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Brain Tumor Detection and Segmentation In MRI Images

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Abstract- Brain tumor is a serious life-altering disease condition. It is an abnormal mass of tissue in which some cells grow and multiply uncontrollably in the limited space of intercranial cavity (space formed inside the skull), apparently unregulated by the mechanisms that control normal cells. The growth of a tumor takes up space within the skull and interferes with normal brain activity. So detection of the tumor is very important in earlier stages. Various techniques were developed for detection of tumor in brain. Generally, MRI images produce a complete image of the brain which is visually examined by the physician for detection & diagnosis of brain tumor. However, this method resists the accurate determination of stage and size of tumor. To avoid that, this project uses computer aided method for detection and segmentation of brain tumor. Image segmentation plays a significant role in image processing as it helps in the extraction of suspicious regions from the medical images. In this project, we propose an image segmentation method to detect tumor from the brain magnetic resonance imaging (MRI). Image segmentation is the process of partitioning a digital image into multiple segments to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. The main concentration is on those techniques which use image segmentation to detect brain tumor. There are many methods developed but they have different results in each image. These techniques use the MRI Scanned Images to detect the tumor in the brain. So, we need a method by which detection of tumor can be done uniquely. In this project, we propose a set of image segmentation algorithms which gives a satisfactory result on brain tumor images.

Index Terms-Image Processing, Parallel Processing, Clustering, Quantization, Segmentation, Feature Extraction, Pixels labeling.

1. INTRODUCTION

1.1 Brain Tumor

Brain tumor is a serious life-changing disease condition. It is an abnormal mass of tissues in which some cells grow and multiply without any control in the intracranial cavity (space formed inside the skull). The growth of tumor takes up space inside the skull and interferes with the normal activities of the brain. Most of the times, the detection occurs in the advanced stages - once the tumor is responsible for unexplained symptoms. [1,4]

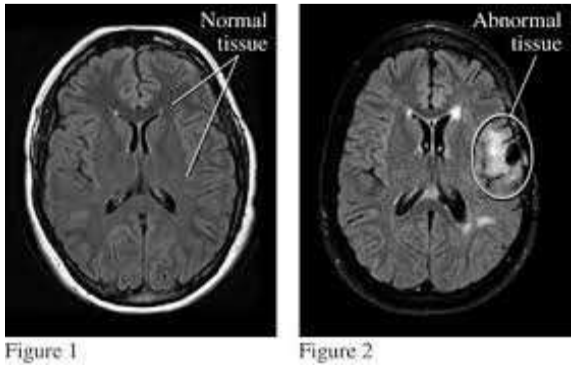

Fig. 1 Normal and Abnormal Tissues

Tumors can be of two types - benign or malignant. Since the brain is well protected by the skull, earlier detection of brain tumor occurs provided that diagnostic tools are inclined to the intracranial cavity.

1.2 Diagnosis

A neurological examination is basically a series of tests to measure the function of the patient in the nervous system and his/her physical and mental alertness. A brain scan is a picture of the internal structures inside the brain.

Some of these techniques are as follows:

- **MRI** (Magnetic Resonance Imaging) - It is a scanning device that uses magnetic fields and computers to capture images of the brain on a film. It provides pictures from various planes, which permit the doctors to create a three-dimensional image of the tumor present in the brain. The MRI detects signals emitted from the normal and abnormal tissues, providing clear images of most of the tumors.
- **CT** scan (Computed Tomography) – It combines sophisticated x-ray and computer technology. CT scan shows a combination of soft tissue, bone, and blood vessels. CT images can determine some types of tumors, as well as help detect swelling, bleeding, and calcification of bones and tissues.[6]

A **Biopsy** is the most accurate method of obtaining a diagnosis of brain tumor. Biopsy is a surgical procedure in which a sample of tissue is taken from the tumor site and examined carefully under a microscope. The purpose of conducting a biopsy is to discover the grade/level and type of a tumor.

1.3 Image Segmentation

Image segmentation is the process of partitioning a digital image into multiple segments which consist of sets of pixels. Image segmentation is basically used to locate objects and boundaries (lines, curves, etc.) in a particular image. More precisely, image segmentation is the process of assigning a label to each and every pixel in an image such that the pixels with the same label share certain visual characteristics. The goal of segmentation is to simplify and/or change the representation of an image into something that is easier and more meaningful to analyze.

In case of medical image segmentation, the aim is to:

• Study anatomical structure.

• Identify the Region of Interest ,i.e., locate tumor, lesion and any other abnormalities.

• Measure tissue volume to measure growth of tumor (also decrease in size of tumor with treatment).

• Help in treatment planning prior to radiation therapy in radiation dose calculation. [3,5]

1.4 Literature Survey

The problem which currently exists in the medical field is that blood is needed immediately for an injured person or for any major operation, it is not easily available even though blood banks are present. There are some web sites present for donating blood were the phone numbers of the donors are present which are not reliable since they don't get often updated. At present there are no proper websites and Apps.

Technology	**Done By**	**Features**	**Limitations**
watershed algorithm, Hough transform ,automatic nuclei localization mechanism	Abdel-Maksoud, Eman, Mohammed Elmogy, and Rashid Al-Awadi	Quality work	Performs poor on 3D object segmentation
K-means algorithm	Halder, Amitava, Chandan Giri, and Amiya Halder	median filtering and morphological operation	has ignored the poor quality images

Fuzzy C means	Preetha, R., and G. R. Suresh	high computational complexity, it shows superior results in segmentation efficiency and convergence rate	neglected the use of fuzzy and region growing segmentation
semiautomatic brain tumor segmentation algorithm	Zeljkovic, V., C. Druzgalski, Y. Zhang, Z. Zhu, Z. Xu, D. Zhang, and P. Mayorg	valuation of segmentation	poor in case of time complexity

Table 1 Comparison between various projects on brain tumor

2. PROPOSED SYSTEM

2.1 Problem Definition

Generally, MRI images produce a complete image of the brain which is visually examined by the physician for detection & diagnosis of brain tumor. However, this method resists the accurate determination of stage and size of tumor. To avoid that, this project uses computer aided method for detection and segmentation of brain tumor.

2.2 Mathematical Model

Let S be the set of System for Detection of Tumor using MRI Images....

$S = \{ I , O , f , \varphi \}$

where,

I = Input set of MRI images to the system S.

O = Output image + Report

φ = Constraints

f = Functions carried out within system 'S'.

$I = \{I_1 , I_2 , I_3, ..., I_n\}$

$O = \{O_1, \text{Report}\}$

$\varphi = \{ I_c\}$

$I_c = \{I_{c1}, I_{c2,...}\}$

where I_{c1} = Image is in acceptable format,

I_{c2} = Image resolution is in acceptable range

f = { Preprocessing(), Segmentation(), Tumor Detection() }

f = { x -> y | x Є I and y Є O where I has $I_c$constraints}

f_1 = {Preprocessing()} :: Take input image with constraints I_c.

Processing(I) -> I_x where I_x is the preprocessed image ready for processing.

f_2 = {Segmentation()} :: Take output image of f_1 as input and remove cranial nerves, normal tissues, etc.

Segmentation(I_x) ->I_y where I_y is the output of segmentation.

f_3 = {Tumor Detection()} :: Detect tumor with specified size and provide its grading level.

Tumor Detection(I_y) -> O_1 where O_1 Є O.

2.3 Parallel Computing Implementation

In this project, we are going to implement more than two algorithms for processing images. This proposed system divides the input image into number of slices and pre-processing takes place in parallel. This software also runs on Multi-Core environment for processing and extraction of each and every image slices separately. For this purpose, we will be using one of the parallel paradigm frameworks – OpenCV/Java. These separately pre-processed slices are further processed and the system combines the output of each slice together to form a combined result. This obtained image is final tumor detection image which shows the Region of Interest.

3. SYSTEM ARCHITECTURE

Basically, in this paper we introduce our system architecture. So we can clearly figure out basic idea about this problem definition. These system

architectures help us to enhance the technologies currently available for processing image usually in medical field.

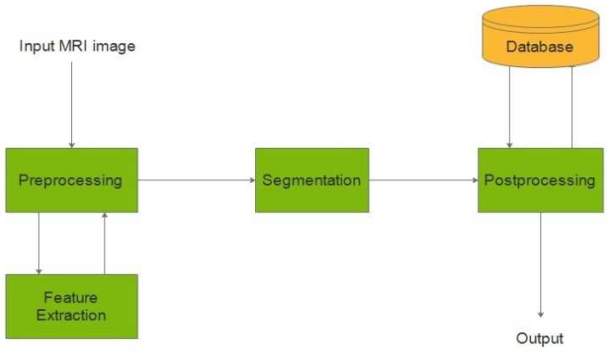

Fig. 2 System Architecture

The basic idea of this project is to develop an application software to detect the presence of brain tumor in MRI images. This project aims to develop accurate determination of tumor in the brain. The project is aimed to be cheap and as useful as possible.

5. RESULT AND DISCUSSION

The following figures show the images as output stages,i.eHSV image, mask image, threshold image, processed and segmented image. Finally the detected tumor from input MRI image is shown. Along with the images, the tumor stage, count, and size of each detected tumor is also specified. The time required for execution is also specified. For this purpose, real-time patient data is taken for analysis.As the tumor in an MRI image has an intensity more than that of its background so it becomes very easy locate it and extract it from the MRI image.

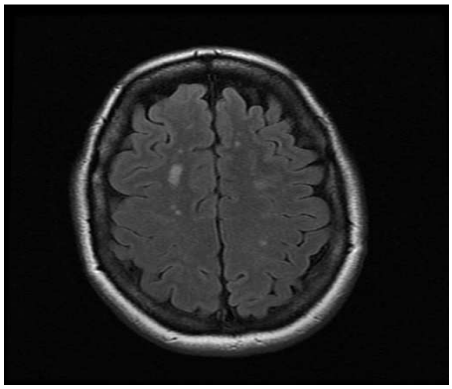

Fig. 3MRI image of brain with affected tumor

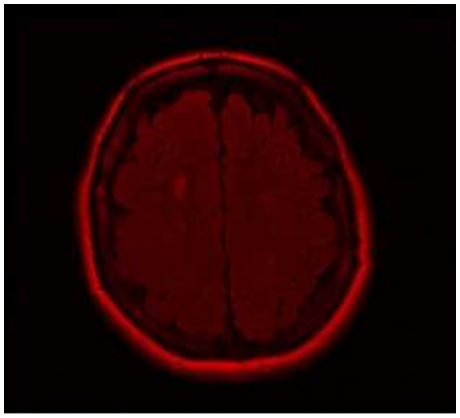

Fig. 4HSV image of Fig-3

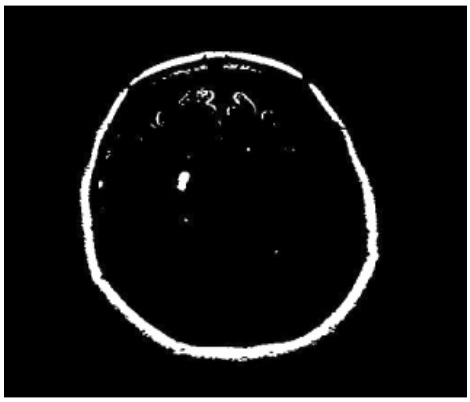

Fig. 5Mask image of Fig-3

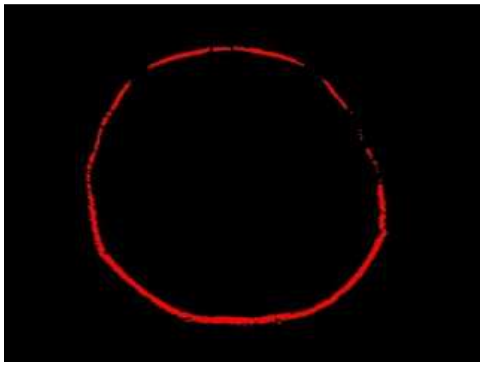

Fig. 6Threshold image of Fig-3

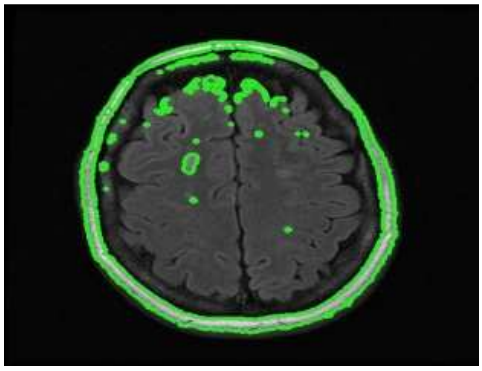

Fig. 7Processed image of Fig-3

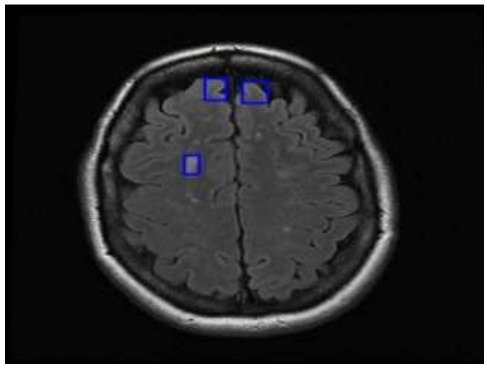

Fig. 8Final image with tumor detection of Fig-3

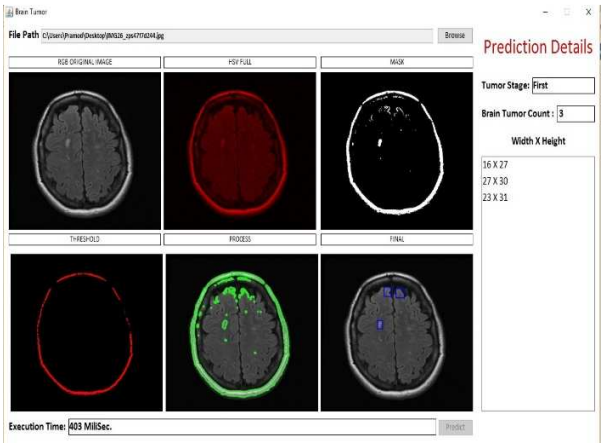

Fig. 9Result with execution time, tumor stage and tumor size

5. CONCLUSION

In this project, various techniques that are being used to detect the brain tumor from MRI images of brain are evaluated. A brief study is made about various techniques. After evaluation of well-known techniques it is clearly seen that in the various methods which can detect the tumor efficiently and provide accurate results, brain is scanned and the MRI image of the brain is obtained which is noise free. The overall goal of this project work is to propose an efficient brain tumor detection technique. The proposed technique has the capability to produce effective results even in case of high density of the noise. The proposed project will detect the presence of brain tumor with increased accuracy and within a minimum time span, thus developing an efficient and faster tumor detection system.

6. FUTURE SCOPE

In future, this programme can be more developed so that the tumor can be specified in a more descriptive format or maybe a 3D format. Also, the tumorgrowth can be analysed by plotting a graph which can be obtained by studying sequential images of the tumor-affected patient.

Acknowledgment

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