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TUMOR DETECTION IN MRI IMAGES

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Abstract - Brain tumor extraction and its analysis are challenging tasks in medical image processing because brain image and its structure is complicated that can be analyzed only by expert radiologists. Edge detection plays an important role in the processing of medical images. MRI (magnetic resonance imaging) has become a particularly useful medical diagnostic tool for diagnosis of brain and other medical images. In this present a comparative study of edge detection method implemented for tumor detection. The methods include smoothing, gradients, no maxima suppression, thresholding At the end of process the tumor is extracted from the MRI image and its exact position and the shape are determined.

Keywords: MRI, Canny edge detection, smoothing, Gradients, Non maxima suppression, Thresolding.

I. INTRODUCTION

The brain is the most important part of the central nervous system. The structure and function of the brain need to be studied noninvasively by doctors and researchers using MRI imaging techniques. The body is made up of many types of cells. Each type of cell has special functions. 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. MRI acts as an assistant diagnostic tool for the doctors during disease diagnosis and treatment. This imaging modality produces images of soft tissues. The acquired medical images show the internal structure, but the doctors want to know more than peer images, such as emphasizing the abnormal tissue, quantifying its size, depicting its shape, and so on. Segmentation is an important process to extract suspicious region from complex medical images. Initially, Genetics is implemented on complete tumor image, because of this the initial population set is quite large but now the size of the population set for the genetics is reduced.

The main objective of the present work is an efficient segmentation method is to detect and extract the tumor region in MRI Images.

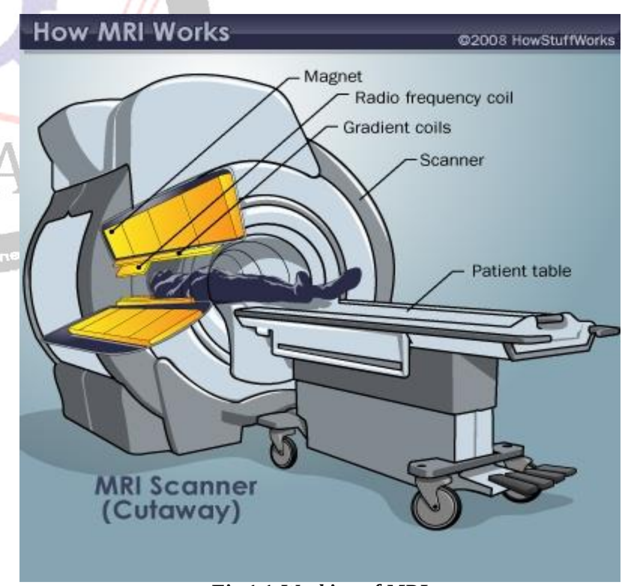

Fig 1.1-Working of MRI

A. MAGNETIC RESONANCE IMAGING (MRI)

A magnetic resonance imaging (MRI) scanner uses powerful magnets to polarize and excite hydrogen nuclei (single proton) in human tissue, which produces a signal that can be detected and it is encoded spatially, resulting in images of the body. MRI is a technique that can changes in the blood properties as they related to brain activity. MRI has also proven valuable in the surgical treatment of brain by allowing regions with essential brain functions to be located. The surgeon can avoid damaging this regions while removing as much diseases or dysfunctional tissue as possible.

How an MRI works

When a patient receives an MRI scan, they are placed in a narrow tube. Surrounding them is a very strong magnet. When this magnet is turned on, randomly spinning hydrogen atoms line up in the direction of the magnetic field. A radio pulse is applied to the area of the body to be examined. Atoms in this area absorb some of the pulse's energy, which leads them to spin in a specific frequency and direction. Smaller magnets are turned off and on in such a way to activate very precise regions known as slices. When the radio frequency pulse is turned off, the hydrogen atoms release absorbed energy, giving off a signal detected by the MRI machine in the brain.

B. AIM AND OBJECTIVE

The present work implements a system for the improved detection of brain tumor using various steps of processing steps. The implemented work can be useful for biomedical early and improved brain cancer detection. The proposed work will also take input from the output of this application and integrate them with the concept of ontology. Existing system involves doctors identifies the boundary of tumor in MRI images manually and this depends on how well the physician can perceive the image under consideration to get the required region extracted out, which is made difficult because of minute variation and resemblance between the original and affected biological part in the image

The propose segmentation method that uses the K-means clustering technique to identify the tumor in magnetic resonance image (MRI).Brain images segmentation is one of the most important parts of clinical diagnostic tools brain images mostly contain noise, in homogeneity and some times deviation. So, K-means clustering algorithm is to convert the given RGB image into gray scale image and then separate the position of tumor objects. This improves the tumor boundaries accurately and is less time consuming when compared to many other clustering algorithms. The main objective is the design of a computer system able to detect the presence of digital images of the brain and to accurately define its borderlines

II. LITERATURE SURVEY

Comparative study of previous Algorithm as follows:

Title	Proposed techniques	Algorithms used	Benefits	Identified problems
Segmentation of Brain MR Images through a Hidden Markov Random Field Model and the Expectation-Maximization Algorithm[1]	Segmentation	Expectation Maximization	Technique possesses ability to encode both spatial and statistical properties of an image.	The method requires estimating threshold and does not produce accurate results most of the time
A modified fuzzy c-means algorithm for bias field estimation and segmentation of MRI data[2]	Bias field estimation	Modified fuzzy C-means	Faster to generate results	Technique is limited to a single feature input
MR-Brain Image Segmentation Using Gaussian Multi resolution Analysis and the EM Algorithm[3]	Gaussian Multi resolution Analysis	Expectation Maximization	Less sensitive to noise	Rarely preserve edges
Segmentation of MR Images of the Human brain using Fuzzy Adaptive Radial Basis function Neural Network[4]	Neural network	Fuzzy adaptive radial basis function	It preserves sharpness of image.	Able to do only one task related to fusion
Three-level Image Segmentation Based on Maximum Fuzzy Partition Entropy of 2-D Histogram and Quantum Genetic Algorithm[5]	Fuzzy partition entropy of 2D histogram and genetic algorithm	QGA	QGA is selected for optimal combination of parameters.	Practically impossible
A Texture based Tumour detection and automatic Segmentation using Seeded Region Growing Method[6]	Texture based Tumour detection and automatic segmentation	Seeded Region growing	This is region growing segmentation method for segmentation of brain tumour in MRI, in which it is possible to determine abnormality is present in the image or not.	It takes more time.
Detection and Quantification of Brain Tumour from MRI of Brain and it's Symmetric Analysis[7]	Modular approach to solve MRI segmentation	Symmetry analysis	The proposed approach can be able to find the status of increase in the disease using quantitative analysis	Time consuming.
Brain Tumour Identification in MRI with BPN Classifier	Brain Tumour Identification in MRI BPN	k-means clustering, BPN classifier	It combines clustering and classification algorithm	Accuracy can be improved in less time

Table 2.1 – Comparative study of algorithms

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III. PROPOSED SYSTEM

SYSTEM ARCHITECTURE

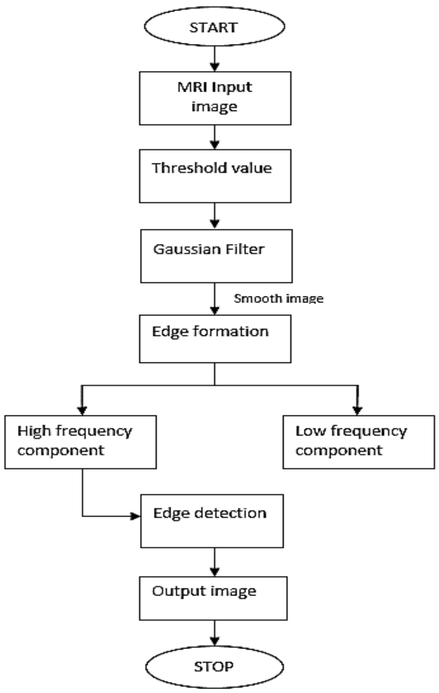


Fig 3.1 -System architecture

IV. PROPOSED ALGORITHMS

The Canny Edge Detection Algorithm

The algorithm runs in 5 separate steps:

1. Smoothing: Blurring of the image to remove noise.

2. Finding gradients: The edges should be marked where the gradients of the image has large magnitudes.

3. Non-maximum suppression: Only local maxima should be marked as edges.

4. Double thresholding: Potential edges are determined by thresholding.

5. Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

V. MATHEMATICAL MODEL

Canny Edge Detector

1) Smooth image with a Gaussian •optimizes the trade-off between noise filtering and edge localization
2) Compute the Gradient magnitude using approximations of partial derivatives •2x2 filters
3) Thin edges by applying non-maxima suppression to the gradient magnitude
4) Detect edges by double thresholding

Gradient

- At each point convolve with

  $G_x = \begin{bmatrix} -1 & 1 \\ -1 & 1 \end{bmatrix}, G_y = \begin{bmatrix} 1 & 1 \\ -1 & -1 \end{bmatrix}$

- magnitude and orientation of the Gradient are computed as

  $M[i,j]=\sqrt{P[i,j]^2 + Q[i,j]^2}$

  $\Theta[i,j]=\tan^{-1}(Q[i,j], P[i,j])$

- Avoid floating point arithmetic for fast computation.

Non-Maxima Suppression

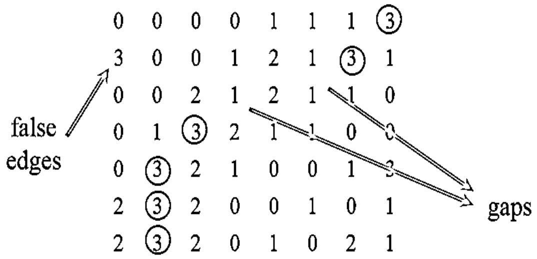
- Thin edges by keeping large values of Gradient
  - not always at the location of an edge
  - there are many thick edges

$$\begin{matrix} 0 & 0 & 0 & 0 & 1 & 1 & 1 & 3 \\ 0 & 0 & 0 & 1 & 2 & 1 & 3 & 1 \\ 0 & 0 & 2 & 1 & 2 & 1 & 1 & 0 \\ 0 & 1 & 3 & 2 & 1 & 1 & 0 & 0 \\ 0 & 3 & 2 & 1 & 0 & 0 & 1 & 0 \\ 2 & 3 & 2 & 0 & 0 & 1 & 0 & 1 \\ 2 & 3 & 2 & 0 & 1 & 0 & 2 & 1 \end{matrix}$$

Non-Maxima Suppression (2)

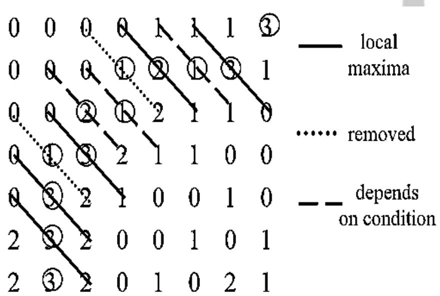
- Thin the broad ridges in M[i,j]into ridges that are only one pixel wide

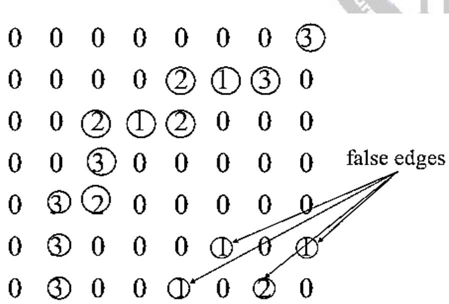
- Find local maxima in M[i,j] by suppressing all values along the line of the Gradient that are not peak values of the ridge



Gradient Orientation

- Reduce angle of Gradient θ[i,j]to one of the 4 sectors
- Check the 3x3 region of each M[i,j]
- If the value at the centeris not greater than the 2 values along the gradient, then M[i,j]is set to 0





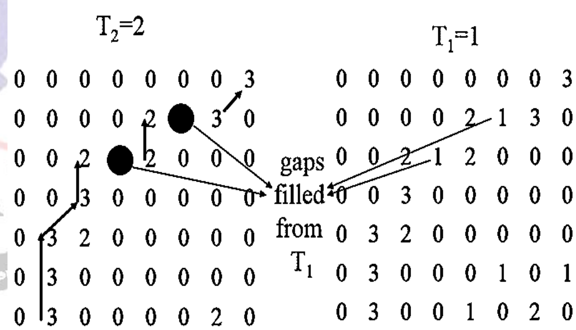
- The suppressed magnitude image will contain many false edges caused by noise or fine texture.

Thresholding

- Reduce number of false edges by applying a threshold T
  - all values below Tare changed to 0
  - selecting a good values for T is difficult
  - some false edges will remain if Tis too low
  - some edges will disappear if Tis too high
  - some edges will disappear due to softening of the edge contrast by shadows

Double Thresholding

- Apply two thresholds in the suppressed image
  - T 2= 2T2
  - two images in the output
  - the image from T2 contains fewer edges but has gaps in the contours
  - the image from T1 has many false edges
  - combine the results from T1and T2
  - link the edges of T2 into contours until we reach a gap
  - link the edge from T2 with edge pixels from a T1 contour until a T2 edge is found again



- A T2 contour has pixels along the green arrows
- Linking: search in a 3x3 of each pixel and connect the pixel at the center with the one having greater value
- Search in the direction of the edge (direction of Gradient)

Edge Linking

- Fill gaps in the Canny edge
  - e.g., after thresholding follow edge

- 4 T2=8
- 9 T1=4 ->4 is lost!!
- 5
- 6

- scan bottom-up and combine the edges
- scan left-to-right and right-to-left
- scan across the diagonals

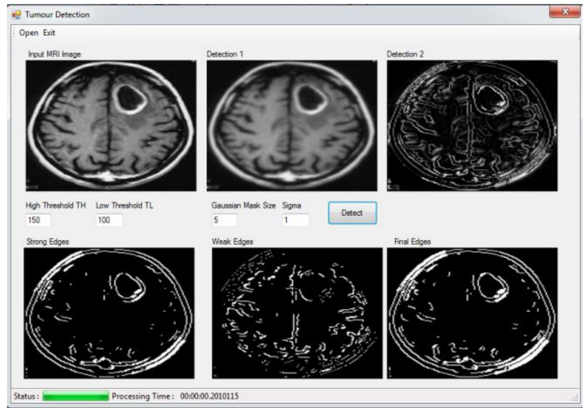
Line Detection

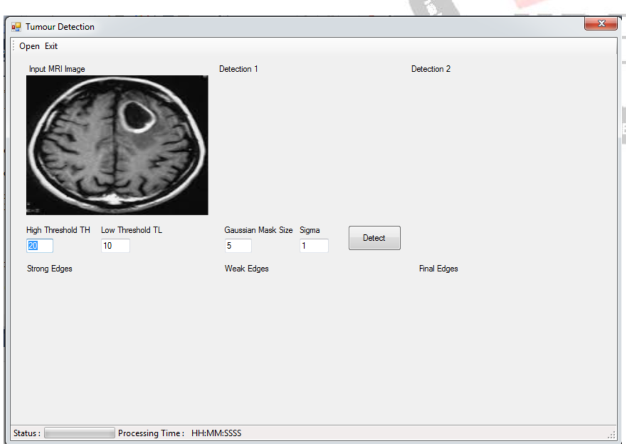
- Model of a line: two edges with opposite polarity in distance less than the size of the smoothing filter.
- Apply non maxima suppression on the smoothed output

VI. RESULTS AND DISCUSSION

In this current version of software, included basic functionalities. In the future version to come, effort can be made to include as many functions. Following modules are added:

1. Provide Application for Windows.
2. Able to view exact portion of tumor in percentage.





VII. CONCLUSION

It gives accurate result due to Canny edge detection algorithm. Image processing is fast. It also gives quick identification of tumor if possible. Simple, reduce place, work on large database.

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