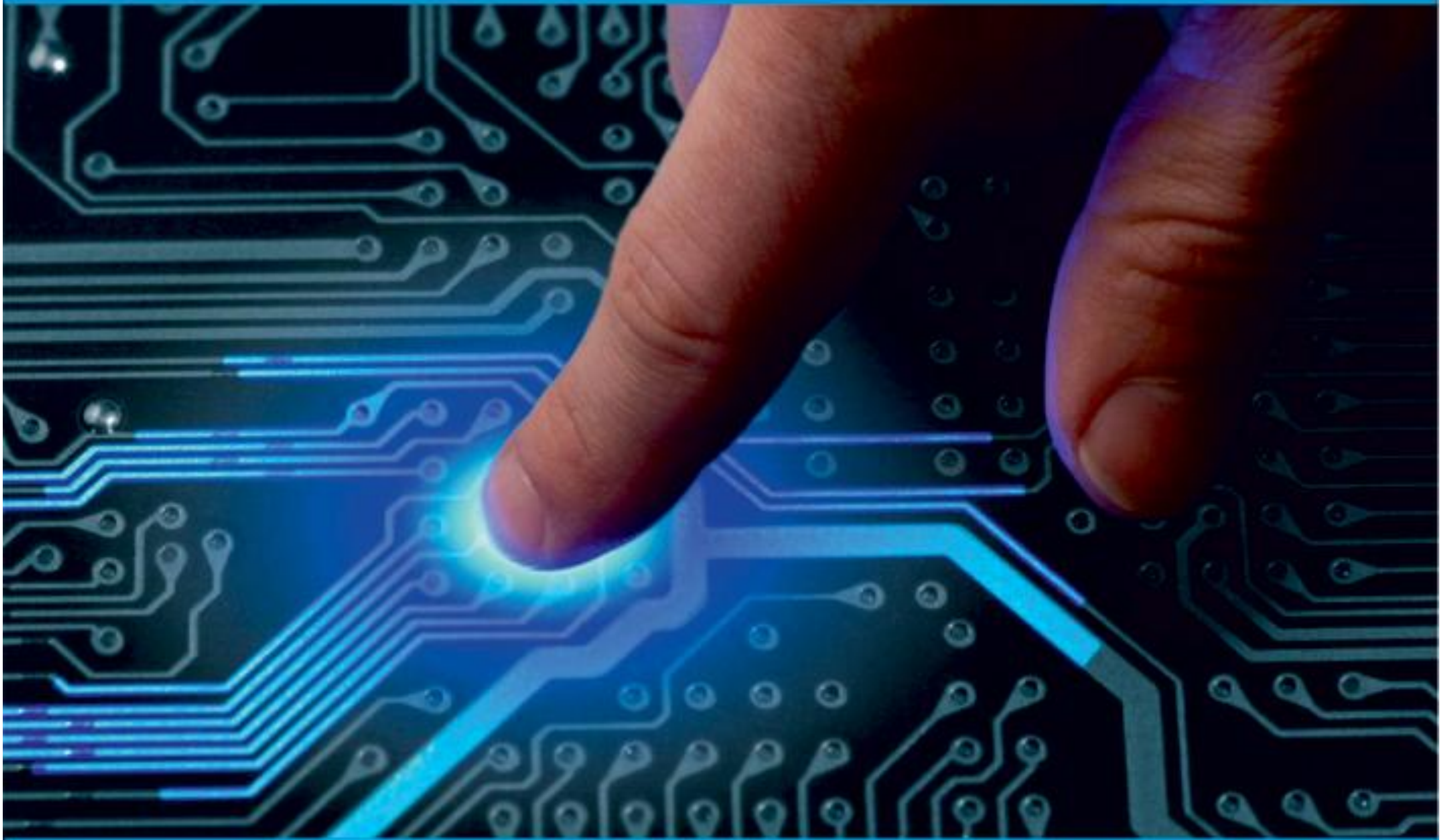
e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 8, Issue 8, August 2020

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.488

Brain Tumor Detection and Segmentation from MRI Images

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ABSTRACT: Brain Tumor is a fatal disease which cannot be confidently detected without MRI. In the project, it is tried to detect whether patient's brain has tumor or not from MRI image using MATLAB simulation. To pave the way for morphological operation on MRI image, the image was first filtered using Anisotropic Diffusion Filter to reduce contrast between consecutive pixels. After that the image was resized and utilizing a threshold value image was converted to a black and white image manually. This primary filter the plausible locations for tumor presence. On this semi processed image morphological operations have been applied and information on solidity and areas of the plausible locations was obtained. A minimum value of both of this characters has been determined from statistical average of different MRI images containing tumor. Then it was used to deliver final detection result. Though this simulation routine can give correct result most of the time, it fails to perform when tumor's size is too small or tumor is hollow. The larger goal of the project is to build a data base of 2D image data of tumor from the MRI images taken from different angle of a particular human and by analyzing them to point out the exact 3D location of the tumor. To fulfill this, 2D tumor detection and segmentation have been developed to better accuracy so that 3D detection can be more reliable. This is the primary target of the project.

KEYWORDS: Brain tumor, MRI, Matlab.

I.INTRODUCTION

The body is made up of many types of cells. Each type of cell has special functions. Most cells in the body grow and then divide in an orderly way to form new cells as they are needed to keep the body healthy and working properly. When cells lose the ability to control their growth, they divide too often and without any order. The extra cells form a mass of tissue called a tumor. Tumors are benign or malignant. The aim of this work is to design an automated tool for brain tumor quantification using MRI image data sets. Magnetic Resonance Imaging (MRI) is the state of the art medical imaging technology which allows cross sectional view of the body with unprecedented tissue contrast. MRI plays an important role in assessing pathological conditions of the ankle, foot and brain. It has rapidly evolved into an accepted modality for medical imaging of disease processes in the musculoskeletal system, especially the foot and brain due to the use of nonionizing radiation.

MRI provides a digital representation of tissue characteristic that can be obtained in any tissue plane. The images produced by an MRI scanner are best described as slices through the brain.

In this Paper, the technique used is Magnetic Resonance Imaging (MRI). The segmentation of brain tumors in magnetic resonance images (MRI) is a challenging and difficult task because of the variety of their possible shapes, locations, image intensities.

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 to partition an image into mutually exclusive and exhausted regions such that each region of interest is spatially contiguous and the pixels within the region are homogeneous with respect to a predefined criterion. Here Watershed segmentation based algorithm has been used for detection of tumor. Watershed segmentation uses the intensity as a parameter to segment the whole image data set. Moreover, the additional complexity of estimation imposed to other algorithms causes a tendency towards density dependent approaches. Among all possible methods for this purpose, watershed can be used as a powerful tool which implicitly extracts the tumor surface.

II.LITERATURE SURVEY

Title: Abnormality Segmentation in Brain Images via Distributed Estimation

Abstract: The aim of this paper is to introduce a novel semi supervised scheme for abnormality detection and segmentation in medical images. Semi supervised learning does not require pathology modeling and, thus, allows high degree of automation. In abnormality detection, a vector is characterized as anomalous if it does not comply with the probability distribution obtained from normal data. The estimation of the probability density function, however, is usually not feasible due to large data dimensionality. In order to overcome this challenge, treat every image as a network of locally coherent image partitions (overlapping blocks). In this paper [1] the author formulate and maximize a strictly concave likelihood function estimating abnormality for each partition and fuse the local estimates into a globally optimal estimate that satisfies the consistency constraints, based on a distributed estimation algorithm. The likelihood function consists of a model and a data term and is formulated as a quadratic programming problem.

The method explains in this paper is applied for automatically segmenting brain pathologies.

Title :Automatic Image Segmentation by Dynamic Region Merging

ABSTRACT :This paper addresses the automatic image segmentation problem in a region merging style. With an initially over segmented image, in which many regions (or super pixels) with homogeneous color are detected, an image segmentation is performed by iteratively merging the regions according to a statistical test. There are two essential issues in a region-merging algorithm: order of merging and the stopping criterion. In the proposed algorithm, these two issues are solved by a novel predicate, which is defined by the sequential probability ratio test and the minimal cost criterion. Starting from an over segmented image, neighboring regions are progressively merged if there is an evidence for merging according to this predicate. This also proves that the produced segmentation satisfies certain global properties. This paper [2] explains a novel method for segmenting an image into distinct components. The algorithm is implemented in a region-merging style.

Title: Abnormal Tissues Extraction in MRI Brain Medical Images

Abstract Background: study is a comparison between two image segmentation's methods; the first method is based on normal brain's tissue recognition then tumor extraction using thresholding method. The second method is classification based on EM segmentation which is used for both brain recognition and tumor extraction. The goal of these methods is to detect, segment, extract, classify and measure properties of the brain normal and abnormal (tumor) tissues. It presents brain recognition methods to separate the abnormal tissues. This paper shows an applied method based on thresholding used for tumor extraction (GBM and MS diseases). This paper [5] explains that the local thresholding gives a good results comparing with the others. It conclude that When we combine median filter, local thresholding and post processing in such way that the resultant algorithm is more robust.

Title: A Multiple-Kernel Fuzzy C-Means Algorithm for Image Segmentation

Abstract Background: In this paper [6], a generalized multiple-kernel fuzzy C-means (FCM) (MKFCM) methodology is introduced as a frame-work for image-segmentation problems. In the 11 framework, aside from the fact that the composite kernels are used in the kernel FCM (KFCM), a linear combination of multiple kernels is pro-posed and the updating rules for the linear coefficients of the composite kernel are derived as well. The proposed MKFCM algorithm provides us a new flexible vehicle to fuse different pixel information in image-segmentation problems. It is shown that two successful enhanced KFCM- based image-segmentation algorithms are special cases of MKFCM.

III.PROPOSED SYSTEM

The proposed system can be summarized in three stages. First stage contains filtering technique which removes noise by using Anisotropic Filter (AF) from the brain MRI image and then adjustment based segmentation which segments the region of the tumor from the filtered image using a structuring element. Third stage contains morphological operation which shows the location of the tumor on the original image.

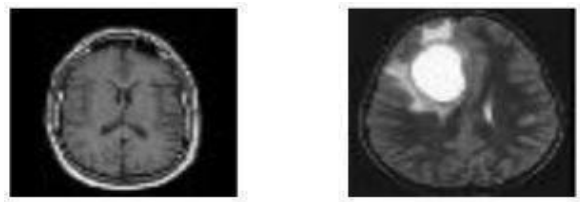
Fuzzy c-means is different from hard c-means, mainly because it employs fuzzy partitioning, where a point can belong to several clusters with degrees of membership.

A. Dataset

A single abnormal MR image [6] is taken as input to detect the tumor. The input image is 256*256 pixels and 8-bit grayscale.

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | Impact Factor: 7.488 |

|| Volume 8, Issue 8, August 2020 ||



(a) Normal image (b) Abnormal image

Fig 3.1 Brain MRI images

B. Anisotropic Filtering

The main objective of filtering an image is to remove the noises on the digital images. The quality of the image is attacked badly by the noises. There are many ways to get rid of the noise in the image. Most of the image processing algorithms do not work well in the noisy environment. Among various filter Anisotropic Filter is used in this thesis for de noising purposes.

$$\frac{\partial x}{\partial t} = div\left(c(m,n,t)\nabla I\right) = \nabla c \cdot \nabla x + c(m,n,t)\nabla x \quad (1)$$

This method uses a different "distance" for each cluster that changes over the early iterations to fit the clusters. Clustering refers to the process of unsupervised partitioning of a data set based on a dissimilarity measure, which determines the cluster shape.

$$I_{ij}^{t+1}=I_{ij}^{t}+dt\sum_{(k,l)\in N_4} g\left(I_{kl}^{t}-I_{ij}^{t}\right)\cdot\left(I_{kl}^{t}-I_{ij}^{t}\right) \quad (2)$$

$$h\left(I_{kl}^{t}-I_{ij}^{t}\right)=\frac{c_{kl}^{t}+I_{ij}^{t}}{2} \quad (3)$$

Where, N4 = {(i-1, j), (i+1, j), (i, j-1), (i, j+1)}

Denotes the 4-neighborhood of the central pixel

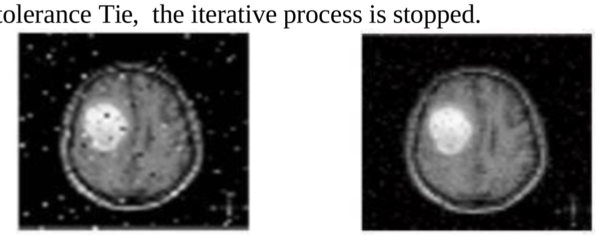
.From Eq. (3) we can see that noise pixel has strong diffusion action and signal pixel has weak diffusion action. Thus noise can be removed and signal will be kept. Here a better iteration step is proposed in the Eq. (4).

$$dt=\frac{1}{4}c \quad (4)$$

Where, 1/4 is used to promise the convergence of the Eq. (2). Final output phase image is obtained by iterative process. For iteration process, iteration error (IE) is used for controlling the iterative number and its formula is:

$$IE=\frac{\|I^{n}-I^{n-1}\|}{\|I^{n}\|}\leq T_{ie} \quad (5)$$

When IE is less than or equal to tolerance Tie, the iterative process is stopped.



(a) Noisy Image with Salt & Pepper Noise (b) AF output

Fig 3.2 Input and Output for Anisotropic Filter

C. SVM for Image Segmentation The procedure of distribution an image into multiple parts is known as image segmentation. Let's consider the following simple problem to obtain the optimal hyper plane:

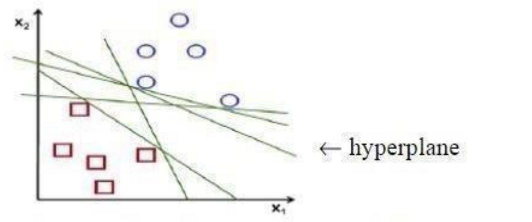


Fig 3.3 For a linearly separable set of 2d points

Let's consider the following equation which is used to define a hyper plane:

$$p(x) = \propto_0 + \propto^T z \quad (6)$$

Where, ∝ represents the weight vector and ∝0 as the bias. A vast number of various paths by scaling of ∝ and ∝0 describe the satisfactory hyperplane. Among all the feasible legation of the hyperplane, the following one is chosen:

$$|\propto_0 + \propto^T z| = 1 \quad (7)$$

Where, z represents the training examples closest to the hyperplane. Commonly, support vectors are the nearest training examples to the hyperplane. Now we use the outcome of geometry that gives the difference between a point z and a hyperplane (∝,∝0):

$$D = \frac{|\propto_0 + \propto^T z|}{\|\propto\|} \quad (8)$$

The numerator is equal to one for the canonical hyperplane and the difference to the support vectors is,

$$D_{support\ vectors} = \frac{|\propto_0 + \propto^T z|}{\|\propto\|} = \frac{1}{\|\propto\|} \quad (9)$$

The following equation that is two times the difference to the nearest examples represents the margin, denoted as M

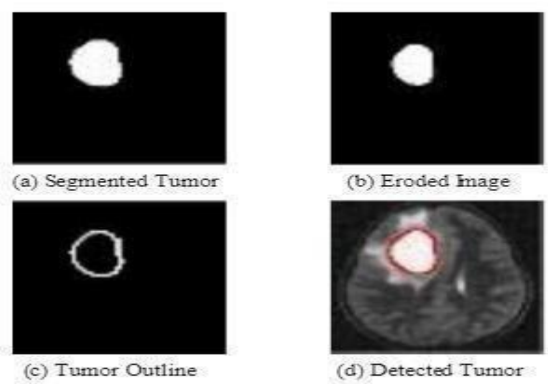
$$M = \frac{2}{\|\propto\|} \quad (10)$$

Ultimately, maximizing problem for M is identical to the minimizing problem for a function R(∝) subject to several confines. To classify correctly all the training examples z the confines model for the hyper plane is,

$$\min_{\propto,\propto_0} R(\propto) = \frac{1}{2}\|\propto\|^2 subject\ to\ y_i(\propto^T z_i + \propto_0) \geq 1\ \forall_i, (11)$$

Where, yi represents each of the labels of the training examples. This is a problem of Lagrangian optimization which can be solved using Lagrange multipliers to attain the weight vector ∝ and the bias ∝0 of the satisfactory hyper plane.

D. Morphological Operation Morphology is an instrument to extract image features useful in the legation and recital of region shape such as- boundaries, skeletons and convex hulls. For morphological operation structuring element (kernel) is required .



(a) Segmented Tumor (b) Eroded Image

(c) Tumor Outline (d) Detected Tumor

Fig 4.4 Output for Morphological Operation

IV.IMPLEMENTATION

True anisotropic filtering probes the texture anisotropically on the fly on a per-pixel basis for any orientation of anisotropy.

In graphics hardware, typically when the texture is sampled anisotropically, several probes (Texel samples) of the texture around the centre point are taken, but on a sample pattern mapped according to the projected shape of the texture at that pixel, although earlier software methods have used summed area tables. Each anisotropic filtering probe is often in itself a filtered MIP map sample, which adds more sampling to the process.

Sixteen trilinear anisotropic samples might require 128 samples from the stored texture, as trilinear MIP map filtering needs to take four samples times two MIP levels and then anisotropic sampling (at 16-tap) needs to take sixteen of these trilinear filtered probes.

However, this level of filtering complexity is not required all the time. There are commonly available methods to reduce the amount of work the video rendering hardware must do.

V.CONCLUSION AND FUTURE ENHANCEMENT

The MRI brain Input image may contain various noise. For proper segmentation and for morphological operation's performance the input images should be noise free. That is why we have used the anisotropic filter for its better performance. SVM classifier is used for segmentation purpose which classifies the pixels into two classes. Since we have designed our system for any MRI brain input image hence SVM is selected with kernel for unsupervised learning.

Future research in MRI segmentation should strive toward improving the accuracy, precision, and computation speed of the segmentation algorithms, while reducing the amount of manual interactions needed. This is particularly important as MR imaging is becoming a routine diagnostic procedure in clinical practice. It is also important that any practical segmentation algorithm should deal with 3D volume segmentation instead of 2D slice by slice segmentation, since MRI data is 3D in nature

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