Brain Tumor Detection from MRI Image

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ABSTRACT:

Image processing is an active research area in which medical image processing is a highly challenging field. Medical imaging techniques are used to image the inner portions of the human body for medical diagnosis. Brain tumor is a serious life altering disease condition. Image segmentation plays a significant role in image processing as it helps in the extraction of suspicious regions from the medical images. In this paper we have proposed segmentation of brain MRI image using K-means clustering algorithm followed by morphological filtering which avoids the misclustered regions that can inevitably be formed after segmentation of the brain MRI image for detection of tumor location. Region growing is an important application of image segmentation in medical research for detection of tumors. In this paper, we propose an effective modified region growing technique for detection of brain tumors. Modified region growing includes an orientation constraint in addition to the normal intensity constrain. The performance of the proposed technique is systematically evaluated using the MRI brain images received from the public sources. For validating the effectiveness of the modified region growing, the quantity rate parameter has been considered

INTRODUCTION:

In bio-medical applications, image processing is widely used for diagnosis of different tissues purpose. Image processing has various applications in medical field like tumor detection, MRI-CT images enhancement, image fusion, etc. We plan to study the design of a computer system able to detect the presence of a tumor in the digital images of the brain and to accurately define its border lines. Among different types of methods we focus on choosing appropriate method. Brain tumors may be benign or malignant. Primary brain tumors are originated in the brain, and they do not spread or affect the surrounding tissues. The secondary brain tumors are spread to the brain from another place in the body. Brain tumors affect the normal brain activity. So accurate detection of tumor is important for human disorder diagnosis. Clustering techniques examine the boundaries of brain tissues along with less interaction of user interface.

MAGNETIC RESONANCE IMAGING:

Protons and neutrons of the nucleus of an atom have an angular momentum which is known as a spin. These spins will cancel when the number of subatomic particles in a nucleus is even. Nuclei with odd number will have a resultant spin .This forms the basis of magnetic resonance imaging. 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. The MRI machine emits radio frequency (RF) pulse that specifically binds only to hydrogen. The system sends the pulse to that specific area of the body that needs to be examined. Due to the RF pulse, protons in that area absorb the energy needed to make them spin in a different direction. This is meant by the resonance of MRI. The RF pulse makes the protons spin at the larmour frequency, in a specific direction. This frequency is found based on the particular tissue being imaged and the strength of the main magnetic field. MRI uses three electromagnetic fields: static field which is a very strong static magnetic field which polarizes the hydrogen nuclei; gradient field which is a weaker time-varying field used for spatial encoding; and a weak radio frequency field for manipulation of the hydrogen nuclei to produce measurable signals, which are collected through radio frequency antenna.

CHALLENGES:

The brain is the anterior most part of the central nervous system. Brain tumor is an intracranial solid neoplasm. Tumors are created by an abnormal and uncontrolled cell division in the brain. In this work, we have used axial view of the brain image (2D) from MRI scan because MRI scan is less harmful than CT brain scan. A patient is subjected to different diagnostic methods to determine the cause of the symptoms mentioned by him. Techniques like performing a biopsy, performing imaging, like taking a MRI or CT scan of the brain will be done. In biopsy, pathologists take a specimen of the brain tissue under consideration for checking the presence of tumor. A pathologist looks at the tissue cells under a microscope to check for presence of abnormality. Though biopsy will show the presence of tumor and its pathology, when doctors go for surgery, they must know the tumor extent and the exact location of tumor in the brain, which can be found by taking MRI scan of the patient as MRI doesn’t involve the use of harmful radiations when compared to CT scan. Supervised segmentation method requires considerable amount of training and testing data which comparatively complicates the process

LITERATURE SURVEY:

Literature survey suggests that k-means is most frequently used clustering algorithm. It is relatively efficient and fast. It computes result at O(tkn),where n is number of objects or points, k is number of clusters and t is number of iterations. k-means clustering can be applied to machine learning or data mining. The paper *Manali Patil,Samata Prabhu,Sonal Patil,Sunilka Patil, Mrs.Prachi Kshirsagar,"Brain Tumor Identification Using K-Means Clustering", International Journal of Engineering Trends and Technology- Volume4, Issue3- 2013,* describes the application of k-means clustering to MR images for tumor detection.

WHAT IT IS:

Magnetic resonance imaging (MRI) of the brain is a safe and painless test that uses a magnetic field and radio waves to produce detailed images of the brain and the brain stem. An MRI differs from a CAT scan (also called a CT scan or a computed axial tomography scan) because it does not use radiation. An MRI scanner consists of a large doughnut-shaped magnet that often has a tunnel in the center. Patients are placed on a table that slides into the tunnel. Some centers have open MRI machines that have larger openings and are helpful for patients with claustrophobia. MRI machines are located in hospitals and radiology centers.

During the exam, radio waves manipulate the magnetic position of the atoms of the body, which are picked up by a powerful antenna and sent to a computer. The computer performs millions of calculations, resulting in clear, cross-sectional black and white images of the body. These images can be converted into three-dimensional (3-D) pictures of the scanned area. This helps pinpoint problems in the brain and the brain stem when the scan focuses on those areas.

WHY IT’S DONE:

MRI can detect a variety of conditions of the brain such as cysts, tumors, bleeding, swelling, developmental and structural abnormalities, infections, inflammatory conditions, or problems with the blood vessels. It can determine if a shunt is working and detect damage to the brain caused by an injury or a stroke.MRI of the brain can be useful in evaluating problems such as persistent headaches, dizziness, weakness, and blurry vision or seizures, and it can help to detect certain chronic diseases of the nervous system, such as multiple sclerosis.In some cases, MRI can provide clear images of parts of the brain that can't be seen as well with an X-ray, CAT scan, or ultrasound, making it particularly valuable for diagnosing problems with the pituitary gland and brain stem.

PROPOSED METHODOLOGY:

We have proposed segmentation of the brain MRI images for detection of tumors using clustering techniques. A cluster can be defined as a group of pixels where all the pixels in certain group defined by a similar relationship

[1]. Clustering is also known as unsupervised classification technique. The name unsupervised classification because the algorithm automatically classifies objects based on user given criteria. Here K-means clustering algorithm for segmentation of the image followed by morphological filtering is used for tumor detection from the brain MRI images. The proposed block diagram is as shown.

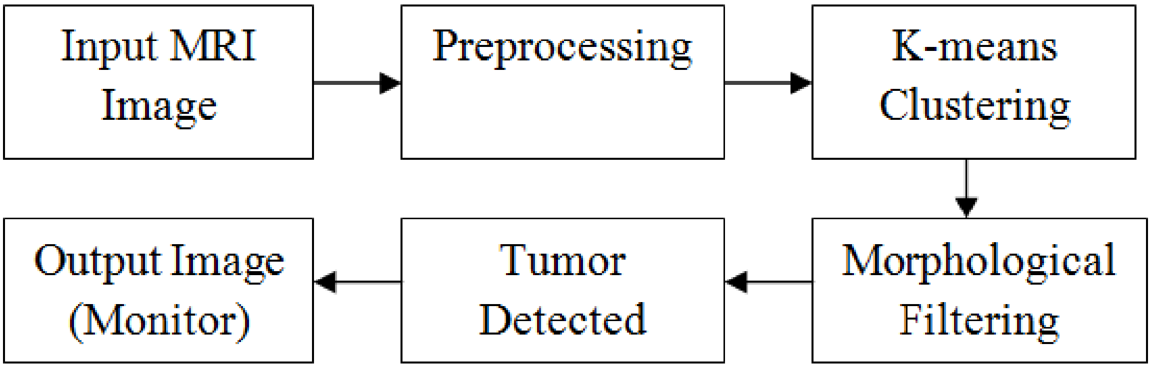

Fig-1: Proposed block diagram

MRI scans of the human brain forms the input images for our system where the grey scale MRI input images are given as the input. The preprocessing stage will convert the RGB input image to grey scale. Noise present if any, will be removed using a median filter. The preprocessed image is given for image segmentation using K-means clustering algorithm. As there are chances of occurrence of misclustered regions after the application of K-means clustering algorithm[15], we have proposed morphological filtering which is performed after the image is segmented by K-means clustering algorithm Various approaches have been carried out in the field of brain tumor detection. Sindhushree. K.S, et al has developed a brain tumor segmentation method and validated segmentation on two dimensional MRI data. Also, detected tumors are represented in 3-Dimensional view.

High pass filtering, histogram equalization, thresholding, morphological operations and segmentation using connected component labeling was carried out to detect tumor. The two dimensional extracted tumor images were reconstructed into three dimensional volumetric data and the volume of the tumor was also proposed a methodology that integrates K Means clustering with marker controlled watershed segmentation algorithm and integrates Fuzzy C Means clustering with marker controlled watershed segmentation algorithm separately for medical image segmentation. The proposed methodology is a two stage process. First K-means clustering (Fuzzy C Means) is used to get a primary segmentation of the input image, and secondly marker controlled watershed segmentation algorithm is applied to the primary segmentation to get the final segmented image.

PROPOSED ALGORITHM:

The algorithm that we have proposed is as follows:

1. Let x1… xM are N data points in the input image, let k be the number of clusters which is given by the user.
2. Choose c1… cK cluster centres.
3. Distance between each pixel and each cluster centre is found.

4. The distance function is given by
5. J=| - | for i=1,…,N and for j=1,…,k, where | , the absolute difference of the distance between a data point and the cluster centre indicates the distance of the N data points from their respective cluster centers.
6. Distribute the data points x among the k clusters using the relation x∈ if |x- |<|x- | for i=1,2,…,k, i≠j, where denotes the set of data points whose cluster centre is
7. Updated cluster centre is given as,= , for i=1,…,k, where is the number of objects in the dataset ,where is the cluster and is the centre of cluster .
8. Repeat from Step 5 to Step 8 till convergence is met.
9. After segmentation and detection of the desired region, there are chances for misclustered regions to occur after the segmentation algorithm, hence morphological filtering is performed for enhancement of the tumor detected portion. Here structuring element used is disk shaped.

DESIGN AND ANALYSIS:

Pre- processing -> Segmentation -> Feature extraction -> approximate reasoning

1. Pre-processing:-Translate the image to bring it to one orientation if the image captured is rotated or misplaced Filtering of noise and other artifacts to remove unwanted data. Sharpening the edges in the image so that tumor can be properly detected.
2. Segmentation: - Partitioning digital image into regions using a clustering algorithm.
3. Feature extraction: - To segment an image into objects, some features are extracted and objects with similar features are clustered together.
4. Reasoning: - Using the above data, we decide whether image contains tumor or not and if present, we calculate the area of the tumour.

SIMULATION RESULTS:

Some of the brain MR images containing tumor taken for testing our proposed algorithm are shown.

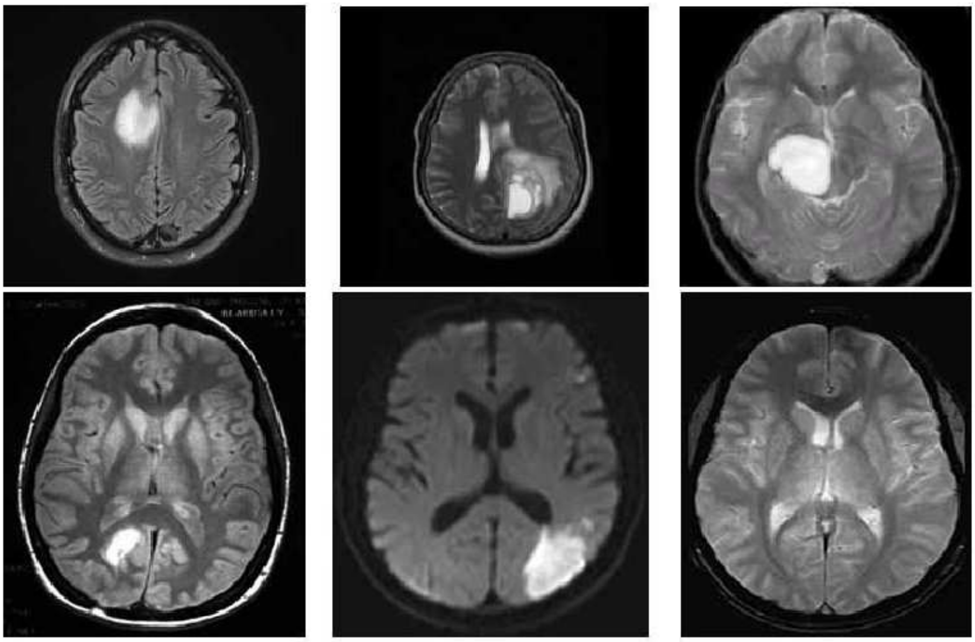

Fig-2: Brain MR images containing tumor

The brain tumor location is found out by applying our proposed algorithm using Matlab Simulator. A GUI (Graphical User Interface) is created to make the system user-friendly. Collect the required input brain MR image from the database which is shown in Fig 2. In our design we have taken the number of clusters as four. Fig 4 shows the final clustering of brain MR image after being processed by our algorithm.

MORPHOLOGICAL FILTERING:

Morphology is the study of shapes and structures from a scientific perspective. Morphological filters are formed from the basic morphology operations. A structuring element is mainly required for any morphological operation.

Morphological operations operate on two images, structuring element and the input image. Structuring elements are small images that are used to probe an input image for properties of interest. Origin of a structuring element is defined by the centre pixel of the structuring element.

In morphology, the structuring element defined will pass over a section of the input image where this section is defined by the neighborhood window of the structuring element and the structuring element either fits or not fits the input image. Wherever the fit takes place, corresponding image that represents the input image’s structure is got and suppression of the geometric features of the input image that doesn’t fit the structuring element’s neighborhood takes place. Two main morphology operations are erosion and dilation where erosion results in the thinning of the objects in the image considered and dilation results in thickening of the objects in the image. Dilation uses the highest value of all the pixels in the neighborhood of the input image defined by the structuring element and erosion uses the lowest value of all the pixels in the neighborhood of the input image

BENEFITS:

MRI is a noninvasive imaging technique that does not involve exposure to ionizing radiation. MR images of the soft-tissue structures of the body—such as the heart, liver and many other organs— is more likely in some instances to identify and accurately characterize diseases than other imaging methods. This detail makes MRI an invaluable tool in early diagnosis and evaluation of many focal lesions and tumors. MRI allows physicians to assess the biliary system noninvasively and without contrast injection. The contrast material used in MRI exams is less likely to produce an allergic reaction than the iodine-based contrast materials used for conventional x-rays and CT scanning.

APPLICATIONS:

- The main application of our system is brain tumor detection.
- Our system can be used in other brain disorder diagnosis.
- It can be combined with manual inputs to improve the accuracy of diagnosis.
- It can help reduce the workload of doctors who have to go through a lot of MRI images by only sending them the images which have tumor detected by our system.

CONCLUSION:

We propose to implement an automated brain tumor detection system by using segmentation of MRI images using clustering algorithm Segmentation of brain image is imperative in surgical planning and treatment planning in the field of medicine. In this work, we have proposed a computer aided system for brain MR image segmentation for detection of tumor location using K - means clustering algorithm followed by morphological filtering. We were able to segment tumor from different brain MRI images from our database.

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