Identification of Brain Tumor using Image Processing Technique: Overviews of Methods

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Abstract:
A brain tumor is an abnormal growth of tissue in the brain or central spine that can disrupt proper brain function. Doctors refer to a tumor based on where the tumor cells originated, and whether they are cancerous (malignant) or not (benign). According to the National Brain Tumor Society types of brain are divided into Benign, Malignant, Primary and Metastatic. Over 10,600 people in the UK are diagnosed with a brain tumor each year. It shows that it is the need to detect the brain tumor as early as possible. This paper introduces the brain tumor with symptoms and signs that affect the brain tumor. And overviews of different methods to detect and diagnosis brain tumor using various image processing algorithm includes image processing, enhancement, segmentation, feature extraction and classification.

Keywords
MRI, CT, Preprocessing, Segmentation, Classification.

1. INTRODUCTION

According to George Krucik, A brain tumor is a collection, or mass, of abnormal cells in your brain. Your skull, which encloses your brain, is very rigid. Any growth inside such a restricted space can cause problems. Brain tumors can be cancerous (malignant) or non-cancerous (benign). When benign or malignant tumors grow, they can cause the pressure inside your skull to increase. This can cause brain damage, and it can be life-threatening.
Brain tumors are categorized as primary or secondary. A primary brain tumor originates in your brain. Many primary brain tumors are benign. A secondary brain tumor, also known as a metastatic brain tumor, occurs when cancer cells spread to your brain from another organ, such as your lung or breast [1].

The National Brain Tumor Foundation (NBTF) for research in United States estimates the death of 13000 patients while 29,000 undergo primary brain tumor diagnosis. This high mortality rate of brain tumor greatly increases the importance of Brain Tumor detection and diagnosis [2].

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I. **Benign:** The least aggressive type of brain tumor is often called a benign brain tumor. They originate from cells within or surrounding the brain, do not contain cancer cells, grow slowly, and typically have clear borders that do not spread into other tissue.
II. **Malignant:** Malignant brain tumors contain cancer cells and often do not have clear borders. They are considered to be life threatening because they grow rapidly and invade surrounding brain tissue
III. **Primary:** Tumors that start in cells of the brain are called primary brain tumors. Primary brain tumors may spread to other parts of the brain or to the spine, but rarely to other organs
IV. **Metastatic:** Metastatic or secondary brain tumors begin in another part of the body and then spread to the brain. These tumors are more common than primary brain tumors and are named by the location in which they begin.

There are over 120 types of brain and central nervous system tumors. Brain and spinal cord tumors are different for everyone. They form in different areas, develop from different cell types, and may have different treatment options [3]. In this paper we introduce the concept of Brain Tumor with its symptoms and signs, including various types of medical modalities. The main focus of the paper is to review the various technique that are used for the detection of brain tumor using image processing method.

2. SYMPTONS AND SIGNS

A general symptom is caused by the pressure of the tumor on the brain or spinal cord. Specific symptoms are caused when a specific part of the brain is not working well because of the tumor [4].

2.1 General symptoms include:

- Headaches, which may be severe and worsen with activity or in the early morning.
- Seizures- Motor seizures, also called convulsions, are sudden involuntary movements of a person's muscles. People may experience different types of seizures, including myclonic and tonic-clonic (grand mal). Certain drugs can help prevent or control them.

According to the Brain Tumor Charity Brain tumors are relatively rare. Over 10,600 people in the UK are diagnosed with a brain tumour each year. This means that most times the symptoms you are showing will not be due to a brain tumor [5].

3. DIAGNOSE OF BRAIN TUMOR

The various modalities are Neurologic exam, MRI, CT scan, Angiogram, Spinal tap, Biopsy, Biopsy at the same time as treatment, Stereotactic biopsy [6].

3.1 Neurological Exam

The neurological examination is a series of simple questions and tests that provide crucial information about the nervous system. It is an inexpensive, noninvasive way to determine what might be wrong. The neurological examination is divided into several components, each focusing on a different part of the nervous system mental status, cranial nerves, motor system, sensory system, the deep tendon reflexes, coordination and the cerebellum [7].

3.2 Magnetic Resonance Imaging (MRI)

MRI is basically used in the biomedical to detect and visualize finer details in the internal structure of the body. This technique is basically used to detect the differences in the tissues which have a far better technique as compared to computed tomography (CT). So this makes this technique a special one for the brain tumor detection and cancer imaging [8].

3.3 Computed tomography (CT) scan

The CT scan is an x-ray test that produces detailed cross-sectional images of your brain. Instead of taking one picture, like a regular x-ray, a CT scanner takes many pictures. CT scans are not used as often as MRI scans when looking at brain or spinal cord tumors, but they can be useful in some cases. Before the CT scan, you may get an injection of a contrast dye through an IV (intravenous) line. This helps better outline any tumors that are present.

3.4 Angiogram

For this test, a special dye is injected into blood vessels near the tumor, and the area is then viewed with x-rays. This helps doctors look at the blood supply of a tumor. An angiogram may be used as part of the treatment for certain brain tumors. It is done as a first step of a procedure called embolization, in which the radiologist injects tiny particles into the blood vessels feeding the tumor to block them and make it easier to remove the tumor. This test is not done much for brain or spinal cord tumors anymore, as it has largely been replaced by other tests that can look at blood vessels, such as computerized tomographic angiography (CTA) or magnetic resonance angiography (MRA) [9].

4. LITERATURE REVIEW

Here we have given the review of image processing techniques which are used to detect the brain using preprocessing, enhancement, segmentation, feature extraction and classification.

Sehrawat et al used a new method for Brain Tumor Classification using Back Propagation Neural Network (BPNN) with Fuzzy C Means (FCM) is proposed.The proposed work is about the detection of brain tumor in the Medical Images.The flow of proposed system is shown in Fig. 1[10].

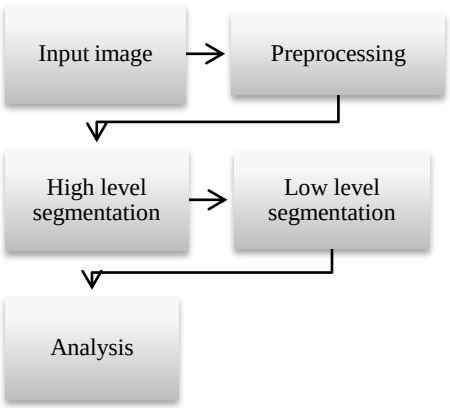

Fig.1: Stages of Tumor Detection

Kabade et al works on brain MR images. CT scan or MRI that is directed into intracranial cavity produces a complete image of brain. The MRI scan is more comfortable than CT scan for diagnosis. It is not affect the human body. Because it doesn't use any radiation. It is based on the magnetic field and radio waves.The purpose of automatic diagnosis of the segments is to find the number of divided image areas of an image according to its entropy and with correctly diagnose of the segment of an image also increased the precision of segmentation[11].

Laddha et al proposed a method to detect brain tumor using medical imaging techniques. The main technique used was segmentation, which is done using a method based on threshold segmentation, watershed segmentation andmorphological operators. The proposed segmentation method was experimented with MRI scanned images of human brains thus locating tumor in the images. Firstly they work on quality of scanned image is enhanced and then morphological operators are applied to detect the tumor in the scanned image. They also propose an efficient wavelet based algorithm for tumor detection which utilizes the complementary and redundant information from the Computed Tomography (CT)

image and Magnetic Resonance Imaging (MRI) images.

Dahab et alproposed two approaches for Brain tumor detection, identification and classification. The first approach is based on an integrated set of image processing algorithms, while the other is based on a modified and improved Probabilistic artificial neural networks structure. The proposed integrated image processing algorithm is based on a modified canny edge detection algorithm and implemented using MATLAB.Also in this paper, a modified Probabilistic Neural Network (PNN) model that is based on learning vector quantization (LVQ) with image and data analysis and manipulation techniques is proposed to carry out an automated brain tumor classification using MRI-scans.Using above technique authors says that results also claim that the proposed LVQ-based PNN system decreases the processing time to approximately 79% compared with the conventional PNN which makes it very promising in the field of in-vivo brain tumor detection and identification[12].

Selkar et al describes Brain tumor detection, using Watershed and thresholding segmentation and describes the comparative study about the tumor detection.After applying Watershed and thresholding segmentation they get a high intensity portion from whole image and this portion is called tumor. This portion contains only high intensity pixels and its showing with totally white portion.The stages of detection of brain tumor are shown in Fig. 2 following way (Step are point wise).

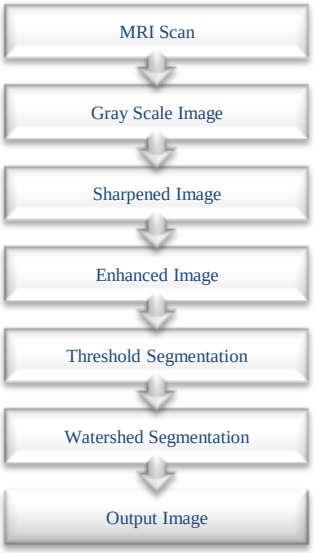

Fig.2: Stages of detection of brain tumor

Brain tumor segmentation in magnetic resonance imaging (MRI) has become an emergent research area in the field of medical imaging system. Brain tumor detection helps in finding the exact size, shape, boundary extraction and location of tumor [13].

Dilber et al work onbrain tumor was detected from the MRI images obtained from locally available sources using watershed algorithms and filtering techniques. For the brain tumor detection, pre-processing was applied so as to enhance the input MRI image and also to remove the noise from the MRI image. The pre-processing was implemented using filtering, grey-levelling and adjusting the image. For different input images, different values have to be assigned to some operators because the tumor is not always at the same part or location. For different people, tumor may be at different places, or it may or may not be deep inside the brain (as it depends on the level of the tumor). An image segmentation method was proposed for the identification or detection of tumor from the brain. The methodology consists of the following steps: pre-processing by using grey-level, sharpening and median filters; segmentation of the image was performed by thresholding and also by applying the watershed segmentation. In this work, axial view of the brain image (2D) from MRI scan has been used because MRI scan is less harmfulthan CT brain scan. The study of brain tumor is important as it is occurring in many people [14].

There are different types of tumors available. They may be mass in the brain or malignant over the brain. Suppose if it is a mass, then K- means algorithm is enough to extract it from the brain cells. If there is any noise present in the MR image it is removed before the K-means process. The noise free image is given as input to the k-means and tumors are extracted from the MRI image. The performance of brain tumor segmentation is evaluated based on K-means clustering.The stage of the tumor is based on the area of tumor.
Authors implement of Simple Algorithm for detection of range and shape of tumor in brain MR Images. Normally the anatomy of the Brain can be viewed by the MRI scan or CT scan. MRI scanned image is used for the entire process.

Jose et al proposed system has mainly four modules namely Pre-processing, segmentation using k-means and fuzzy c-means, Feature extraction, and approximate reasoning.According to the need of the next level the pre-processing step converts the image.Pre-processing is done by filtering. Segmentation is carried out by advanced K-means and Fuzzy C-means algorithm. The feature extraction is done by considering the threshold and finally, approximating the reasoning method to recognize the tumor shape and position in MRI image using edge detection method [15].

Azhari et al propose an automatic brain tumor detection and localization framework that can detect

and localize brain tumor in magnetic resonance imaging. The proposed brain tumor detection and localization framework comprises five steps: image acquisition, pre-processing, edge detection, modified histogram clustering and morphological operations. After morphological operations, tumors appear as pure white color on pure black backgrounds.The proposed tumor detection and localization system was found to be able to accurately detect and localize brain tumor in magnetic resonance imaging [16].

Raghtate et al analysis and diagnosis brain tumor in MRI image involves segmentation as very essential steep. It separates the region of interest objects from the background and the other objects to increase the segmentation accuracy of FCM, Ant Colony Algorithm (ACA) is used. ACA initializes the cluster center to best proper value thereby increasing the segmentation accuracy. But it increases the computational time as well. They calculates the performance of segmentation using Peak signal to noise ratio, segmentation accuracy, convergence rate or execution time [17].

Accurate detection of size and location of brain tumor plays a vital role in the diagnosis of tumor. An efficient algorithm is proposed for tumor detection based on segmentation and morphological operators. Firstly quality of scanned image is enhanced and then morphological operators are applied to detect the tumor in the scanned image.

Deshmukh et at presents a automated recognition system for the MRI image using the neuro fuzzy logic. It is observed that the system result in better classification during the recognition process.In the proposed methodology, features are extracted from raw images which are thenfed to ANFIS (Artificial neural fuzzy inference system). ANFIS being neuro-fuzzy system harness power of both hence it proves to be a sophisticated framework for multi object classification. A comprehensive feature set and fuzzy rules are selected to classify anabnormal image to the corresponding tumor type [18].

The global thresholding method separate out infected region with the help of single threshold point and converts gray scale image into binary image. Similarly watershed segmentation technique also separate out tumor region successfully from brain tumor MRI region. From these segmented images it is possible to get the detail information about the tumor location, its shape a attempt has been made to summarize segmentation techniques which are useful for separation of tumor region from brain tumor MRI images. By selecting a proper segmentation technique , it is possible to segment tumor region accurately, which helps in measuring the area of tumor region from brain tumor MRI image. This is possible by using digital image processing tool. Digital image processing is useful for CT scan, MRI, and Ultrasound type of medical images [19].

CONCLUSIONS

A brain tumor is a collection, or mass, of abnormal cells in your brain. Accurate detection of size and location of brain tumor plays a vital role in the diagnosis of tumor. This paper introduces the concept of brain tumor with its symptoms and signs. Its gives the overview of various methods that brain tumor can be detected by using image processing techniques as preprocessing, enhancement, segmentation and feature extraction and various classification algorithms.

REFERENCES

[1] Brain Tumor: Definition of Brain tumor: Retrieved from: http://www.healthline.com/health/brain-tumor#Overview1/, Retrieved on: 13Octobar 2016.

[2] Ms. Roopali R. Laddha, "Brain Tumor Detection Using Morphological And Watershed Operators", International Journal of Application or Innovation in Engineering & Management (IJAIEM) Volume 3, Issue 3, March 2014.

[3] Brain Tumor: Types of Brain tumor: Retrieved from:http://braintumor.org/brain-tumor-information/understanding-brain-tumors/, Retrieved on: 13Octobar 2016.

[4] Brain Tumor: Symptoms and Signs, Retrieved from:http://www.cancer.net/cancer-types/brain-tumor/symptoms-and-signs/, Retrieved on: 13Octobar 2016.

[5] Brain Tumor: Symptoms and Signs, Retrieved from: https://www.thebraintumourcharity.org/understanding-brain tumours/symptoms-and-information/adult-symptoms/, Retrieved on: 13Octobar 2016.

[6] Brain Tumor: tumors diagnosed, Retrieved from: http://www.medicinenet.com/brain_tumor/page6.htm/, Retrieved on: 13Octobar 2016.

[7] Brain tumors diagnosed, Retrieved from: http://www.healthcommunities.com/brain-nerve-tests/what-is-a-neuro-exam.shtml, Retrieved on: 13 Octobar 2016.

[8] Roopali R. Laddha, S.A.Ladhake, "A Review on Brain Tumor Detection Using Segmentation And Threshold Operations", International Journal of Computer Science and Information Technologies (IJCSIT), Vol. 5 (1), pp 607-611, 2014.

[9] Brain tumors diagnosed, Retrieved from: http://www.cancer.org/cancer/braincnstumorsinadults/detailedguide/brain-and-spinal-cord-tumors-in-adults-diagnosed/, Retrieved on: 13Octobar 2016.

[10] Sangeeta Sehrawat, Ritu Khatri , "Brain Tumor Detection Using FCM and BPNN", International Journal of Basic and Applied Biology (IJBAB) Volume 2, Number 1; pp. 83 – 88 October, 2014.

[11] Mr. Rohit S. Kabade, M. S. Gaikwad, "Segmentation of Brain Tumor and Its Area Calculation in Brain MR Images using K-Mean Clustering and Fuzzy C-Mean Algorithm", International Journal of Computer Science & Engineering Technology (IJCSET), Vol. 4, pp 524-531, 05 May 2013.

[12] Dina Aboul Dahab, Samy S. A. Ghoniemy, Gamal M. Selim, "Automated Brain Tumor Detection and Identification Using Image Processing and Probabilistic Neural Network Techniques", International Journal of Image Processing and Visual Communication, Volume (Online) 1, Issue 2, October 2012.

[13] Roshan G. Selkaret, M. N. Thakare, "Brain Tumor Detection and Segmentation By Using Thresholding And Watershed Algorithm", IJAICT, Volume 1, Issue 3, July 2014 Doi: 01.0401/ ijaict.2014.03.08, Published Online 05 (08) 2014.

[14] Dawood Dilberet, Jasleen, "Brain Tumor Detection using Watershed Algorithm", International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET),DOI-10.15680/IJIRSET.2016.0503062.

[15] Alan Jose, S.Ravi, M.Sambath, " Brain Tumor Segmentation Using K-MeansClustering And Fuzzy C-Means Algorithms And Its Area Calculation", International Journal of Innovative Research in Computer and Communication Engineering(ijircc) Vol. 2, Issue 3, March 2014.

[16] Ed-Edily Mohd. Azhari, Muhd. Mudzakkir Mohd. Hatta, Zaw Zaw Htike, and Shoon Lei Win, "Brain Tumor Detection And Localization In Magnetic Resonance Imaging", International Journal of Information Technology Convergence and Services (IJITCS) Vol.4, No.1, February 2014.

[17] Ganesh S. Raghtate, Suresh. S. Salankar ,"Brain Tumor Segmentation Using Fuzzy C Means With Ant Colony Optimization Algorithm", Current Trends in Technology and Science (ctts) ISSN: 2279-0535. Volume: 04, Issue: 02 (Feb. - Mar. 2015).

[18] R. J. Deshmukh, R. S Khule, "Brain Tumor Detection Using Artificial Neural Network Fuzzy Inference System (ANFIS)" ,International Journal of Computer Applications Technology and Research Volume 3– Issue 3, pp. 150 - 154, 2014.

[19] Shubhangi S. Veer (Handore), P.M. Patil, "An efficient method for Segmentation and Detection of Brain Tumor in MRI images", International Research Journal of Engineering and Technology (IRJET), Volume: 02, Issue: 09, Dec-2015.